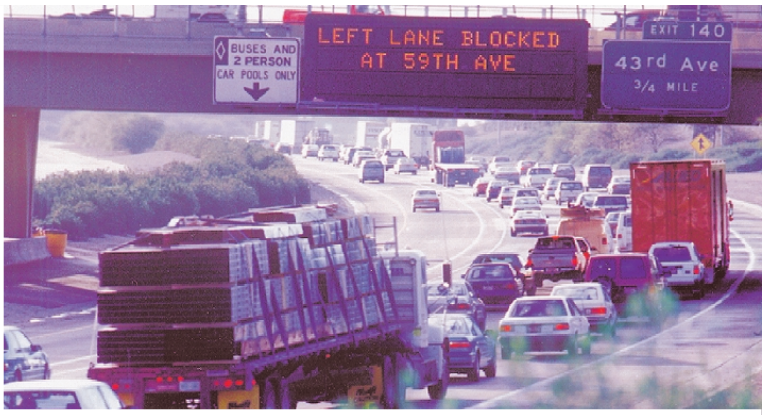
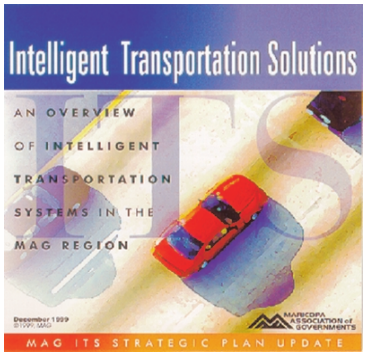
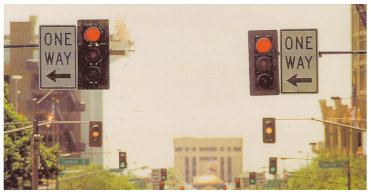
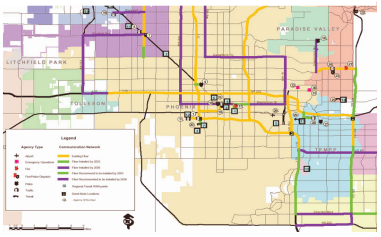
Intelligent Transportation Systems

MAG ITS STRATEGIC PLAN UPDATE









APRIL 2001

MARICOPA ASSOCIATION of GOVERNMENTS

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ADOT	Arizona Department of Transportation
ALERT	Arizona Local Emergency Response Team
ATLAS	Advanced Traffic and Logistics Algorithms and Software
ATM	Asynchronous Transfer Mode
AVI	Automatic Vehicle Incident
AVL	Automatic Vehicle Locator
CCTV	Closed-Circuit Television
CITE	Consortium for ITS Training and Education
CMAQ	Congestion Mitigation and Air Quality
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
DPS	Department of Public Safety
EDL	Electronic Document Library
FAST	Freeway and Arterial System of Transportation
FHWA	Federal Highway Administration
FMS	Freeway Management System
FTA	Federal Transit Administration
FTE	Full-Time Employees
HAR	Highway Advisory Radio
HCRS	Highway Condition Reporting System
HOV	High Occupancy Vehicle
ICDN	ITS Cooperative Deployment Network
IDAS	ITS Deployment Analysis System
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
ITSA	Intelligent Transportation Society of America
IVR	Interactive Voice Response

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JPO	Joint Program Office
LOS	Level of Service
LTAP	Local Technical Assistance Program
M&O	Management and Operations
MAG TAG	MAG Telecommunications Advisory Group
MAG	Maricopa Association of Governments
MAGIC	Metropolitan Area Governments Information Center
MCDOT	Maricopa County Department of Transportation
MCSO	Maricopa County Sheriff's Office
MDI	Model Deployment Initiative
MMDI	Metropolitan Model Deployment Initiative
MPO	Metropolitan Planning Organization
NHI	National Highway Institute
NHS	National Highway System
NTSC	National Televisions Standards Committee
PCB	Professional Capacity Building
PD	Police Department
POE	Ports of Entry
PSAP	Public Safety Access Point
RCRS	Roadway Condition Reporting System
REACT	Regional Emergency Action Coordinating Team
RISG	Regional ITS Stakeholders Group
RPTA	Regional Public Transportation Authority
SAFER	Safety and Fitness Electronic Records System
SMART Corridor	Systematically Managed Arterial Corridor
SONET	Synchronous Optical Network
STP	Surface Transportation Program
TCB	Training and Capacity Building

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TEA-21	Transportation Equity Act for the 21st Century
TIP	Transportation Improvements Program
TMC	Traffic Management Center
TOC	Traffic Operations Center
USDOT	United States Department of Transportation
VLAN	Virtual LAN
VMS	Variable Message Signs
WAN	Wide Area Network
WIM	Weigh-in-Motion

1. INTRODUCTION

Intelligent Transportation Systems, or ITS, is the application of advanced technologies to the transportation system to help save lives, money and time. In urban areas, these systems often consist of field elements (such as variable message signs [VMS], closed-circuit television [CCTV] cameras, ramp meters, detectors, etc.) integrated by a regional communications network, and routed to a centralized traffic management center (TMC).

ITS is already at work in the Maricopa Association of Governments (MAG) region on freeways and arterial roadways. Agencies have been planning, deploying, and operating ITS in the region since the mid-1980s. Several of these systems have received national and international recognition for innovation in ITS and institutional partnering. Regionally-significant systems and programs include:

- Arizona Department of Transportation's (ADOT) Freeway Management System (FMS);
- MAGIC Advanced Traffic Management System Study;
- AZTech™ Model Deployment Initiative (MDI); and
- The original ITS Strategic Plan for the region (completed in 1995).

Recognizing the importance of ITS to help manage the region's transportation system, MAG took a leadership role to update the region's ITS Strategic Plan.

The 14-month study has resulted in a "roadmap" that will guide ITS projects and programs in the MAG region for the next 20 years. The following are some of the key elements that were identified or developed during the Update:

- ITS solutions to be deployed over the next 20 years to meet regional transportation needs;
- System architecture for the region that shows how all of the systems, subsystems, and field elements work together;
- Telecommunications Plan to support the candidate technologies;
- Implementation Plan for short-, medium-, and long-term ITS deployment;
- Operational and Implementation Strategies to outline agency roles, responsibilities, and resources needed to support long-term ITS operations in the region;
- ITS Training and Capacity Building (TCB) Plan; and
- ITS Evaluation Plan.

1.1 Scope of Work

The 14-month project to update the ITS Strategic Plan for the MAG region was divided into 15 tasks that addressed the following key activities and deliverables:

- A comprehensive stakeholder involvement and outreach program which included focus group workshops, newsletters, an ITS overview presentation, a project Web site, e-mail address, and toll-free hotline;
- Identification of regional transportation needs and priorities;
- Updated User Service Focus and prioritized Market Packages;
- A regional ITS architecture consistent with the National ITS Architecture;
- Operational and Implementation Strategies;
- Regional ITS Implementation Plan;

- Regional ITS Telecommunications Plan;
- ITS Evaluation Plan; and
- ITS Training and Capacity Building Plan.

Figure 1.1 provides an overview of the major tasks and their interrelationships.

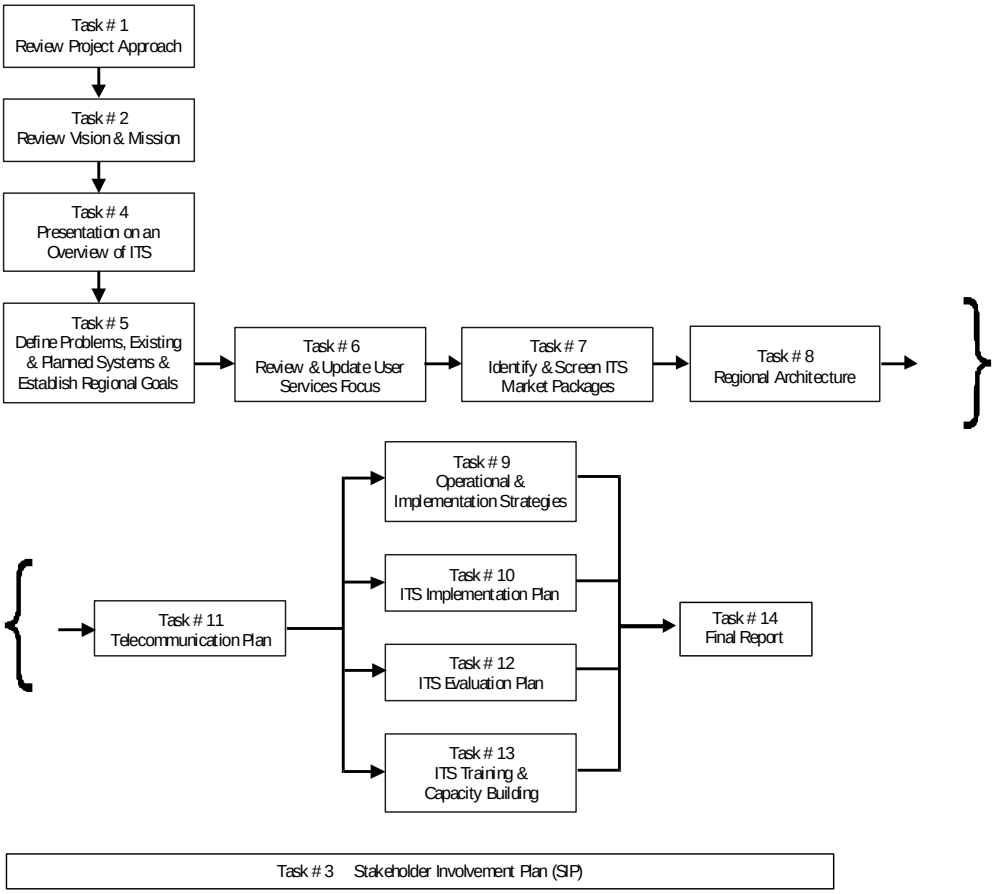

Figure 1.1 – Task Overview

1.2 Project Deliverables

The following are technical memoranda that were prepared and submitted by the project team as part of the *MAG ITS Strategic Plan Update*:

- TM #1: Project Approach, Vision and Mission, and Stakeholder Involvement Plan
- TM #2: Overview of ITS Presentation (in PowerPoint)
- TM #3: Define Problems, Existing and Planned Systems and Establish Regional Goals
- TM #4: ITS User Services and Market Packages
- TM #5: Regional ITS Architecture
- TM #6A: Operational and Implementation Strategies
- TM #6B: Implementation Plan

- TM #7: Regional ITS Telecommunications Plan
- TM #8: ITS Project Evaluation Plan
- TM #9: ITS TCB Plan
- Final Report and Executive Summary

In addition to the above technical memoranda, the following also were prepared as part of the study:

- Four project newsletters;
- Project Web page (www.mag.maricopa.gov/ITS/index.html);
- Meeting minutes and agendas; and
- Toll-free hotline.

Draft copies of the technical memoranda were presented and distributed to the Regional ITS Stakeholders Group (RISG) for review and comment. Feedback from the MAG project manager and RISG was incorporated, and the technical memoranda were finalized, distributed, and posted on the MAG ITS Strategic Plan web page.

1.3 Regional ITS Stakeholders Group

Under the auspices of the MAG ITS Committee, a multijurisdictional group of ITS champions was established to guide, review project deliverables, and provide input to the *MAG ITS Strategic Plan Update*. The RISG was comprised of representatives from public, private, academic and public safety agencies, and membership was open to anyone interested. The RISG met monthly to review the Plan's progress, provide feedback to the consultant team about project deliverables, and establish consensus on future directions for the Plan.

The following is a list of the MAG ITS Strategic Plan RISG members:

- Jim Book, City of Glendale (Chairman);
- Tom Buick, Maricopa County Department of Transportation;
- Bob Ciotti, Phoenix Transit;
- Terry Conner, Arizona Department of Public Safety;
- David Cowley, AAA Arizona;
- Jim Decker, City of Tempe;
- Don Dey, TransCore;
- Mike Frisbie, City of Phoenix;
- Alan Hansen, Federal Highway Administration;
- Sarath Joshua, MAG (Project Manager);
- Mary Kihl, Arizona State University;
- Brian Latte, City of Chandler;
- Jim Matteson, Phoenix Aviation;
- Scott Nodes, City of Peoria;
- Ellis Perl, City of Surprise;
- Steve Ramsey, City of Scottsdale;
- Alan Sanderson, City of Mesa;
- Dale Thompson, Maricopa County Department of Transportation;

- Bruce Ward, Town of Gilbert; and
- Tim Wolfe, Arizona Department of Transportation.

1.4 ITS Vision and Mission

In keeping with the advances in ITS deployment in the MAG region, the ITS vision and mission statements developed in the 1995 ITS Strategic Plan were reviewed and revised. The RISG developed the following new vision and mission statements early in the project:

VISION: Enhance the quality of life in the MAG region by applying technology and information-sharing to improve the multimodal transportation system.

MISSION: To plan, implement and evaluate appropriate ITS technologies, consistent with the national ITS program, that address regional goals and objectives of the transportation users.

The vision statement is intended to be regionally applicable (summarize the ITS goals, as a whole, for the MAG region), and the mission statement summarizes the major goals and objectives of the *MAG ITS Strategic Plan Update*.

2. STAKEHOLDER INVOLVEMENT AND IDENTIFICATION OF REGIONAL NEEDS

Stakeholder involvement in the development of the *MAG ITS Strategic Plan Update* was identified as being very critical to its success – the information gathered as part of the stakeholder involvement and outreach phase served as the foundation for the entire project. The challenge of stakeholder involvement was reaching out to specific individuals, groups and organizations, educating them about ITS, and encouraging participation and feedback. To accomplish this endeavor, the study team used several outreach methods to identify the issues most important to the users of the regional transportation system, as well as kept them informed about the progress and findings of the project.

2.1 Stakeholder Involvement Plan

A multi-step, multi-level approach was used to educate and involve regional stakeholders in the development of the *MAG ITS Strategic Plan Update*.

2.1.1 Focus Groups and Questionnaires

Four focus group workshops were scheduled early in the project. These interactive workshops included an overview of the Update, an educational presentation on ITS, and a brainstorming session that allowed attendees to voice their opinions about the region's transportation needs and how ITS could be used to address those needs and problems. Needs were written on oversized boards placed throughout the rooms, and at the end of the workshops, participants were asked to prioritize the needs that were discussed using color-coded stickers to indicate high, medium, and low priorities. Participants could also write in additional needs.

The focus group workshops were targeted to specific audiences:

- The first was open to the public sector to get the traffic and transportation agencies' perspective;
- The second was held in conjunction with the ITS Arizona Sixth Annual Meeting to get input from professionals in the local ITS community;
- The third was open to the general public; and
- The fourth was held as part of a scheduled monthly 911 Public Safety Access Point (PSAP) meeting which yielded valuable input from emergency services personnel.

In addition to the focus group workshops, a questionnaire was distributed asking respondents to fill in their top transportation concerns.

2.1.2 Stakeholder Communication

An important part of the stakeholder involvement plan for the *MAG ITS Strategic Plan Update* was to keep the stakeholders informed of the project's progress, as well as provide several opportunities to get in touch with the members of the project team to answer any questions.

Four project newsletters were prepared at key points in the project and distributed to over 290 stakeholders throughout the region. A database containing public agencies, private engineering firms, academic institutions, public and private transportation providers, commercial vehicle operators, tourism industry representatives, emergency services providers, major employers, the media, and members of the general public was maintained and used as a mailing list for the newsletters. A project Web page, e-mail address, and toll-free hotline also were established. The Web page contained an overview of the project, RISG agendas and minutes, a project schedule, and downloadable copies of project deliverables. E-mail links and phone numbers for members of the project team also were included on the Web page, and contact information was included in each newsletter.

2.1.3 ITS Presentation

A multimedia presentation was developed which served as an excellent tool to educate project stakeholders and others in the region with an interest in ITS and transportation issues. The *"Intelligent Transportation Solutions: An Overview of Intelligent Transportation Systems in the MAG Region"* presentation combined narrated video clips with PowerPoint slides. It can be narrated by a presenter, or run as a stand-alone slide-show file as there is sufficient text on the presentation slides to give the viewer a clear understanding of the key points.

The presentation was shown at each of the focus groups, and several CDs were produced and distributed to MAG region agencies to educate technical and non-technical audiences about ITS in the MAG region and benefits of implementing integrated ITS.

2.2 Stakeholder Needs and Prioritization

As a result of the focus group workshops and questionnaires, more than 100 needs were identified by stakeholders in the MAG region. These needs were refined into ITS need statements. As part of the needs identification process, participants at the focus groups and questionnaire respondents were asked to prioritize the needs as high, medium, and low, and to approach the prioritization process as if they were allocating funding dollars for specific ITS programs. Based on the priority(ies) assigned by the stakeholders, each need statement was assigned a score and then ranked against the other identified needs.

The need statements were reviewed to determine if they were in fact ITS needs, or if the need would be more appropriately addressed through a different type of project. The RISG also reviewed the needs to determine if it was feasible to address the need in the *MAG ITS Strategic Plan Update*. Based on the review by the RISG, it was decided to address all identified needs as ITS needs.

Finally, needs were reviewed to determine if existing systems were in place that addressed the need. The existing system was rated as "No" (no systems exist to address the need), "Partially" (some systems exist to partially meet need), or "Yes" (adequate systems are in place to meet the need). Planned systems also were reviewed to determine if the systems planned in the MAG region would meet the need. Finally, the planned systems were rated as "No," "Partially," or "Yes" to describe the ability of the planned systems to meet the identified need.

The results of this review are presented in **Table 2.1**. In the case of most needs, at least one system was planned that would continue to address that need in the future; however, there were no needs identified where planned systems were expected to fully meet the need. This is due to the fact that the transportation system in the MAG region continually grows and changes, and while systems might be planned to address the need, it is difficult to say that any system would fully meet a transportation need in the future.

2.3 Regional ITS Objectives

Based on the ITS needs identified by stakeholders, several regional objectives were developed to help meet those needs. The regional objectives for the *MAG ITS Strategic Plan Update*, and the identification numbers of the needs in **Table 2.1** that they address, are identified below.

- Coordinate signal systems across jurisdictional boundaries and improve progression. (1, 4, 10, 17, 52)
- Improve incident detection capabilities and reduce incident clearance times. (2, 5, 8, 52)
- Improve accuracy, timeliness and availability of real-time traveler information to the public. (6, 11, 12, 19, 20, 23, 26, 32, 49, 52)
- Increase the use of VMS for more types of traffic and incident information. (7)
- Increase inter-agency and intra-agency coordination. (1, 16, 17)
- Improve bus progression using traffic signal priority. (13)
- Develop and facilitate ITS education and marketing efforts to the public. (15)
- Enhance traffic management capabilities for special events. (16)
- Provide advanced warning at railroad/street crossings. (21, 52)
- Increase automated traffic data collection and archiving ability. (15, 52)
- Install freeway call boxes. (25)
- Provide PSAP managers with access to real-time traffic information. (32)

Table 2.1 – Stakeholder Needs

ID#	Need	Score	ITS Need	RISG Agreement With Need	Existing Systems Address Need	Planned Systems Continue to Address Need	Planned Systems Meet Need
1	Need to integrate signal systems with freeway management system	91	Yes	Yes	Partially	Yes	Partially
2	Need improved incident clearance at freeway interchanges	68	Yes	Yes	Partially	Yes	Partially
3	Need enhanced transit service (routes, frequency, hours)	68	No	-	-	-	-
4	Need to enhance regional signal coordination/improve progression	67	Yes	Yes	Partially	Yes	Partially
5	Need to reduce incident clearance time	64	Yes	Yes	Partially	Yes	Partially
6	Need to improve accuracy and timeliness of traffic information to public	60	Yes	Yes	Partially	Yes	Partially
7	Need to increase use of VMS for more types of traffic and incident information	47	Yes	Yes	No	No	No
8	Need to improve incident detection and notification to motorists	47	Yes	Yes	Partially	Yes	Partially
9	Need a regional light rail system	39	No	-	-	-	-
10	Need to increase inter- and intra-agency coordination	38	Yes	Yes	Partially	Yes	Partially
11	Need real-time transit schedule information	30	Yes	Yes	Partially	Yes	Partially
12	Need more accurate information about road construction/closures and alternate routes	29	Yes	Yes	Partially	Yes	Partially
13	Need bus priority at traffic signals	29	Yes	Yes	Partially	Yes	Partially
14	Need more HOV lanes on freeways	28	No	-	-	-	-
15	Need to develop and facilitate ITS education and marketing efforts to public	28	Yes	Yes	Partially	No	Partially
16	Need enhanced traffic management capabilities for special events	27	Yes	Yes	No	Yes	Partially
17	Need to increase use of computerized traffic signals	26	Yes	Yes	Partially	Yes	Partially
18	Need to improve real-time communication between TMCs and CVOs	25	Yes	Yes	No	Yes	Partially
19	Need to increase use of HAR	23	Yes	Yes	No	Yes	Partially
20	Need in-vehicle traffic information	22	Yes	Yes	Partially	Yes	Partially
21	Need more advanced warning at RR/street crossings	21	Yes	Yes	No	No	No
22	Need to increase use of automated enforcement technology (red lights, speed, etc.)	21	No	-	-	-	-
23	Need to integrate transit information with arterial and freeway management systems	21	Yes	Yes	Partially	Yes	Partially
24	Agencies need more traffic data to plan infrastructure improvements	20	Yes	Yes	Partially	Yes	Partially
25	Need freeway call boxes	20	Yes	Yes	No	No	No
26	Need AVL for transit	19	Yes	Yes	Partially	Yes	Partially
32	PSAPs need access to real-time traffic information	12	Yes	Yes	No	No	No
49	Need enhanced information at transit centers	5	Yes	Yes	Partially	Yes	Partially
52	Need to increase use of detector data/travel time data	3	Yes	Yes	Partially	Yes	Partially

3. INVENTORY OF THE EXISTING AND PLANNED MULTIMODAL ITS INFRASTRUCTURE

Agencies throughout the MAG region have been planning and deploying ITS since the mid 1980s. With the continued build-out of ADOT's FMS, municipal signal and traffic management programs, and the launch of the AZTech™ project, the region has evolved into a sophisticated ITS community. Many local traffic agencies are in various stages of planning, deploying and operating ITS within their respective jurisdictions, and continued growth of both local and regional ITS is a significant goal toward regional integration and a seamless transportation network.

This section addresses the existing and planned ITS in the MAG region, and summarizes the inventory of ITS infrastructure that was conducted as part of this project. Specific projects and amounts of infrastructure for each jurisdiction are included in Technical Memorandum Number 3, ITS Inventory and Objectives, of the *MAG ITS Strategic Plan Update*.

3.1 Existing ITS

In order to develop a regional ITS strategic plan for an area with an established intelligent transportation infrastructure, it was important to take into account the systems that are in place as well as those planned for the near-term. This inventory effort ensured that the strategic plan developed did not duplicate any efforts that were already underway. Several sources were reviewed to determine the existing ITS systems in the MAG region. Documentation such as the Federal Highway Administration (FHWA) ITS Deployment Tracking Surveys (1997 and 1999) were reviewed as well as the *AZTech™ Final Report* and the *Valley Metro Vehicle Management System* report. Direct contact was made with representatives of many of the agencies throughout the region to discuss systems they had in place. While every attempt was made to be thorough, ITS continues to be deployed throughout the MAG region and therefore the list of existing systems will be continually increasing.

The following agencies currently operate or maintain one or more ITS applications in their jurisdiction within the MAG region:

Freeways and Arterials
Arizona Department of Transportation
Maricopa County
City of Chandler
Town of Gilbert
City of Glendale
City of Mesa
City of Peoria
City of Phoenix
City of Scottsdale
City of Tempe

Airport
Sky Harbor International Airport

Emergency Management
ADOT – Arizona Local Emergency Response Team (ALERT)
Phoenix Fire
Rural Metro
Arizona Department of Public Safety (DPS)
Mesa Fire and Police

Commercial Vehicle Operations (CVO)
ADOT
Arizona DPS

Transit
Maricopa County
Glendale Transit
Mesa Transit
Peoria Transit
Phoenix Transit
Regional Public Transportation Authority (RPTA)
Scottsdale Transit
Sun City Area Transit System
Tempe Transit

Private Sector
ETAK
Fastline
Metro Networks
CUE/Auto PC

There are several common types of ITS infrastructure elements among the various agencies in the MAG region (i.e., centrally-controlled municipal traffic signal systems, computerized transit dispatch, detection stations, emergency preemption at traffic signals, etc.). The inventory conducted for this task documented field hardware, communications infrastructure, operations centers, and on-board devices (where applicable). The most common elements found in the region included:

- Municipal, county, and state traffic management and operations centers;
- Traveler information disseminated via freeway and arterial VMS, Internet, broadcast TV and radio, kiosks, and in-vehicle systems;
- Centrally-controlled traffic signal systems;
- Signalized intersections with loop detection capability (county and municipal);
- Signalized intersections with preemption for emergency vehicles (state, county, municipal);
- AZTech™ workstations in local jurisdictions (county and municipal);
- Roadway Condition Reporting System (RCRS) (between AZTech™ and local cities);
- CCTV cameras on freeways and arterials (at strategic locations in some municipalities);
- Fixed-route and demand-responsive buses equipped with automatic vehicle location and identification (AVL/AVI) technologies;
- Electronic transit fare payment systems;
- Computer-aided transit dispatch systems;
- Transit routes, schedules, fares, etc. available on the Internet;
- Computer-aided dispatch systems for police, fire, and other emergency services; and
- Data archiving.

Unique ITS in the MAG region includes:

- Airport electronic parking revenue and control system (Sky Harbor Airport);
- Security cameras on buses (Tempe); and
- Nikon Total Station for accident investigation (DPS) and Phoenix Police Department.

3.2 Planned ITS

Planned ITS were identified as any ITS that had funding identified and implementation scheduled within the next 20 years. Documents such as the FHWA ITS Deployment Tracking Surveys (1999), *Valley Metro Vehicle Management System* report, and the FY 2001-2005 MAG Transportation Improvement Program were reviewed. In addition, representatives from the

different agencies were contacted to discuss other ITS that were planned for their jurisdiction but have not yet been documented.

Many of the planned ITS projects in MAG region jurisdictions were enhancements to or expansions of existing systems. The following summarizes major planned and funded ITS programs over the next 20 years in the region (by agency type):

Freeways and Arterials

- Expansion of FMS
- Capability to distribute incident information through e-mail and in-vehicle navigation systems
- Additional AZTech™ Systematically Managed Arterial (SMART) Corridors equipped with CCTV, VMS, and detection
- Additional municipal RCRS (Phoenix and Scottsdale)
- Enhancements and expansion of the regional archived data server
- Municipal traffic signal system upgrades (communications, emergency vehicle preemption, video and loop intersection data collection)
- Upgrades to municipal traffic operations/management centers
- Downtown special event traffic management system (Phoenix)
- Traffic and transit operations center (Tempe)
- Electronic surveillance and electronic train arrival predication capability at highway-rail intersections (Tempe)

Transit

- Expand electronic fare payment systems to include more vehicles (fixed-route and demand-responsive)
- Deploy navigation aids on transit vehicles
- Expand AVL and AVI on transit vehicles
- Enhance dissemination of real-time transit schedule and arrive/departure information through telephone, kiosks, VMS, monitors, etc.
- Provide for transit and traveler information displays at fixed-bus transit stops
- Increase use of computer aided dispatch for transit
- Archive transit information

Airport

- Expand airport parking revenue control system at Sky Harbor International Airport to include additional lots

Emergency Management

- Provide for a fiber-optic connection between the ADOT Traffic Operations Center (TOC) and DPS
- Freeway service patrol

Commercial Vehicle Operations

- Deploy additional weigh-in-motion (WIM) sites
- Install additional Special Response Interactive Ports (Sprint Ports)
- Connect to Safety and Fitness Electronic Records System (SAFER)
- Deploy a real-time CVO traveler information system to include e-mail dissemination, congestion map, and current CVO restriction information
- Implement CVISN Level 1

Private Sector

- Real-time traveler and transit information via in-vehicle devices, broadcast fax network, paging network, and palm-sized PC
- Personalized real-time traveler information website (Traffic Station)
- Telewarning™ cellular telephone traveler information network (Traffic Station)
- RouteFinder™ and StreetPilot™ hand-held devices with real-time traveler information (CUE)
- CVO ATIS website by TranSmart Technologies

The public sector projects have been funded and programmed. Private sector deployments are dependent on public interest and the public's willingness to support (i.e., pay for) real-time personalized information. The total number of units ultimately deployed by these private systems depends largely on the public's demand. The successes of these deployments will, in many ways, affect the future of private sector involvement in ITS in the region.

4. ITS USER SERVICES AND MARKET PACKAGES

User services describe the transportation services that the MAG ITS can provide to satisfy the user's needs. To date, 31 user services have been jointly developed by the United States Department of Transportation (USDOT) and ITS America with substantial stakeholder input. The MAG region logical system architecture defines the processes (the activities or functions) that are required to satisfy the user services identified as part of this task.

Market packages provide a deployment-oriented perspective to the MAG regional architecture. They group ITS technologies that work together to deliver a given transportation service. In other words, market packages identify the pieces of the physical system architecture that are required to implement a particular transportation service. While ITS user services describe what MAG needs to provide to its transportation users, market packages focus on how these services actually are to be delivered.

As part of the *MAG ITS Strategic Plan Update*, an integrated user service plan was developed that addresses the MAG region's transportation needs through the selection of appropriate ITS user services. Applicable market packages also were selected and prioritized into high, medium, and low priorities and corresponding short-, mid-, and long-term deployment timeframes. This section summarizes the development of the user service plan and market package priorities. More detailed information about the user services and market package selection process is located in Technical Memorandum Number 4, ITS User Services and Market Packages, of the *MAG ITS Strategic Plan Update*.

4.1 User Services

4.1.1 Matching User Services to MAG Regional ITS Needs

MAG's regional transportation needs and priorities, identified earlier in the project, were matched with the 31 ITS user services in order to identify candidate user services to best address those needs. **Figure 4.1** shows a matrix of user needs matched to the user services. This process resulted in the following list of candidate user services for the MAG region:

Travel and Traffic Management

- Pre-trip Travel Information (1.1)
- En-route Driver Information (1.2)
- Route Guidance (1.3)
- Ride Matching and Reservation (1.4)
- Traveler Services Information (1.5)
- Traffic Control (1.6)
- Incident Management (1.7)
- Travel Demand Management (1.8)
- Emissions Testing and Mitigation (1.9)
- Highway-rail Intersection (1.10)

Figure 4.1 – Matching User Needs to User Services

			0																															
			Travel And Traffic Management										**Public Transportation Management**				**Electronic Payment**	**Commercial Vehicle Operations**						**Emergency Management**		**Advanced Vehicle Safety Systems**							**Information Management**	**Other**
			1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	2.1	2.2	2.3	2.4	3.1	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	6.1	6.2	6.3	6.4	6.5	6.6	6.7	7.1	8.1
ID#	**User Needs**	Need Score	Pre-trip Travel Information	En-route Driver Information	Route Guidance	Ride Matching And Reservation	Traveler Services Information	Traffic Control	Incident Management	Travel Demand Management	Emissions Testing And Mitigation	Highway-rail Intersection	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Electronic Payment Services	Commercial Vehicle Electronic Clearance	Automated Roadside Safety Inspection	On-board Safety Monitoring	Commercial Vehicle Administrative Processes	Hazardous Material Incident Response	Commercial Fleet Management	Emergency Notification And Personal Security	Emergency Vehicle Management	Longitudinal Collision Avoidance	Lateral Collision Avoidance	Intersection Collision Avoidance	Vision Enhancement For Crash Avoidance	Safety Readiness	Pre-crash Restraint Deployment	Automated Vehicle Operation	Archived Data Function	Other
1	Need to integrate signal systems with freeway management system	91						X	X		X																							
2	Need improved incident clearance at freeway interchanges	68						X	X		X											X		X	X									
4	Need to enhance regional signal coordination/improve progression	67						X			X																							
5	Need to reduce incident clearance time	64						X	X		X											X		X	X									
6	Need to improve accuracy and timeliness of traffic information to public	60	X	X	X		X			X				X									X											
7	Need to increase use of VMS for more types of traffic and incident information	47		X	X		X	X	X	X																								
8	Need to improve incident detection and notification to motorists	47	X	X	X		X	X	X													X	X	X	X									
10	Need to increase inter- and intra-agency coordination	38	X	X	X	X	X	X	X	X		X	X	X	X	X						X	X	X	X								X	
11	Need real-time transit schedule information	30	X			X	X						X	X	X																			
12	Need more accurate info. about road construction/closures and alternate routes	29	X	X	X		X	X	X														X		X									
13	Need bus priority at traffic signals	29						X					X																					
15	Need to develop and facilitate ITS education and marketing efforts to public	28	X			X				X			X																					X
16	Need enhanced traffic management capabilities for special events	27	X	X	X	X	X	X	X	X	X		X	X	X																		X	
17	Need to increase use of computerized traffic signals	26						X																										
18	Need to improve real-time communication between TMCs and CVOs	25		X			X																X											
19	Need to increase use of HAR	23		X			X		X																									
20	Need in-vehicle traffic information	22		X	X		X																											
21	Need more advanced warning at RR/street crossings	21						X				X																						
22	Need to increase use of automated enforcement tech. (red lights, speed, etc.)	21																																X
23	Need to integrate transit info. with arterial and freeway management systems	21					X			X			X	X																				
24	Agencies need more traffic data to plan infrastructure improvements	20																															X	
25	Need freeway call boxes	20							X															X										
26	Need AVL for transit	19											X			X																		
32	PSAPs need access to real-time traffic information	12	X	X				X	X													X			X									
49	Need enhanced information at transit centers	5											X	X																				
52	Need to increase use of detector data/travel time data	3	X	X				X	X																								X	

Public Transportation Management

- Public Transportation Management (2.1)
- En-route Transit Information (2.2)
- Personalized Public Transit (2.3)
- Public Travel Security (2.4)

Commercial Vehicle Operations

- Hazardous Material Incident Response (4.5)
- Commercial Fleet Management (4.6)

Emergency Management

- Emergency Notification and Personal Security (5.1)
- Emergency Vehicle Management (5.2)

Information Management

- Archived Data Function (7.1)

Other (8.1)

These user services were anticipated to achieve early deployment success in the MAG region and were considered top priority. This list of candidate user services was not intended to exclude other user services as needed in specific areas; however, this list of user services represents recommendations of region-wide services on which the remainder of this updated strategic deployment plan was based.

4.1.2 Priorities and Deployment Timeframes for Recommended User Services

The candidate user services were then prioritized to help identify those which were most needed or critical to successful ITS deployment in the region. Prioritization of the user services was based on the ranking of each of the needs. The importance (or ranking) of each user service was determined by adding up the numerical scores of all the needs matched to that particular user service. The recommended deployment time frames for the identified user services are summarized in **Table 4.1**.

Table 4.1 – Proposed Deployment Timeframes for ITS User Services in the MAG Region

Short-Term 2002-2006	Mid-Term 2007-2011	Long-Term 2012-2021
▪ Pre-trip travel information ▪ En-route driver information ▪ Traveler services information ▪ Traffic control ▪ Incident management ▪ Emissions testing and mitigation ▪ Public transportation management ▪ Commercial fleet management ▪ Emergency notification and personal security ▪ Emergency vehicle management ▪ Archived data function ▪ Other*	▪ Ride matching and reservation ▪ Travel demand management ▪ Highway-rail intersection ▪ En-route transit information ▪ Hazardous material incident response	▪ Route guidance ▪ Personalized public transit ▪ Public travel security

(*) This category captures the following two needs:

- *Need to develop and facilitate ITS education and marketing efforts to public*
- *Need to increase use of automated enforcement technologies (red lights, speed, etc.)*

Time frames were assigned based on the relative urgency of the corresponding needs and took into consideration the current implementation status of related services in the MAG region.

For example, the Archived Data Function user service had a relatively low score when compared to the other user services. A regional archived data server was recently implemented, and there are plans in the very near term to expand regional data archiving and management capabilities. This near-term planned infrastructure that specifically addresses one of the identified user services increased the deployment priority (i.e., likelihood) for that user service.

4.1.3 MAG Region User Service Objectives

The transportation needs identified for the MAG region were evaluated for commonalties, and seven classes of needs were identified that expressed the shared goals of those needs. These goals can be thought of as the system objectives that must be accomplished through the deployment of the selected user services or, in other words, as the user service objectives. They are:

1. Collect, process, and disseminate accurate up-to-date traveler information;
2. Provide safe and efficient flow of traffic;
3. Improve incident detection and clearance capabilities;
4. Improve transit performance;
5. Improve automated traffic data collection and archival ability;
6. Improve inter- and intra-agency coordination, cooperation, and information exchange; and
7. Develop and facilitate ITS education and marketing.

4.2 Market Packages

Market packages are directly traceable to the user services and often include capabilities that span more than one user service. Conversely, a single user service sometimes includes a range of incremental capabilities that are segregated into separate market packages so that they can be considered separately from a deployment perspective. As a result, there is usually a many-to-many relationship between the market packages and the user services.

The National ITS Architecture has identified 63 market packages in the following categories:

- Archived Data (3 market packages);
- Advanced Public Transportation Systems (8 market packages);
- Advanced Traveler Information Systems (9 market packages);
- Advanced Traffic Management Systems (19 market packages);
- Advanced Vehicle Control and Safety Systems (11 market packages);
- Commercial Vehicle Operations (10 market packages); and
- Emergency Management (3 market packages).

4.2.1 Matching Market Packages to User Services

The relationship between user services and market packages for the MAG region is presented in **Figure 4.2.** For each user service, all market packages that could be deployed to help achieve that user service were identified. Forty-six of the 63 available market packages were identified for deployment in the MAG region.

4.2.2 Priorities and Deployment Timeframes for Recommended Market Packages

Market packages, like the user services, were categorized into short-term, mid-term, and long-term deployment timeframes, which are synonymous with high, medium, and low priorities. The timeframes for the market packages were based on the relative importance of a market package as it related to its corresponding user service, the feasibility of implementing the market package in the MAG region, and the availability of the technology in the market package.

The market packages for the MAG region were divided into deployment timeframes as shown in **Table 4.2**

Figure 4.2 – Matching Market Packages to Selected User Services

			User Services																		
			Short-term											Mid-term					Long-term		
			1.1	1.2	1.5	1.6	1.7	1.9	2.1	4.6	5.1	5.2	7.1	8.1	1.4	1.8	1.10	2.2	4.5	1.3	2.3	2.4
	ID#	Market Packages	Pre-trip Travel Information	En-route Driver Information	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Public Transportation Management	Commercial Fleet Management	Emergency Notification And Personal Security	Emergency Vehicle Management	Archived Data Function	Other	Ride Matching And Reservation	Travel Demand Management	Highway-rail Intersection	En-route Transit Information	Hazardous Material Incident Response	Route Guidance	Personalized Public Transit	Public Travel Security
Short-term	AD1	ITS Data Mart											S									
	AD2	ITS Data Warehouse											S									
	APTS1	Transit Vehicle Tracking							S									M			L	L
	APTS2	Transit Fixed-Route Operations							S									M				
	ATIS1	Broadcast Traveler Information	S	S														M				
	ATIS2	Interactive Traveler Information	S	S	S										M			M			L	
	ATIS3	Autonomous Route Guidance		S																L		
	ATIS7	Yellow Pages and Reservation	S	S	S										M			M				
	ATMS1	Network Surveillance				S																
	ATMS3	Surface Street Control				S	S										M					
	ATMS4	Freeway Control				S	S									M						
	ATMS5	HOV Lane Management				S										M						
	ATMS5	Traffic Information Dissemination			S	S											M					
	ATMS7	Regional Traffic Control				S																
	ATMS8	Incident Management System					S															
	ATMS9	Traffic Forecast and Demand Management				S										M						
	ATMS11	Emissions Monitoring and Management						S														
	ATMS16	Parking Facility Management		S		S										M						
	ATMS18	Road Weather Information System		S		S	S															
	ATMS19	Regional Parking Management		S		S										M						
	CVO10	Fleet Administration								S										L		
	EM1	Emergency Response									S	S										
	EM2	Emergency Routing				S						S										
	EM3	Mayday Support									S	S										
Mid-term	AD3	ITS Virtual Data Warehouse											M									
	APTS3	Demand Response Transit Operations							M									M			L	
	APTS4	Transit Passenger and Fare Management																M				
	APTS5	Transit Security							M													L
	APTS7	Multi-modal Coordination				M			M							M						
	APTS8	Transit Traveler Information							M									M				
	ATIS4	Dynamic Route Guidance		M	M		M											M		L		
	ATIS5	ISP Based Route Guidance	M	M																L		
	ATIS8	Dynamic Ridesharing	M	M											M	M		M		L	L	
	ATMS2	Probe Surveillance				M																
	ATMS12	Virtual TMC and Smart Probe Data		M		M	M															
	ATMS13	Standard Railroad Grade Crossing															M					
	ATMS14	Advanced Railroad Grade Crossing															M					
	ATMS15	Railroad Operations Coordination															M					
	CVO2	Freight Administration																	M			
	CVO9	CVO Fleet Maintenance								M												
	CVO10	HAZMAT Management					M			M									M			
Long-term	APTS6	Transit Maintenance							L													
	ATIS6	Integrated Transp Mgmt/Route Guidance		L																L		
	ATIS9	In Vehicle Signing		L		L											L					
	AVSS5	Intersection Safety Warning															L					
	AVSS10	Intersection Collision Avoidance															L					

S - Short-term Implementation (2002-2006), M - Mid-term Implementation (2007-2011), L - Long-term Implementation (2012-2021)

Table 4.2 – Selected Market Packages

Short-term 2002-2006	Mid-term 2007-2011	Long-term 2012-2020
▪ ITS data mart ▪ ITS data warehouse ▪ Transit vehicle tracking ▪ Transit fixed-route operations ▪ Broadcast traveler information ▪ Interactive traveler information ▪ Autonomous route guidance ▪ Yellow pages and reservation ▪ Network surveillance ▪ Surface street control ▪ Freeway control ▪ HOV lane management ▪ Traffic information dissemination ▪ Regional traffic control ▪ Incident management system ▪ Traffic forecast and demand management ▪ Emissions monitoring and management ▪ Parking facility management ▪ Road weather information system ▪ Regional parking management ▪ Fleet administration ▪ Emergency response ▪ Emergency routing ▪ Mayday support	▪ ITS virtual data warehouse ▪ Demand response transit operations ▪ Transit passenger and fare management ▪ Transit security ▪ Multi-modal coordination ▪ Transit traveler information ▪ Dynamic route guidance ▪ ISP based route guidance ▪ Dynamic ridesharing ▪ Probe surveillance ▪ Virtual TMC and smart probe data ▪ Standard railroad grade crossing ▪ Advanced railroad grade crossing ▪ Railroad operations coordination ▪ Freight administration ▪ CVO fleet maintenance ▪ HAZMAT management	▪ Transit maintenance ▪ Integrated transportation management/route guidance ▪ In vehicle signing ▪ Intersection safety warning ▪ Intersection collision avoidance

5. MAG REGIONAL ITS ARCHITECTURE

An architecture provides the framework to accommodate technology changes, evolution, and growth of the system. Rather than installing technologies and implementing systems in a piecemeal fashion, it is important to have a plan and a framework in which the various systems can be designed and integrated to satisfy regional goals and objectives. By establishing this framework (the regional ITS architecture) to deploy ITS systems in the MAG region, the MAG ITS Committee can select future projects that meet both local jurisdiction needs and regional goals, and comply with federal funding requirements.

The MAG regional ITS architecture was based on the identified needs of transportation users in the MAG region, and the associated user services and market packages as defined in the National ITS Architecture. Development of the MAG regional architecture also involved close coordination with the existing statewide architecture for Arizona, the AZTech™ architecture, and the FMS architecture.

More detailed information about the architecture development activities is located in Technical Memorandum Number 5, MAG Regional ITS Architecture, of the *MAG ITS Strategic Plan Update.*

5.1 Logical Architecture

The logical framework of MAG's regional ITS defined the processes and data flows that are needed to provide the user services identified earlier in the *MAG ITS Strategic Plan Update*. It was the most abstract of all the steps involved in the development of MAG's ITS architecture framework. The development of a logical architecture was removed from any hardware or software constraints which gives the system planner the freedom necessary to ensure that all processes and data needed to support the future MAG ITS are included in the architecture.

This task took advantage of the National ITS Architecture and its frameworks to simplify the development of MAG's logical architecture and ensure consistency with the ITS National Architecture. In order to avoid the large number of logical architecture diagrams representing processes and data flows at various levels of decomposition, a tabular listing of Level 2 National ITS Architecture processes was used.

The basis for selecting logical processes for the MAG region was the user service objectives previously identified (all except for the seventh objective which relates to ITS outreach and marketing, which did not impact any architecture process or data flow). These user service objectives defined a broad focus for the future MAG ITS and directly represented the needs of the system users.

Table 5.1 outlines a set of logical processes that when implemented together are anticipated to fulfill the transportation needs identified earlier in the *MAG ITS Strategic Plan Update*. This table identifies which processes closely matched public sector functions, private sector functions, and those processes that are likely to be supported through public-private partnerships.

Table 5.1 – Logical ITS Processes for MAG

LOGICAL ARCHITECTURE PROCESSES (From National ITS Architecture)	Public	Private	Public-Private	PRINCIPAL USER SERVICE OBJECTIVES[1]: Collect, process and disseminate accurate and up-to-date traveler information	Provide safe and efficient flow of traffic	Improve incident detection and clearance capabilities	Improve transit performance	Improve automated traffic data collection and archival ability	Improve inter and intra agency coordination and cooperation and
1 MANAGE TRAFFIC									
1.1 Provide Traffic Surveillance	X			X	X	X		X	
1.2 Provide Device Control	X			X	X	X		X	
1.3 Manage Incidents	X			X	X	X			X
1.4 Manage Travel Demand	X			X	X			X	X
1.5 Manage Emissions	X				X			X	
1.6 Manage Highway Rail Intersections	X				X	X			X
2 MANAGE COMMERCIAL VEHICLES									
2.1 Manage Commercial Vehicle Fleet Operations		X							X
2.2 Manage Commercial Vehicle Driver Operations		X							
2.3 Provide Commercial Vehicle Roadside Facilities	X	X	X						
2.4 Provide Commercial Vehicle Data Collection	X	X						X	X
2.5 Administer Commercial Vehicles	X	X							X
2.6 Provide Commercial Vehicle On-board Data		X	X						X
2.7 Manage Cargo		X							
3 PROVIDE VEHICLE MONITORING AND CONTROL									
3.1 Monitor Vehicle Status		X			X	X			
3.2 Provide Automatic Vehicle Operation									
3.3 Provide Automatic Emergency Notification		X			X	X			X
3.4 Enhance Driver's Vision		X			X				
4 MANAGE TRANSIT									
4.1 Operate Vehicles and Facilities	X						X		
4.2 Plan and Schedule Transit Services	X				X		X		X
4.3 Schedule Transit Vehicle Maintenance	X				X		X		
4.4 Support Security and Coordination	X					X	X	X	X
4.5 Generate Transit Driver Schedules	X			X	X		X		
4.6 Collect Transit Fares in the Vehicle	X						X		
4.7 Provide Transit User Roadside Facilities	X			X			X		
5 MANAGE EMERGENCY SERVICES									
5.1 Provide Emergency Service Allocation	X								
5.2 Provide Operator Interface for Emergency Data	X								
5.3 Manage Emergency Vehicles	X					X			
5.4 Provide Law Enforcement Allocation	X					X			
5.5 Update Emergency Display Map Data	X			X		X			X
5.6 Manage Emergency Services Data	X			X		X			
6 PROVIDE DRIVER AND TRAVELER SERVICES									
6.1 Provide Trip Planning Services	X	X	X	X	X	X	X	X	X
6.2 Provide Information Services	X	X	X	X	X	X	X	X	X
6.3 Provide Traveler Services at Kiosks	X	X	X	X		X	X		
6.4 Manage Ridesharing	X			X	X		X		X
6.5 Manage Yellow Pages Services		X	X	X					X

Table 5.1 – Logical ITS Processes for MAG									
				PRINCIPAL USER SERVICE OBJECTIVES[1]					
LOGICAL ARCHITECTURE PROCESSES (From National ITS Architecture)	Public	Private	Public-Private	Collect, process and disseminate accurate and up-to-date traveler information	Provide safe and efficient flow of traffic	Improve incident detection and clearance capabilities	Improve transit performance	Improve automated traffic data collection and archival ability	Improve inter and intra agency coordination and cooperation and
6.6 Provide Guidance and Trip Planning Services		X	X	X	X	X	X		X
6.7 Provide Driver Personal Services		X		X		X			
6.8 Provide Traveler Personal Services		X		X			X		
7 PROVIDE ELECTRONIC PAYMENT SERVICES									
7.1 Provide Electronic Toll Payment	X	X	X						
7.2 Provide Electronic Parking Payment	X	X	X		X				
7.3 Provide Electronic Fare Collection	X	X	X		X		X		
7.4 Carry-out Centralized Payments Processing	X	X			X				
7.5 Provide Payment Instrument Interfaces	X	X			X				
8 MANAGE ARCHIVED DATA									
8.1 Get Archive Data	X				X	X	X	X	X
8.2 Manage Archive	X				X	X	X	X	X
8.3 Manage Archive Data Administrator Interface	X							X	X
8.4 Coordinate Archives	X				X			X	X
8.5 Process Archived Data User System Requests	X				X			X	X
8.6 Analyze Archive	X				X	X	X	X	X
8.7 Process On Demand Archive Requests	X				X			X	X
8.8 Prepare Government Reporting Inputs	X							X	X
8.9 Manage Roadside Data Collection	X		X		X			X	X

[1] Principal User Services defined in Technical Memorandum Number 4, except ITS Education and Training which is addressed elsewhere.

5.2 Physical Architecture

5.2.1 Existing Subsystems in the MAG Region

The physical architecture focuses on the physical entities and interfaces of the system. It defines the functionality of physical subsystems and communication interfaces among those subsystems. The physical architecture is comprised of the transportation and communications layers, operating in the context of the institutional layer.

The *transportation layer* includes various processing centers, roadside equipment, vehicle equipment, and other equipment used by the traveler to access ITS services and information. The typical representation of the transportation layer and its 19 subsystems is through the National ITS Architecture Interconnect Diagram, often referred to as the "sausage diagram." The *communication layer* provides for the transfer of information between the transportation layer elements. The transportation and communication layers together form the framework that coordinates overall system operation. The *institutional layer* introduces the policies, funding incentives, working arrangements, and jurisdictional structures that support the technical layers of the architecture.

The MAG physical architecture focuses on the transportation layer, with the top-level view of the communication layer being inherent in this physical architecture. There are several subsystems that are already in place, or partially in place, in various jurisdictions throughout the MAG region. The existing level of subsystem implementation is shown in **Table 5.2**.

5.2.2 Existing Physical Architecture

Based on the existing level of subsystem implementation, the existing physical architecture for the MAG region was developed. The existing Statewide ITS Architecture for Arizona and the AZTech™ architecture were reviewed to ensure that the existing MAG architecture adequately reflected these systems. The MAG ITS architecture was developed in such a format that it could easily be traced back to the National ITS Architecture Interconnect Diagram. The existing architecture for the MAG region is presented in **Figure 5.1**.

5.3 Future Architecture

5.3.1 Future Subsystems in the MAG Region

Before developing the future ITS architecture (2021), the future subsystems that should be implemented by the agencies in the MAG region were defined. A high level of deployment is envisioned for each of the subsystems in the future in order to fully deploy identified market packages and ultimately satisfy the identified user needs in the MAG region. **Table 5.3**, Recommended Future Subsystem Implementation in the MAG Region, displays the high level of implementation recommended for each subsystem and the agencies to which they are matched.

5.3.2 Future Architecture and MAG ITS Architecture Vision

Building on the recommended subsystem implementation, a future MAG ITS architecture was developed. The future MAG ITS architecture is displayed similar to the National ITS Architecture Interconnect Diagram to allow an easy traceability from the MAG ITS Architecture to the National ITS Architecture. The future MAG ITS architecture is displayed in **Figure 5.2**.

To tailor the future MAG ITS Architecture and further define certain elements of the architecture, an architecture "vision" diagram was developed. The MAG Regional ITS Architecture Vision is provided in **Figure 5.3**.

The MAG regional architecture vision provides for the addition of such future components as new roadside technologies, new vehicle subsystem technologies, new traveler subsystems, and the addition of new ITS cities to the center subsystems. As technologies evolve and smaller cities in the MAG region grow and develop their ITS programs, it is important that these technologies and cities are incorporated into the regional architecture.

Also identified in the MAG regional ITS architecture is an integrated system to assume the current functions of the separate FMS, AZTech™, and Highway Condition Reporting System/Roadway Condition Reporting System (HCRS/RCRS) servers.

Table 5.2 – Status of Existing and Recommended Subsystem Implementation in the MAG Region

	Subsystems																		
	Centers									Roadside				Traveler		Vehicle			
Responsible Agency	**Regional Archived Data Mgmt**	**Commercial Vehicle Admin**	**Emergency Management**	**Emissions Management**	**Fleet and Freight Management**	**Information Service Provider**	**Toll Administration**	**Traffic Management**	**Transit Management**	**Commercial Vehicle Check**	**Parking Management**	**Roadway**	**Toll Collection**	**Personal Info Access**	**Remote Traveler Support**	**Commercial Vehicle**	**Emergency Vehicle**	**Transit Vehicle**	**Vehicle**
MAG[1]	◐	○	◐	◐	◐	◐	N/A	◐	◐	◐	○	◐	N/A	◐	◐	◐	◐	◐	◐
RPTA[1]	◌	N/A	N/A	N/A	N/A	◐	N/A	N/A	◐	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
ADOT	◐	○	◐	◐	○	◐	N/A	◐	N/A	◐	N/A	◐	N/A	N/A	◐	N/A	◐	N/A	N/A
MCDOT	○	N/A	○	N/A	○	◐	N/A	◐	N/A	N/A	○	◐	N/A	N/A	◐	N/A	◌	N/A	N/A
Chandler Traffic	◌	N/A	N/A	N/A	N/A	◐	N/A	◐	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Gilbert Traffic	◌	N/A	N/A	N/A	N/A	◐	N/A	○	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Glendale Traffic	◌	N/A	N/A	N/A	N/A	◐	N/A	○	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Mesa Traffic	◌	N/A	N/A	N/A	N/A	◐	N/A	◐	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Paradise Valley Traffic	◌	N/A	N/A	N/A	N/A	◌	N/A	◐	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Peoria Traffic	◌	N/A	N/A	N/A	N/A	◌	N/A	○	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Phoenix Traffic	◌	N/A	N/A	N/A	N/A	○	N/A	◐	N/A	N/A	◐	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Scottsdale Traffic	◌	N/A	N/A	N/A	N/A	○	N/A	◐	N/A	N/A	◌	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
Tempe Traffic	◌	N/A	N/A	N/A	N/A	◐	N/A	◐	N/A	N/A	○	◐	N/A	N/A	◐	N/A	N/A	N/A	N/A
New ITS Cities Traffic	◌	N/A	N/A	N/A	N/A	◌	N/A	◌	N/A	N/A	◌	◌	N/A	N/A	◌	N/A	N/A	N/A	N/A
Glendale Transit	◌	N/A	N/A	N/A	N/A	◌	N/A	N/A	◌	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
Mesa Transit	◌	N/A	N/A	N/A	N/A	◌	N/A	N/A	◐	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
Peoria Transit	◌	N/A	N/A	N/A	N/A	◌	N/A	N/A	◌	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
Phoenix Transit	◌	N/A	N/A	N/A	N/A	◐	N/A	N/A	◐	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
Scottsdale Transit	◌	N/A	N/A	N/A	N/A	◌	N/A	N/A	◐	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
Tempe Transit	◌	N/A	N/A	N/A	N/A	◌	N/A	N/A	◐	N/A	N/A	○	N/A	○	◐	N/A	N/A	◐	N/A
DPS	N/A	N/A	○	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	◐	N/A	◌	N/A	N/A
MC Sheriff's Office	N/A	N/A	○	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	◌	N/A	◌	N/A	N/A
Local Police	N/A	N/A	◐	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	◌	N/A	◐	N/A	N/A
Fire	N/A	N/A	◐	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	◌	N/A	◐	N/A	N/A
PSAPs	N/A	N/A	◐	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	◌	N/A	N/A	N/A	N/A
Airports	N/A	N/A	N/A	N/A	N/A	◐	N/A	N/A	N/A	N/A	○	◌	N/A	N/A	◐	N/A	N/A	N/A	N/A
MC Flood Control	N/A	N/A	◌	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	○	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MC Environ. Services	N/A	N/A	N/A	◐	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Private Sector	◌	◌	◐	N/A	◐	◐	N/A	N/A	N/A	N/A	◌	◌	N/A	◐	◐	◐	N/A	N/A	◐

[1]Indicates the role of MAG and RPTA in coordination, funding, and policy making of subsystem implementation.

● - Full Implementation (Subsystem has been fully implemented to the level of functionality and coverage desired by the agency, and additional deployments of subsystem components will be added as needed or as funding becomes available in the future).

◐ - Partial Implementation (Subsystem has been partially implemented to the level of functionality and coverage desired by the agency, and additional deployments of subsystem components will be added as needed or as funding becomes available in the future).

○ - Low/Planning/Design Phase of Implementation (Subsystem is at a low level of implementation or is currently being planned or designed for implementation).

◌ - No Implementation (Subsystem has been identified as appropriate for the agency, however plans do not exist for implementation of this subsystem).

N/A - Not Applicable (Agency will not have primary responsibility for implementation of subsystem).

Existing MAG ITS Physical Architecture

MARICOPA ASSOCIATION of GOVERNMENTS

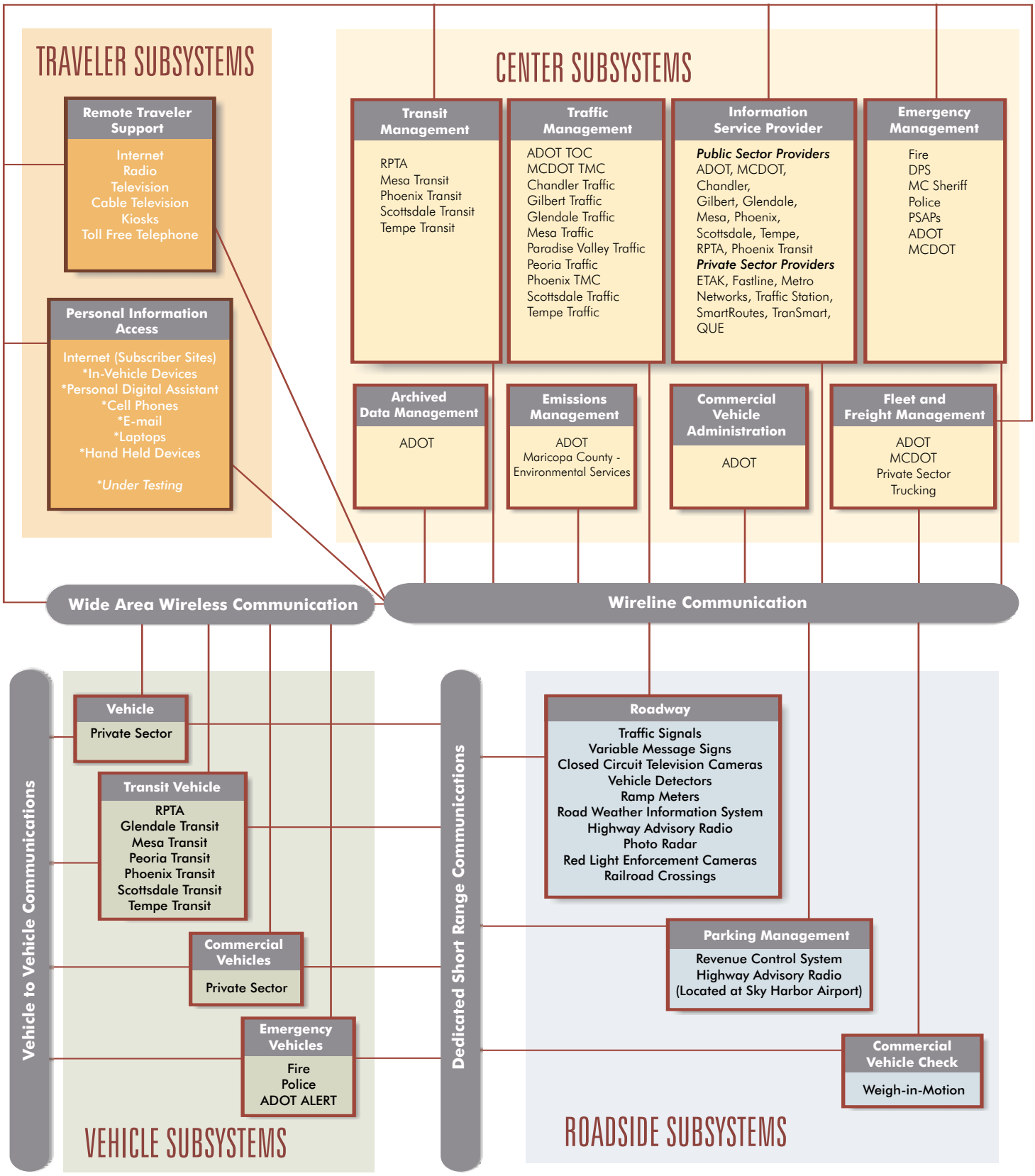

Figure 5.1

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Table 5.3 – Recommended Future Subsystem Implementation in the MAG Region

	Subsystems																		
	Centers									Roadside				Traveler		Vehicle			
Responsible Agency	**Regional Archived Data Mgmt**	**Commercial Vehicle Admin**	**Emergency Management**	**Emissions Management**	**Fleet and Freight Management**	**Information Service Provider**	**Toll Administration**	**Traffic Management**	**Transit Management**	**Commercial Vehicle Check**	**Parking Management**	**Roadway**	**Toll Collection**	**Personal Info Access**	**Remote Traveler Support**	**Commercial Vehicle**	**Emergency Vehicle**	**Transit Vehicle**	**Vehicle**
MAG[1]	●	●	●	●	●	●	N/A	●	●	●	●	●	N/A	●	●	●	●	●	●
RPTA[1]	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
ADOT	●	●	●	●	●	●	N/A	●	N/A	●	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A
MCDOT	●	N/A	●	N/A	●	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	●	N/A	N/A
Chandler Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Gilbert Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Glendale Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Mesa Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Paradise Valley Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Peoria Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Phoenix Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Scottsdale Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Tempe Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
New ITS Cities Traffic	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
Glendale Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
Mesa Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
Peoria Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
Phoenix Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
Scottsdale Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
Tempe Transit	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	N/A	N/A	●	N/A	●	●	N/A	N/A	●	N/A
DPS	N/A	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A
MC Sheriff's Office	N/A	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A
Local Police	N/A	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A
Fire	N/A	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A
PSAPs	N/A	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A
Airports	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	●	N/A	N/A	●	N/A	N/A	N/A	N/A
MC Flood Control	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MC Environ. Services	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Private Sector	●	●	●	N/A	●	●	N/A	N/A	N/A	N/A	●	●	N/A	●	●	●	N/A	N/A	●

[1]Indicates the role of MAG and RPTA in coordination, funding, and policy making of subsystem implementation.

● - Full Implementation (Subsystem has been fully implemented to the level of functionality and coverage desired by the agency, and additional deployments of subsystem components will be added as needed or as funding becomes available in the future).

N/A - Not Applicable (Agency will not have primary responsibility for implementation of subsystem).

Future MAG ITS Physical Architecture

MARICOPA ASSOCIATION of GOVERNMENTS

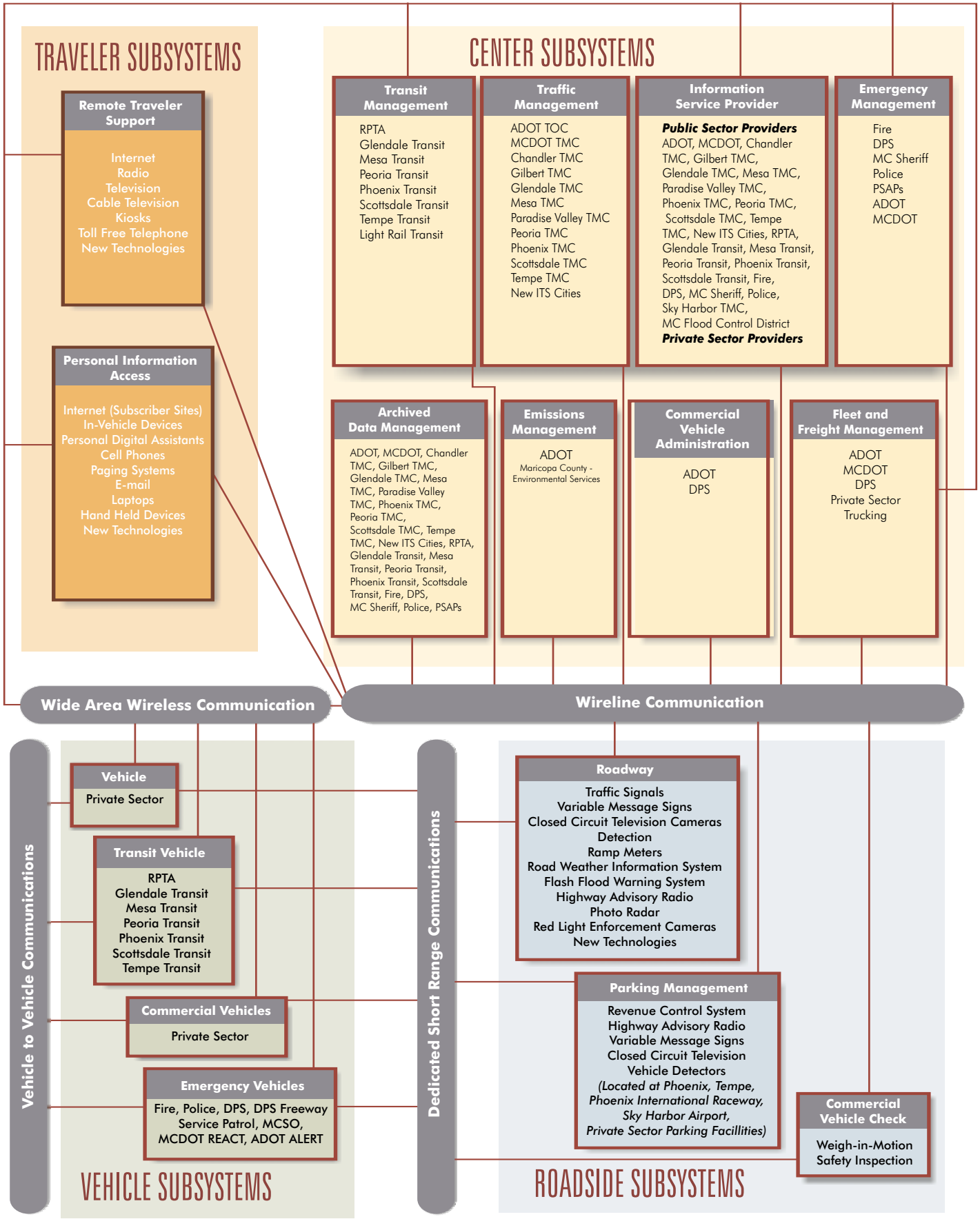

Figure 5.2

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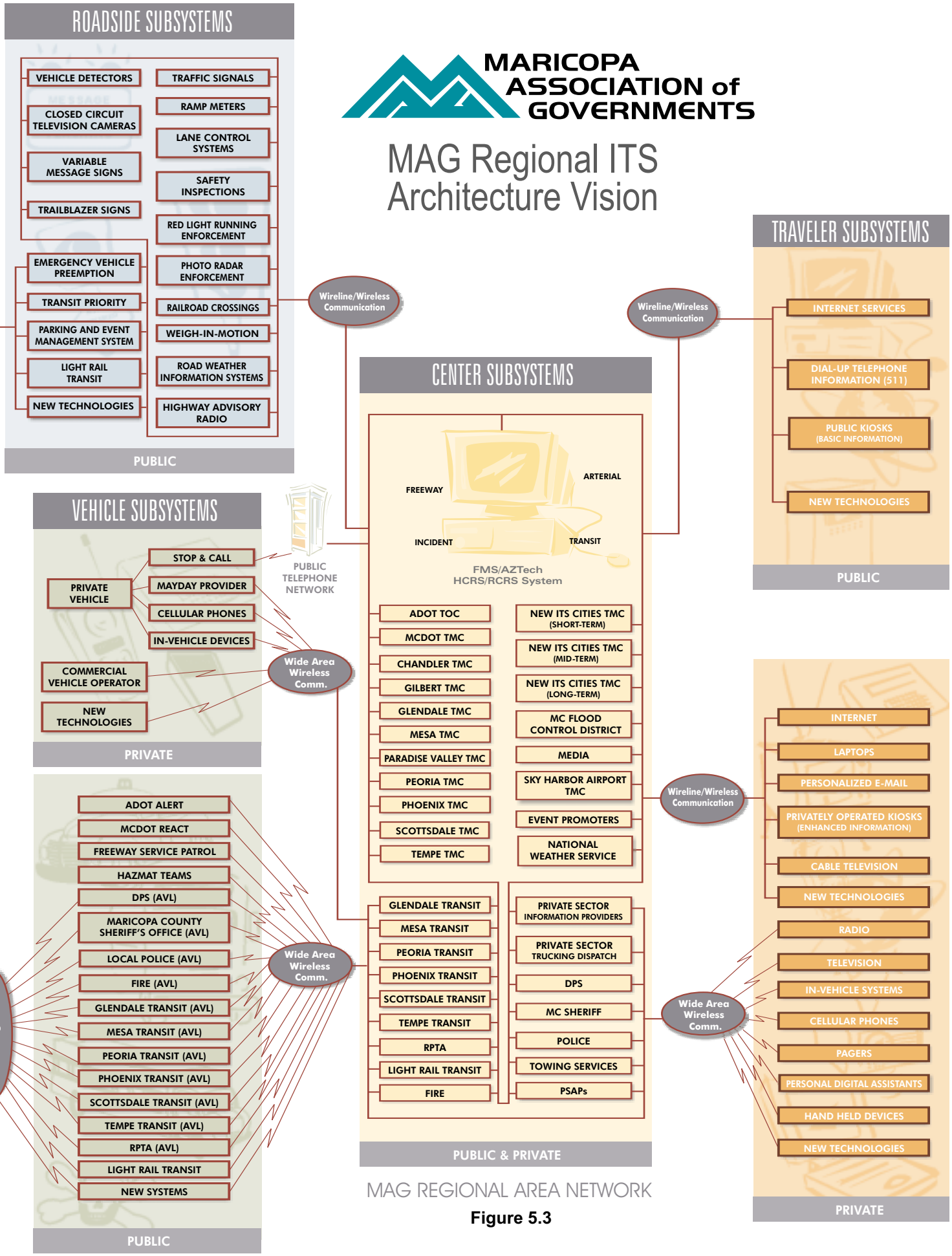

MARICOPA ASSOCIATION of GOVERNMENTS
MAG Regional ITS Architecture Vision
ROADSIDE SUBSYSTEMS
VEHICLE DETECTORS
CLOSED CIRCUIT TELEVISION CAMERAS
VARIABLE MESSAGE SIGNS
TRAILBLAZER SIGNS
EMERGENCY VEHICLE PREEMPTION
TRANSIT PRIORITY
PARKING AND EVENT MANAGEMENT SYSTEM
LIGHT RAIL TRANSIT
NEW TECHNOLOGIES
TRAFFIC SIGNALS
RAMP METERS
LANE CONTROL SYSTEMS
SAFETY INSPECTIONS
RED LIGHT RUNNING ENFORCEMENT
PHOTO RADAR ENFORCEMENT
RAILROAD CROSSINGS
WEIGH-IN-MOTION
ROAD WEATHER INFORMATION SYSTEMS
HIGHWAY ADVISORY RADIO
PUBLIC
Wireline/Wireless Communication
TRAVELER SUBSYSTEMS
INTERNET SERVICES
DIAL-UP TELEPHONE INFORMATION (511)
PUBLIC KIOSKS (BASIC INFORMATION)
NEW TECHNOLOGIES
PUBLIC
CENTER SUBSYSTEMS
FREEWAY
ARTERIAL
INCIDENT
TRANSIT
FMS/AZTech HCRS/RCRS System
ADOT TOC
MCDOT TMC
CHANDLER TMC
GILBERT TMC
GLENDALE TMC
MESA TMC
PARADISE VALLEY TMC
PEORIA TMC
PHOENIX TMC
SCOTTSDALE TMC
TEMPE TMC
NEW ITS CITIES TMC (SHORT-TERM)
NEW ITS CITIES TMC (MID-TERM)
NEW ITS CITIES TMC (LONG-TERM)
MC FLOOD CONTROL DISTRICT
MEDIA
SKY HARBOR AIRPORT TMC
EVENT PROMOTERS
NATIONAL WEATHER SERVICE
GLENDALE TRANSIT
MESA TRANSIT
PEORIA TRANSIT
PHOENIX TRANSIT
SCOTTSDALE TRANSIT
TEMPE TRANSIT
RPTA
LIGHT RAIL TRANSIT
FIRE
PRIVATE SECTOR INFORMATION PROVIDERS
PRIVATE SECTOR TRUCKING DISPATCH
DPS
MC SHERIFF
POLICE
TOWING SERVICES
PSAPs
PUBLIC & PRIVATE
VEHICLE SUBSYSTEMS
PRIVATE VEHICLE
STOP & CALL
MAYDAY PROVIDER
CELLULAR PHONES
IN-VEHICLE DEVICES
COMMERCIAL VEHICLE OPERATOR
NEW TECHNOLOGIES
PRIVATE
PUBLIC TELEPHONE NETWORK
Wide Area Wireless Comm.
ADOT ALERT
MCDOT REACT
FREEWAY SERVICE PATROL
HAZMAT TEAMS
DPS (AVL)
MARICOPA COUNTY SHERIFF'S OFFICE (AVL)
LOCAL POLICE (AVL)
FIRE (AVL)
GLENDALE TRANSIT (AVL)
MESA TRANSIT (AVL)
PEORIA TRANSIT (AVL)
PHOENIX TRANSIT (AVL)
SCOTTSDALE TRANSIT (AVL)
TEMPE TRANSIT (AVL)
RPTA (AVL)
LIGHT RAIL TRANSIT
NEW SYSTEMS
PUBLIC
Dedicated Short-Range Comm.
Wide Area Wireless Comm.
Wireline/Wireless Communication
INTERNET
LAPTOPS
PERSONALIZED E-MAIL
PRIVATELY OPERATED KIOSKS (ENHANCED INFORMATION)
CABLE TELEVISION
NEW TECHNOLOGIES
RADIO
TELEVISION
IN-VEHICLE SYSTEMS
CELLULAR PHONES
PAGERS
PERSONAL DIGITAL ASSISTANTS
HAND HELD DEVICES
NEW TECHNOLOGIES
Wide Area Wireless Comm.
PRIVATE
MAG REGIONAL AREA NETWORK

Figure 5.3

5.4 Institutional Framework

5.4.1 Existing Institutional Environment

An institutional layer that supports the transportation and communications layers of the future MAG regional ITS architecture demands complete institutional integration to realize the complete benefits of a fully-developed and integrated ITS infrastructure in the MAG region.

Some of the needed capability to implement the MAG region's intelligent transportation infrastructure is in place and operational. State, regional, and local jurisdictions throughout the region have been planning, deploying and operating ITS since the mid 1980s. Collaborative efforts include the MAGIC study in 1994, the ITS Strategic Plan for Early Deployment, and the AZTech™ MDI. The basis of "peer-to-peer-with-permissive-control" for traffic control was established prior to AZTech™ and public sector coalitions were established. AZTech™ built on that sound and successful foundation to strengthen and expand the coalitions as well as involve the private sector.

The institutional arrangements have since changed to accommodate the modified needs of the stakeholders in the MAG region. The current institutional framework in the MAG region is shown in **Figure 5.4.**

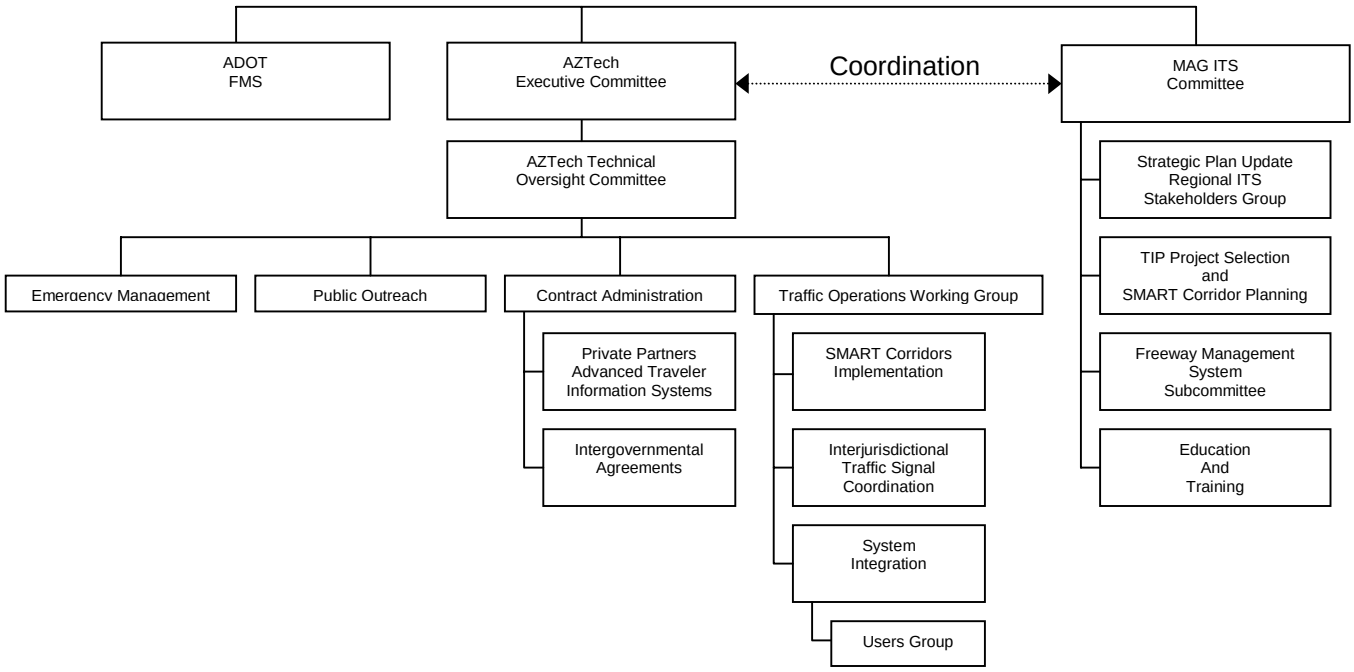


Figure 5.4 – Current Institutional Framework

The MAG ITS Committee has assumed the overall planning, coordinating and funding responsibility for the region's ITS program and has, among other activities, spearheaded the update of the region's ITS Strategic Plan. In addition, MAG has made a commitment to considering ITS as a project element in all future planning projects. ADOT has continued its currently funded expansion of the FMS through separate funding sources; however, the MAG ITS Committee has assumed the responsibility for future prioritization of the FMS. The AZTech™ organizational structure has been streamlined to address the on-going support of the system and to expand the existing infrastructure and services. The current institutional arrangements are successful because of the solid foundation of cooperation that was laid over the last six years.

5.4.2 Future Institutional Framework

To support the regional ITS architecture, a new regional ITS institutional framework has been adopted and is shown in **Figure 5.5**. The future institutional framework focuses on the planning and operations of ITS, and requires close coordination between these two functions.

The MAG Regional Council, Management Committee, Transportation Review Committee and ITS Committee will have primary responsibilities for ITS planning in the region. Specific responsibilities of these groups will include:

- Regional infrastructure planning;
- Regional operations planning;
- Regional standards and architecture;
- Performance measures and evaluation;
- Regional telecommunications infrastructure;
- Public outreach; and
- Training and capacity building.

The AZTech™ Executive Committee and Transportation Operations Working Group will have primary responsibility for regional ITS operations. Specific operational responsibilities of the AZTech™ Executive Committee and Transportation Operations Working Group will include:

- Incident management coordination;
- Signal timing;
- Traveler information services;
- Transit operations;
- Traffic management coordination;
- Event management;
- Parking management;
- Regional transportation network management;
- Public outreach; and
- Training and capacity building.

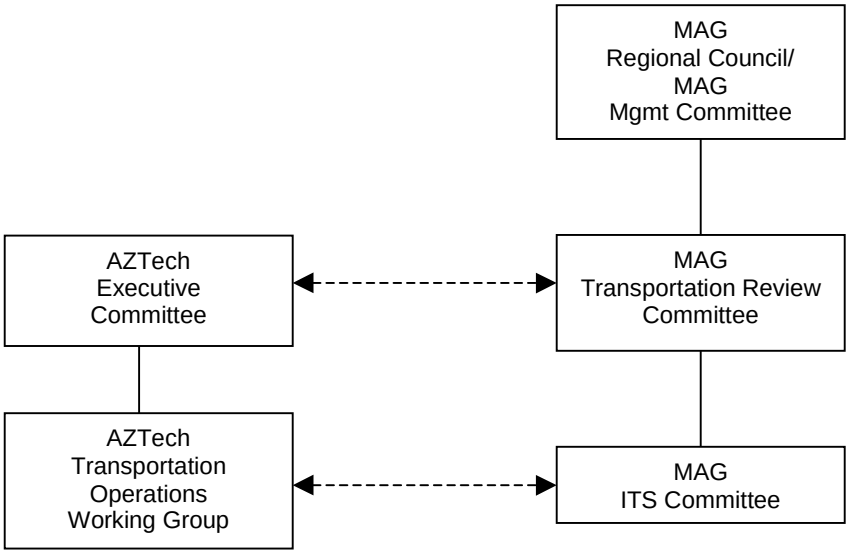


Figure 5.5 – Future Institutional Framework

Close coordination between planning and operational groups is critical to the successful deployments of ITS in the region. Planning must consider how ITS will be operated and ensure that resources are available to adequately operate and maintain the systems that are planned. Operational groups must coordinate with planners to ensure that projects which are planned meet operational needs and that the resources are available to operate and maintain planned projects. In the future institutional framework for the MAG region, the AZTech™ Executive Committee and the MAG Transportation Review Committee will coordinate activities. Similarly, the AZTech™ Transportation Operations Working Group and the MAG ITS Committee will coordinate activities.

5.5 Standards

ITS standards define how system components interconnect and work within the overall framework of the National ITS Architecture. Standards allow for different components, technologies, and infrastructure to interact together to support a seamless transportation system.

The National ITS Architecture is, essentially, a "standard" framework and foundation for ITS interoperability.

Several national and international standards organizations are working toward developing ITS standards for communications, field infrastructure, messages and data dictionaries, and other areas. The organizations developing standards most applicable to ITS include:

- American National Standards Institute (ANSI);
- American Association of State Highway and Transportation Officials (AASHTO);
- Institute of Transportation Engineers (ITE);
- National Electrical Manufacturers Association (NEMA); and
- National Transportation Communications for ITS Protocol Joint Committee (NTCIP).

These national standards are in various stages of development, testing, and formalization. As appropriate standards are finalized and published, MAG and its partner agencies are encouraged to promote the use of these standards in their project specifications. To be eligible for federal funding for ITS projects, conformance with the National ITS Architecture as well as use of USDOT-adopted ITS standards (where applicable) are required.

6. ITS TELECOMMUNICATIONS PLAN

The ITS Telecommunications Plan in the *MAG ITS Strategic Plan Update* consisted of several key activities, including:

- *Review of telecommunications technologies and standards* – This activity includes a description of the ITS communications framework and terminology, a review of communications technology, and a description of network standards.
- *Review of ITS telecommunications needs* – Agencies in the MAG region were interviewed to determine their existing and future ITS telecommunications needs.
- *Telecommunications infrastructure* – This activity included a review of the existing and planned components of the ITS telecommunications infrastructure for the MAG agencies.
- *Short-term telecommunications plan* – A short-term (years 2001-2006) telecommunications plan was developed that recommended projects that must be completed in order for MAG agencies to transition to a regional fiber network by the year 2006.
- *Medium and long-term strategies* – Medium and long-term strategies to address the time-frame beyond 2006 were developed to recommend the steps that the MAG agencies which were not addressed in the near-term telecommunications plan should complete to transition to a regional fiber network.
- *Collaboration with the private sector* – This activity provides recommendations for possible collaboration with the private sector to implement portions of the MAG ITS Telecommunications Plan.

This chapter focuses on the review of the telecommunications needs, infrastructure, short-term plan, medium- and long-term strategies, and collaboration with the private sector. Information regarding the review of telecommunications technologies and standards, as well as more detailed information about regional telecommunications needs and connectivity requirements, can be found in Technical Memorandum Number 7, ITS Telecommunications Plan, of the *MAG ITS Strategic Plan Update*.

6.1 ITS Telecommunication Needs

In order to support the transportation needs identified by stakeholders in the MAG region, the number of agencies interconnected using the existing communications lines (AZTech™) will need to grow, and in some cases, the level of connectivity also will need to increase. At the time of the development of the Telecommunications Plan, 13 agencies or departments were interconnected by AZTech™, which consists of an AZTech™ server at the ADOT TOC and leased line communications to linked agencies. The number of interconnected agencies is expected to grow to 30 within the next 20 years. Of the 13 existing connections, nine agencies or departments can share both video and data. The remaining four existing connections only support the exchange of data. **Table 6.1** summarizes some of the agencies or departments that would eventually be connected and their existing connectivity level. It is important to note that other departments/agencies/cities not listed in the following table also could be interconnected into the regional fiber network as their ITS programs grow and staff to support this endeavor is identified.

Table 6.1 – Existing Regional Connectivity (2000)

Agency	Address		Level of Connectivity
1. ADOT TOC	2302 W Durango	Phoenix	Hub Facility
2. Arizona Department of Public Safety	2102 W Encanto Boulevard	Phoenix	None
3. Chandler Police Department	250 E Chicago Street	Chandler	None
4. Chandler TMC	215 E Buffalo Street	Chandler	Leased Circuit (T-1)
5. Glendale Police Department	6835 N 57th Drive	Glendale	None
6. Glendale TMC	6210 W Myrtle Avenue	Glendale	Leased Circuit (DS-3)
7. Gilbert Police Department	1025 S Gilbert Road	Gilbert	None
8. Gilbert TMC	1025 S Gilbert Road	Gilbert	Leased Circuit (T-1)
9. MCDOT TMC	2901 W Durango	Phoenix	Leased Circuit (DS-3)
10. Maricopa County Sheriff's Office	102 W Madison	Phoenix	None
11. Mesa Police and Fire Dispatch Center	161 E. 6th Place	Mesa	None
12. Mesa TMC	320 E 6th Street	Mesa	Leased Circuit (DS-3)
13. Mesa Transit	Greenfield and Virginia	Mesa	None
14. Paradise Valley Police	6443 E Lincoln Dr	Paradise Valley	Leased Circuit (T-1)
15. Peoria Police Department	8343 W Monroe	Peoria	None
16. Peoria TMC	8850 N 79th Avenue	Peoria	Leased Circuit (T-1)
17. Phoenix Fire	150 S 12th Street	Phoenix	Leased Circuit (DS-3)
18. Phoenix Police Department	620 W Washington St.	Phoenix	None
19. Phoenix TMC	200 W Washington St.	Phoenix	Regional Fiber Network (DS-3)
20. Phoenix Transit	2225 W Lower Buckeye	Phoenix	Leased Circuit (DS-3)
21. Rural Metro	8401 E Indian School	Scottsdale	None
22. Scottsdale Police Department (1)	9065 E Via Linda	Scottsdale	None
23. Scottsdale Police Department (2)	3700 N 75th Street	Scottsdale	None
24. Scottsdale TMC	7447 E Indian School Road	Scottsdale	Leased Circuit (DS-3)
25. Scottsdale Transit	7800 Pierce Street	Scottsdale	None
26. Sky Harbor Airport	3400 Sky Harbor Boulevard	Phoenix	None
27. Tempe Police Department	120 E 5th Street	Tempe	None
28. Tempe TMC	945 W Rio Salado	Tempe	Leased Circuit (DS-3)
29. Tempe Transit	1031 W 1st Street	Tempe	None

As shown in **Table 6.1**, there are a number of agencies that currently use a leased communication link into the regional network. Because these links are not part of the regional fiber optic network, there is a substantial monthly operating expense to maintain these leased services. In order to connect these agencies into the system and maintain a reasonable operating budget during the transition period, some existing leased links will need to transition over to the regional fiber optic network. The ultimate goal of the communication infrastructure is to have all agencies interconnected via a regional fiber optic Wide Area Network (WAN) with both data and multiple video communication channels.

6.2 Telecommunications Infrastructure

6.2.1 Current Telecommunications Infrastructure

The current regional ITS communications network is arranged in a star topology that is centered around the ADOT TOC as the hub facility. Through the use of a telecommunication service provider, point-to-point digital connections have been established between the agencies and departments and the hub facility. Although the bandwidth is leased, the departments and agencies own their own end communication

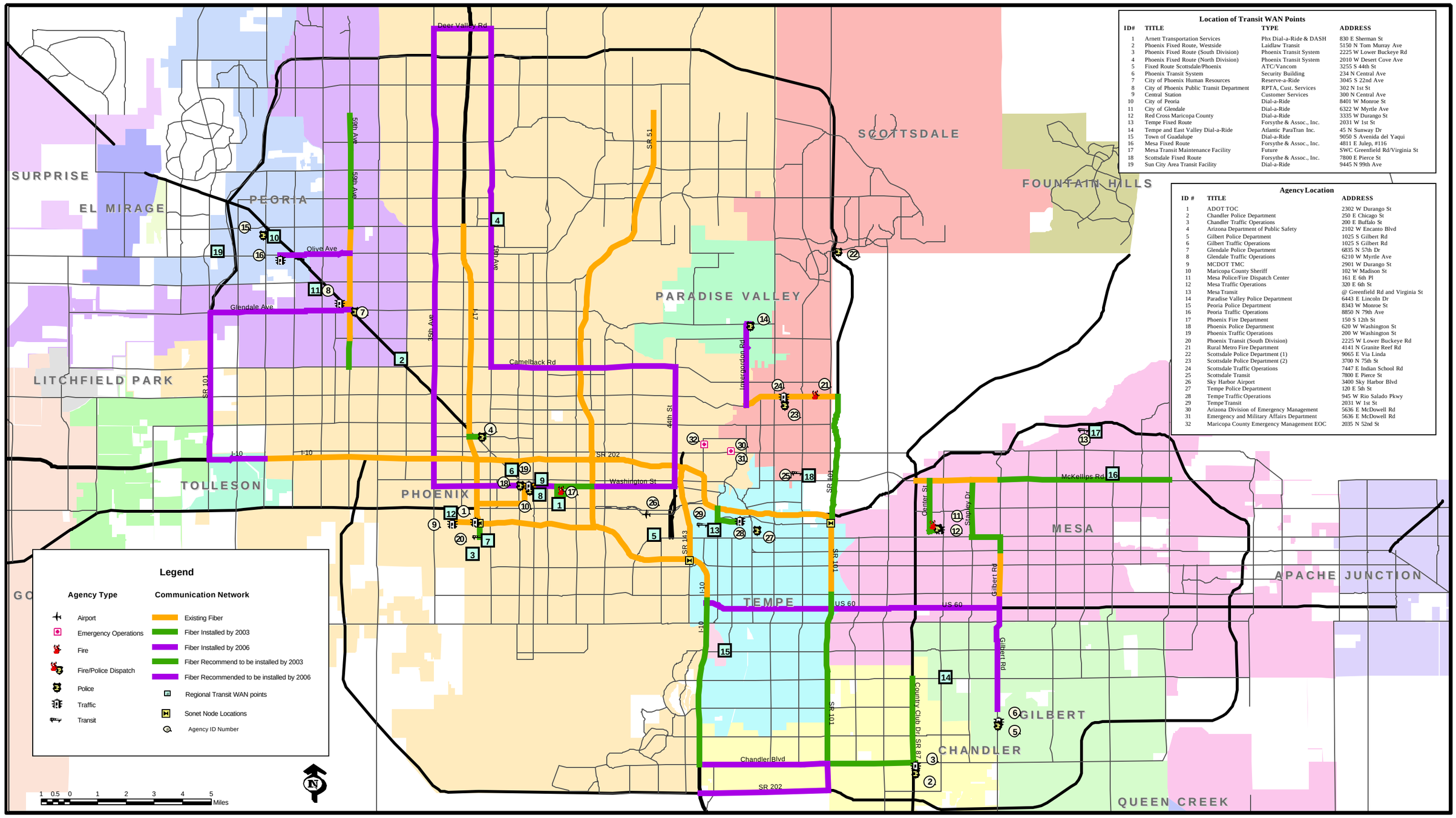
equipment (i.e., asynchronous transfer mode [ATM] switches). As shown previously in **Table 6.1**, seven of the agencies are currently using leased point-to-point DS-3 (44.7 Mbps) full duplex circuits, and four are connected via lower speed T-1 (1.54 Mbps) point-to-point full duplex leased circuits. Currently there is only one agency (City of Phoenix TMC) that is connected to the hub facility via the region's private fiber optic network.

A partial map of the MAG region that shows the locations of the agencies and departments that are currently connected into the regional network and those that have been identified for future connectivity is shown in the **Figure 6.1**. As shown on this map, there is a substantial amount of existing fiber optic infrastructure owned by various agencies and departments within the MAG region. In addition to the existing fiber optic infrastructure, future infrastructure already slated for construction also is shown. The dashed lines indicate recommended future fiber infrastructure in key areas that need to be programmed for construction.

Within some of the existing fiber infrastructure shown on the map, ADOT is deploying a Synchronous Optical Network (SONET) OC-12 WAN (Optical Carrier, level 12, 622 Mbps). By 2003, ADOT will have deployed three SONET node locations.

6.2.2 Other Government Networks

As with all public-funded networks within the MAG Region, the citizens benefit from the increased service availability and reduced cost when public conduit and fiber infrastructure is shared to serve multiple government networks. As the regional fiber network grows and new fiber cables are installed, additional fiber capacity will be needed for other networks to use. Typically these other networks do not have the bandwidth-intensive demands such as real time 30/60 frames per second video applications associated with the transportation CCTV coverage; therefore, providing these agencies with access to bandwidth within the regional network of data switches also could be another way of helping these networks reduce monthly expenses associated with leasing lines from a telecommunications service provider. Current network switching technology offers virtual LAN (VLAN) capabilities that can logically separate multiple networks within the same network switching platform. Logically separating networks controls the links to which an incoming data path can have access. This will provide a level of security between the various networks and a means of controlling/prioritizing the bandwidth consumed. As time goes on, more and more bandwidth will be needed to support data applications and voice/video conferencing on existing data networks; therefore, providing bandwidth into the regional WAN should be viewed as a secondary or temporary choice if direct access to spare fibers is not currently available for these networks.



Location of Transit WAN Points

ID#	TITLE	TYPE	ADDRESS
1	Arnett Transportation Services	Phx Dial-a-Ride & DASH	830 E Sherman St
2	Phoenix Fixed Route, Westside	Laidlaw Transit	5150 N Tom Murray Ave
3	Phoenix Fixed Route (South Division)	Phoenix Transit System	2225 W Lower Buckeye Rd
4	Phoenix Fixed Route (North Division)	Phoenix Transit System	2010 W Desert Cove Ave
5	Fixed Route Scottsdale/Phoenix	ATC/Vancom	3255 S 44th St
6	Phoenix Transit System	Security Building	234 N Central Ave
7	City of Phoenix Human Resources	Reserve-a-Ride	3045 S 22nd Ave
8	City of Phoenix Public Transit Department	RPTA, Cust. Services	302 N 1st St
9	Central Station	Customer Services	300 N Central Ave
10	City of Peoria	Dial-a-Ride	8401 W Monroe St
11	City of Glendale	Dial-a-Ride	6322 W Myrtle Ave
12	Red Cross Maricopa County	Dial-a-Ride	3335 W Durango St
13	Tempe Fixed Route	Forsythe & Assoc., Inc.	2031 W 1st St
14	Tempe and East Valley Dial-a-Ride	Atlantic ParaTran Inc.	45 N Sunway Dr
15	Town of Guadalupe	Dial-a-Ride	9050 S Avenida del Yaqui
16	Mesa Fixed Route	Forsythe & Assoc., Inc.	4811 E Juley, #116
17	Mesa Transit Maintenance Facility	Future	SWC Greenfield Rd/Virginia St
18	Scottsdale Fixed Route	Forsythe & Assoc., Inc.	7800 E Pierce St
19	Sun City Area Transit Facility	Dial-a-Ride	9445 N 99th Ave

Agency Location

ID #	TITLE	ADDRESS
1	ADOT TOC	2302 W Durango St
2	Chandler Police Department	250 E Chicago St
3	Chandler Traffic Operations	200 E Buffalo St
4	Arizona Department of Public Safety	2102 W Encanto Blvd
5	Gilbert Police Department	1025 S Gilbert Rd
6	Gilbert Traffic Operations	1025 S Gilbert Rd
7	Glendale Police Department	6835 N 57th Dr
8	Glendale Traffic Operations	6210 W Myrtle Ave
9	MCDOT TMC	2901 W Durango St
10	Maricopa County Sheriff	102 W Madison St
11	Mesa Police/Fire Dispatch Center	161 E 6th Pl
12	Mesa Traffic Operations	320 E 6th St
13	Mesa Transit	@ Greenfield Rd and Virginia St
14	Paradise Valley Police Department	6443 E Lincoln Dr
15	Peoria Police Department	8343 W Monroe St
16	Peoria Traffic Operations	8850 N 79th Ave
17	Phoenix Fire Department	150 S 12th St
18	Phoenix Police Department	620 W Washington St
19	Phoenix Traffic Operations	200 W Washington St
20	Phoenix Transit (South Division)	2225 W Lower Buckeye Rd
21	Rural Metro Fire Department	4141 N Granite Reef Rd
22	Scottsdale Police Department (1)	9065 E Via Linda
23	Scottsdale Police Department (2)	3700 N 75th St
24	Scottsdale Traffic Operations	7447 E Indian School Rd
25	Scottsdale Transit	7800 E Pierce St
26	Sky Harbor Airport	3400 Sky Harbor Blvd
27	Tempe Police Department	120 E 5th St
28	Tempe Traffic Operations	945 W Rio Salado Pkwy
29	Tempe Transit	2031 W 1st St
30	Arizona Division of Emergency Management	5636 E McDowell Rd
31	Emergency and Military Affairs Department	5636 E McDowell Rd
32	Maricopa County Emergency Management EOC	2035 N 52nd St

Figure 6.1

MAG ITS Strategic Plan Update
ITS Telecommunications Plan

Kimley-Horn and Associates, Inc.

MARICOPA ASSOCIATION of GOVERNMENTS

6.2.2.1 MAG Regional Video Conferencing System

MAG Telecommunications Advisory Group (MAG TAG) is currently implementing a Videoconferencing System. The MAG Videoconferencing System will allow member agencies to videoconference to meetings thereby reducing travel and congestion and enhancing air quality. It also will allow for greater participation by member agencies in regional decision-making, provide additional public outreach opportunities, and assist with multi-jurisdictional collaboration.

Initial implementation of the video conferencing network will predominantly use leased ISDN circuits. As the network expands, it will need to migrate over to a fiber-based network to alleviate the monthly operating expenses incurred from leasing circuits. For this reason it is strongly recommended that additional fibers be installed and reserved within the regional fiber network to support this innovative endeavor that MAG TAG is undertaking.

6.2.2.2 Transit Wide Area Network

The various transit agencies and transit service providers in the MAG region have developed a network that is based on leased T1 and lower speed circuits. The transit network is currently set up as follows:

- The Phoenix Transit Security Building (PTS Admin) is connected to both Phoenix Transit North and South Divisions with leased T1 lines allowing data to be shared between the three sites;
- PTS Admin is then connected to Phoenix Transit Dispatch PTD/RPTA by a leased T1 line;
- PTD/RPTA is connected to the City of Phoenix Frame Relay by a T1 frame relay;
- PTD/RPTA is connected to Maricopa County for internet access by a LADA circuit; and
- Arnett (City of Phoenix Dial-A-Ride) is connected to PTD/RPTA by an ISDN line for e-mail.

When the new scheduling system is implemented (FY 2001) with a regional dispatch module, there will be a need for at least a T1 type of connection to Laidlaw, Forsythe Mesa, Forsythe Tempe, Forsythe Scottsdale, South Division, North Division, and PTD/RPTA. The servers will be located at PTD/RPTA. This will allow for all the dispatch locations to access and use the same scheduling system.

With the new regional scheduling system it also will be necessary to connect all Dial-A-Ride locations for both data and voice. This will allow the Dial-A-Ride agencies to use a regional phone number, a regional Automatic Call Distribution system and a future Interactive Voice Response (IVR) system.

6.3 Proposed Telecommunications Infrastructure

The proposed regional ITS WAN is a single-mode fiber optic based infrastructure that is not dependent on leased links for center-to-center communications. The basic interface standards between systems are Ethernet for data and the National Television Standards Committee (NTSC) for video. How the Ethernet and NTSC are transported from center to center is fully open to any type of telecommunications equipment that makes sense at the time based on available budget, quantity and length of available fibers, quality of service deemed acceptable, and the ability to use existing equipment. Although ATM technology is currently being used, there is no reason to dictate the need for additional ATM equipment when another technology might better fit the requirements of a particular agency or department.

In order to keep the regional ITS WAN as open as possible for many different types of telecommunication technologies, the ITS WAN will continue to use the ADOT TOC as its primary hub facility. The equipment at the ADOT TOC hub that provides connectivity between the data networks and the video networks is a high-speed ATM/Ethernet network switch and an NTSC video switch. Each agency or department can decide the best way to utilize the available fibers between its location and the hub.

Although the majority of fiber needed for the regional ITS WAN infrastructure is already existing or programmed, there is still a substantial amount needed before the region can fully transition from the leased center-to-center links previously identified in **Table 6.1**. **Table 6.2** shows the target dates established for various agencies and departments in the MAG region to use the regional fiber infrastructure. The target dates were established based on the locations of existing or programmed fiber infrastructure, the anticipated time new fiber links could be established, and the priority level of the particular agency/department.

The new fiber links, identified within this document are “best guess” and need to remain flexible in order to take advantage of future projects along different routes as they arise. In turn, the established target dates also must remain flexible with respect to any future cost saving opportunities.

As previously mentioned, other departments/agencies/cities, not listed in the following table, may also be interconnected into the regional WAN as their ITS programs grow and staff to support this endeavor is identified.

Table 6.2 – Transition Target Dates for Regional WAN Connections

Currently Connected	Connected by 2003	Connected by 2006	Connected by 2020
ADOT TOC	Chandler TMC	Glendale TMC	Chandler PD
Phoenix TMC	Department of Public Safety	Gilbert TMC	Glendale PD
	MCDOT TMC	MC Sheriff	Gilbert PD
	Phoenix Fire	Mesa TMC	Mesa PD & Fire Dispatch
	Phoenix Transit	Paradise Valley PD	Mesa Transit
	Rural Metro	Peoria TMC	Peoria PD
	Scottsdale TMC		Phoenix PD
	Tempe TMC		Scottsdale PD (1)
			Scottsdale PD (2)
			Scottsdale Transit
			Sky Harbor Airport
			Tempe PD
			Tempe Transit
			New ITS Cities

The future telecommunication connections are also referenced systematically in **Figure 6.2**.

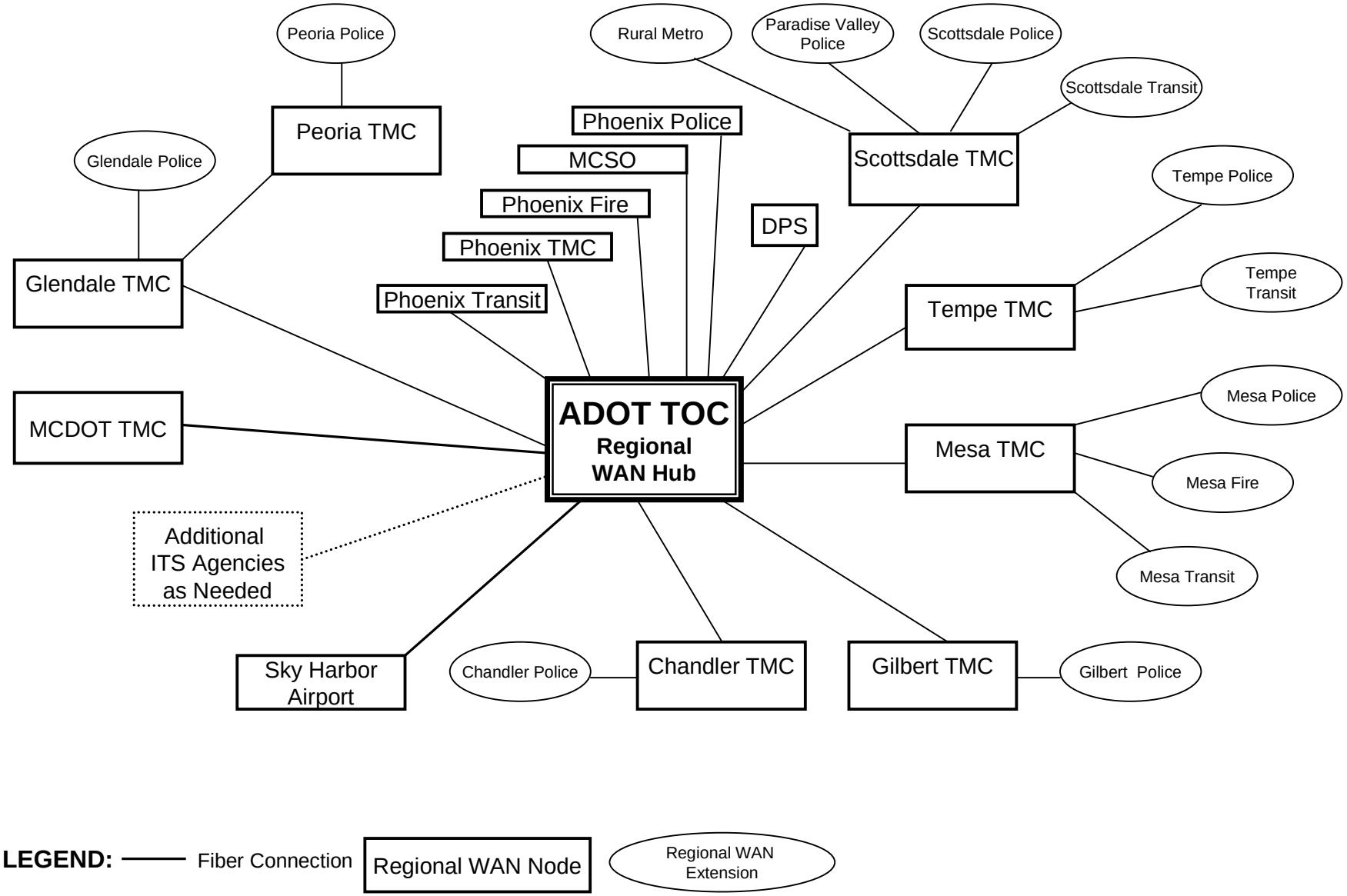


Figure 6.2 – Future ITS Telecommunications Connections

6.4 Short-Term Telecommunications Plan

The short-term telecommunications plan covers those agencies and departments that are to transition to the regional WAN by year 2003 and 2006. A summary of the short-term telecommunications recommendations is provided in **Table 6.3**. The preliminary estimate of probable cost provided is based on the assumption that spare single-mode fiber is available within existing and programmed infrastructure and that the existing ATM equipment will be available in the future. The short-term telecommunications projects also are represented in the map in **Figure 6.1**.

The fiber routes identified in this section are preliminary. The exact path taken between two points is not germane, but having available fibers to provide the connection between the locations is critical. Taking advantage of potential resource sharing opportunities with other agency/department projects along a different path is encouraged.

Because the ADOT TOC is to remain the hub facility for the regional ITS WAN, a significant amount of existing spare fiber infrastructure needs to be identified and reserved for agencies and departments in the MAG region to create the regional WAN. It is recommended that ADOT perform an evaluation of its existing fiber optic infrastructure to identify where and how much spare capacity is available. It is then recommended that ADOT develop a plan for interconnecting these spare fiber segments for each of the WAN links identified within this ITS Telecommunications Plan. It is important to note that not all of the WAN fiber links need to be brought back to the ADOT TOC. ADOT may decide to add DS-3 channels and other types of interfaces within their existing SONET. If this is the case, then some fiber paths only need to go to the nearest SONET node.

6.5 Medium and Long-Term Strategies

The medium and long-term plans cover those agencies and departments that are targeted to transition over to the regional WAN after the year 2006. This section focuses on the recommended steps that need to take place before a particular agency can transition to the regional WAN. As other cities and agencies develop needs for ITS infrastructure and assign the regional fiber network support, they should be added to the regional WAN. The medium- and long-term strategies, further discussed in Technical Memorandum Number 7, ITS Telecommunications Plan, of the *MAG ITS Strategic Plan Update*, focuses on agencies which are anticipated to have a need in the future to connect to the regional fiber optic network. This list is not all-inclusive and should be periodically reviewed to reflect new regional and local priorities.

Table 6.4 provides a summary of the recommendations in the medium- and long-term strategies.

Table 6.3 – Short-Term Telecommunications Plan

Agency/ Department	Task Description	Target Date	Estimated Cost
ADOT	Evaluate existing infrastructure, develop a plan for interconnecting spare fiber segments, and perform the fiber connections needed to for each of the WAN links identified.	2003	$75,000
	Configure SONET equipment to support WAN links.	2006	$125,000
	Program the installation of fiber cable within the conduit infrastructure along U.S. 60 beyond Dobson Road to Gilbert Road (fiber design and installation).	2006	$125,000
	Installation of fiber optic cable within programmed conduit infrastructure along SR-101 between Chandler Boulevard and Guadalupe RD (fiber installation).	2003	$100,000
	Install new fiber within existing conduit infrastructure along Loop 101 between Glendale Ave and I-10.	2006	$137,500
	Design and install new conduit and fiber infrastructure along I-10 between Loop 101 and 83rd Ave.	2006	$370,000
	Upgrade the existing video switching system.	2003	$250,000
	Upgrade WAN hub data equipment (ATM/Ethernet switches)	2006	$100,000
Department of Public Safety	Provide WAN connection on the regional fiber network that supports DPS (evaluation and installation).	2003	$30,000
	Install new fiber connection between the DPS and I-17.	2003	$400,000
Chandler TMC	Design and install the fiber connections between ADOT and Chandler infrastructure.	2003	$50,000
	Provide WAN connection on the regional fiber network that supports both Chandler TMC and PD (evaluation and installation).	2003	$170,000
Glendale TMC	Design and install new conduit and fiber infrastructure within Glendale city limits for the fiber path between Peoria TMC and Glendale TMC.	2006	$277,500
	Design and install new fiber and conduit infrastructure along Glendale Ave between 59th Ave and 75th Ave.	2006	$370,000
	Design and install new fiber within existing City of Glendale conduit infrastructure along Glendale Ave between 75th Ave and Loop 101.	2006	$75,000
	Provide WAN connection on the regional fiber network that supports Peoria TMC and PD, the Glendale TMC and PD (evaluation and installation).	2006	$150,000
Gilbert TMC	Design and install new conduit and fiber infrastructure within Gilbert town limits for the fiber path along Gilbert Road between Baseline and the Gilbert TMC.	2006	$647,500
	Provide WAN connection on the regional fiber network that supports Gilbert TMC and PD.	2006	$170,000
MC Sheriff's Office (MCSO)	Design and install new conduit and fiber infrastructure within Phoenix City Limits to connect to existing infrastructure for the fiber path between MCSO and ADOT TOC.	2006	$92,500
	Provide WAN connection on the regional fiber network that supports MCSO (evaluation and installation).	2006	$30,000
Mesa TMC	Design and install new conduit and fiber infrastructure within Mesa city limits for the fiber path along Gilbert Road between U.S. 60 and Baseline.	2006	$185,000

Table 6.3 – Short-Term Telecommunications Plan

Agency/ Department	Task Description	Target Date	Estimated Cost
	Design and make fiber connections within programmed fiber infrastructure for fiber optic path between Mesa TMC and U.S. 60.	2006	$50,000
	Provide WAN connection on the regional fiber network that supports Mesa TMC, Fire, Transit and PD.	2006	$120,000
Paradise Valley PD	Design and install new conduit and fiber infrastructure within Paradise Valley town limits for the fiber path between Paradise Valley PD and Scottsdale TMC.	2006	$92,500
	Design and install new conduit and fiber infrastructure within Phoenix city limits for the fiber path between Paradise Valley PD and Scottsdale TMC.	2006	$92,500
	Design and install new conduit and fiber infrastructure within Scottsdale city limits for the fiber path between Paradise Valley PD and Scottsdale TMC.	2006	$92,500
	Provide WAN connection on the regional fiber network that supports Paradise Valley PD (evaluation and installation).	2006	$30,000
Peoria TMC	Design and install new conduit and fiber infrastructure within Peoria city limits for the fiber path between Peoria TMC and Glendale TMC.	2006	$277,500
	Provide WAN connection on the regional fiber network that supports Peoria TMC and PD (evaluation and installation).	2006	$60,000
Phoenix Fire	Design and install new fiber within the programmed conduit infrastructure along 12th St. and Washington between Phoenix Fire and the existing ADOT conduit/fiber infrastructure at SR 51.	2003	$50,000
	Provide WAN connection on the regional fiber network that supports Phoenix Fire (evaluation and installation).	2003	$30,000
Phoenix Transit	Design and install new conduit and fiber infrastructure between Phoenix Transit and the ADOT TOC.	2003	$92,500
	Provide WAN connection on the regional fiber network that supports Phoenix Transit (evaluation and installation).	2003	$30,000
Rural Metro	Design and install new conduit and fiber infrastructure between the Scottsdale existing infrastructure and the Rural Metro building.	2003	$92,500
	Provide WAN connection on the regional fiber network that supports Rural Metro (evaluation and installation).	2003	$30,000
Scottsdale TMC	Program the installation of 12 single-mode fibers into existing conduit infrastructure along SR-101 between Indian School Road and SR-202 and provide fiber connection within existing fiber infrastructures (fiber installation).	2003	$112,500
	Provide WAN connection on the regional fiber network that supports Scottsdale TMC, Transit, PDs (1 and 2) and Rural Metro (evaluation and installation).	2003	$150,000
Tempe TMC	Design and install the fiber connections between the ADOT and Tempe infrastructure.	2003	$30,000
	Provide WAN connection on the regional fiber network that supports Tempe TMC, Transit, and PD (evaluation and installation).	2003	$90,000
Total Estimate of Probable Cost			**$5,452,500**

Table 6.4 – Medium- and Long-Term Strategy Recommendations

Agency	Recommendation
Chandler Police Department	Provide WAN extension of the Chandler TMC
Glendale Police Department	Provide WAN extension of the Glendale TMC
Gilbert Police Department	Provide WAN extension of the Gilbert TMC
Mesa Police Department and Fire Dispatch Center	Provide WAN extension of the Mesa TMC
Mesa Transit	Provide WAN extension of the Mesa TMC
Peoria Police Department	Provide WAN extension of the Peoria TMC
Phoenix Police Department	Provide direct fiber connection to the ADOT TOC
Scottsdale Police Department and Transit	Provide WAN extension of the Scottsdale TMC
Sky Harbor Airport	Provide direct WAN connection to the ADOT TOC
Tempe Police Department and Transit	Provide WAN extension off the Tempe TMC

6.6 Collaboration with the Private Sector

When considering resource sharing opportunities with the private sector, there are two fundamental considerations: 1) negotiate for conduit installation by an agency that is already trenching down that route; and/or 2) negotiate for use of spare fibers.

Timing is critical when working with private agencies as well as other public agencies with different agendas and deadlines. Therefore, the ability to act quickly on another agency's deployment of fiber may not always produce the desired results. This could potentially cause an overestimate of fiber in a particular area, not enough fiber in another, or even a fiber cable that is stranded along a corridor due to lack of connection to any other communication routes. In cases where a route under evaluation is only a portion of the total network, it may be advisable to only provide for an empty conduit to be installed at the time of trenching. With this approach, the high cost of trenching is offset by two or more parties, thereby reducing the future cost of deploying fiber. When the time is right and a design plan is complete, the appropriate sized fiber cable can be pulled through the existing conduit system to its end destination.

It is recommended that agencies in the MAG region coordinate with local utilities including Salt River Project, Qwest, Cox Communications, and Arizona Public Service to explore infrastructure sharing opportunities. These utilities were contacted for this ITS Telecommunications Plan, but were not available. MAG and its partner agencies will need to work further to establish mutually agreeable relationships with these potential partners.

7. ITS TRAINING AND CAPACITY BUILDING PLAN

The mission of the MAG ITS Training and Capacity Building (TCB) Plan is to assist existing and future transportation professionals in the MAG region to develop the knowledge, skills, and abilities to plan, design, install, operate, manage, maintain and evaluate ITS more efficiently and effectively. Towards this end, the MAG ITS TCB Plan will continue to provide training and education that is ***tailored*** in its content, ***targeted*** to meet MAG and its partner agencies' needs, and ***accessible*** where, when, and as needed.

The short-term actions and recommendations outlined in the TCB Plan were based on existing ITS training and professional development needs in the MAG region, available training materials and courses, and existing resources.

These short-term strategies address the following:

- Identifying a local ITS TCB champion and assembling a working group to implement, monitor and promote the regional TCB program;
- Scheduling and conducting identified courses and workshops to address the ITS training needs of staff in the region;
- Identifying opportunities to partner with national professional associations such as ITS America and Institute of Transportation Engineers (ITE) and Arizona Universities to schedule specialized symposiums, workshops, and courses;
- Maximizing use of available on-line training resources to provide flexible, cost-effective training and professional development for local ITS staff;
- Developing general guidelines for ITS staff in the region addressing such issues as roles, functions, desired competencies, recommended training activities and applicable certifications; and
- Funding issues and requirements, as well as alternatives to maximize training and staff development dollars in the MAG region.

More specific information about the recommendations for the MAG Regional ITS TCB Program are documented in Technical Memorandum Number 9, Training and Capacity Building Plan, of the *MAG ITS Strategic Plan Update*.

7.1 Identification of Training and Capacity Building Needs

To identify the regional ITS training needs a survey was distributed to the RISG to gather information from MAG and its partner agencies. The survey questionnaire asked how training is best delivered to local agencies and what barriers exist to delivering training. It also asked respondents to select and prioritize those ITS knowledge areas that were critical to their agency. These 39 knowledge areas were derived from the FHWA's Joint Program Office's (JPO) PCB Program, and are distributed among the following categories:

- Transportation Planning Process;
- Project Planning/Design;
- Procurement/Funding;
- Contracts Management;
- Systems Engineering;
- Telecommunications;

- Installation/Deployment;
- Operations Center;
- Legal Issues;
- Maintenance; and
- Project Evaluation.

The following summarizes the survey responses for training methods, barriers and training provider preferences for the MAG region:

Best methods for training delivery (in order):

- Workshops, classes and seminars;
- On-the-job training and peer-to-peer networks; and
- Professional associations (i.e., ITS America, ITS Arizona, ITE, etc.).

Barriers to delivering training to local agencies:

- Funding;
- Meeting facility availability;
- Staff availability;
- Time for staff to attend;
- Finding quality and relevant workshops; and
- Convenience of training locations.

Preference for training providers (in order):

- Commercial vendors;
- Federal agencies;
- Universities; and
- Internal staff.

The ITS knowledge area needs identified on the surveys for the MAG region were prioritized and are summarized in **Table 7.1**. The high priority areas were used to develop the short-term TCB strategies (2002-2006) for the region, and medium and lower priorities will be considered for longer-term TCB planning (2007-2021).

Table 7.1 – Prioritized ITS Knowledge Areas

Priority	Rank	Prioritized Knowledge Areas
High	1	Cost/Benefit Analysis
	2	Regional Concept of Operations
	2	Technology Analysis – Range of Options
	4	ITS Projects in the MPO Regional Transportation Plan/TIP
	5	System Integration
	6	Capacity Analysis – Transmission: Wireline vs. Wireless
Medium	7	Sources of Funding – Federal/State/Local/Private
	7	Writing Specifications – Technical and Legal Issues
	7	System Analysis and Design
	7	Lease / Build Decision Making
	7	Project Evaluation
	12	Consistency with National ITS Architecture and Standards
	13	Comparing/Combining ITS and Capital Improvements
	13	Data Sharing between Agencies
	13	Procurement Options: Design / Build / Lease Agreements, Shared Resources Agreements and RFPs
	13	Managing Software Development and Costs
	13	Liability Issues
	13	Software/Data Maintenance
	19	Partnerships – Structuring/Public/Private Agreements
	19	Public Relations
	19	Analysis of Existing ITS Infrastructure
	19	Using the National ITS Architecture for Planning
	19	Use of Prototypes
Low	24	Identifying Organizational Barriers and Managing Change
	24	Managing Contractors: Developers and System Integrators
	24	Acceptance Testing
	24	Operations Center Staffing Requirements
	24	Management of an Operations Center
	24	Human Factors
	24	Privacy of Data and Identification
	24	Security Systems & Network Vulnerability
	32	Requirements Management
	32	Intellectual Property Rights
	32	Inspection Procedures for ITS equipment / systems
	35	Developing a Business Plan
	35	Quality Assurance
	35	Training
	38	Risk Management
	39	Coalition Building with New Stakeholders

7.2 Existing Resources for ITS Training and Capacity Building

7.2.1 Training Courses

Training courses and workshops were the most preferred method to deliver training to ITS professionals in the MAG region. The FHWA National Highway Institute (NHI) and JPO, the National Transit Institute, and the Transportation Safety Institute offer several workshop/classroom instructional courses on a variety of topics. Some of the relevant course topics include the National ITS Architecture, regional ITS deployment strategies, specialized telecommunications courses, system interoperability and integration, and traffic signal systems, among others. These workshops range from one day to four days, and are taught by recognized experts in their respective fields from both the public and private sectors. The Arizona Local Technical Assistance Program (LTAP) often works with state and federal agencies to sponsor and promote training activities.

The role of the universities in Arizona in ITS capacity building also is critical. Several innovative research projects are in progress at the University of Arizona's Advanced Traffic and Logistics Algorithms and Systems (ATLAS) Research Center. These include in-depth research and applications in region-wide dynamic traffic management, incident detection and management, traffic adaptive algorithms, decision support systems, and logistics management. Arizona State University is offering certificate programs in ITS and transportation to supplement various Master's Degree programs. Northern Arizona University in Flagstaff has recently established a Transportation Research Lab and is conducting research on fuzzy logic algorithms and variable speed signs. The activities at these institutions offer accessible opportunities for ITS professionals in the region to be on the cutting edge of new technologies and practices in the evolving ITS industry, whether through a degree program or specialized course or symposium. There are also opportunities to involve universities in ITS evaluations.

Professional associations, such as ITS America, ITE, Woman's Transportation Seminar, American Society of Civil Engineers, and the Transportation Research Board also are resources for workshop training. These privately-sponsored workshops often draw attendance from all over the country, which provides valuable interaction with peers from agencies outside of the MAG region. These organizations should be included in MAG's TCB resource pool.

7.2.2 On-Line Training, CD-Roms, and Reading Materials

Materials of ITS PCB short courses and seminars can be downloaded in .pdf or PowerPoint, viewed online, or provided as supplemental materials with CD-ROMs. These course and seminar materials are designed to be used for informational purposes and offer important opportunities to build awareness on critical ITS topics. This cost-effective format allows for flexible training in a manner that is conducive to busy agency and individual schedules.

Interactive, on-line training courses are available through the Consortium for ITS Training and Education (CITE). These courses are individual modules of the full semester course "Fundamentals of ITS and Traffic Management."

Downloadable presentations and documents on a wide range of ITS topics are available from several sources, including the FHWA, JPO, National Transportation Library, ITS America, the ITS Cooperative Deployment Network (ICDN), and the Electronic Document Library (EDL).

Training course materials and other valuable TCB information can be obtained from the following web sites:

- **http://www.citeconsortium.org** – provides information about the "Fundamentals of ITS and Traffic Management" course modules.
- **http://www.itsa.org/educate.html** – ITS America's ITS Learning Institute web page, with links to information about relevant TCB activities.
- **http://pcb.volpe.dot.gov/informational.asp** – provides links to available training and courses, as well as downloadable course materials from NHI and FHWA courses.

Other on-line resources for ITS information, training, and other professional development needs include:

- **http://www.itsa.org** – ITS America's web site with links to specialized areas (i.e., traffic management, traveler information, standards, etc.) as well as information and press releases of importance to the ITS industry.
- **http://www.its.dot.gov** – USDOT/JPO Electronic Document Library.
- **http://www.nawgits.com/jpo** – USDOT/JPO ICDN
- **http://www.azltap.org** – Home page for the Arizona LTAP with information about upcoming training courses.
- **http://www.ite.org** – Institute for Transportation Engineers.

7.2.3 Peer-to-Peer Program

The Intelligent Transportation Peer-to-Peer Program is an FHWA and Federal Transit Administration (FTA) Technical Assistance Program that provides public sector transportation stakeholders with a convenient method to tap into the growing knowledge base of ITS experience and to receive short-term assistance. "Peers" can be from other transportation agencies, private consultants, academic, and other specialists in ITS.

7.3 MAG Regional Training and Capacity Building Program

7.3.1 Regional ITS TCB Champion

In order to develop a structured, formal TCB program for the MAG region, it requires support from local ITS managers and professionals, as well as a "champion" who has a vested interest in the success of a regional training program.

As the Metropolitan Planning Organization (MPO) for the region, the Maricopa Association of Governments, specifically the MAG ITS Committee, is the ideal entity to champion a regional ITS training and professional development program. The MAG ITS Committee is an established group of traffic and ITS managers, representatives from transit agencies, public safety, and university interests from throughout the region. This Committee meets monthly to discuss issues affecting regional traffic and ITS operations, as well as conduct regional ITS planning, programming, and coordination. It is recommended that a subcommittee or working group of the MAG ITS Committee be established to focus on developing and coordinating the MAG Regional ITS TCB Program.

The subcommittee or working group should be responsible for promoting regional training efforts for ITS staff at various agencies throughout the MAG region. A preliminary list of short-term recommendations to "jump start" the MAG ITS TCB Program includes:

- Develop a schedule of courses identified in the TCB Plan that are applicable to ITS in the MAG region;
- Work with LTAP to help advertise and promote the courses, and coordinate with FHWA to secure sponsorship;
- Assemble and maintain a library of current ITS documentation, reports, and CD-based instructional material for use by MAG partner agencies;
- Develop and maintain a web page that provides an overview of the MAG TCB program, schedule and information about training activities, ITS TCB message boards and forums, as well as links to valuable ITS resources and web-based training tools;
- Identify general staff categories in ITS-related positions at various MAG partner agencies as well as recommend qualifications and competencies for local agencies to use as a guideline for training existing staff as well as hiring new staff;
- Implement a regional ITS Peer-to-Peer program based on the FHWA/FTA model to match up local professionals and experts with training or informational needs of MAG partner agencies;
- Closely coordinate with ITS programs at Arizona's universities (University of Arizona, Arizona State University, and Northern Arizona University) to involve them in TCB activities and to document and share information about current research projects, seminars, and coursework;
- Coordinate with professional associations to promote and sponsor TCB courses and activities; and
- Develop and maintain a database of addresses (physical as well as e-mail) of local ITS personnel to distribute information about upcoming workshops, seminars and ITS activities.

7.3.2 Recommended Courses, Workshops and Training Tools

Based on the high priority knowledge areas identified by the stakeholders, several courses, workshops, on-line training tools, and other resources were identified for the short-term MAG TCB Plan. These workshops and other tools are summarized in **Table 7.2** on the following page.

As new courses or training technologies become available (i.e., training via video-conferencing), they should be evaluated by the ITS TCB Subcommittee for possible inclusion in the MAG ITS training curricula.

Table 7.2 – Summary of Recommended Workshops, Courses, On-line Tools and Other Resources for the MAG TCB Program (Short-Term)

Course/Workshop	On-Line or Web Based Training Tools	Other Resources to include in TCB Library
Cost/Benefit Analysis Value Engineering Workshop (NHI) ITS Deployment Analysis Systems (IDAS) (NHI) ITS and the Transportation Planning Process (NHI) **Regional Concept of Operations** Freeway Traffic Operations (NHI) Deploying Integrated ITS – Metropolitan/Rural (NHI) Computerized Traffic Signal Systems (NHI) **Technology Analysis/Range of Options** NTCIP and ITS Standards – What do They Mean for You? (ITE) Procuring New Technologies for Transit (NTI) Telecommunications for ITS Professionals (ITSA) Lessons in ITS Procurement (NHI) ITS Applications and Traffic Management (web-based) (CITE) **ITS Projects in the MPO Regional Transportation Plan/TIP** ITS for Transit: Solving Real Problems (NTI) Deploying Integrated ITS: Metropolitan (NHI) Statewide and Metropolitan Transportation Programming (NTI) ITS and Transit Management (NHI) **System Integration** Deploying Integrated ITS: Metropolitan and Rural (NHI) Interoperability – ITS System Architecture and Standards (web-based) (CITE) Shared Resources for Telecommunications (NHI) Integrated Transportation Information System (FHWA) System Integration for ITS Professionals (ITSA) **Capacity Analysis – Transmission: Wireline v. Wireless** ITS Telecommunications Overview (NHI) Wireless Technology for ITS (Rensselaer Polytechnic Institute, soon available on CD) Telecommunications for ITS Professionals (ITSA) NHI – National Highway Architecture NTI – National Transit Institute ITSA – ITS America	Fundamentals of ITS Traffic Management *Available from CITE* *On-line training modules applicable to priority TCB needs:* Introduction to Intelligent Transportation Systems Introduction to Telecommunications Technology Introduction to Information System Technology The Tools of ATMS Interoperability: ITS System Architecture and Standards Corridor Management Traffic Signal Systems Fundamentals *Additional modules of the course that could be used for regional training and special interests:* Traffic Flow Theory Transportation Management Incident Management and Emergency Management Dynamic Route Guidance and In-Vehicle Systems Other CD/On-Line Training not yet available: ▪ Wireless Technology for ITS (Rensselaer Polytechnic Institute – when available on CD) ▪ Planning Regionally Integrated ITS – A web-based learning network.	Downloads from web sites – Volpe course materials ▪ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architectural Standards (Feb 1999) ▪ Deploying Integrated Intelligent Transportation Systems – Metropolitan Course (1999) ▪ ITS and the Transportation Planning Process (1997) ▪ ITS Telecommunications Overview (1997) ▪ Telecommunications Shared Resources (1997) National Architecture CD Relevant USDOT and FHWA Publications ("ITS Greatest Hits CD) Publication number FHWA-OP-99-028

7.3.3 Funding the MAG ITS TCB

Training is not often a high priority when local and regional agencies develop their annual operating budgets. It is important for agencies in the MAG region to carefully consider the existing and future training needs of their ITS staff and plan for the training and PCB that they need.

As the regional MPO, MAG can make a positive impact toward regional coordination of training activities. In the Implementation Plan of the MAG ITS Strategic Plan Update, MAG has been identified as the lead agency for ITS Training with a budget of $250,000 for years 2002-2006. This budget has been recommended to be used for FHWA, LTAP, and University-based training and related activities. Specifically, it is recommended that this outreach funding be applied to the regional ITS TCB program to:

- Maintain a web page that will be used as a central clearinghouse for information about the regional TCB program (will require a monthly fee for server space if not set up as a page on an existing web server);
- Sponsor some of the regionally-significant courses and seminars identified in this TCB Plan that will address training needs of local ITS staff. Funding for training should be coordinated with FHWA, LTAP, and Universities;
- Purchase CD and printed materials, compendiums, and other relevant information to be stored in a central TCB library for use by partner agencies; and
- Promote and advertise upcoming courses, new courses, and other pertinent information to a wide range of ITS staff and personnel in the region.

MAG can help to offset the costs of some of the TCB elements and requirements by:

- Working with FHWA and LTAP to obtain federal sponsorship of identified courses;
- Coordinating with universities to hold seminars/symposiums about relevant ITS research programs in the state;
- Maximizing the use of on-line training resources, as well as on-line documents whenever possible; and
- Distributing information to stakeholders via e-mail alerts and notices rather than mailing flyers.

7.4 Long-Term TCB Strategies for the MAG Region

The long-term success of the MAG TCB Program depends on many factors: a local TCB champion to spearhead and coordinate training activities; a commitment on the part of local agencies to make TCB an essential part of staff development and department operations; and continued updates to the TCB Program as ITS in the region expands and becomes more integrated. The TCB plan is intended to be flexible to respond to new courses and additional needs that might not have been identified as part of this planning effort.

For longer-term TCB considerations, it is recommended that:

- The MAG TCB Program be evaluated and updated every two to four years to include additional staff classifications and additional courses and delivery methods as the need for expanded capabilities grows with the regional systems;
- New courses and delivery methods that provide a cost-effective opportunity to address a specific or regional ITS need to be incorporated into the Program as they are identified and become available; and
- Local agencies consider TCB an essential part of long-term operations, and include TCB activities in their respective management and operations (M&O) budgets.

8. ITS OPERATIONAL AND IMPLEMENTATION STRATEGIES

The implementation and operation of ITS often requires regional, multi-jurisdictional coordination at an increased level compared to traditional transportation infrastructure. A coordinated approach to ITS planning and deployment and a strong focus on operational planning are necessary to provide for continued maintenance and operation as regional systems continue to expand. The Operational and Implementation Strategies described in this Chapter are discussed in further detail in Technical Memorandum Number 6A, Operational and Implementation Strategies, of the *MAG ITS Strategic Plan Update*.

8.1 Opportunities for Regional Operational Collaboration

8.1.1 Regional Collaboration

The coordination between MAG member agencies in the deployment of ITS in the greater Phoenix region is one of the better examples of regional collaboration in the nation today. Through the AZTech™ MDI and current, ongoing MAG region activities, the local agencies have established communication links and decision-making procedures that promote a coordinated approach to developing the region's ITS infrastructure and services. This history of multi-jurisdictional collaboration forms a strong foundation for further enhancing regional coordination and cooperation.

Table 8.1 presents some of the systems currently deployed or planned in the MAG region, and identifies the agency or group of agencies *typically* responsible for various activities.

Table 8.1 – Agency System Responsibilities

System	Planning	Implementation	Operations	Maintenance
Freeway Management System	MAG/ADOT	ADOT	ADOT	ADOT
Freeway Service Patrol	MAG/DPS/ ADOT	MAG/DPS/ ADOT	DPS	DPS
Highway Condition Reporting System	ADOT	ADOT	ADOT	ADOT
ALERT – Incident Response	ADOT	ADOT	ADOT	ADOT
REACT – Incident Response	MCDOT	MCDOT	MCDOT	MCDOT
SMART Corridors	MAG	AZTech™/Local	Local	Local
Parking Management	Local	Local	Local	Local
Central Signal Control Systems	MAG/Local	Local	Local	Local
Transit Systems	RPTA/Local	RPTA/Local	RPTA/Local	RPTA/Local
Traffic Management Centers	MAG/Local	AZTech™/Local	AZTech™/Local	AZTech™/Local
TMC Information Sharing	MAG/Local	AZTech™/Local	AZTech™/Local	AZTech™/Local
azfms.com Website	ADOT	ADOT	ADOT	ADOT
511	ADOT/MAG	ADOT	ADOT	ADOT
Additional Traveler Information Systems	MAG/AZTech™/ Private	AZTech™/Private	Private	Private

Improving regional collaboration to implement and operate ITS has many potential benefits for the region. Significant opportunities to improve regional cooperation and coordination include:

- **MAG ITS Strategic Plan Update –** The Strategic Plan is a regional, collaborative effort and the MAG ITS Committee should facilitate the continued use of the Plan. Member jurisdictions should make every effort to maintain consistency and compatibility with the MAG ITS Strategic Plan. This includes ensuring that all ITS elements presented in the Plan are properly incorporated into all applicable state, regional, and local transportation plans.
- **Maintaining Consistency with the Regional Architecture** – The MAG Regional ITS Architecture provides a framework for improving the compatibility of regional ITS infrastructure and components. ITS implementations and modifications to existing ITS deployments should be consistent with the MAG ITS Regional Architecture.
- **Coordination with the AZTech™ MDI** – The MAG ITS Committee should continue with efforts to coordinate activities with the AZTech™ MDI. Additional opportunities for coordination and cooperation between these entities should be encouraged.
- **Shared Management and Operations Agreements** – Opportunities to develop and expand the shared M&O of ITS across multiple jurisdictions should be investigated and encouraged.

8.1.2 Shared Operating Agreements

The development of shared operating and maintenance agreements among agencies in the MAG region presents a significant opportunity to improve regional collaboration in addressing M&O issues. These sharing agreements allow the better specialization of personnel and provide for more efficient utilization of agency resources. These agreements often result in improved standardization of deployments and improved procurement efficiencies.

Shared operating agreements can vary greatly in scope and complexity – from a simple agreement to allow one agency to view another agency's CCTV feed, to complex multi-jurisdictional agreements to cooperatively operate TMCs for an entire region. The AZTech™ Operations Working Group is currently investigating some multi-jurisdictional opportunities, including:

- Coordinating traffic signal operations across multiple agencies;
- Sharing CCTV viewing and control;
- Sharing VMS use and control; and
- Coordinating incident management responsibilities.

These opportunities are expected to provide significant cross-agency benefits and cost reductions, and should be encouraged and facilitated by the MAG ITS Committee. Joint operational initiatives have recently been recognized for their high potential to provide benefits to agencies and are being evaluated by the FHWA. Several examples of shared operating agreements are presented in Technical Memorandum Number 6A, Operational and Implementation Strategies, of the *MAG ITS Strategic Plan Update*. These examples include the Silicon Valley Smart Corridor, Seattle I-5 Corridor Operational Coordination, Twin Cities Orion Project, and the Las Vegas Freeway and Arterial System of Transportation (FAST).

The collocation of traffic management centers with emergency management dispatch is a unique multi-jurisdictional sharing opportunity that is being considered nationwide. These arrangements can provide both a cost savings to agencies as well as increased functionality. The ability of traffic and emergency management providers to coordinate and share information during an incident is increased due to the location of operators in the same facility. Shared use of building facilities, traffic monitoring and surveillance devices, and communications equipment can lead to a cost savings for all agencies. The MAG 911 Oversight Committee has also identified a goal to develop a plan for interfacing with ITS in their *Draft 911 System Five Year Plan (August 2000)*. These types of arrangements should be further considered by the MAG ITS Committee.

In addition to the multi-jurisdictional operations agreements being considered, there are several additional opportunities to improve cooperative operations of ITS in the MAG region, including:

- Joint contracting with a private sector provider of ITS operational services (e.g., private sector involvement in providing regional traveler information systems);
- Encouraging standardization of operating procedures to improve the opportunities for operational sharing (regional CCTV and VMS agreements);
- Joint training programs to educate personnel from multiple agencies in the operations of new technologies (e.g., NHI Incident Management training course);
- Shared procurement of ITS equipment to ensure operational compatibility across jurisdictions (e.g., AZTech™ procurement service);
- Sharing agreements that allow technical personnel from one agency to operate another agency's ITS components on a full-time or situational basis;
- Operations sharing agreements that allow an agency remote access to another agency's traffic management capabilities during periods when the TMC is not staffed (e.g., evenings and weekends);
- Allowing one agency to design and/or implement a system that will be operated and maintained by other jurisdictions (e.g., MCDOT design of SMART Corridors);
- Sharing of real-time and archived traffic data for use in operations and planning; and
- Additional public/public partnerships to jointly operate multi-jurisdictional ITS components.

Several procedures and strategies are presented in Technical Memorandum Number 6A that can be used to improve the implementation potential of shared operating agreements among agencies in the MAG region. Examples of constructive procedures to promote and support shared ITS operations include formalizing multi-jurisdictional agreements and developing detailed operations plans for potential shared ITS deployments.

8.1.3 Shared Maintenance Agreements

Combining maintenance and maintenance-related activities among jurisdictions in the MAG region can produce significant benefits for local agencies. Some examples of potential shared maintenance activities include:

- Formal public/public agreements to allow one agency to maintain another agency's ITS equipment;
- Multi-agency agreements to share maintenance resources and expertise among agencies;

- Joint training of agency personnel in the maintenance of new technologies;
- Multi-agency purchasing and sharing of specialized maintenance and diagnostic equipment required by ITS deployments;
- Arrangements to combine equipment purchases in order to lessen the procurement burden and secure volume purchase discounts; and
- Multi-agency agreements to coordinate planning and scheduling of maintenance activities.

There are several benefits of these types of shared maintenance agreements:

- Increased specialization of maintenance staff skills and knowledge;
- Improved upkeep and reliability of ITS equipment;
- Reduced agency costs due to improved efficiency;
- Improved ability to maintain adequate inventory of spare and replacement ITS equipment;
- Improved planning and scheduling of maintenance activities; and
- Reduced liability for individual agencies.

8.2 Procedures for Multi-Jurisdictional Issues

The MAG ITS Committee, AZTech™ MDI and other regional efforts have effectively promoted the coordinated implementation of ITS on a regional, multi-jurisdictional basis. Over time, these efforts have become the *de facto* forums for addressing local multi-jurisdictional deployment issues. Both formal and informal agreements and communication procedures have been developed among the jurisdictions to deal with deployment issues.

Procedures for addressing multi-jurisdictional issues recommended in this section are primarily focused on improving the resolution of operational and maintenance issues between jurisdictions. Recommended procedures include:

- **Identify Regional Goals for ITS Operations** – The MAG ITS Committee should initiate discussions to develop a list of common goals for ITS operations. These goals will provide guidance to member agencies on how ITS will be used to enhance the operations of the regional transportation system, and provide a basis for forming and maintaining sharing agreements between agencies in the region. It is recommended that MAG define regional ITS goals for operations by developing a regional concept of operations. In the Intelligent Transportation System Architecture and Standards Notice of Proposed Rule Making, filed by the Federal Highway Administration in May 2000, a regional concept of operations is identified and recommended for implementation; however, a definition of the components that should be included in the regional concept of operations has not been developed. The MAG regional concept of operations, in addition to identifying regional ITS goals, could also contain many of the bullet items listed in this section.
- **Expand the Regional Operations Committee** – The MAG ITS Committee should encourage the AZTech™ Traffic Operations Working Group to assume broader operational responsibilities, and coordinate with additional jurisdictions and types of systems. This group would serve as a forum for improving planning and coordination of regional M&O activities to promote the more efficient use of M&O resources and improved reliability of the ITS deployments.

- **Formalize Operating Procedures** – Operating procedures, particularly those for multi-jurisdictional ITS deployments in the region, should be formalized and documented. This will promote the clear understanding of the procedures and ensure they are properly maintained over time. Documentation currently exists for CCTV and VMS deployments. Other deployments should be documented in a similar manner.
- **Develop Management and Operations Plans** – The process of developing M&O plans should be focused on guiding the long-term M&O activities. The impact of any deployment on M&O activities should be carefully weighed when designing any ITS implementation or modification to existing ITS. Individual jurisdictions should be encouraged to develop their own internal M&O plans prior to entering into multi-jurisdictional agreements to implement and operate ITS improvements. The MAG ITS Committee should encourage member agencies to enhance their own M&O plans for individual ITS deployments.
- **Enhance Operational Budgeting Procedures** – The budgeting procedures for operational expenditures should be enhanced to minimize the chance of future funding shortfalls. Operational budgets need to consider the full costs of ITS M&O, and also anticipate the impact on M&O expenditures of incremental expansion of the ITS infrastructure.

8.3 Costs and Resource Requirements

Compared to more traditional infrastructure improvements, ITS improvements typically incur a greater proportion of their costs as continuing M&O costs rather than up-front capital costs. ITS equipment also typically has a much shorter anticipated useful life than many traditional improvements, and they must be replaced as they reach obsolescence. Further complicating the ITS cost estimation process is the fact that ITS deployment costs are greatly impacted by the degree in which ITS equipment and resources are shared across different deployments and jurisdictions.

8.3.1 Cost Estimates of ITS Components

The National ITS Architecture provides ITS equipment cost estimates to help planners estimate the costs of various types of improvements. This cost data includes estimates of the average capital cost, M&O cost, and anticipated useful life for hundreds of pieces of equipment and resources needed to deploy and operate ITS improvements. For this study, the ITS Deployment Analysis System (IDAS) software, an ITS planning tool developed by Cambridge Systematics for FHWA, was used to provide an interface to the extensive cost data contained in this documentation. Specifically, the IDAS software tool was used to produce estimates of costs and resource requirements for ITS improvements being planned or considered for deployment in the MAG region; however, when local cost data were available, the local figures supersede the national figures in the presentation of costs. These costs have been presented in further detail in Technical Memorandum Number 6A, Operational and Implementation Strategies, of the *MAG ITS Strategic Plan Update*.

Costs are presented for various ITS components including:

- Arterial traffic management systems;
- Freeway traffic management systems;
- Advanced public transportation systems;
- Incident management systems;
- Emergency management systems;
- Regional traveler information systems;

- Commercial vehicle operation; and
- Additional deployments.

The capital and M&O costs also are shown, segmented by infrastructure and incremental costs. Capital costs represent the total expenditure while M&O costs are annual estimates. A detailed inventory of the ITS equipment associated with each component along with the cost assumptions for each individual piece of equipment is presented as Appendix A of Technical Memorandum Number 6A. These detailed equipment inventories are useful in determining cost allocation and identifying funding responsibilities.

8.3.2 Potential Funding Sources

The Transportation Equity Act for the 21st Century (TEA-21) legislation continues eligibility for funding of operating costs for traffic monitoring, management, and control. While continuing to permit annually apportioned federal-aid funds to be eligible for traffic systems operations and management activities, TEA-21 does not provide separate funding exclusively for system M&O.[1] Available general funding programs include:

- **National Highway System (NHS) –** Provides for capital and operating costs for traffic monitoring, management, and control facilities and programs;
- **Surface Transportation Program (STP) –** Provides for capital and operating costs for traffic monitoring, management, and control facilities and programs; and
- **Congestion Mitigation and Air Quality Improvement Program (CMAQ) –** Provides funds to establish or operate traffic monitoring, management, and control facilities or programs in non-attainment areas. Explicitly includes, as an eligible condition for funding, programs or projects that improve traffic flow.

TEA-21 also authorized several additional federal funding programs to help agencies deploy and operate ITS. These funds have been largely apportioned through congressional earmarks and include:

- **ITS Integration –** This component of the ITS Deployment Program provides funding for activities necessary to integrate ITS infrastructure components that are either deployed (existing) or will be deployed with other sources of funds;
- **Commercial Vehicle Information Systems and Networks (CVISN) –** This component of the ITS Deployment Program can be used to fund state ITS deployments intended to improve the safety and productivity of commercial vehicles and drivers; and
- **Corridor Planning and Development and Border Infrastructure (Corridors and Borders) –** This program (through the FHWA's Office of Intermodal and Statewide Programs) is intended to improve the safety and efficiency of the movement of people and goods through US international ports of entry (POE) and along multi-modal trade corridors.

A number of additional federal funding opportunities have helped to deploy the ITS infrastructure in the MAG region. For example, the Metropolitan Model Deployment Initiative (MMDI) effort provided the funding for AZTech™ and its related initiatives.

[1] Currently, US DOT rule making has been proposed to better define eligible ITS deployments and enhance the availability of these funding mechanisms for long-term operations financing. The issue is being studied and a Final Rule on eligibility is expected by late 2000.

ITS projects will increasingly need to compete for the same construction and operating funds as traditional infrastructure projects. There may be opportunities to secure dedicated funding for specific ITS deployments if and when the funds become available. Periodic inquiries to regional FHWA representatives should be made to identify these potential opportunities.

Beyond federal funding, there are a number of additional funding sources available for some ITS deployments, including:

- Public/private partnerships;
- Resource sharing with public agencies external to the transportation agency; and
- Revenue opportunities.

8.3.3 Potential Private Sector Opportunities

Several initiatives are currently underway by private sector organizations to provide ITS services in the MAG region. The public sector's involvement in these improvements is primarily limited to a supportive role as data providers. These private-sector initiatives include in-vehicle systems, media information service providers, and commercial vehicle traveler information systems.

Other ITS initiatives are more often better suited to deployment and/or operation by partnerships formed between the public and the private sectors. The lead organization, either public or private, is often determined by the specific characteristics of the deployment. These public/private partnership opportunities include telephone and Internet-based traveler information systems, parking management systems, and ITS communications provisions.

9. ITS PROJECT EVALUATION PLAN

The evaluation of ITS deployments provides a key link in the development and operation of ITS. The performance evaluation provides critical feedback to the ITS implementers and operators on the performance of the system measured against the project goals. This feedback can be used to modify and adjust the system to maximize the system performance and achieve project objectives. Performing an evaluation may also be a requirement of the funding mechanism used to finance the improvement. The ITS Evaluation Plan described in this Chapter is discussed in further detail in Technical Memorandum Number 8, Evaluation Plan, of the *MAG ITS Strategic Plan Update*.

Beyond meeting these goals, evaluating ITS also provides valuable information that can be used for planning future deployments and training personnel and decision makers on the impacts of ITS on the regional transportation network.

9.1 Evaluation Process

An evaluation framework is presented in this chapter to help guide MAG region agencies in conducting relevant and useful evaluations of future ITS deployments. This framework is based on evaluation guidelines developed by the USDOT. The framework is designed to be flexible based on the deployment being evaluated, the evaluation resources available, and the goals of the project participants. An overview of the framework is presented in **Figure 9.1**.

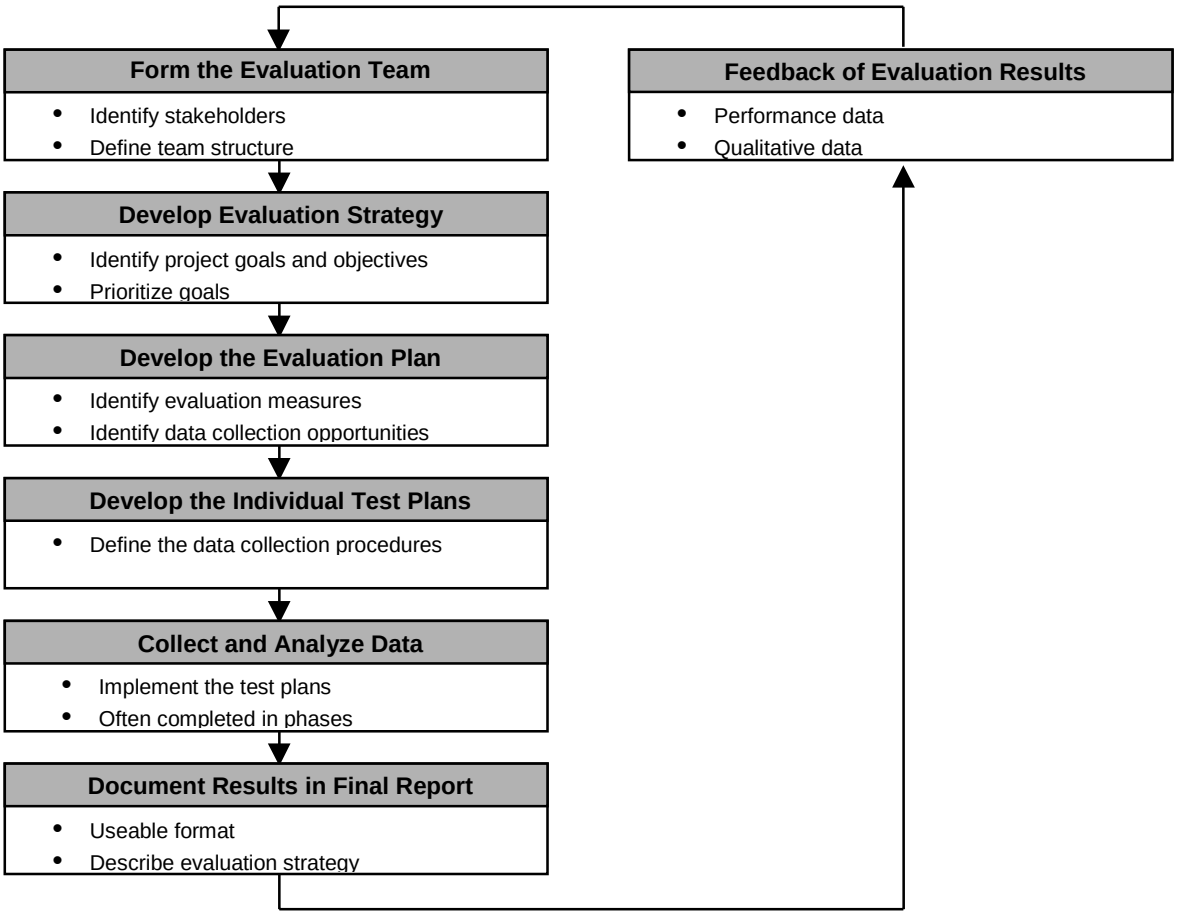


Figure 9.1 – MAG ITS Evaluation Process

The MAG evaluation framework recommends the following steps be followed when conducting an ITS evaluation:

1. **Form the Evaluation Team**. Each participating partner or stakeholder should identify a representative to serve on the evaluation team. One representative should be chosen to serve as the evaluation leader, or an independent evaluator may fulfill this role. Universities also should be involved as members of the evaluation team. The evaluation team provides technical and managerial oversight of the evaluation.
2. **Develop the Evaluation Strategy**. An evaluation strategy should be developed early in the process to identify the project goals and prioritize the goals according to the evaluation team's ratings. These prioritized goals will be used to guide the evaluation and allocate evaluation resources. The evaluation strategy should identify measures that could be used to evaluate the effectiveness of the project in meeting the identified goals.
3. **Develop the Evaluation Plan**. The evaluation plan refines the evaluation approach by defining the hypothesis to be tested, identifying the measures that will be used to test against the hypothesis, and identifying opportunities to collect data on the measurements. The evaluation plan also identifies other non-quantitative analysis to be performed to evaluate qualitative issues such as customer satisfaction or institutional cooperation.
4. **Develop Test Plans**. The test plans provide specific details to guide how particular evaluation measures will be collected and analyzed. These details include identifying personnel and resources needed to collect the measure, the procedures to be followed, and evaluation schedule.
5. **Collect and Analyze Data**. This phase implements the test plans. Data is collected from a variety of sources, including data generated by the ITS improvements themselves (in some cases). The data is archived and analyzed according to directions provided by the test plan. Depending on the improvement and the measure being tested, the data can be collected in several phases, such as before and after deployment.
6. **Document Results in Final Report**. The conclusions of the evaluation should be documented in a report that is understandable and useful to planners and decision-makers. The reports and conclusions should be sufficiently detailed to provide useful feedback to the project partners on the performance of the system compared with the project goals. The final report should include documentation of the evaluation strategy and evaluation plans.
7. **Feedback Performance Data**. The performance results from the evaluation should be used to modify and enhance the ITS deployment to better achieve project goals. The results also should be disseminated to other stakeholders to provide data on the system performance.

This evaluation framework is not designed to provide a comprehensive evaluation of all potential system impacts for all deployments. Instead, the framework is flexible to allow the evaluation team to focus the effort on those measures that are most locally relevant and can be most effectively evaluated given the available resources. Other tools, such as the IDAS developed by Cambridge Systematics for the FHWA, are available to provide more comprehensive analysis of ITS improvements.

9.2 Evaluation Measures

In developing the Evaluation Strategy (Step 2) and the Evaluation Plan (Step 3), the evaluation team needs to identify relevant measures to test the performance of the system. These measures should be relevant to the overall project goals and be able to be measured with the available evaluation resources. Typically an evaluation effort will focus on a few primary measures to maximize the evaluation resources. **Table 9.1** presents some of the typical evaluation measures

that are used to evaluate projects being considered for deployment in the MAG region. The primary impacts presented in this table represent the measures that are most typically evaluated for these types of projects. The secondary impacts indicate those impacts which might be significant, but are not typically considered the principal metrics for evaluating these types of ITS projects.

9.3 Resource and Infrastructure Needs

9.3.1 Resource Needs

The evaluation resources should be identified early in the planning process so that the evaluation measures selected are appropriate to the available resources. The FHWA currently retains two percent of project funds to provide evaluation resources for projects. The evaluation funds from a number of projects are pooled and used to evaluate a small subset of the funded deployments.

It is recommended that MAG create a pool of funds for evaluation that would be equal to five percent of each project budget. Similar to the FHWA evaluation model, the pooled evaluation funds will be used to evaluate a subset of the ITS projects funded in the MAG region. Surface Transportation Funds are one possible source of funding that could be used for the evaluation pool. Matching funds could also be provided from local agencies; however, the funding mechanism for the pool will require further consideration before being decided upon.

Without the pooling of evaluation resources and targeting of evaluation resources, the percentage of project funding required to conduct a meaningful evaluation is higher for any given project. A typical evaluation is estimated to be between 5 and 12 percent of the project budget, but the actual amount is dependent on the deployment being evaluated and the importance of the project goals to the region.

To optimize resources available for evaluations, it is recommended that MAG encourage the involvement of Arizona Universities in evaluation. Coordination of the MAG evaluation program with the Pima Association of Governments (PAG) and ADOT research program is also recommended to promote the sharing of information and possible joint evaluation of projects.

9.3.2 Infrastructure Needs

The evaluation test plans also should identify any specialized equipment or infrastructure that would be required for the evaluation. If data generated from ITS infrastructure is used, the plans for obtaining and securing this data should be thoroughly explored in the development of the test plans.

Specifically, the test plans should identify any specialized software or hardware that may be required. This includes any equipment required for the data analysis as well as the data collection. This equipment should be identified and its availability scheduled so that it is procured prior to the initiation of the data collection effort. Contingency plans should be included to provide back-up data storage capabilities and identify alternative collection and analysis methods.

Table 9.1 – Suggested Evaluation Measures for Selected ITS Projects

	Accident Rate	# Of Fatality Accidents	# Of Injury Accidents	Response Time to Incident	Recurring Delay	Travel Time Variability	Customer Satisfaction	Facility Throughput	Cost Savings	Emission Levels	Energy Consumption
Arterial Traffic Management Systems											
Actuated Corridor Signal Coordination	●	○	○		○	●	○	●		○	○
Central Control Signal Coordination	●	○	○		○	●	○	●		○	○
Emergency Vehicle Signal Priority		○	○	●							
Transit Vehicle Signal Priority					●	●	●	○		○	○
Arterial Highway Advisory Radio						●	●	○			
Arterial Variable Message Sign						●	●	○			
Freeway Management Systems											
Pre-set Ramp Metering	●				●	○		○		○	○
Traffic Actuated Ramp Metering	●				○	●		○		○	○
Central Control Ramp Metering	●				○	●		○		○	○
Highway Advisory Radio						●	●	○			
Variable Message Sign						●	●	○			
Advanced Public Transit Systems											
Fixed Route – Automated Scheduling System					○	●	●		●		
Fixed Route – Automatic Vehicle Location					○	●	●		●		
Fixed Route – Security System	○	○	○				●				
Paratransit – Automated Scheduling System					○	●	●		●		
Paratransit – Automatic Vehicle Identification					○	●	●		●		
Electronic Transit Fare Payment							●		●		
Incident Management Systems											
Incident Detection/Verification	○	●	○			●	○	○		○	○
Incident Response/Management	○	●	○			●	○	○		○	○
Emergency Management Services											
Emergency Vehicle Control Service		●							○		
Emergency Vehicle Automatic Vehicle Location		●							○		
Regional Traveler Information Systems											
Telephone-Based Traveler Information System						●	●				
Web/Internet-Based Traveler Information System						●	●				
Kiosk-Based Traveler Information System						●	●				
Commercial Vehicle Operations											
Weigh-in-Motion							●	●	○		
Safety Information Exchange	●						●	●	●		
Additional Deployments											
Traffic Management Center[1]	○							●	●	○	○
Traffic Surveillance – CCTV		○						○	○		
Traffic Surveillance – Loop Detectors								○	○		
Parking Management Systems							○	●			
Railroad Crossing Monitoring System[2]	●										

● = Primary Impacts ○ = Secondary Impacts

[1]ITS improvements that support or serve as links between other ITS components, such as traffic management centers, are typically evaluated using qualitative measures of the integration impacts. The user impacts of these deployments are usually analyzed in the evaluations of roadside components supported by the traffic management center.

[2]Railroad crossing monitoring systems typically are designed to enhance the monitoring of at grade rail crossings to aid in the enforcement of gate compliance. In a limited number of situations, the video feed from the crossing monitoring system is being relayed to the train engineer to provide advanced warning of obstructions in the rail right-of-way.

The test plans should include a data management plan that specifically identifies the format of all collected data and specifically defines how the data is to be stored and archived. In the MAG region, several automated data sources already exist (or are in the planning stages) that should aid evaluation teams in collecting data. Arizona maintains the AALIS database system, which chronicles statewide accident and incident information. This database can be used to determine historical accident trends and rates for specific facilities or facility types. Likewise, this database can be used to document accident occurrences during the post implementation phase or ITS evaluations.

The Arizona DOT also maintains the FMS in the Phoenix region. Some of the advanced capabilities of this infrastructure can be used to collect data on freeway and freeway access performance statistics. Other local traffic management systems can provide real-time or continuous historical data for local streets. Several regional transit systems are utilizing ITS to improve system performance, and components of the deployed transit ITS infrastructure can generate data for evaluations.

Additionally, the Maricopa County DOT is currently developing an archived data server, which will provide access to a variety of local ITS-generated data. This database will link various ITS data generating components of the AZTech™ deployments and provide the data to users through a single portal. Although these capabilities are only in the developmental stage, the benefit to regional evaluators could be significant. Providing this type of comprehensive data accessibility could reduce the resources and infrastructure necessary to properly collect and analyze continuous performance data.

9.4 Links with the Planning Process

Evaluations of ITS deployments provide an increasingly valuable link for integrating ITS in the planning process. Planners have increasingly recognized the crucial nature of this link, as evidenced by the recent development of the IDAS which integrates the many evaluation and planning processes. Compiling and analyzing relevant evaluation results can help planners avoid pitfalls encountered in previous deployments and can provide guidance in answering critical deployment issues such as:

- Which ITS components represent the best overall investment?
- Which ITS deployments have shown the greatest potential for meeting the needs identified for the MAG region?
- In what locations and conditions has ITS been most successfully deployed?
- How does the level of deployment (i.e., market penetration) impact the performance of ITS components?
- What are the performance impacts of linking different ITS components into an integrated system? Are these integrated impacts greater than stand-alone systems?
- How does ITS investment compare with investment in traditional capacity adding improvements?
- What are user's reactions and views of ITS deployments?
- What has been the implementation and M&O costs experienced by other deployments?

A significant opportunity exists to promote integrating evaluation data into the planning process. MAG can facilitate this integration process in several ways, including:

- **Disseminating Evaluation Findings** – Evaluations are likely to be performed by a variety of MAG partners. A key element to integrating evaluation data into the planning process is ensuring that the findings from these diverse evaluation sources are disseminated and made available to planning personnel in other jurisdictions. MAG is a logical clearinghouse for evaluation findings and should establish a library of regional evaluation reports. This will allow planners to easily locate and access reports from a variety ITS projects through a single source. The USDOT ITS Joint Program Office has collected a number of evaluation reports and plans and has made these resources available on-line at http://www.its.dot.gov/eval/eval.htm. MAG should include information on accessing and using this national data along with the locally relevant evaluation reports.
- **Encouraging the Use of Evaluation Findings** – MAG needs to encourage the use of evaluation findings early in the planning process and prior to scoping new ITS projects. This injection of information early in the planning process will increase the ITS knowledge of planners and increase the efficiency of the planned investments.
- **Identifying Evaluation Knowledge Gaps** – Although a significant body of evaluation literature exists, there are still many information gaps where insufficient data is available. After compiling locally-relevant ITS evaluation data in a library, information gaps (e.g., lack of information on particular types of ITS deployments or categories of impacts) will become apparent. MAG partners may then be encouraged to look for opportunities in future evaluations to collect this data. This will add locally-relevant data to the pool of evaluation data that can be used in regional planning efforts.

The Evaluation Plan of the *MAG ITS Strategic Plan Update* is designed to provide a systematic framework for evaluating future ITS projects in the region. The recommendations presented in this plan will guide planners in conducting evaluations that provide locally-relevant and useful performance feedback, meet federally-mandated evaluation requirements, and support the regional ITS planning process.

10. ITS IMPLEMENTATION PLAN

The main purpose of the ITS Implementation Plan is to recommend ITS projects for possible inclusion in the MAG Regional Transportation Plan and Transportation Improvements Program (TIP). These projects have been designed to satisfy the needs identified in the MAG region by transportation stakeholders and are considered to be regionally significant projects. The projects that are recommended in Technical Memorandum Number 6B, Implementation Plan, of the *MAG ITS Strategic Plan Update* correspond to the recommended market packages, and fit into the regional ITS architecture vision that was developed as part of the *MAG ITS Strategic Plan Update.* The Implementation Plan is described in further detail in Technical Memorandum Number 6B, Implementation Plan, of the *MAG ITS Strategic Plan Update*.

10.1 Existing ITS Transportation Improvement Plan

MAG currently produces a 20-year Regional Transportation Plan (formerly called the Long-Term Transportation Plan) and a five-year TIP that includes both regionally and locally significant projects. The TIP is developed on an annual basis and allows MAG to program funds for projects consistent with regional and local priorities. The MAG ITS Committee has the responsibility for prioritizing ITS projects that are submitted for inclusion and funding in the MAG TIP to determine which projects should be included. The funded projects are then included in MAG's Annual Work Program.

The current draft TIP includes projects for fiscal years 2001 through 2005. The total cost of the ITS projects in the draft TIP is $31,236,800, and includes locally and federally funded projects. In some cases, projects are included in the draft TIP without having an identified source of funding available. A funding source must be identified for these projects before they can be implemented.

Table 10.1 provides a description of the current ITS projects that are in the MAG Draft TIP for the years 2001 through 2005. The agencies that are responsible for implementing the projects as well as the agencies responsible for operations and management have been identified. Implementation includes the planning, design and construction of a project. Operations and management include the staffing, operations, management, and maintenance of all facilities and equipment involved in the project. Fiscal year describes the year in which funding for the project is to begin. The amount to be funded locally and through federal funds also have been identified. In some cases, the total cost does not equate to the sum of the local and federal cost, indicating that additional funding must still be identified.

Table 10.1 – MAG Draft Transportation Improvement Program ITS Projects (FY 2001-2005)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	OPERATIONS AND MANAGEMENT AGENCY	FISCAL YEAR	FUND TYPE	LOCAL COST	FEDERAL COST	TOTAL COST
Freeway Management System								
FMS Phase 7A (FY 2001)	Install FMS components on I-10 (Southern Ave to Pecos Rd)	ADOT	ADOT	2001	CMAQ	$262,000	$4,338,000	$4,600,000
FMS Phase 7B	Install FMS components on US 60 (I-10 to Dobson Rd)	ADOT	ADOT	2001	CMAQ	$500,000	$7,500,000	$8,000,000
FMS Phase 7A (FY 2002)	Install FMS components on I-10 (Southern Ave to Pecos Rd)	ADOT	ADOT	2002	CMAQ	$171,000	$2,829,000	$3,000,000
Freeway Service Patrol	Freeway Service Patrol (FY 2001)	DPS/MAG	DPS	2001	CMAQ	$30,900	$542,000	$572,900
Freeway Service Patrol	Freeway Service Patrol (FY 2002)	DPS/MAG	DPS	2002	CMAQ	$11,900	$208,000	$219,900
Freeway Service Patrol	Freeway Service Patrol (FY 2003)	DPS/ADOT	DPS	2003	State	$250,000	$0	$250,000
Freeway Service Patrol	Freeway Service Patrol (FY 2004)	DPS/ADOT	DPS	2004	State	$250,000	$0	$250,000
Freeway Service Patrol	Freeway Service Patrol (FY 2005)	DPS/ADOT	DPS	2005	State	$250,000	$0	$250,000
Arterial Management Systems								
Chandler Traffic Operations Center Upgrade	Upgrade Chandler Traffic Operations Center	Chandler	Chandler	2001	CMAQ	$22,800	$377,200	$400,000
Chandler Citywide Traffic Control Upgrades	Citywide upgrades to traffic control	Chandler	Chandler	2001	Local	$400,000	$0	$400,000
Chandler Signal Intertie	Traffic signal intertie/upgrade on Chandler Blvd (McQueen Rd to Cooper Rd)	Chandler	Chandler	2001	Local	$40,000	$0	$40,000
Chandler CCTV	Install CCTV camera at Alma School Rd/Elliot Rd and Alma School Rd/Warner Rd	Chandler	Chandler	2003	Local	$100,000	$0	$100,000
Chandler CCTV	Install CCTV camera at Chandler Blvd/Arizona Ave and Chandler Blvd/Price Rd	Chandler	Chandler	2003	Local	$100,000	$0	$100,000
Gilbert ATMS	Install Advanced Traffic Management System (Phase II) on Baseline and Guadalupe Rds from Gilbert Rd to Power Rd, and Val Vista Dr from Baseline Rd to Warner Rd	Gilbert	Gilbert	2001	CMAQ	$22,800	$377,200	$400,000
Glendale Computerized Signal System (Phase I)	Construct Phase I of computerized signal system on 59th Ave from Camelback Rd to Beardsley Rd, include hardware and software to interface with Peoria and Phoenix signals	Glendale	Glendale	2001	CMAQ	$48,165	$796,835	$845,000

Table 10.1 – MAG Draft Transportation Improvement Program ITS Projects (FY 2001-2005)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	OPERATIONS AND MANAGEMENT AGENCY	FISCAL YEAR	FUND TYPE	LOCAL COST	FEDERAL COST	TOTAL COST
Glendale Computerized Signal System (Phase II)	Construct Phase II of computerized signal system on Bell Rd from 51st Ave to 83rd Ave	Glendale	Glendale	2001	CMAQ	$50,000	$745,000	$795,000
Glendale Computerized Signal System (Phase III)	Construct Phase III of computerized signal system on Glendale Ave from 43rd Ave to 99th Ave, integrate with Peoria and Phoenix	Glendale	Glendale	2001	CMAQ	$27,000	$441,000	$468,000
Glendale Traffic Management Center	Design, construct and operate Glendale Traffic Management Center	Glendale	Glendale	2001	CMAQ	$55,119	$911,881	$967,000
MCDOT Traffic/Air Quality Monitoring	Perform realtime traffic/air quality monitoring to develop correlation between air quality and traffic control strategies	MCDOT	MCDOT	2001	Local	$550,000	$0	$550,000
MCDOT Regional Traveler Information System	Establish Regional Traveler Information System (travel and diversion routing to alleviate congestion)	MCDOT	MCDOT	2001	Local	$600,000	$0	$600,000
MCDOT Regionwide Traffic Signal Equipment Upgrades	Upgrade of regionwide traffic signal equipment, interconnection and timing to improve traffic flow	MCDOT	MCDOT	2001	Local	$2,500,000	$0	$2,500,000
AZTech SMART Corridor Program (Phase II)	Install AZTech SMART Corridor Program (Phase II)	AZTech/MCDOT	MCDOT	2001	CMAQ	$68,400	$1,131,600	$1,200,000
AZTech CCTV Program (Phase II)	Install AZTech CCTV Program (Phase II)	AZTech/MCDOT	MCDOT	2001	CMAQ	$100,000	$400,000	$500,000
AZTech VMS (Phase III)	Install AZTech VMS (Phase III - Note that Phase III VMS will be installed on Phase II SMART Corridors)	AZTech/MCDOT	MCDOT	2002	CMAQ	$100,000	$200,000	$300,000
MCDOT Bell Road	Install real-time traffic coordination and messaging system on Bell Rd	MCDOT	MCDOT	2004	CMAQ	$75,000	$775,000	$850,000
Mesa Traffic Operations Center	Upgrade and expand Mesa Traffic Operations Center	Mesa	Mesa	2001	CMAQ	$200,000	$500,000	$700,000
Mesa Traffic Control Signal System	Install traffic control signal system (instrumentation and communications) on Stapley Dr from University Dr to McKellips Blvd	Mesa	Mesa	2001	CMAQ	$20,520	$339,480	$360,000
Mesa SMART Corridor	Install SMART corridor traffic control system on McKellips Rd from Gilbert Rd to Power Rd	Mesa	Mesa	2003	CMAQ	$250,000	$1,550,000	$1,800,000
Mesa Real-Time Adaptive Signal System	Install real-time adaptive signal system on Country Club Dr from 8th Ave to Baseline Rd	Mesa	Mesa	2004	CMAQ	$600,000	$1,100,000	$1,700,000

Table 10.1 – MAG Draft Transportation Improvement Program ITS Projects (FY 2001-2005)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	OPERATIONS AND MANAGEMENT AGENCY	FISCAL YEAR	FUND TYPE	LOCAL COST	FEDERAL COST	TOTAL COST
Peoria Citywide Traffic Signal Interconnect System (Phase III)	Design and construct citywide traffic signal interconnect system	Peoria	Peoria	2002	CMAQ	$57,000	$943,000	$1,000,000
Peoria Citywide Interconnect	Interconnect citywide traffic signal system	Peoria	Peoria	2004	CMAQ	$57,000	$943,000	$1,000,000
Scottsdale Fiber Optic and CCTV	Install fiber optic hardware and CCTV cameras and connect to AZTech system	Scottsdale	Scottsdale	2001	CMAQ	$200,000	$780,000	$980,000
Scottsdale SMART Corridor Traffic Control System	Install SMART corridor traffic control system on Scottsdale Rd from Pima Fwy to Indian School Rd	Scottsdale	Scottsdale	2005	CMAQ	$1,980,000	$2,200,000	$4,180,000
Tempe Traffic Signal Controller Cabinet Upgrade	Traffic signal controller cabinet upgrade at various locations	Tempe	Tempe	2002	Local	$17,500	$500,000	$517,500
Tempe Traffic Signal Controller Cabinet Upgrade	Traffic signal controller cabinet upgrade at various locations	Tempe	Tempe	2003	Local	$17,500	$500,000	$517,500
Tempe Traffic Signals	Install new/upgrade modular traffic signals at various locations	Tempe	Tempe	2004	Local	$320,000	$0	$320,000
Incident/Emergency/Event Management Systems								
MCDOT Parking and Traffic Management System (PIR)	Parking and traffic management system utilizing VMS and monitoring systems	MCDOT	MCDOT	2001	Local	$1,600,000	$0	$1,600,000
Phoenix Downtown Traffic Management System (Phase I)	Construct Phoenix Downtown Traffic Management System (Phase I)	Phoenix	Phoenix	2001	CMAQ	$90,000	$1,476,000	$1,566,000
Phoenix Downtown Traffic Management System (Phase II)	Construct Phoenix Downtown Traffic Management System (Phase II)	Phoenix	Phoenix	2002	CMAQ	$57,000	$943,000	$1,000,000
Planning and Outreach Support								
Chandler ITS Planning Study	Perform local ITS planning study	Chandler	Chandler	2004	Local	$80,000	$0	$80,000
Telecommunications Infrastructure								
Chandler Fiber Optic Line	Install fiber optic communications line on Arizona Ave from Elliott Rd to Chandler Blvd	Chandler	Chandler	2003	Local	$200,000	$0	$200,000
Chandler Fiber Optic Line	Install fiber optic communications line on Arizona Ave from Elliott Rd to Chandler Blvd (Phase II)	Chandler	Chandler	2003	Local	$250,000	$0	$250,000
Chandler Fiber Optic Line	Install fiber optic communications line on Arizona Ave from Chandler Blvd to Riggs Rd	Chandler	Chandler	2003	Local	$400,000	$0	$400,000
TOTAL TIP PROJECTS						**$12,981,604**	**$33,347,196**	**$46,328,800**

10.2 Recommended ITS Projects for the MAG Region

The stakeholder needs identified in **Table 2.2** (Chapter 2) were used to develop ITS user services and market packages for the MAG region, which are presented in Chapter 4. Based on the user services and market packages, a vision of the MAG regional architecture was then developed and is provided in Chapter 5. It is critical that projects identified in the MAG region be consistent with the MAG regional architecture, but also critical that the projects address the stakeholder needs.

A series of recommended projects have been developed for consideration for implementation in the MAG TIP. These projects do not include projects in the current TIP. They are proposed in addition to the current TIP. They were developed based on stakeholders needs and are not matched against available funding. Projects have been developed for the following timeframes:

- Short-term (2002-2006), presented in **Table 10.2**;
- Mid-term (2007-2011), presented in **Table 10.3**; and
- Long-term (2012-2021), presented in **Table 10.4**.

The projects presented in **Tables 10.2, 10.3** and **10.4** represent regionally significant projects. It is anticipated that a number of locally significant projects will be developed by local agencies and also will need to be considered for inclusion in the TIP. It will be the responsibility of the MAG ITS Committee to determine which projects are most important and should receive funding – the prioritization of the funded projects is determined by the year that is programmed. The projects recommended in the short-term, mid-term and long-term Implementation Plan are not intended to supercede projects in the existing MAG TIP; however, projects in the Implementation Plan are encouraged to be implemented in order to meet the needs of the regional stakeholders.

Several of the projects identified for short-term, mid-term and long-term implementation are in excess of $1 million. It is anticipated that these projects will actually be implemented in phases.

Each project identified includes the following categories:

Program Area/Project – The program area, such as Traveler Information System or Arterial Management System, to which the project is most closely identified with, as well as the name of the potential project.

Description – Brief description of the project.

Implementing Agency – The agency responsible for the planning, design and construction of a project.

Managing and Operating Agency – The agency responsible for the staffing, operations, management, and maintenance of all facilities and equipment involved in the project

Opinion of Probable Cost – An estimate of the probable cost of the project. The cost may vary significantly depending on the level of deployment that the implementing agency desires. For example, the project to implement arterial speed maps may target a limited number of arterials and not require a high level of accuracy, in which case the cost of the project could decrease. If the number of arterials identified increases and a robust system with a very high level of accuracy is desired, the cost could increase.

Associated User Needs (ID Number) – The identification number (see **Figure 4.1**[Chapter 4]) of the stakeholder needs that this project would satisfy.

Table 10.2 – MAG ITS Strategic Plan - Recommended Short-Term Projects (2002-2006)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
Traveler Information Systems					
Integration of a Regional ATIS/ATMS System	Integrate ADOT FMS/AZTech/HCRS servers (and possibly replace TRW system) at ADOT TOC to provide integrated traveler information/traffic management system	ADOT/MCDOT	ADOT/MCDOT	$2,500,000	6,23
AZTech Work Stations (15)	Add AZTech Work Stations to up to 15 new ITS cities/agencies	AZTech/MCDOT	Local Agencies	$150,000	6,10,32
Traveler Information Systems Upgrade	Upgrade existing traveler information systems (HCRS/411-ROAD/RCRS) to accommodate new technologies, such as wireless internet and in-vehicle applications	ADOT/Local Agencies/Private Sector	ADOT/Local Agencies/Private Sector	$1,000,000	6,8,11,20
Arterial Speed Maps	Develop maps to display speeds on arterial streets	MAG/Local Agencies	Local Agencies	$500,000	6,52
SUBTOTAL				**$4,150,000**	
Freeway Management System					
FMS Phase 8	Install FMS components on US 60 (Dobson Rd to Power Rd)	ADOT	ADOT	$14,070,000	2,5,6,8,16
FMS Phase 3B	Install FMS components on I-17 (Peoria Ave to Happy Valley Rd)	ADOT	ADOT	$10,350,000	2,5,6,8,16
FMS Phase 6B	Install FMS components on Loop 202N (Loop 101 to SR 87) Install FMS components on Loop 101 (Loop 202 to 90th St)	ADOT	ADOT	$16,560,000	2,5,6,8,16
FMS Phase 9A	Install FMS components on Loop 101S (Guadalupe Rd to Loop 202)	ADOT	ADOT	$6,000,000	2,5,6,8,16
FMS Phase 12B	Install FMS components on Loop 101 (I-17 to Scottsdale Rd) Install FMS components on SR51 (Bell Rd to Loop 101)	ADOT	ADOT	$14,600,000	2,5,6,8,16
Freeway Service Patrol/ATMS Link	Develop and implement links to connect the freeway service patrol with the ADOT TOC traffic management system	ADOT/DPS	ADOT/DPS	$500,000	2,5,8,10,12
ADOT TOC Upgrades	Upgrade ADOT TOC software and hardware	ADOT	ADOT	$1,000,000	2,5,6,8,16
SUBTOTAL				**$63,080,000**	
Arterial Management Systems					
AZTech SMART Corridor Program (Phase III)	Install AZTech SMART Corridor Program (Phase III)	AZTech/MCDOT	Local Agencies	$3,000,000	2,5,10,12
Roadway Condition Reporting System	Add RCRS to large cities w/o existing or planned RCRS capability (Goodyear, Peoria, MCDOT)	AZTech/MCDOT	Local Agencies	$100,000	6,8,10,12,32
Traffic Management Center	Implement TMC in Gilbert	Gilbert	Gilbert	$250,000	4,17
Signal Timing Improvements to Interjurisdictional Signals and	Improve signal coordination at interjuriscitional borders and along SMART Corridors	MAG/Local Agencies	Local Agencies	$500,000	4

Table 10.2 – MAG ITS Strategic Plan - Recommended Short-Term Projects (2002-2006)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
SMART Corridors					
Railroad Crossing Pilot Program	Railroad crossing pilot program to demonstrate effectiveness of advanced railroad crossing warning devices	MAG/Local Agencies/ Railrds	MAG/Local Agencies/ Railrds	$250,000	21
SUBTOTAL				**$4,100,000**	
Transit Management System					
Scheduling System	Implement Scheduling System with dispatch module for fixed route fleet.	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$750,000	6
Trip Planning System	Implement Trip Planning System with option for Internet connection for trip planning and interactive voice recognition	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$750,000	11
Regional Validating Farebox	Implement system for regional validating farebox	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$10,000,000	24
Vehicle Management System	Implement Vehicle Management System which will include new radios, AVL/GPS equipment, silent alarms and computer aided dispatch	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$12,000,000	6,11,26,49
Bus Rapid Transit and Light Rail Signal Priority	Implement signal prioritization along bus rapid transit and light rail routes	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$5,000,000	13
Audio/Visual Announcements	Implement system to provide on-board audio/visual announcements to transit passengers	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$3,000,000	6
Passenger Counting	Implement automated passenger counting system	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$2,500,000	24
Real Time Transit Arrival Time	Provide real time information on transit arrival at light rail and bus stops	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$500,000	6,11,49
Transit Routing Based on Incident Information	Implement fixed route/dial-a-ride bus routing based on incident information	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$500,000	23
SUBTOTAL				**$35,000,000**	
Incident/Emergency/Event Management Systems					
Regional Incident Management Plans	Development and pilot implementation of regional incident management strategies to integrate freeway and arterial	MAG/Incident Mgt. Working Group	ADOT/Local Agencies	$500,000	1,2,5,10

Table 10.2 – MAG ITS Strategic Plan - Recommended Short-Term Projects (2002-2006)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
	streets				
Regional Incident Management Coalition	Establish a regional incident management coalition, provide training and support	MAG/Incident Mgt. Working Group	ADOT/Local Agencies	$300,000	2,5,10
Integrate Traffic/Dispatch System	Integrate traffic information on FMS/local streets with PSAP CAD dispatching	ADOT/Phoenix Fire	ADOT/Phoenix Fire	$3,000,000	32
Phoenix International Raceway Special Event Traffic Management System	Implement special event traffic management system at Phoenix International Raceway	MCDOT	MCDOT	$4,000,000	16
SUBTOTAL				**$7,800,000**	
Commercial Vehicle Operations					
CANAMEX Corridor ITS Study	Study designated CANAMEX Corridor to determine feasibility of implementing ITS technologies	ADOT/MAG	ADOT	$150,000	18
				$150,000	
Planning and Outreach Support					
Local ITS Deployment Plans	Individual ITS deployment plans for Local Agencies	Local Agencies	Local Agencies	$1,000,000	10
Regional Concept of Operations	Develop regional concept of operations plan	MAG	ADOT/Local Agencies	$250,000	1,4,7,10,52
ITS Training	Implement training program to enhance professional development	MAG	MAG	$250,000	15
ITS Outreach	Develop program to inform public of ITS technologies and how they can use information to improve travel	MAG/ITS Arizona	MAG/ITS Arizona	$250,000	15
ITS Project Evaluation	Approximately 5% of total budget for ITS projects to be used for evaluating projects (Evaluation budget to be spread out over 5 years)	MAG	MAG	$1,500,000	15
ITS Pedestrian/Bicycle Projects	Study and plan for ITS pedestrian and bicycle projects	MAG/Local Agencies	Local Agencies	$250,000	15, 16, 52
SUBTOTAL				**$3,500,000**	
Telecommunications Infrastructure (Projects Developed in Technical Memorandum No. 7, ITS Telecommunications Plan)					
Telecommunications Projects	Identified in **Table 6.3** of Section 6			$5,452,500	10
SUBTOTAL				**$5,452,500**	
TOTAL				**$123,232,500**	
TOTAL FMS				**$61,580,000**	
TOTAL TRANSIT				**$35,000,000**	

Table 10.3 – MAG ITS Strategic Plan - Recommended Mid-Term Projects (2007-2011)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
Traveler Information Systems					
Regional ATIS	Implement regional advanced traveler information projects	ADOT/MCDOT/ Local Agencies	ADOT/Local Agencies	$1,000,000	6
AZTech Work Stations	Add AZTech work stations to new ITS cities	AZTech/MCDOT	Local Agencies	$100,000	6,10,32
HAR Pilot Program	HAR pilot program to demonstrate HAR effectiveness	ADOT/MCDOT	ADOT/MCDOT	$250,000	19
SUBTOTAL				**$1,350,000**	
Freeway Management System					
FMS Phase 12A	Install FMS components on Loop 101 (90th St to Scottsdale Rd)	ADOT	ADOT	$9,200,000	2,5,6,8,16
FMS Phase 10	Install FMS components on Loop 101 (Grand Avenue to I-17)	ADOT	ADOT	$16,700,000	2,5,6,8,16
FMS Phase 7C	Install FMS components on I-10 (Chandler Blvd to Queen Creek Rd)	ADOT	ADOT	$5,200,000	2,5,6,8,16
FMS Phase 11	Install FMS components on I-10 (99th Ave to 83rd Ave) Install FMS components on Loop 101 (I-10 to Grand Ave)	ADOT	ADOT	$13,550,000	2,5,6,8,16
ADOT TOC Upgrades	Upgrade ADOT TOC software and hardware	ADOT	ADOT	$1,000,000	6,8
Travel Time Display on FMS	Develop software to allow VMS display of travel times to known points in the Valley	ADOT	ADOT	$400,000	7
SUBTOTAL				**$46,050,000**	
Arterial Management Systems					
SMART Corridor Freeway Alternate Routes Expansion/Addition	Expand existing SMART corridors and add new corridors as needed with freeway growth to assist in diversion of traffic during incidents (Approximately 10 Routes)	AZTech/MCDOT	Local Agencies	$3,000,000	1,2,5,10,12
SMART Corridor Expansion/Addition	Expand existing corridors and add new corridors to provide additional coverage for high growth areas (Approximately 15 expanded or new routes)	AZTech/MCDOT	Local Agencies	$5,000,000	4,6,8,10
Signal Timing Improvements to SMART Corridors	Improve signal coordination along SMART Corridors	AZTech/MCDOT	Local Agencies	$500,000	4
Roadway Condition Reporting System	Add RCRS to new ITS cities w/o existing RCRS	AZTech/MCDOT	Local Agencies	$100,000	6,8,10,12,32
Traffic Management Center	Implement TMCs in new ITS cities	Local Agencies	Local Agencies	$1,000,000	4,17
Central Control Signal System	Install central control signal system into new ITS cities	Local Agencies	Local Agencies	$2,500,000	17
Railroad Crossing Deployment	Deployment of advanced railroad crossing devices if the pilot project proves effective	Local Agencies/ Railrds	Local Agencies/ Railrds	$2,000,000	21

Table 10.3 – MAG ITS Strategic Plan - Recommended Mid-Term Projects (2007-2011)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
ITS Pedestrian/Bicycle Projects	ITS pedestrian and bicycle projects	MAG/Local Agencies	Local Agencies	$500,000	15, 16, 52
SUBTOTAL				**$14,600,000**	
Transit Management System					
Bus Rapid Transit Priority	Increase signal prioritization project to accommodate new signals and buses	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$1,000,000	13
Real Time Transit Arrival Time	Expand number of stops/routes that provide real time information on transit arrival at light rail and bus stops	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$2,000,000	6,11,49
SUBTOTAL				**$3,000,000**	
Incident/Emergency/Event Management Systems					
Regional Incident Management Plans Automation	Automate implementation of regional incident management plans on freeway and arterial streets	MAG/Incident Mgt. Working Group	ADOT/Local Agencies	$2,000,000	1,2,5,10
Sky Harbor Parking Management System	Implement Parking Management System for the Sky Harbor Airport	Phoenix	Phoenix	$4,000,000	16
SUBTOTAL				**$6,000,000**	
Information Management					
Archived Data Server Expansion	Expand regional archived data server to allow increased data storage from additional sources	MCDOT	MCDOT	$300,000	24,52
SUBTOTAL				**$300,000**	
Commercial Vehicle Operations					
CANAMEX Corridor ITS Deployment	If study proves feasible, implement ITS technologies on designated CANAMEX Corridor	ADOT/MAG	ADOT	$1,000,000	18
				$1,000,000	
Planning and Outreach Support					
ITS Strategic Plan Update	Update ITS Strategic Plan	MAG	MAG	$350,000	10
ITS Training	Implement training program to enhance professional development	MAG	MAG	$250,000	15
ITS Outreach	Develop program to inform public of ITS technologies and how they can use information to improve travel	MAG/ITS Arizona	MAG/ITS Arizona	$250,000	15

Table 10.3 – MAG ITS Strategic Plan - Recommended Mid-Term Projects (2007-2011)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
ITS Project Evaluation	Approximately 5% of total budget for ITS projects to be used for evaluating projects (Evaluation budget to be spread out over 5 years)	MAG	MAG	$1,500,000	15
SUBTOTAL				**$2,350,000**	
Telecommunications Infrastructure					
Telecommunications Projects	Identified in Technical Memorandum No. 7			$460,000	10
SUBTOTAL				**$460,000**	
TOTAL				**$75,110,000**	
TOTAL FMS				**$44,650,000**	
TOTAL TRANSIT				**$3,000,000**	

Table 10.4 – MAG ITS Strategic Plan - Recommended Long-Term Projects (2012-2021)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
Traveler Information Systems					
Regional ATIS	Implement regional advanced traveler information projects	ADOT/MCDOT/ Local Agencies	ADOT/Local Agencies	$2,000,000	6
AZTech Work Stations	Add AZTech work stations to new ITS cities	AZTech/MCDOT	Local Agencies	$100,000	6,10,32
HAR Deployment	Deployment of HAR if the pilot project proves effective	ADOT/MCDOT	ADOT/MCDOT	$1,000,000	19
SUBTOTAL				**$3,100,000**	
Freeway Management System					
FMS Phase 13	Install FMS components on US60 (Power Rd to Idaho Rd)	ADOT	ADOT	$10,300,000	2,5,6,8,16
FMS Phase 14	Install FMS components on Loop 202S (Gilbert Rd to I-10)	ADOT	ADOT	$14,100,000	2,5,6,8,16
FMS Phase 15	Install FMS components on Loop 202N (SR 87 to Power Road)	ADOT	ADOT	$12,250,000	2,5,6,8,16
FMS Phase 16	Install FMS components on Loop 202 NE-SE (Power Rd to Gilbert Rd)	ADOT	ADOT	$31,900,000	2,5,6,8,16
ADOT TOC Upgrades	Upgrade ADOT TOC software and hardware	ADOT	ADOT	$1,000,000	6,8
SUBTOTAL				**$69,550,000**	
Arterial Management Systems					
SMART Corridor Upgrade	Upgrade components on existing SMART Corridors and add additional components as needed	AZTech/MCDOT	Local Agencies	$10,000,000	4,6,8,10
SMART Corridor Expansion/Addition	Expand existing corridors and add new corridors to provide additional coverage for high growth areas (Approximately 10 expanded or new routes)	AZTech/MCDOT	Local Agencies	$3,000,000	4,6,8,10
Signal Timing Improvements to SMART Corridors	Improve signal coordination along SMART Corridors	AZTech/MCDOT	Local Agencies	$500,000	4
Roadway Condition Reporting System	Add RCRS to new ITS cities w/o existing RCRS	AZTech/MCDOT	Local Agencies	$250,000	6,8,10,12,32
Traffic Management Center	Implement TMC in new ITS cities	Local Agencies	Local Agencies	$2,000,000	4,17
Centralized Signal System	Install central control signal system to new ITS cities	Local Agencies	Local Agencies	$2,000,000	17
Upgrade of Central Control Signal System	Upgrade of central control signal systems as needed	ADOT/Local Agencies	ADOT/Local Agencies	$10,000,000	17
ITS Pedestrian/Bicycle Projects	ITS pedestrian and bicycle projects	MAG/Local Agencies	Local Agencies	$1,000,000	15, 16, 52
SUBTOTAL				**$28,750,000**	

Table 10.4 – MAG ITS Strategic Plan - Recommended Long-Term Projects (2012-2021)

PROGRAM AREA/PROJECT	DESCRIPTION	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	OPINION OF PROBABLE COST	ASSOCIATED USER NEEDS (ID NUMBER)
Transit Management System					
Real Time Transit Arrival Time	Expand number of stops/routes that provide real time information on transit arrival at light rail and bus stops	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$2,000,000	6,11,49
Upgrade of Transit Systems	Scheduling/Payment Systems/AVL	Valley Metro/Local Agencies	Valley Metro/Local Agencies	$5,000,000	11,23,26,49
SUBTOTAL				**$7,000,000**	
Incident/Emergency/Event Management Systems					
Parking and Event Management System	Implement parking and event management systems at locations as needed	Local Agencies	Local Agencies	$10,000,000	16
SUBTOTAL				**$10,000,000**	
Information Management					
Archived Data Server Expansion	Expand regional archived data server to allow increased data storage from additional sources	MCDOT	MCDOT	$500,000	24,52
SUBTOTAL				**$500,000**	
Planning and Outreach Support					
ITS Strategic Plan Updates	Update ITS Strategic Plans	MAG	MAG	$500,000	10
ITS Training	Implement training program to enhance professional development	MAG	MAG	$250,000	15
ITS Outreach	Develop program to inform public of ITS technologies and how they can use information to improve travel	MAG/ITS Arizona	MAG/ITS Arizona	$250,000	15
ITS Project Evaluation	Approximately 5% of total budget for ITS projects to be used for evaluating projects (Evaluation budget to be spread out over 10 years)	MAG	MAG	$3,000,000	15
SUBTOTAL				**$4,000,000**	
Telecommunications Infrastructure					
Upgrade WAN Connections to Direct Fiber	Upgrade Agency WAN Connections to Direct Fiber	ADOT/AZTech/ Local Agencies	ADOT/AZTech/ Local Agencies	$4,000,000	10
SUBTOTAL				**$4,000,000**	
TOTAL				**$126,900,000**	
TOTAL FMS				**$68,550,000**	
TOTAL TRANSIT				**$7,000,000**	

The cost for all projects are provided in current dollars. The total costs of the short-term, mid-term, and long-term recommended projects are as follows:

	Short-Term	Mid-Term	Long-Term	Totals
Total FMS:	$61,580,000	$44,650,000	$68,550,000	**$174,780,000**
Total Transit:	$35,000,000	$3,000,000	$7,000,000	**$45,000,000**
Total Other ITS Projects:	$26,652,500	$27,460,000	$51,350,00	**$105,462,500**
Total Implementation Plan:	**$123,232,500**	**$75,110,000**	**$126,900,000**	**$325,242,500**

The cost of the projects recommended in the ITS Implementation Plan exceed the existing amount of funding provided by MAG for ITS deployment in the region; however, these projects are important to meet the regional needs of stakeholders in the MAG region. It is recommended that the MAG ITS Committee request additional funding from the MAG Regional Council to assist in implementing the projects in the ITS Implementation Plan.

It should be noted that several other significant efforts are underway in the MAG region to address ITS needs. ADOT is currently involved in the Commercial Vehicle Information Systems and Networks (CVISN) program to integrate ITS projects into the CVO processes. As part of that project, an ITS/CVO Business Plan was produced that identified several statewide ITS/CVO projects. While these projects will be implemented on a statewide basis, they could provide significant benefits for motor carriers operating in the MAG region.

There is also an effort underway by Valley Metro to develop and implement a Vehicle Management System. This would include several ITS projects that would integrate ITS technologies into Valley transit agencies. Currently, Valley Metro has issued two Requests for Proposals for the Vehicle Management System, including a project to implement a Fixed-Route Transit Scheduling System and a project to implement a Trip Planning System. Projects that are planned by Valley Metro have been included in the ITS Implementation Plan.

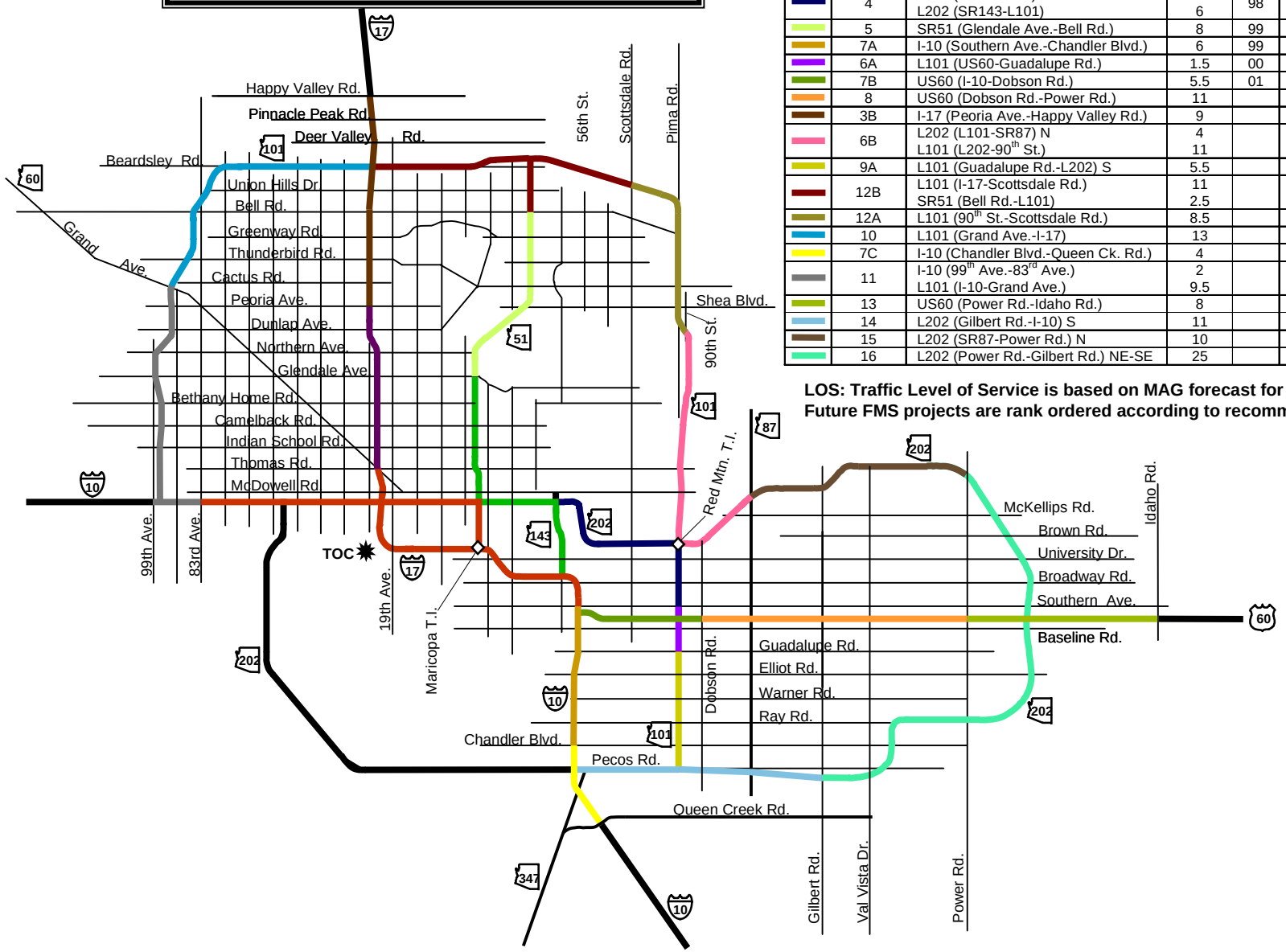
10.2.1 Freeway Management System Prioritization

Segments of the FMS that have been prioritized by MAG, in consultation with ADOT, have been included in the Implementation Plan. **Tables 10.2, 10.3,** and **10.4** identify which segments should be included for short-term, mid-term, and long-term implementation.

Segments which are currently operating at a level of service (LOS) D or less have been included for implementation in the short-term. Those segments currently operating at a LOS C are recommended in the mid-term, and those segments with a LOS B or greater are recommended in the long-term.

A color-coded map is included in **Figure 10.1** which displays the segments of the FMS, the status of implementation, and the current LOS for which the segment is operating. In **Figure 10.2**, the level of planned implementation of FMS on the freeway system is displayed. **Figures 10.1** and **10.2** were developed by ADOT and represent the latest information available as of March 2000.

FREEWAY MANAGEMENT SYSTEM
PHOENIX METROPOLITAN AREA
FIELD IMPLEMENTATION
EXISTING AND RECOMMENDED PROJECTS



	PHASE	DESCRIPTION	MILE	FY	STATUS	LOS
	1	I-10 (83rd Ave.-Southern Ave.) I-17 (Thomas Rd.-Maricopa T.I.)	21 8	94	Completed	
	2	SR51 (I-10-Glendale Ave.) SR143 (I-10-L202) L202 (I-10-SR143)	5.5 4 3	96	Completed	
	3A	I-17 (Thomas Rd.-Peoria Ave.)	7	99	Under Constr.	
	4	L101 (US60-L202) L202 (SR143-L101)	3 6	98	Under Constr.	
	5	SR51 (Glendale Ave.-Bell Rd.)	8	99	Under Constr.	
	7A	I-10 (Southern Ave.-Chandler Blvd.)	6	99	Under Design	
	6A	L101 (US60-Guadalupe Rd.)	1.5	00	Under Design	
	7B	US60 (I-10-Dobson Rd.)	5.5	01	Programmed	
	8	US60 (Dobson Rd.-Power Rd.)	11		Not Programmed	D-F
	3B	I-17 (Peoria Ave.-Happy Valley Rd.)	9		Not Programmed	D-F
	6B	L202 (L101-SR87) N L101 (L202-90th St.)	4 11		Not Programmed	D-F
	9A	L101 (Guadalupe Rd.-L202) S	5.5		Not Programmed	B-D
	12B	L101 (I-17-Scottsdale Rd.) SR51 (Bell Rd.-L101)	11 2.5		Not Programmed	B-D
	12A	L101 (90th St.-Scottsdale Rd.)	8.5		Not Programmed	A-C
	10	L101 (Grand Ave.-I-17)	13		Not Programmed	A-C
	7C	I-10 (Chandler Blvd.-Queen Ck. Rd.)	4		Not Programmed	A-C
	11	I-10 (99th Ave.-83rd Ave.) L101 (I-10-Grand Ave.)	2 9.5		Not Programmed	A-C
	13	US60 (Power Rd.-Idaho Rd.)	8		Not Programmed	A-B
	14	L202 (Gilbert Rd.-I-10) S	11		Not Programmed	A-B
	15	L202 (SR87-Power Rd.) N	10		Not Programmed	A-B
	16	L202 (Power Rd.-Gilbert Rd.) NE-SE	25		Not Programmed	A-B

LOS: Traffic Level of Service is based on MAG forecast for 2005.
Future FMS projects are rank ordered according to recommended implementation priority.

Figure 10.1 – FMS Existing and Recommended Projects
March 2000

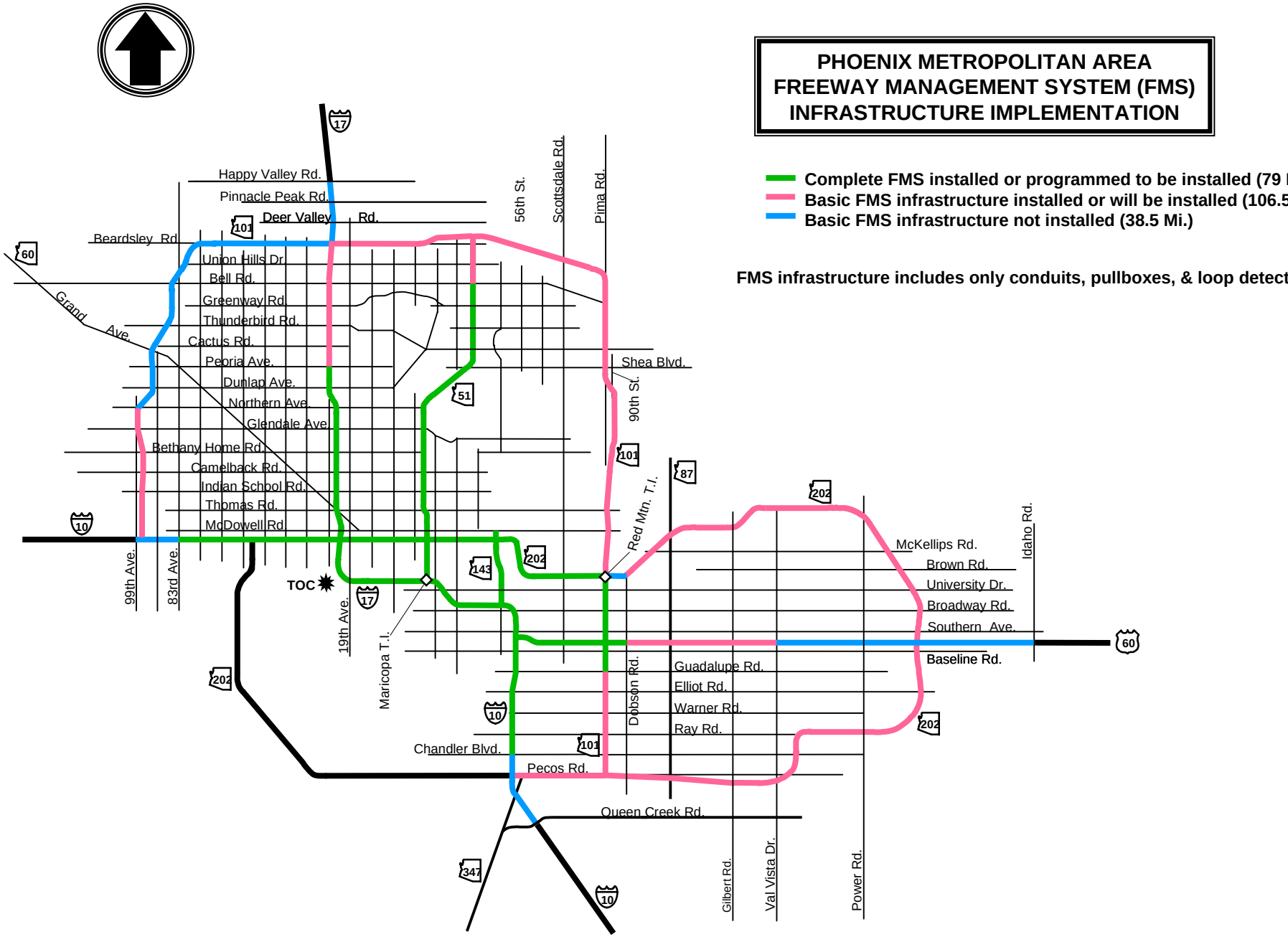


Figure 10.2 – FMS Infrastructure Implementation
March 2000

10.2.2 SMART Corridors

The ITS Implementation Plan includes projects to complete the SMART Corridor implementation as well as improve interjurisdictional signal coordination along the corridors.

A total of 24 SMART Corridors were identified in the AZTech™ MMDI project. These corridors are key arterial links that span the urban area and pass through multiple jurisdictions. SMART Corridors are implemented with detection, CCTV cameras and variable message signs. Traffic signals are coordinated across multiple jurisdictional boundaries and freeway interchanges signals are coordinated with arterial street signal systems. Implementation of SMART Corridors will improve safety standards and facilitate regional mobility.

Figure 10.3, provided by MCDOT, displays the three phases of the SMART Corridors that are currently planned for implementation. Phase 1 of the SMART Corridors has been implemented, and Phase 2 is currently in the design phase. Phase 3 is expected to begin design in the year 2001.

10.3 Management and Operations Resources

Tables 10.5 and **10.6** provide a recommendation for the full-time employees (FTE) needed to manage and operate the recommended projects in the MAG Draft TIP and the short-term implementation plan. Mid-term and long-term projects are not addressed in this section; these assumptions regarding the maintenance and operational requirements of ITS technologies in the mid-term and long-term would be questionable.

M&O of ITS projects is critical, and it is important for agencies to determine the required staff needed when considering implementing an ITS project. Without the proper staffing, an ITS project might not deliver its intended services and the expected benefits of the projects might not be realized. It is recommended that the MAG ITS Committee consider M&O of an ITS project as part of project prioritization.

FTEs include all personnel needed to staff, operate, manage, and maintain the infrastructure and facilities associated with the project. The required number of FTEs depends on both the level of implementation of the project (i.e., the number of field components, level of maintenance required, etc.) and the level of operation of the project. For example, a TMC may be staffed 24 hours per day, only during business hours, or only during incidents or special events.

The ITE has recommended that for maintenance, an average of one FTE is required for 37 traffic signals. This number provides a basis for establishing the maintenance requirements for ITS equipment. Variable message signs typically require more maintenance than other types of ITS field devices, and may be considered equivalent to the maintenance of a traffic signal. Other field devices, such as CCTV cameras and detectors will require considerably less maintenance. Operations of the ITS systems is harder to quantify, as several variables will factor into the operations. Depending on the level that an agency desires to operate its system and the number of functions its staff can perform, the FTEs for operating a system can vary from agency to agency.

In **Tables 10.5** and **10.6**, FTEs are estimated for all aspects of operating and managing the ITS system. The numbers are conservative, and should be used as a starting point to determine the need for additional staff when implementing ITS projects. The agency responsible for M&O of the project being implemented must consider existing staff and the LOS that they wish to operate their ITS system, and use these considerations to determine the appropriate number of FTEs.

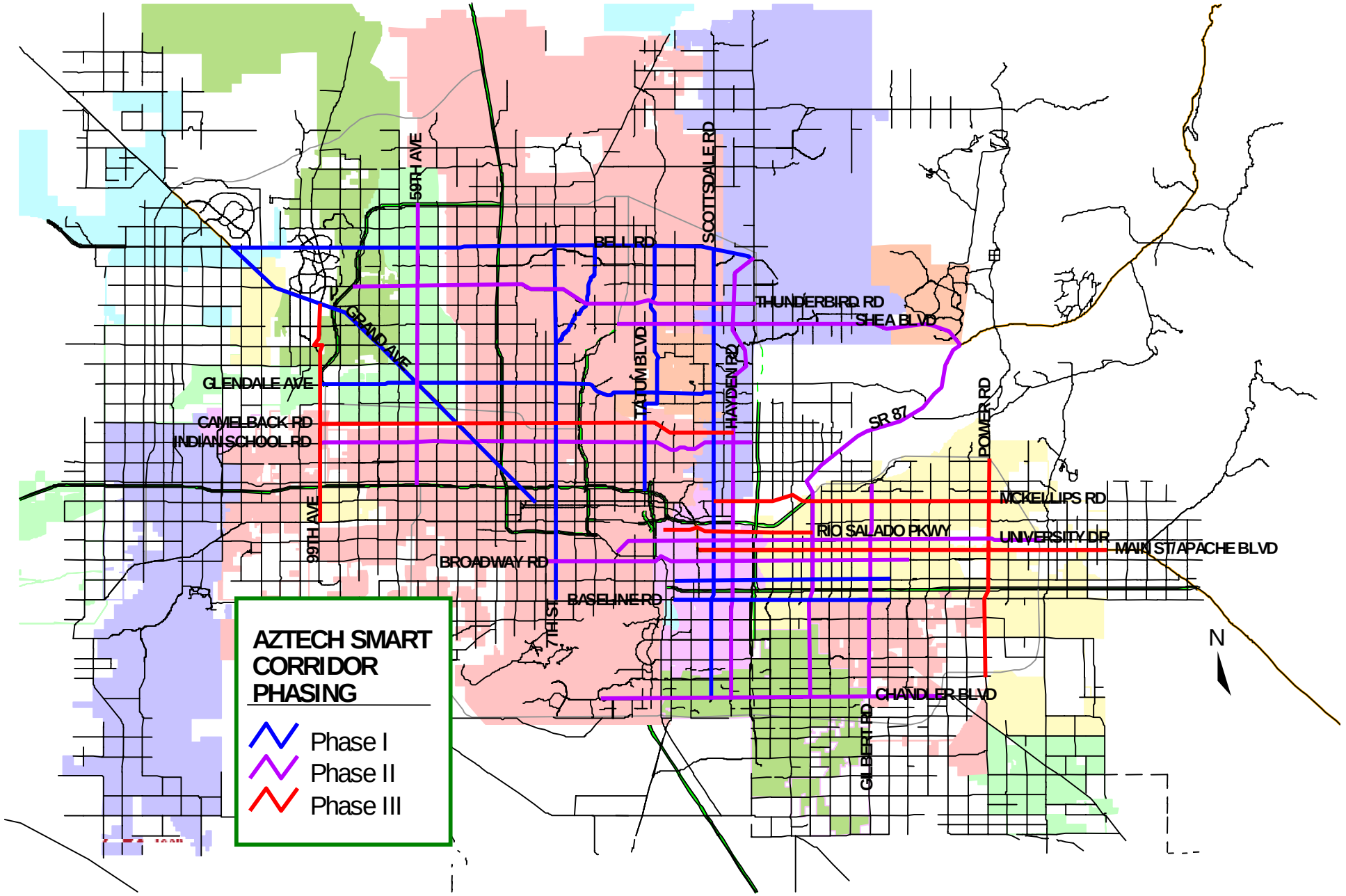


Figure 10.3 – AZTech™ SMART Corridors

Table 10.5 – Recommended New Full Time Employees (FTE) Needed For Management and Operations of 2001-2005 Draft Tip Projects

PROGRAM AREA/PROJECT	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	FTEs (MANAGEMENT AND OPERATIONS)
Freeway Management System			
Freeway Service Patrol (FY 2001)	DPS/MAG	DPS	6
Freeway Service Patrol (FY 2002)	DPS/MAG	DPS	1
Freeway Service Patrol (FY 2003)	DPS/ADOT	DPS	1
Freeway Service Patrol (FY 2004)	DPS/ADOT	DPS	1
Freeway Service Patrol (FY 2005)	DPS/ADOT	DPS	1
Arterial Management Systems			
Chandler Traffic Operations Center Upgrade	Chandler	Chandler	0.1
Chandler Citywide Traffic Control Upgrades	Chandler	Chandler	0.1
Chandler Signal Intertie	Chandler	Chandler	0.1
Chandler CCTV	Chandler	Chandler	0.1
Gilbert ATMS	Gilbert	Gilbert	0.25
Glendale Computerized Signal System (Phase I, II, and III)	Glendale	Glendale	1
Glendale Traffic Management Center	Glendale	Glendale	1.5
MCDOT Traffic/Air Quality Monitoring	MCDOT	MCDOT	0.05
MCDOT Regional Traveler Information System	MCDOT	MCDOT	0.5
MCDOT Regionwide Traffic Signal Equipment Upgrades	MCDOT	MCDOT	0.25
AZTech CCTV Program (Phase II)	MCDOT	Local Cities	0.1
AZTech SMART Corridor Program (Phase II)	MCDOT	Local Cities	1
AZTech VMS	MCDOT	Local Cities	0.25
MCDOT Bell Road	MCDOT	MCDOT	0.5
Mesa Traffic Operations Center Projects (2001)	Mesa	Mesa	0.25
Mesa Traffic Control Signal System	Mesa	Mesa	0.1
Mesa Communications/ITS Infrastructure	Mesa	Mesa	0.25
Mesa SMART Corridor	MCDOT/Mesa	Mesa	0.25
Mesa Traffic Control System (2003)	Mesa	Mesa	0.25
Mesa Real-Time Adaptive Signal System	Mesa	Mesa	0.1
Peoria Citywide Traffic Signal Interconnect System	Peoria	Peoria	1
Scottsdale Fiber Optic and CCTV	Scottsdale	Scottsdale	0.25
Scottsdale SMART Corridor Traffic Control System	Scottsdale	Scottsdale	0.25
Tempe Traffic Signal Controller Cabinet Upgrade (2002-03)	Tempe	Tempe	0.1
Tempe Traffic Signals	Tempe	Tempe	0.25
Incident/Emergency/Event Management Systems			
MCDOT Parking and Traffic Management System	MCDOT	MCDOT	0.5
Phoenix Downtown Traffic Management System (Phase I and II)	Phoenix	Phoenix	6
Planning and Outreach Support			
Chandler ITS Planning Study	Chandler	Chandler	0.1
Telecommunications Infrastructure			
Chandler Fiber Optic Line	Chandler	Chandler	0.25
TOTAL FTEs			**25.7**

Table 10.6 – Recommended New Full Time Employees (FTE) Needed for Management and Operations of Short-Term Implementation Projects

PROGRAM AREA/PROJECT	IMPLEMENTING AGENCY	MANAGING AND OPERATING AGENCY	FTEs (MANAGEMENT AND OPERATIONS)
Traveler Information Systems			
Integration of a Regional ATIS/ATMS System	ADOT/MCDOT	ADOT/MCDOT	0.5
AZTech Work Stations	AZTech/MCDOT	Local Agencies	1
Traveler Information Systems Upgrade	ADOT/Local Agencies/Private Sector	ADOT/Local Agencies/Private Sector	0.25
Arterial Speed Maps	MAG/Local Agencies	Local Agencies	0.5
Freeway Management System			
FMS Phase 8 (11miles)	ADOT	ADOT	1.5
FMS Phase 3B (9 miles)	ADOT	ADOT	1.25
FMS Phase 6B (15 miles)	ADOT	ADOT	2.25
FMS Phase 9A (5.5 miles)	ADOT	ADOT	1
FMS Phase 12B (13.5 miles)	ADOT	ADOT	2
Freeway Service Patrol/ATMS Link	ADOT/DPS	ADOT/DPS	0.25
ADOT TOC Upgrades	ADOT	ADOT	0.1
Arterial Management Systems			
SMART Corridor Freeway Alternate Routes Expansion/Addition	AZTech/MCDOT	Local Agencies	1.5
Roadway Condition Reporting System	AZTech/MCDOT	Local Agencies	0.5
Traffic Management Center	Gilbert	Gilbert	1
Signal Timing Improvements to Interjurisdictional Signals and SMART Corridors	MAG/Local Agencies	Local Agencies	0.1
Railroad Crossing Pilot Program	Local Agencies	Local Agencies	0.25
Transit Management System			
Scheduling System	Valley Metro/Local Agencies	Valley Metro/Local Agencies	1
Trip Planning System	Valley Metro/Local Agencies	Valley Metro/Local Agencies	1
Regional Validating Farebox	Valley Metro/Local Agencies	Valley Metro/Local Agencies	1
Vehicle Management System	Valley Metro/Local Agencies	Valley Metro/Local Agencies	2
Bus Rapid Transit and Light Rail Signal Priority	Valley Metro/Local Agencies	Valley Metro/Local Agencies	1
Audio/Visual Announcements	Valley Metro/Local Agencies	Valley Metro/Local Agencies	0.5
Passenger Counting	Valley Metro/Local Agencies	Valley Metro/Local Agencies	0.5
Real Time Transit Arrival Time	Valley Metro/Local Agencies	Valley Metro/Local Agencies	1
Transit Routing Based on Incident Information	Valley Metro/Local Agencies	Valley Metro/Local Agencies	0.25
Incident/Emergency/Event Management Systems			
Regional Incident Management Plans	MAG	ADOT/Local Agencies	0.5
Regional Incident Management Coalition	MAG	MAG	0.1
Integrate Traffic/Dispatch System	ADOT/Phoenix Fire	ADOT/Phoenix Fire	1
Phoenix International Raceway Special Event Traffic Management System	MCDOT	MCDOT	0.25
Commercial Vehicle Operations			
CANAMEX Corridor Study	ADOT/MAG	ADOT	0.1
Planning and Outreach Support			
Local ITS Deployment Plans	Local Agencies	Local Agencies	0.25
Regional Concept of Operations	MAG	ADOT/Local Agencies	0.25
ITS Training	MAG	MAG	1
ITS Outreach	MAG/ITS Arizona	MAG/ITS Arizona	0.1
ITS Project Evaluation	MAG	MAG	0.5
ITS Pedestrian/Bicycle Projects	MAG/Local Agencies	Local Agencies	0.1
Telecommunications Infrastructure			
Combined Communication System Projects	Various Agencies	Various Agencies	2
TOTAL FTEs			**28.35**

Perhaps the most important function of **Tables 10.5** and **10.6** is that they clearly show that additional staff is needed to manage and operate new ITS projects in the MAG region. While the exact number of FTEs may be debated, what is most important is that agencies realize that the new ITS systems implemented in the MAG region will require additional staff to be effective and to realize the benefits that can be achieved.

10.4 Project Prioritization

The MAG ITS Committee has developed an ITS Project Rating System designed to help the Committee prioritize ITS projects submitted by member agencies for inclusion in the annual update of the TIP. The system provides a systematic and objective comparison of projects, taking into account key factors considered important by the Committee. The ITS Project Rating System has been revised several times since it was first launched in 1998, and the description below represents the version of the system that was adopted by the MAG ITS Committee on June 21, 2000.

The rating system has been developed for both transit and non-transit ITS projects. A number of factors are considered in the rating system to ensure that projects that foster regional integration, consistency with the architecture, and yield a high cost-benefit ratio are considered in the project prioritization process. Projects are scored on the following factors:

Deployment Priority – Non-transit projects receive points for location of the project within a priority area as defined by the city or town and location of the project on an ITS priority corridor. Non-transit projects may be penalized if the project is an upgrade or improvement to a system launched with federal funds, and bonus points may be awarded for systems that address special events. For transit projects, points are awarded if the project is recommended in RPTA's Vehicle Management System Master Plan.

Congestion/Utilization – Non-transit projects receive points for high levels of congestion based on vehicle miles traveled per lane mile. Transit projects receive points based on prevailing load capacity.

Cost Benefit – Non-transit projects receive points based on the vehicle miles traveled served by the project per dollar of project cost. Transit projects receive points based on the amount of total passenger miles traveled served per dollar of project cost.

Jurisdiction Match – Both non-transit and transit projects receive points based on the amount of cost sharing proposed by local jurisdictions.

The rating system will continually evolve as the MAG ITS Committee seeks to develop a system that will evaluate projects and allocate MAG funding in an equitable fashion that benefits both the region and local areas. Regardless of the methodology used to rate projects, the ITS Project Rating System purpose will continue to be to accomplish the following objectives:

- Provides the ability to rate projects submitted by all member agencies on an objective basis;
- Encourages integrated rather than fragmented systems;
- Encourages regional cooperation;
- Encourages projects that extend seamlessly across boundaries;
- Encourages projects that are likely to yield higher cost-benefits ratio; and
- Encourages higher matching funds by cities and stretches the federal funds for more projects.

In order to encourage the implementation of the regionally significant projects recommended in the ITS Implementation Plan, it is recommended that the MAG ITS Committee adjust the ITS Project Rating System so that projects included in the ITS Implementation Plan may receive additional points.

11. ITS STRATEGIC PLAN UPDATE RECOMMENDATIONS

The MAG ITS Strategic Plan covers a variety of topics that are critical to the successful implementation of ITS in the MAG region. Based on these topics, a series of final recommendations have been developed to guide MAG in the implementation of ITS. These recommendations are described below.

11.1 Regional ITS Architecture

- USDOT-adopted ITS standards should be used where available and applicable.
- The MAG ITS architecture vision outlined in the Strategic Plan should serve as a roadmap for future project deployments and phasing. It will be important for agencies to consider this regional architecture when they are programming future projects in their jurisdictions. While the architecture is regional in nature, it will be important for individual deployments to comply with the regional vision for integration and interconnectivity.
- MAG should consider ITS as a planning element in all future transportation planning activities.
- A new regional ITS institutional framework has been adopted in the MAG region that focuses on the planning and operations of ITS. Close coordination between the planning and operations groups is recommended to ensure that projects that are planned meet operational needs and that the resources are available to operate and maintain planned projects.

11.2 ITS Telecommunications Plan

- Agencies should eliminate leased line service where possible and a regional fiber optic Wide Area Network should be installed to support center-to-center communications and data sharing among agencies.
- The ITS Telecommunications Plan has identified cities and agencies to connect to the regional WAN. It is anticipated that other cities and agencies that are growing will need to be considered for connection to the regional WAN as they add new ITS infrastructure and staff.
- The ADOT TOC should continue to serve as the regional hub for the fiber network. A significant amount of existing spare fiber needs to be identified and reserved for agencies and departments in the MAG region to create the regional WAN. It is recommended that ADOT perform an evaluation of its existing fiber optic infrastructure to identify where and how much spare capacity is available. It is then recommended that ADOT develop a plan for interconnecting these spare fiber segments for each of the WAN links identified within this ITS Telecommunications Plan.
- Agencies should coordinate with local utilities to explore infrastructure-sharing possibilities. Where possible, installation of empty conduit in existing trenching operations should be considered to accommodate future fiber optic needs.

11.3 Regional ITS Training and Capacity Building

- It is recommended that MAG serve as the regional TCB champion, and that a subcommittee or working group of the MAG ITS Committee provide ongoing coordination, guidance, and review of the regional TCB strategies. This regional champion will have responsibility for

coordinating with LTAP and FHWA to bring the identified courses to local professionals, developing a training schedule, and promoting the training to MAG region agencies.

- This champion also should identify opportunities to partner with national professional associations (such as ITS America and ITE) and Arizona Universities to schedule specialized symposiums, workshops, and courses.
- It is recommended that a centralized library be developed to include relevant publications, copies of course material, and other resources for use by MAG partner agencies. Along the same lines as a centralized library is a regional TCB Web page, with links to ITS TCB Web sites, on-line training materials, an overview of MAG's regional TCB program, and contact information. This Web site will be a valuable resource for local ITS staff and professionals.
- Funding issues and requirements of the TCB need to consider federal sponsorship of courses, as well as the potential for alternative course delivery methods that might be more cost-effective, such as on-line training.

11.4 ITS Operational and Implementation Strategies

- Member jurisdictions should make all efforts to maintain consistency and compatibility with the MAG ITS Strategic Plan. This includes ensuring that all ITS elements presented in the plan are properly incorporated into all applicable state, regional, and local transportation plans.
- Opportunities to develop and expand the shared operations of ITS across multiple jurisdictions, including joint location of traffic operations with emergency services dispatch, should be investigated and encouraged. These shared operations have the potential to greatly enhance operational capabilities and improve agency efficiency.
- It is recommended that MAG define the regional ITS goals for operations by developing a regional concept of operations.
- Jurisdictions should investigate developing joint maintenance agreements to improve the maintenance of ITS equipment and reduce agency costs. The MAG ITS Committee should encourage and facilitate the development of these agreements.
- The MAG ITS Committee should encourage the AZTech™ Traffic Operations Working Group to assume a broader operational responsibilities, and integrate with additional jurisdictions and types of systems. This committee would increasingly serve as a forum for improving planning and coordination of regional M&O activities to promote the more efficient use of M&O resources and improved reliability of the ITS deployments.
- Operating procedures, particularly those for multi-jurisdictional ITS deployments, should be formalized and documented. This will promote the clear understanding of the procedures and ensure they are properly maintained over time.
- The process of developing M&O plans should be enhanced to ensure that the final plans adequately provide sufficient detail to guide the long-term M&O activities. The impact of any deployment on M&O activities should be carefully weighed when designing any ITS implementation or modification to existing ITS. Individual jurisdictions should be encouraged to develop their own internal M&O plans prior to entering into multi-jurisdictional agreements to implement and operate ITS improvements. The MAG ITS Committee should encourage member agencies to enhance their own M&O plans for individual ITS deployments.
- The budgeting procedures used to plan for operational expenditures should be enhanced to minimize the chance of future funding shortfalls. These budgeting procedures should

consider the full costs of ITS M&O, and also anticipate the impact on M&O expenditures of incremental expansion of the ITS infrastructure.

- MAG and its member agencies should continue to pursue available federal funding for ITS projects as well as continue to explore opportunities for public/private partnerships to deploy ITS in the MAG region.

11.5 ITS Evaluation Plan

- An ITS evaluation framework, based on evaluation guidelines developed by the USDOT is designed to be flexible to allow the modification of each evaluation based on the deployment being evaluated, the evaluation resources available, and the goals of the project participants. It is recommended that this framework be used for conducting evaluations of ITS projects in the MAG region.
- It is recommended that MAG create a pool of funds for ITS evaluations. Similar to the FHWA evaluation model, the pooled evaluation funds will be used to evaluate a subset of the ITS projects funded in the MAG region. Surface Transportation Funds are one possible source of funding that could be used for the evaluation pool; local matching funds also should be considered, depending on the type of project being evaluated.
- It is recommended that MAG facilitate the use of evaluation results by serving as a clearinghouse for locally relevant evaluation results, encouraging the use of ITS evaluation results as a reference source early in the planning process, and identifying ITS knowledge gaps and opportunities to collect locally relevant evaluation data.
- Universities should be involved as key partners in local and regional ITS evaluation programs. Coordination with other evaluation programs (such as PAG or ADOT's research program) is encouraged.

11.6 ITS Implementation Plan

- Regionally significant ITS projects implemented in the MAG region should address the stakeholder needs of the region. Locally significant ITS projects should address local needs and support regional objectives.
- All ITS projects implemented in the MAG region should be consistent with the regional architecture that has been adopted by the MAG ITS Committee.
- The MAG ITS Committee should continue to prioritize ITS projects for both regional and local needs. Projects that have been recommended in the ITS Implementation Plan are intended to meet regional stakeholder needs. The MAG ITS Committee should consider incorporating as many of these projects as possible into the existing TIP to better address the regional needs of stakeholders in the MAG region.
- An agency submitting an ITS project for inclusion in the TIP should address the staffing requirements and the M&O required for the project. The MAG ITS Committee should consider M&O of an ITS project as part of project prioritization.
- The MAG ITS Committee should modify the ITS Project Rating System so that projects included in the ITS Implementation Plan may receive additional points to encourage their implementation; and
- The MAG ITS Committee should request additional funding from the MAG Regional Council to assist in implementing the projects in the ITS Implementation Plan.