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16. Abstract

The Houston ITS Priority Corridor is one of four corridors selected by the U.S. Department of Transportation to showcase intelligent transportation systems (ITS) applications. The Texas Transportation Institute assisted the coalition of four local governments, comprised of the Texas Department of Transportation (TxDOT), Metropolitan Transit Authority of Harris County (METRO), Harris County, and City of Houston, along with the Houston-Galveston Area Council (local Metropolitan Organization), in developing the Houston ITS Priority Corridor Program Plan (Report 2931-2, August 1995). The plan was updated in 1996 (Report 2931-3).

This report documents the 2000 update and reflects the Federal Highway Administration funding commitments through FY 99. The plan contains 26 projects, all with work orders defining agency responsibilities, project scope, and budget approved by TxDOT and FHWA. Funding for implementation of the plan is considered complete, as federal funding for the Priority Corridor Program has ended. Total estimated cost for the Priority Corridor Program is $26,293,378.

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HOUSTON ITS PRIORITY CORRIDOR PROGRAM PLAN-2000 UPDATE

by

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Report 2931-4
Project Number 7-2931
Research Project Title: Development of ITS Priority Corridor Program Plan

Sponsored by the
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Development of the plan represents a collaborative effort by the Houston ITS Priority Corridor Technical Committee, with assistance from TTI. Appreciation is extended to the multi-agency committee; to Mr. John Gaynor, who serves as TxDOT's research project director for the Priority Corridor Program Plan; and to Ms. Rita Brohman and Mr. David Fink, who served as program managers.

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1.0 INTRODUCTION

In 1993, the U.S. Department of Transportation (USDOT) selected Houston as one of four intelligent transportation systems (ITS) Priority Corridors. These corridors are to showcase ITS concepts and technologies through implementation and evaluation of ITS demonstration projects that will improve transportation system operations.

HOUSTON PRIORITY CORRIDOR

The Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT) officially created the Houston Priority Corridor in an ITS Partnership Agreement dated September 8, 1993. The agreement established initial funding ($3,105,000 from FHWA and $776,250 from TxDOT), defined a "work order" process for individual project authorization and established other contractual requirements. TxDOT and FHWA have amended the agreement four times to supplement initial FHWA funding. Amendment 1 increased FHWA funding by $2.00 million, Amendment 2 added $2.25 million, Amendment 3 added $6.207 million, Amendment 4 added $3.44 million and Amendment 5 added $1.5 million. The ITS Partnership Agreement and Amendments are provided in Appendix A.

The Houston Corridor is unique among the other national corridors. Similarly, the Houston ITS Priority Corridor Program Plan is unique with demonstration projects, which build on previous and in-process ITS infrastructure development by local agencies. Houston has a longstanding commitment to development of advanced traffic management, incident management, traveler information, electronic toll collection, and public transportation systems. TxDOT developed an operational freeway surveillance and control system in Houston in the mid 1960s. Later research, development, and design by TxDOT and Metropolitan Transit Authority of Harris County (METRO) culminated in the Computerized Transportation Management System (CTMS), which is now near completion on Houston's freeway and high occupancy vehicle (HOV) lane system. In addition, Houston TranStar provides active transportation systems management by transportation operations and public safety staff of TxDOT, METRO, Harris County, and the City of Houston.

THE ITS PROGRAM

Intelligent transportation systems are a family of concepts, technologies, and applications aimed at increasing transportation system performance, efficiency, and safety. ITS applies advanced and emerging technologies to address the following goals, adopted for the ITS program *(1)*:

- Improve the safety of the nation's surface transportation system.
- Increase the operational efficiency and capacity of the surface transportation system.
- Reduce energy and environmental costs associated with traffic congestion.
- Enhance present and future productivity.
- Enhance the personal mobility and the convenience and comfort of the surface transportation system.
- Create an environment in which the development and deployment of ITS can flourish.

USDOT has guided the development and implementation of the ITS program since its inception. Widescale ITS deployment is emphasized with a national goal established by the Secretary of Transportation to reduce travel time by 15 percent in the 75 largest U.S. metropolitan areas in the next 10 years. USDOT's efforts emphasize two program areas to achieve this goal: 1) deployment of the intelligent transportation infrastructure (ITI), and 2) systems integration consistent with the ITS National Architecture.

Intelligent Transportation Infrastructure

FHWA considers implementation of ITI to be a necessary ingredient in deploying urban area traffic management and traveler information services. ITI establishes a foundation upon which ITS deployment by both the public and private sectors can proceed. Development of ITI is a near-term (and evolutionary) deployment activity led by the public sector. FHWA in its Operation TimeSaver *(2)* program has defined ITI as having nine features:

- Regional Multimodal Traveler Information Center,
- Traffic Signal Control System(s),

- Freeway Management System(s),
- Transit Management System(s),
- Incident Management Program,
- Electronic Fare Payment System(s),
- Electronic Toll Collection System(s),
- Railroad Grade Crossing Controls, and
- Emergency Management Services.

Development of ITI directly addresses the six ITS goals established in the National Program Plan for ITS. In addition, deployment of ITI in a "building block" approach provides a rational basis for continued progressive future ITS deployment.

The Houston area has made significant progress in deployment of an ITS infrastructure. A large portion of an extensive CTMS (freeway management systems) is in place, including Houston TranStar. In addition, Houston TranStar agencies are implementing other ITS infrastructure, including a regional computerized traffic signal system, automatic vehicle identification systems on area freeways to monitor traffic operations, and "smart" buses for METRO's transit system. Currently, the Houston Priority Corridor Program has identified 26 short range projects, which are in various stages of planning, deployment operation, and evaluation.

ITS National Architecture

USDOT adopted the National ITS Architecture in 1996 to provide a technical and institutional framework for development, implementation, and operation of ITS. The National Architecture *(3)* essentially translates the concepts of the National Program Plan for ITS and later refinements by USDOT (e.g., user services, user service bundles, ITI, market packages) into a cohesive definition of how these elements are interrelated. The National Architecture defines ITS functions, subsystems, locations, interfaces, information flows, and relationships among these architecture elements. Adherence to the National Architecture provides a common framework, which will permit integration of individual agency systems into areawide systems, facilitating the sharing of information across jurisdictional lines.

The National Architecture defines interactions among three layers of infrastructure: 1) transportation (physical) subsystems, such as traffic management centers, vehicles, travelers, and roadside equipment; 2) communication layer, which connects the transportation subsystems and includes types of information and communication, how data are to be shared, and standards needed for communication; and 3) institutional layer, which involves public and private sector ITS participants in developing policy, financing, partnerships, and roles in ITS deployments.

CONFORMITY WITH NATIONAL ITS ARCHITECTURE AND STANDARDS

Additional federal transportation legislation (Transportation Equity Act for the 21st Century [TEA-21]) has been enacted since completion of the 1996 update of the Houston ITS Priority Corridor Program Plan. TEA-21 requires that ITS projects using funds from the Highway Trust Fund conform to the National ITS Architecture and adopted standards. Thus, Houston ITS Priority Corridor projects that utilize funding provided by TEA-21 must be consistent with the National ITS Architecture.

USDOT issued "Interim Guidance" on conformity with the National Architecture on October 2, 1998. This guidance was expected to be in effect for approximately one year, when a final policy on conformity was anticipated. TEA-21 "aims to accelerate the integrated deployment of ITS in metropolitan areas . . . . . through the use of the National ITS Architecture or locally developed regional architectures. The legislation also aims to facilitate interoperability through the use of standards and protocols."

A Notice of Proposed Rule Making (NPRM) was issued May 25, 2000, for *Intelligent Transportation System Architecture and Standards* details a proposed rule that will replace the Interim Guidance. The NPRM summarizes the rule as follows *(4)*:

> Because it is unlikely that the entire National ITS Architecture would be fully implemented by any single metropolitan area or State, the FHWA proposes in this NPRM that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as an "ITS regional architecture." Therefore, conformance with the National ITS Architecture is defined under this proposal as development of an ITS regional architecture based on the National ITS Architecture, and the subsequent adherence of ITS projects to the ITS regional architecture. The ITS regional architecture would consist of a concept of operations and a conceptual design, which would draw from the National ITS Architecture, but would be tailored to address the local situation and ITS investment needs.

USDOT issued concurrent NPRM regarding *Statewide Transportation Planning, Metropolitan Transportation Planning (5)*, which provides for development of an ITS Integration Strategy and inclusion of operation and management of ITS in the transportation planning process. The Houston-Galveston Area Council regional planning process includes priority corridor projects listed in the regional Transportation Improvement Program (TIP).

HOUSTON PRIORITY CORRIDOR PROGRAM PLAN

One of the FHWA requirements for the ITS Priority Corridor program is that a Priority Corridor Program Plan be developed. Each of the four U.S. priority corridors developed a vision of ITS applications and a program plan that identified projects, schedules, priorities, and estimated funding requirements. The Houston ITS Priority Corridor Program Plan was initially developed in 1995 *(6, 7)* and was updated the following year *(8)*. Several guiding principles were considered in developing the plan:

1. projects based on consumer market needs,
2. employment of the "building block" approach to deployment,

3. cooperative public and private sector efforts, and
4. technical and institutional flexibility in project deployment.

The plan delineated an Immediate Action Program of 14 projects with an original Short Range Plan (1996-2000) of 28 projects and an Intermediate Range Program of nine projects. The 1996 plan update increased the number of short range projects to 31 with an additional 21 projects identified for the Immediate Range Program (2001-2005). This report provides revisions and updates to the plan that have occurred since the 1996 update.

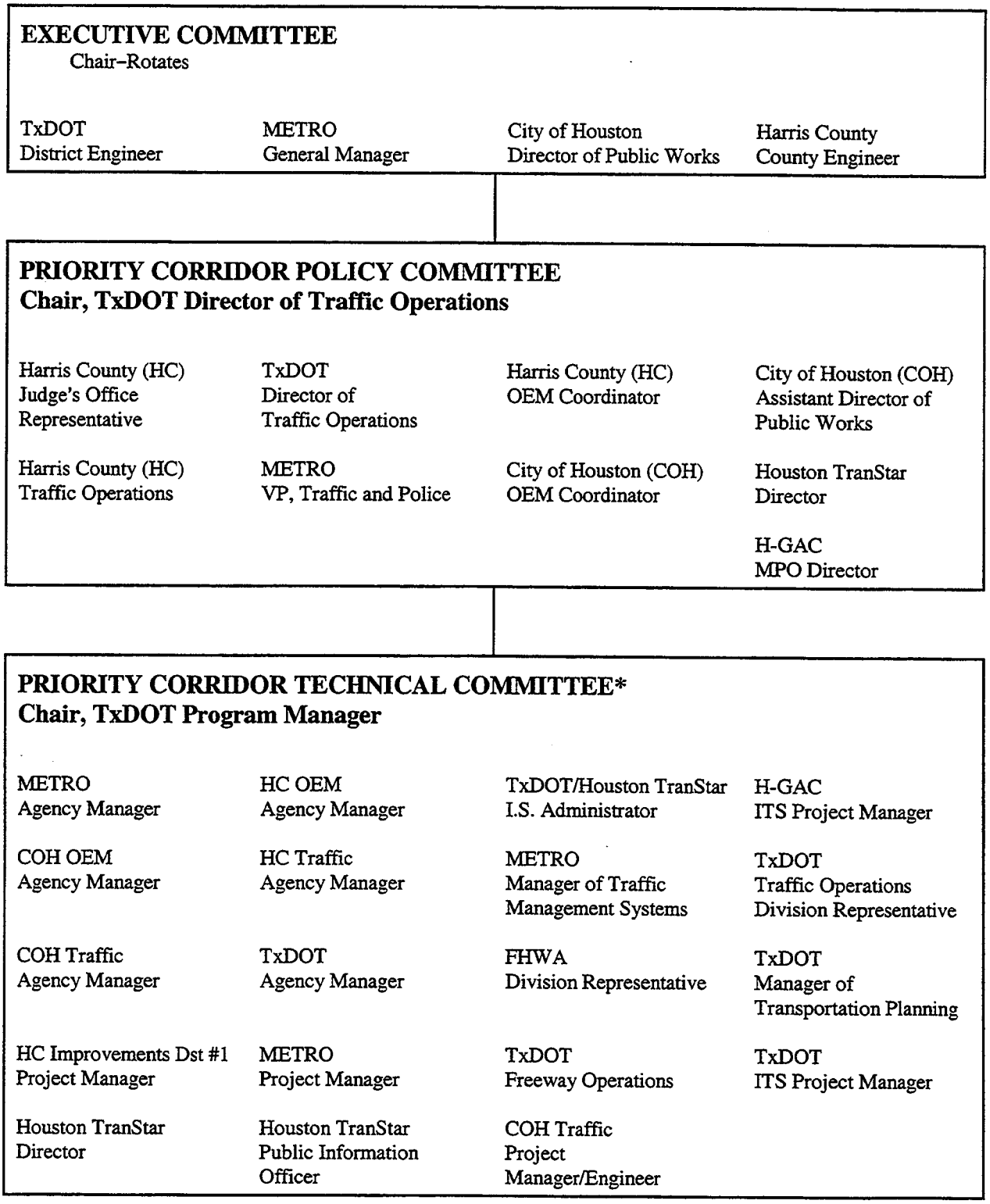
PRIORITY CORRIDOR ORGANIZATION

The agreement between FHWA and TxDOT establishes the framework for program development and administration. The agreement recognizes the importance of involvement of other local implementing agencies in management of the Priority Corridor. TxDOT, Harris County (HC), City of Houston (COH), and METRO entered into a Memorandum of Understanding to manage and implement the Houston ITS Priority Corridor Program.

Figure 1 illustrates the organizational structure for the Houston ITS Priority Corridor. Top management members of the four coalition agencies comprise the Executive Committee. This committee, which also directs Houston TranStar, must approve each agency's funding and participation in the Priority Corridor Program.

Management staff of involved operating divisions of the four agencies comprise the Policy Committee. This committee provides policy and management direction for the program and assigns staff to assist the Program Manager administering the program. The Technical Committee is responsible for the budget, staffing, reporting and technical direction of the corridor program development and implementation of individual projects. This committee developed the Priority Corridor Program Plan and the individual deployment projects and resolved any difficulties and changes in work orders and agreements at the lowest level. The committee, chaired by the TxDOT Program Manager, contains key staff of all implementing agencies, as well as representatives of FHWA and the Houston-Galveston Area Council (H-GAC). H-GAC is the Metropolitan Planning

Organization (MPO) for the eight-county area that includes Houston and Harris County. H-GAC involvement in the planning and deployment of ITS projects is essential to the success of the program, as the program is integrated into the areawide transportation planning process. Members of the Houston TranStar Executive Committee are also members of the Transportation Policy Committee of H-GAC, providing further coordination of the Priority Corridor Program with areawide planning activities.



*Functional titles used for Technical Committee positions.

Figure 1. Organization of Houston ITS Priority Corridor Coalition

2.0 DEVELOPMENT OF THE PLAN UPDATE

USDOT requires the four ITS Priority Corridors to develop and maintain a plan that identifies projects, priorities, schedules, costs, and responsibilities. The Houston ITS Priority Corridor Plan was developed within the multi-agency structure of the four local transportation agencies that formed Houston TranStar (The Greater Houston Transportation and Emergency Management Center). The plan is considered a "living document" to be periodically updated.

BASIS FOR THE PLAN

The approach to development of the plan was to build on the substantial existing ITS infrastructure in the Houston area. ITS development in the Houston area began a number of years ago and actually predated ISTEA and the USDOT program for ITS and the ITS Priority Corridor Program. The Priority Corridor Program has overlaid an ongoing ITS development program in the Houston area, including a multi-agency institutional structure. Because of the extensive existing and planned deployment of ITI by corridor coalition agencies, the Priority Corridor Program Plan builds upon and supplements this ITI. The Houston area ITS foundation, upon which Priority Corridor projects build, includes:

- Computerized Transportation Management System (freeway, HOV, communications),
- Motorist Assistance Program,
- Automatic Vehicle Identification (AVI) System,
- METRO Smart Bus,
- Regional Computerized Traffic Signal System, and
- Houston TranStar.

The vision for the Houston ITS Priority Corridor is to continue to build upon the institutional and ITS deployment foundation, expanding ITS on an incremental basis as successful priority corridor operational tests are deployed on a larger scale. This vision entails:

1. building on previous ITS deployment,

2. deploying ITS through the established multi-agency Houston TranStar/Priority Corridor/Coalition,
3. focusing on deployment of multi-modal transportation management and traveler information systems, and
4. find "champion" agency to continue to fund successful projects past the federal funding period, sometimes this is shared by partners.

CORRIDOR PROGRAM PLAN UPDATE PROCESS

The Technical Committee oriented initial planning activities to development of an Immediate Action Program, which identified key projects to proceed concurrently with completion of the entire Priority Corridor Program Plan. The Immediate Action Plan included 14 projects. The completed plan included a Short Range Program of 28 projects (including immediate action projects) and an Intermediate Range Program of nine projects.

The Corridor Program Plan calls for a periodic review and update. These updates reflect the status of project deployments, latest funding commitments, and a review and update of the plan based on current needs and resources. The plan updates also include development or revision of scope, schedule, and estimated cost of new or revised projects. A 1996 update of the plan expanded the Short Range Program to 31 projects and the Intermediate Range Program to 21 projects.

This report documents the 2000 update of the program plan and reflects FHWA funding commitments through FY 99. The Houston ITS Priority Corridor Program Manager conducted this update, with the assistance of the Texas Transportation Institute (TTI). The Technical Committee conducted frequent working meetings to review changes, and approved the updated plan. This process considered:

- status of current project deployments and project interrelationships;
- review and update of agency needs, resources, and priorities; and
- updated funding commitments (FHWA and local funding).

The product of these efforts is an updated Priority Corridor Program Plan that reflects current conditions, needs, priorities, and agency programs. Table 1 highlights the updated plan, which lists projects by ITI category. The lead agency and estimated cost are also listed for each project. Total estimated cost to implement the program is $26,293,378.

PLAN CHANGES SINCE 1996 UPDATE

In developing the initial plan and the 1996 update, an aggressive program was envisioned, including development of both short and intermediate range programs. The 1996 update contained 31 short range projects with an estimated cost of $25.5 million, while the 21 intermediate range projects were estimated at $35 million (which exceeded the federal funding). Federal legislation relating to ITS programs and funding has resulted in a more focused update for the Year 2000.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) created the Priority Corridor Program, but was not continued as a separate ITS program in the current legislation–TEA-21. Thus, ISTEA funding for Priority Corridor ended with the FY 97 allocations. However, TEA-21 provides funding for urban ITS deployment, and the Houston area's earmarked ITS deployment funding for FY 98 and FY 99 was allocated to the Priority Corridor Program. It is anticipated that no further federal funds will be committed to the Houston ITS Priority Corridor Program. Thus, the plan update includes only the 26 projects for which work orders and funding have been approved. Appendix B provides descriptions of the 26 projects.

The plan update for Year 2000 distributed actual FY 97, FY 98, and FY 99 funding among the existing 26 projects. In addition to eliminating five projects from the 1996 update, several changes were made to individual projects and their funding after making these allocations of FY 97, FY 98, and FY 99 funds. This included the elimination of two additional projects from the program (Work Orders 10 & 23), reducing the program to 24 projects. Table 2 summarizes Priority Corridor project funding by federal fiscal year.

Table 1. Program of Projects Grouped by Intelligent Transportation Infrastructure Category

Category/Project	Lead Agency	Estimated Cost
0. Administrative/Planning		
0-1 Development of ITS Priority Corridor Program Plan (Work Order 2)	TxDOT	$ 600,000
0-2 Public Information/Program Administration (Work Order 5)	METRO	200,000
0-3 Program Administration/Public Information/Project Development (Work Order 18)	TxDOT/METRO	790,000
0-4 ITS Technology for Data Collection and Transportation Planning (Work Order 16)	H-GAC	300,000
0-5 Integration of Priority Corridor Projects into Houston TranStar (Work Order 26)	TxDOT	1,365,000
1. Regional Multimodal Traveler Information Center		
1-1 Real-Time Information Kiosks (Work Order 7)	TxDOT	84,943[1]
1-2 On-Vehicle Navigation/Information Applications (Work Order 10)	TxDOT	0[2]
1-3 Monitoring and Information Systems for Environmental Conditions (Work Order 11)	TxDOT	725,000
1-4 Dissemination of Traveler Information (Work Order 22)	TxDOT	1,508,750
1-5 Condition Responsive Uptown Traveler Information System (Work Order 24)	HCID #1/COH	1,268,890
2. Traffic Signal Control Systems		
2-1 Changeable Lane Assignment System (CLAS) on Frontage Roads (Work Order 4)	TxDOT	750,000
2-2 Changeable Lane Assignment System (CLAS) at Arterial Intersections (Work Order 12)	Harris County	1,050,000
3. Freeway Management Systems		
3-1 Monitoring Traffic and Transit Conditions and Incident Detection with AVI (Phase 4) (Work Order 3)	TxDOT	2,231,250
3-2 Truck Monitoring and Warning Systems for Freeway to Freeway Connections (Work Order 6)	TxDOT	220,000
3-3 Integrated Corridor Transportation Management and Traveler Information System (Work Order 13)	METRO	1,862,500
3-4 Coordinated Ramp Metering and Intersection Traffic Signal Control (Work Order 23)	TxDOT	0[3]

(1) Project 1-1 (Work Order 7) was completed and remaining funds distributed to Project 4-1 (Work Order 19) and 1-5 (Work Order 24).

(2) Project 1-2 (Work Order 10) was eliminated and funds distributed to Project 3-1 (Work Order 3) and Project 5-7 (Work Order 25).

(3) Project 3-4 (Work Order 23) was eliminated and funds distributed to Project 0-3 (Work Order 18) and Project 0-5 (Work Order 26).

Table 1. Program of Projects Grouped by Intelligent Transportation Infrastructure Category (cont.)

Category/Project	Lead Agency	Estimated Cost
4. Transit Management Systems		
4-1 En-Route Transit Information System (Work Order 19)	METRO	1,046,167
5. Incident Management Program		
5-1 CCTV Surveillance System Lease for Astrodome Area (Work Order 1)	TxDOT	480,000
5-2 Automatic Vehicle Locator System for Incident Management (Work Order 9)	TxDOT	100,000
5-3 Washburn Tunnel Traffic Management and Information System (Work Order 14)	Harris County	1,220,000
5-4 Traffic Management and Traveler Information for Critical Roadway Links (Work Order 15)	TxDOT	4,890,878
5-5 ITS Enhanced Incident Management (Work Order 20)	TxDOT/METRO	787,500
5-6 Automatic Traffic Management in Flood Prone Areas through Use of ITS Technologies (Work Order 21)	Harris County	2,000,000
5-7 Automated Incident Management Strategies and Support Systems (Work Order 25)	TxDOT	1,650,000
6. Electronic Fare Payment (no projects)		
7. Electronic Toll Collection		
7-1 Priority Lane Pricing Using AVI (Work Order 17)	METRO	462,500
8. Railroad Grade Crossing Controls		
8-1 Railroad Grade Crossing Monitoring System (Work Order 8)	TxDOT	700,000
9. Emergency Management Services (no projects)		
Estimated Program Cost		**$26,293,378**

(1) Project 1-1 (Work Order 7) was completed and remaining funds distributed to Project 4-1 (Work Order 19) and 1-5 (Work Order 24).

(2) Project 1-2 (Work Order 10) was eliminated and funds distributed to Project 3-1 (Work Order 3) and Project 5-7 (Work Order 25).

(3) Project 3-4 (Work Order 23) was eliminated and funds distributed to Project 0-3 (Work Order 18) and Project 0-5 (Work Order 26).

Table 2. Updated Priority Corridor/ITS Program and Funding Requirements—Houston ITS Priority Corridor

Project	Estimated Cost by FHWA Funding Fiscal Year(1)							
	FY 93	FY 94	FY 95	FY 96	FY 97	TEA-21 FY 98	TEA-21 FY 99	Total Project Cost
5-1 CCTV Surveillance System Lease for Astrodome Area—Work Order 1	$ 480,000							$ 480,000
0-1 Development of ITS Priority Corridor Program Plan—Work Order 2	400,000				$ 200,000			600,000
3-1 Monitoring Traffic and Transit Conditions and Incident Detection with AVI Technology (Phase 4)—Work Order 3	1,831,250	$ 400,000(3)						2,231,250
2-1 Changeable Lane Assignment System (CLAS) on Frontage Roads—Work Order 4	750,000							750,000
0-2 Public Information/Program Administration—Work Order 5	200,000							200,000
3-2 Truck Monitoring and Warning Systems for Freeway to Freeway Connections—Work Order 6	220,000							220,000
1-1 Real-Time Information Kiosks—Work Order 7		84,943(2)						84,943
8-1 Railroad Grade Crossing Monitoring System—Work Order 8		500,000			200,000			700,000
5-2 Automatic Vehicle Locator System for Incident Management—Work Order 9		100,000						100,000
1-2 On-Vehicle Navigation/Information Applications—Work Order 10								0(3)
1-3 Monitoring and Information System for Environmental Conditions—Work Order 11		500,000			225,000			725,000

(1) Priority Corridor is funded under ISTEA for FY 93-FY 97. Funding for FY 98 and FY 99 is under TEA-21. Local match for Priority Corridor projects is 20 percent for FY 93-FY 98 and 50 percent thereafter.
(2) Project 1-1 (Work Order 7) was completed and remaining funds distributed to Projects 4-1 (Work Order 19) and 1-5 (Work Order 24).
(3) Project 1-2 (Work Order 10) was eliminated and funds distributed to Project 3-1 (Work Order 3) and Project 5-7 (Work Order 25).
(4) Project 3-4 (Work Order 23) was eliminated and funds distributed to Project 0-3 (Work Order 18) and Project 0-5 (Work Order 26).

Table 2. Updated Priority Corridor/ITS Program and Funding Requirements—Houston ITS Priority Corridor (continued)

Project	Estimated Cost by FHWA Funding Fiscal Year(1)							
	FY 93	FY 94	FY 95	FY 96	FY 97	TEA-21 FY 98	TEA-21 FY 99	Total Project Cost
2-2 Changeable Lane Assignment System (CLAS) at Selected Arterial Intersections—Work Order 12		$ 250,000			$ 350,000	$ 450,000		$1,050,000
3-3 Integrated Corridor Transportation Management and Traveler Information System—Work Order 13			$1,862,500					1,862,500
5-3 Washburn Tunnel Traffic Management and Information System—Work Order 14			950,000			270,000		1,220,000
5-4 Traffic Management and Traveler Information for Critical Roadway Links—Work Order 15				$1,325,000	400,000		$3,165,878	4,890,878
0-4 ITS Technology for Data Collection and Transportation Planning—Work Order 16				300,000				300,000
7-1 Priority Lane Pricing Using AVI—Work Order 17				462,500				462,500
0-3 Program Administration/Public Information/Project Development—Work Order 18				790,000(4)				790,000
4-1 En-Route Transit Information System—Work Order 19		333,667(2)		712,500				1,046,167
5-5 ITS Enhanced Incident Management—Work Order 20				387,500	400,000			787,500
5-6 Automatic Traffic Management in Flood Prone Areas through Use of ITS Technologies—Work Order 21				1,200,000	200,000	600,000		2,000,000

(1) Priority Corridor is funded under ISTEA for FY 93-FY 97. Funding for FY 98 and FY 99 is under TEA-21. Local match for Priority Corridor projects is 20 percent for FY 93-FY 98 and 50 percent thereafter.
(2) Project 1-1 (Work Order 7) was completed and remaining funds distributed to Projects 4-1 (Work Order 19) and 1-5 (Work Order 24).
(3) Project 1-2 (Work Order 10) was eliminated and funds distributed to Project 3-1 (Work Order 3) and Project 5-7 (Work Order 25).
(4) Project 3-4 (Work Order 23) was eliminated and funds distributed to Project 0-3 (Work Order 18) and Project 0-5 (Work Order 26).

Table 2. Updated Priority Corridor/ITS Program and Funding Requirements—Houston ITS Priority Corridor (continued)

Project	Estimated Cost by FHWA Funding Fiscal Year(1)							
	FY 93	FY 94	FY 95	FY 96	FY 97	TEA-21 FY 98	TEA-21 FY 99	Total Project Cost
1-4 Dissemination of Traveler Information—Work Order 22				$ 483,750	$1,025,000			$1,508,750
3-4 Coordinated Ramp Metering and Intersection Traffic Signal Control—Work Order 23								0(4)
1-5 Condition Response Uptown Traveler Information Systems—Work Order 24		$ 331,390(2)		937,500				1,268,890
5-7 Automated Incident Management Strategies and Support Systems—Work Order 25				750,000	900,000(3)			1,650,000
0-5 Integration of Priority Corridor Projects into Houston TranStar—Work Order 26				410,000(4)	400,000(4)	$ 555,000		1,365,000
Total Cost	$3,881,250	$2,500,000	$2,812,500	$7,758,750	$4,300,000	$1,875,000	$3,165,878	$26,293,378
Estimated USDOT Share Estimated State/Local Share	$3,105,000 $ 776,250	$2,000,000 $ 500,000	$2,250,000 $ 562,500	$6,207,000 $1,551,750	$3,440,000 $ 860,000	$1,500,000 $ 375,000	$1,582,939 $1,582,939	$20,084,939 $ 6,208,439
Program Total Cost	$26,293,378							

(1) Priority Corridor is funded under ISTEA for FY 93-FY 97. Funding for FY 98 and FY 99 is under TEA-21. Local match for Priority Corridor projects is 20 percent for FY 93-FY 98 and 50 percent thereafter.
(2) Project 1-1 (Work Order 7) was completed and remaining funds distributed to Projects 4-1 (Work Order 19) and 1-5 (Work Order 24).
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(4) Project 3-4 (Work Order 23) was eliminated and funds distributed to Project 0-3 (Work Order 18) and Project 0-5 (Work Order 26).

PROGRAM PARTICIPATION BY AGENCIES

Six local agencies are participating in deployment of the Priority Corridor Program. In addition to projects led by the four Houston TranStar partners, the H-GAC and Harris County Improvement District Number 1 are each responsible for one of the projects. USDOT grants account for $20,084,939, with the local agencies responsible for the remaining $6,208,439. Table 3 provides a summary of projects and funding by agency.

CONFORMITY WITH NATIONAL ARCHITECTURE

Houston TranStar's extensive freeway management systems and the Houston ITS Priority Corridor Plan predate the National ITS Architecture. Following completion of the National ITS Architecture and passage of TEA-21, there was a recognized need for development of a regional architecture and mapping a portion of the Priority Corridor projects to the National ITS Architecture. Most members of the Technical Committee attended an FHWA-sponsored training course *Using the National ITS Architecture for Deployment.* Subsequently, the Technical Committee, in a series of working meetings, developed project architecture for 10 Priority Corridor projects, including five projects that utilize funding from the highway trust fund under TEA-21. Appendix C includes the architectural mapping of these projects.

TxDOT and the other Houston TranStar agencies are currently developing the architecture describing Houston TranStar ITS systems. This work (Houston TranStar architecture) and the Priority Corridor project's architecture will provide a starting point for development of the Houston area regional architecture, which will be undertaken by H-GAC.

Table 3. Summary of Program Funding by Agency

Work Order	FHWA	TxDOT	METRO	COH	HC	H-GAC	HCID #1	Total Cost
1 CCTV Surveillance System Lease for Astrodome Area	$ 384,000	$ 96,000						$ 480,000
2 Development of ITS Priority Corridor Program Plan	480,000	120,000						600,000
3 Monitoring Traffic and Transit Conditions and Incident Detection with AVI Technology (Phase 4)	1,785,000	446,250						2,231,250
4 Changeable Lane Assignment System (CLAS) on Frontage Roads	600,000	150,000						750,000
5 Public Information/Program Administration	160,000	40,000						200,000
6 Truck Monitoring and Warning Systems for Freeway to Freeway Connections	176,000	44,000						220,000
7 Real-Time Information Kiosks	67,955	16,988						84,943
8 Railroad Grade Crossing Monitoring System	560,000	140,000						700,000
9 Automatic Vehicle Locator System for Incident Management	80,000	20,000						100,000
11 Monitoring and Information System for Environmental Conditions	580,000	145,000						725,000
12 Changeable Lane Assignment System (CLAS) at Selected Arterial Intersections	840,000	70,000			$ 140,000			1,050,000
13 Integrated Corridor Transportation Management and Traveler Information System	1,490,000		$ 372,500					1,862,500
14 Washburn Tunnel Traffic Management and Information System	976,000				244,000			1,220,000
15 Traffic Management and Traveler Information for Critical Roadway Links								
ISTEA Funding	1,380,000	345,000						1,725,000
TEA-21 Funding	1,582,939	1,582,939[1]						3,165,878

[1]TxDOT may use up to $949,764 of non-ITS FHWA project support as part of local match for TEA-21 funded projects.

Table 3. Summary of Program Funding by Agency (continued)

Work Order	FHWA	TxDOT	METRO	COH	HC	H-GAC	HCID #1	Total Cost
16 ITS Technology for Data Collection and Transportation Planning	$ 240,000					$60,000		$ 300,000
17 Priority Lane Pricing Using AVI	370,000		$ 92,500					462,500
18 Program Administration/Public Information/Project Development	632,000	$ 78,000	80,000					790,000
19 En-Route Transit Information System	836,933		209,234					1,046,167
20 ITS Enhanced Incident Management	630,000	78,750	78,750					787,500
21 Automatic Traffic Management in Flood Prone Areas through Use of ITS Technologies	1,600,00	140,000	50,000		$210,000			2,000,000
22 Dissemination of Traveler Information	1,207,000	90,525	90,525	$90,525	30,175			1,508,750
24 Condition Response Uptown Traveler Information Systems	1,015,112						$253,778	1,268,890
25 Automated Incident Management Strategies and Support Systems	1,320,000	99,000	99,000	99,000	33,000			1,650,000
26 Integration of Priority Corridor Projects into Houston TranStar	1,092,000	273,000						1,365,000
TOTAL	$20,084,939	$3,975,452[1]	$1,072,509	$189,525	$657,175	$60,000	$253,778	$26,293,378

[1]TxDOT may use up to $949,764 of non-ITS FHWA project support as part of local match for TEA-21 funded projects.

CURRENT STATUS OF PROGRAM

Individual projects are in varying levels of planning, deployment, and evaluation, with over half of the Immediate Action Program projects having been completed. The following projects have been completed, and evaluation reports (where applicable) have been produced:

- Work Order 1–CCTV Surveillance System Lease for Astrodome Area,
- Work Order 2–Development of Priority Corridor Program Plan,
- Work Order 4–Changeable Lane Assignment System on Frontage Roads,
- Work Order 5–Public Information/Program Administration,
- Work Order 6–Truck Monitoring and Warning Systems for Freeway to Freeway Connections,
- Work Order 7–Real Time Information Kiosks,
- Work Order 9–Automatic Vehicle Locator System for Incident Management, and
- Work Order 17–Priority Lane Pricing Using AVI.

An additional 11 projects are currently being deployed or evaluated, and five projects are in preliminary development. Two projects have been eliminated from the plan. A final report will be completed by the end of FY 2001 for Work Order 11 – Evaluation of ITS Environmental Monitoring System. Interim reports for Work Order 8 – Railroad Grade-Crossing Monitoring System and Work Order 3 – Automatic Vehicle Identification (AVI) System – Phase IV will be completed in 2001.

3.0 PLAN IMPLEMENTATION

The plan represents the current consensus and desired direction for ITS project deployment in the corridor. Involved local agencies and FHWA consider the plan to be a "living document," which is subject to periodic update and revision. This report is the second update of the plan. Some projects will be modified or even eliminated as further study and detailed project development proceeds. ITS technologies are expected to continue to advance over time, providing additional project deployment opportunities. Therefore, the plan is considered flexible in terms of project makeup, scope, and schedule.

PROJECT DEPLOYMENT

The action elements of the plan are a series of projects that extend or test ITI. The interrelationships of many of the projects foster a building block approach to the incremental development of transportation management and traveler information systems. However, from the standpoint of deployment, each project is developed, implemented, and evaluated separately.

Staffing of the Houston Priority Corridor Program includes a program manager who is a TxDOT employee and is responsible for overall management of the program. The program manager coordinates program development with the Priority Corridor Technical, Policy, and Executive Committees. At the individual project level, a "lead agency" (currently one of the four operating agencies, H-GAC, or HCID #1) is responsible for project management and (typically) providing the local funding match. Deployment of projects is undertaken by the designated lead agency and its project manager. Although there is a lead agency, other local agencies or private sector partners are often involved.

Although each project has its own unique characteristics, most track the four following steps.

Project Approval and Funding

Each project needs to have the necessary administrative processing, approvals, and funding commitments before proceeding with detailed planning, design, and implementation. Approvals typically include the lead agency, TxDOT, and FHWA, with typical local funding by the lead agency. The initial step is development and approval of the project work order, which supplements the ITS Partnership Agreement between FHWA and TxDOT. Each work order describes the project scope, estimated cost and schedule, and financial assistance by FHWA. Projects with funding contributions from agencies other than TxDOT require intergovernmental agreements between the agency and TxDOT. Administrative requirements have created delays for a number of the Priority Corridor projects but are being resolved. Five projects are in preliminary development with intergovernmental agreements pending.

Project Development and Design

Additional planning and preliminary engineering is necessary to define the project sufficiently for design and construction. This plan has developed projects only to the concept (work order) level and need further study and refinement. This refinement leads directly to project design and development of construction plans and specifications and/or system development specifications. Project design could also identify funding shortfalls requiring additional funds or revision in the scope.

Deployment

Project deployment includes several steps, depending upon the nature of the project, i.e., implementation (construction and/or systems development), system integration, public information, and operations/maintenance. Typically, the construction or installation of necessary hardware or facilities will follow the lead agency's bidding/contracting procedures, with the lead agency responsible for contract administration and project acceptance. However, all federal regulations for procurement must be followed, including record-keeping and audit requirements. Many of the projects have components that will be integrated with Houston TranStar and/or other systems. If

system integration is not a part of the construction/installation scope for a specific project, it may be necessary to contract with an independent systems firm to integrate the project.

A public information component may be necessary on a number of the projects to inform travelers of the project's objectives and how the public can utilize or respond to the deployed project (which often involves transportation management or traveler information). The lead agency typically develops a public information program specifically for each deployed project.

Deployment activities should not overlook operation and maintenance needs of developed ITS infrastructure, as these have been recognized as potential weak links in the ITS program. These activities are the responsibility of the local agencies, which should provide sufficient staffing and funding to assure the continuing functionality of the ITS systems deployed. Actual performance of operation and maintenance activities can be in-house or through contracts with qualified private firms. Lead agencies may structure projects to utilize lease systems, with a private supplier responsible for all operations and maintenance.

Project Evaluation

FHWA requires that each project undergo an evaluation study. These evaluation studies provide the documentation and independent assessment needed for technology sharing with the broad ITS community. These evaluation studies should be contracted with qualified research organizations or consultants. Evaluation studies should generally include assessing the achievement of project objectives, quantitative evaluation of measures of effectiveness, and the potential for future deployment.

CONTINUING PLANNING ACTIVITIES

The plan was developed as a living document which should be monitored on a continuing basis and updated as needed. In addition, the plan should be coordinated with other agencies and areawide transportation planning activities. The plan has been coordinated with H-GAC, and the TIP includes individual projects.

Planning for the Houston Priority Corridor is a continuing process, with this second update of the plan an example of this process. This plan update process is illustrated in Figure 2. The Program Manager and Technical Committee monitor progress of the plan as projects are undertaken and the plan updated. Feedback from early project deployments provides input for development of later projects. Recommended planning activities include:

- project deployment planning and coordination, including regular Technical Committee meetings to review an assess status of project development;
- monitoring of national ITS activities and other Priority Corridors; and
- periodic update of plan:
    - meetings with agencies and Technical Committee;
    - assess status of project deployments;
    - review needs and resources;
    - develop new/revised projects; and
    - develop scope, schedule, and cost for projects.
- documentation of recommended plan revisions in an update report.

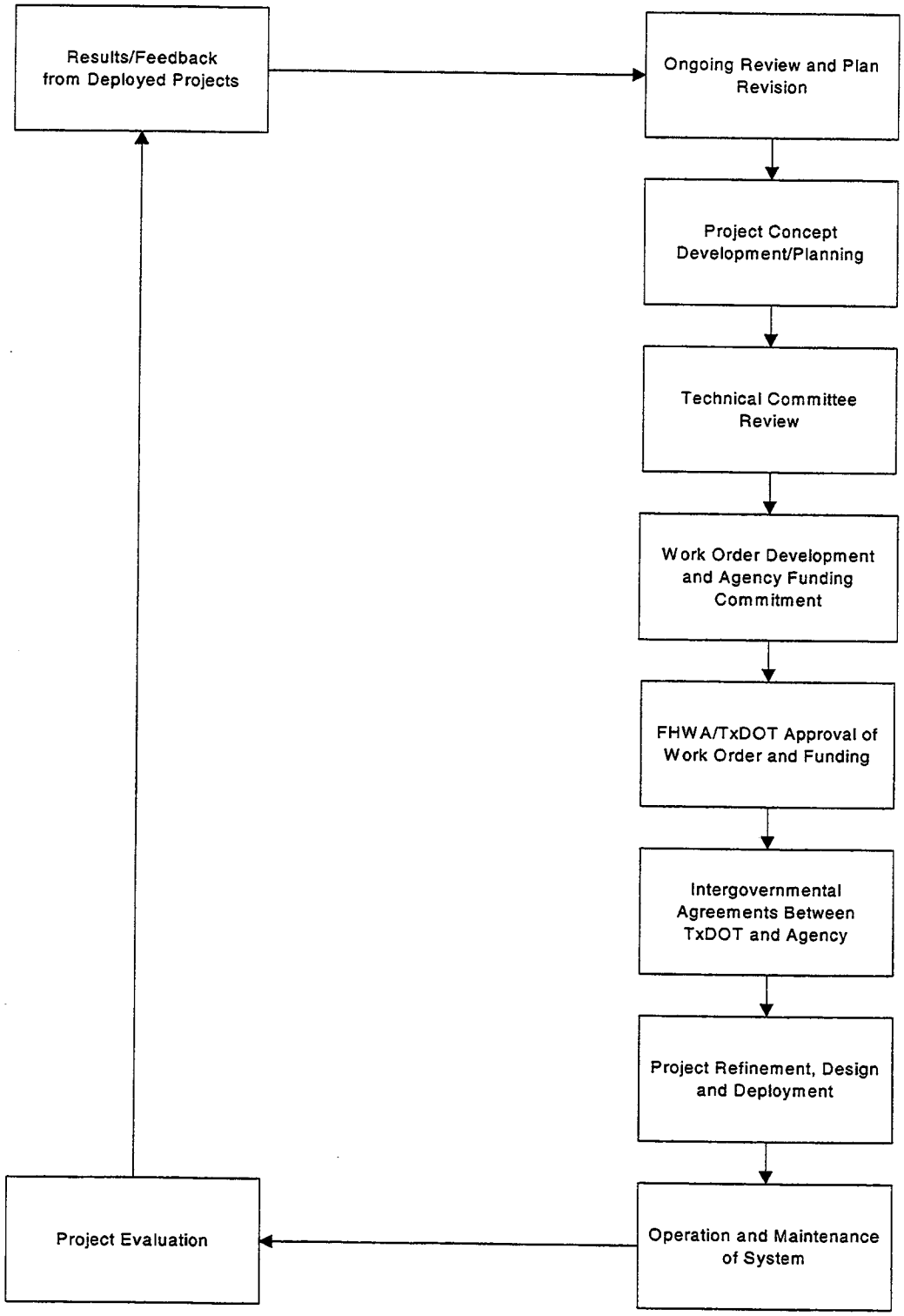


Figure 2. Process for the Plan Revisions

4.0 CONCLUSION

This report documents the current (Year 2000) status of the Houston ITS Priority Corridor Plan. Houston's ITS Priority Corridor plan is unique and builds on previous and in-process ITI development by TxDOT, USDOT, and local transportation agencies. The plan and this 2000 update were developed by the Technical Committee of the multi-agency consortium comprised of TxDOT, METRO, City of Houston, Harris County, and H-GAC, which are currently implementing this plan. Although additional federal funding beyond that shown in this update is not expected, there is a need for periodic review and updates of the plan by the Program Manager and the Priority Corridor Technical Committee.

5.0 REFERENCES

1. *National Program Plan for Intelligent Transportation Systems*, Final Draft, U.S. Department of Transportation, 1995.
2. *Operation TimeSaver*, Press Kit, U.S. Department of Transportation, January 1996.
3. *The National ITS Architecture, A Framework for Integrated Transportation into the 21st Century*, USDOT, 2000.
4. *Intelligent Transportation System Architecture and Standards-Proposed Rule*, Federal Register (Volume 65, Number 102), May 25, 2000.
5. *Statewide Transportation Planning, Metropolitan Transportation Planning-Proposed Rule*, Federal Register (Volume 65, Number 102), May 25, 2000.
6. Goolsby, Merrell E. and William R. McCasland, *Immediate Action Program, Houston ITS Priority Corridor Program Plan*, Research Report 2931-1, Texas Transportation Institute, 1995.
7. Goolsby, Merrell E. and William R. McCasland, *Houston ITS Priority Corridor Program Plan*, Research Report 2931-2, Texas Transportation Institute, 1995.
8. Goolsby, Merrell E., *Houston ITS Priority Corridor Program Plan-1996 Update*, Research Report 2931-3, Texas Transportation Institute, 1996.

APPENDIX A. ITS PARTNERSHIP AGREEMENTS

Greater Houston Traffic Management Center

701 North Post Oak, Suite 439
Houston, Texas 77024-3818

Douglas W. Wiersig, P.E.
Executive Director

Harris County
City of Houston
Metropolitan Transit Authority
Texas Department of Transportation

December 15, 1993

Frank M. Mayer
Division Administrator
Federal Highway Administration
Austin, Texas

RE: Houston IVHS Priority Corridor

Dear Mr. Mayer,

The primary implementing levels of government in the Greater Houston area recognize the importance of a cooperative effort in the delivery of transportation services. To assure this cooperative and integrated delivery, Harris County, The City of Houston, The Metropolitan Transit Authority of Harris County, and the Texas Department of Transportation have formed a consortium to operate a Regional Transportation Management Program. This Consortium, **The Greater Houston Traffic Management Center** has been created through an Interlocal Agreement between the agencies to operate and maintain Traffic Management Systems and manage Intelligent Vehicle Highway Systems (IVHS) in the Greater Houston area. This IVHS management function encompasses all systems being developed by the participating agencies and includes the **Houston IVHS Priority Corridor Program.**

The Greater Houston Traffic Management Center is administered by an Executive Committee which provides overall Program direction through a representative from each of the participating agencies. The Center is administered on a day-to-day basis by an Executive Director who reports to the Executive Committee.

The creation of the Greater Houston Traffic Management Center is a commitment by Houston governments to support each other in the implementation of IVHS programs such that both regional and single agency objectives are achieved and maximized. Each participating Agency considers the Interlocal Agreement a Memorandum of Understanding to manage and implement IVHS Programs including the Houston IVHS Priority Corridor Program in a cooperative and coordinated manner.

Each agency looks forward to implementing the Houston IVHS Priority Corridor Program and working with the Federal Government as we apply innovative IVHS technologies and procedures.

Sincerely,
Executive Committee
Greater Houston Traffic Management Center

Terry A. Anderson, P.E.
County Engineer
Harris County

Milton M. Dietert, P.E.
District Engineer
Texas Department of
Transportation

Robert G. MacLennan, P.E.
General Manager
Metropolitan Transit
Authority of Harris County

Jimmie Schindewolf, P.E.
Chief of Staff,
Office of the Mayor
Director, Department of
Public Works & Engineering
City of Houston

Attachment

HOUSTON, TEXAS PRIORITY IVHS CORRIDOR

IVHS Partnership Agreement

between

The Federal Highway Administration

and

The Texas Department of Transportation

Project No. IVH-9348(305)

The purpose of this Agreement is to award a grant of Federal assistance to the State of Texas (State) for certain specific Intelligent Vehicle Highway Systems (IVHS) activities relating to the Houston IVHS Priority Corridor, and to maximize the involvement of the State and other project participants in the IVHS program, as authorized by P. L. 102-240, Sections 6053(a), 6055(d), and 6056(a) (23 USC 307 note). The parties to this Agreement are independent contracting parties, and nothing in this Agreement shall be deemed to create a business partnership for purposes of sharing profits and losses.

1. Estimated Cost

The State shall be reimbursed for allowable costs incurred in the performance of work under this IVHS Partnership Agreement in an amount not to exceed $3,105,000 in Federal IVHS funds. This amount shall be matched at an 80/20 (Federal/non-Federal) ratio, resulting in a matching share valued at not less than $776,250. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

2. Responsibilities of the State

In conformance with approved Work Orders (see paragraph 3 below), the State shall perform, or cause to be performed, the following:

a. Development and Maintenance of the Houston IVHS Priority Corridor Program Plan

Management of the Houston IVHS Priority Corridor is envisioned as the responsibility of key State and local officials (principally TxDOT, the City of Houston, Houston METRO, Harris County, and the Houston-Galveston Area Council) in cooperation with US DOT participants. These parties have been working together over a number of years to develop a full-featured

transportation management concept which will serve needs such as provision of traveller information, public transportation and ridesharing, and commercial vehicle-oriented elements. The IVHS Priority Corridor Program Plan will document the comprehensive vision for IVHS applications within the Corridor, specifically addressing what IVHS elements will be showcased. Projects, schedules, priorities, and estimated funding needs should be identified. The Priority Corridor Program Plan should break the IVHS vision for the area into realizable segments or incremental capability levels for implementation, each building on the previous segment or capability level. An extended series of projects/tests should be described in the Priority Corridor Program Plan, which would make the Corridor an IVHS test bed and showcase, with sustained deployment of IVHS services and technologies as they become available. The Priority Corridor Program Plan should be closely coordinated with the needs of the national IVHS program as defined in the US DOT Strategic Plan and the National IVHS Program Plan.

Eligible activities included under this item are expected to include overall project management, coordination, and public information / public relations efforts associated with the IVHS Priority Corridor in Houston. In addition, establishment of a systems integration function is envisioned. This would provide for oversight and technical assistance for coordination, communications, and integration of the various IVHS-related projects in the Corridor.

b. Development and Implementation of Selected High-Priority IVHS Operational Tests

The Houston IVHS Priority Corridor officials have identified several IVHS operational test projects having early implementation opportunities. The IVHS Priority Corridor Program Plan discussed above will identify additional opportunities. Specific work tasks, schedules, budget, evaluation goals, and responsibilities will be defined in Work Orders proposed by the State and approved by the FHWA. Beyond currently anticipated opportunities, additional high-priority operational test proposals may be proposed and approved under this IVHS Partnership Agreement, as funding limitations allow.

3. Work Orders

Individual activities agreed to be performed by the State or caused to be performed by the State shall be incorporated in Work Orders. Each Work Order will specify the work and goals to be accomplished and the type and amount of assistance to be provided by the FHWA. Each Work Order must include a description of the work (addressing clearly the technical, institutional, and evaluation goals and objectives to

be included), completion dates for the work, and the signatures of the FHWA Division Administrator and an authorized representative of the State indicating acceptance of the Work Order prior to initiation of any work described therein. Issuance of a Work Order does not constitute a promise, either expressed or implied, that the FHWA will issue further Work Orders or provide additional assistance pursuant to this IVHS Partnership Agreement.

4. Period of Performance, Modifications, and Project Completion

The period of performance and completion date for each task or activity is as stated in the Work Orders. It is expected that this IVHS Partnership Agreement will remain in effect at least through fiscal year 1997, which is the last year of IVHS funding authority currently provided to FHWA under P. L. 102-240 (the Intermodal Surface Transportation Assistance Act [ISTEA] of 1991). Modifications of this Agreement may be made, but no promise, either expressed or implied, is made at this time that FHWA will provide additional funding beyond that specified in paragraph 1. The US DOT will make decisions regarding additional funds under this Agreement (per Section 6056 of the ISTEA; "IVHS Corridors Program") based upon the overall quality of the Corridor's technical and institutional program and the degree to which the proposed activities contribute to achieving the National IVHS Program Plan.

A final project evaluation report shall be delivered within six months from the date of completion of the final Work Order and shall constitute completion of the project. The evaluation report is to include a review of the work completed and a discussion of the technical and institutional issues encountered in completing the project.

5. US DOT Participation

The FHWA and the Federal Transit Administration (FTA) shall be considered full participants in the project. As such, these agencies shall be a voting member of appropriate project management committees as they develop. The FHWA and the FTA shall be provided the opportunity for membership on all sub-committees, working groups, task forces, and other such groups related to the project. The FHWA and the FTA will provide names, addresses, and phone numbers of committee representatives to the State Program Manager as required.

6. Project Documentation and Reporting Requirements

Copies of all project reports, correspondence, meeting announcements, and other documents shall be supplied directly to the FHWA. In addition, brief monthly progress statements and quarterly reports summarizing work performed, significant events, expenditures, and progress of work shall be supplied to the FHWA. The FHWA will provide names and addresses of specific contacts to receive these documents.

7. Evaluation Work Plans

The funding provided by this IVHS Partnership Agreement for individual operational test efforts shall include an appropriate amount for a comprehensive evaluation. An evaluation work plan for each operational test shall be developed and submitted for FHWA approval, normally within eight (8) weeks after the approval of the Work Order which initiates the test. Each evaluation plan shall discuss the scope and method of evaluation for each funded activity. The plan(s) should also assess the opportunity to collect data that can answer questions of both local and national significance. The FHWA will participate in the evaluation of the work performed. As appropriate, the final report for each evaluation shall include a section prepared by legal counsel reporting and analyzing the disposition of significant legal issues, including contract, liability, privacy, regulatory and intellectual property issues. In addition, analysis of all significant institutional issues which are addressed during the project, along with discussion of how they were resolved, shall be part of the evaluation report.

8. Programmatic Changes

The State must obtain the prior approval of the FHWA whenever any significant change is anticipated. These include, but are not limited to:

a. Any revision of the scope, goals or objectives of the consultant contract or related activities (regardless of whether there is an associated budget revision requiring prior approval); and

b. Changes in key personnel, program manager, or prime contractor.

9. Intellectual Property

Intellectual property consists of copyrights, patents, and any other form of intellectual property rights covering any data bases, software, inventions, training manuals, systems design or other proprietary information in any form or medium.

Copyrights. The FHWA reserves a royalty-free, nonexclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, for Federal Government purposes:

(a) The copyright in any works developed under this Agreement, or under a subgrant or contract under this Agreement; and

(b) Any rights of copyright to which the State, its subgrantee or contractor purchases ownership with Federal financial assistance provided by this Agreement.

Patents. Rights to inventions made under this Agreement shall be determined in accordance with 37 C.F.R. Part 401. The standard patent rights clause at 37 C.F.R. §401.14, as modified below, is hereby incorporated by reference.

(a) The terms "to be performed by a small business firm or domestic non-profit organization" shall be deleted from paragraph (g)(1) of the clause;

(b) Paragraphs (g)(2) and (g)(3) of the clause shall be deleted; and

(c) paragraph (1) of the clause, entitled "Communications" shall read as follows: "(1) Communications. All notifications required by this clause shall be submitted to the FHWA Division office.

10. Costs

The State shall limit its progress claims and final claims to those costs incurred in accordance with this IVHS Partnership Agreement, and shall submit its final claim within 90 days after the project is completed.

11. Additional Requirements

The State shall comply with all applicable laws, regulations and FHWA requirements, including but not limited to 49 C.F.R. Parts 18, 20, 21, 27, and 29, and the assurances in OMB SF 424B attached hereto as Appendix A.

12. Certification Regarding Lobbying

The State makes the certification regarding lobbying which is attached hereto as Appendix B.

13. Termination

The State shall notify FHWA immediately of any intent to terminate this IVHS Partnership Agreement.

14. Effective Date

This IVHS Partnership Agreement is effective upon execution by both parties.

Texas Department of Transportation

Executed for the Executive Director and approved by the Texas Transportation Commission under the authority of Minute Order No. 82513 and Administration Order 15-88, for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved by the Texas Transportation Commission under the authority of Minute Order No. 100002.

Roger S. Welsch
Associate Executive Director, Field Operations

Date 9-7-93

Federal Highway Administration

Frank M. Mayer
Division Administrator

Date 9/8/93

ATTACHMENT 1

Houston, Texas, IVHS Priority Corridor

Amendment 1 to the

IVHS Partnership Agreement
between
The Federal Highway Administration
and
The Texas Department of Transportation

Project No. IVH-9348(305)

The Federal Highway Administration (FHWA) hereby provides the State of Texas Department of Transportation (State) with additional Federal assistance funding to support the activities being undertaken as part of the Houston, Texas, Priority IVHS Corridor Program pursuant to 23 USC 307. This document hereby amends sections 1 and 2 of the Intelligent Vehicle Highway Systems (IVHS) Partnership Agreement signed between FHWA and the State on May 11, 1993. All other sections of the original IVHS Partnership Agreement remain in full force.

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this IVHS Partnership Agreement in an amount not to exceed $2,000,000 in Federal IVHS funds. Funding under this Partnership Agreement is available as follows:

	$ 3,105,000	- FY 1993
	$ 2,000,000	- FY 1994 (This Amendment)
Total	$ 5,105,000	

This total amount shall be matched at a minimum 80/20 (Federal/non-Federal) ratio, resulting in a minimum matching share valued at $ 1,276,250. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

2. Responsibilities of the State. In conformance with approved Work Orders (see paragraph 3), the State shall perform, or cause to be performed the activities described in the February 23, 1994 letter from Mr. Gary K. Trietsch to FHWA Technology Assistance Engineer C. L. Chambers. In addition to on-going IVHS activities initiated utilizing funds provided in FY 1993, efforts planned by the State and tentatively supported by this Agreement for FY 1994 include projects concerning:

   a. Advanced Traveler Information for Commercial Vehicles
   b. Dynamic Lane Assignment Controls on Frontage Roads (A System for Traffic Diversion Within the Priority Corridor)

c. Automatic Vehicle Locator (AVL) System for Incident Management
d. On-Vehicle Navigation/Information Applications
e. Monitoring and Information Systems for Environmental Conditions

This amendment is effective upon execution by both parties.

Texas Department of Transportation

Title: Assistant Executive Director Field Operations

Date July 1, 1994

Federal Highway Administration

Division Administrator

Date

ATTACHMENT 1

Houston, Texas, ITS Priority Corridor

Amendment 2 to the

ITS Partnership Agreement
between
The Federal Highway Administration
and
The Texas Department of Transportation

Project No. IVH-9348(305)

The Federal Highway Administration (FHWA) hereby provides the State of Texas Department of Transportation (State) with additional Federal assistance funding to support the activities being undertaken as part of the Houston, Texas, Priority Intelligent Transportation Systems (ITS) Corridor Program pursuant to 23 U.S.C. 307. This document hereby replaces section 1 and amends section 2 of the ITS Partnership Agreement executed between FHWA and the State on May 11, 1993, and amended on July 6, 1994. All other sections of the original ITS Partnership Agreement and Amendment 1 remain in full force.

Section 1 is replaced in its entirety by the following:

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this IVHS Partnership Agreement in an amount not to exceed $7,355,000 in Federal IVHS funds. Funding under this Partnership Agreement is available as follows:

	$3,105,000	- FY 1993
	$2,000,000	- FY 1994 (Amendment 1)
	$2,250,000	- FY 1995 (This Amendment)
Total	$7,355,000	

This total amount shall be matched at a minimum 80/20 (Federal/non-Federal) ratio, resulting in a minimum matching share valued at $1,838,750. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

Section 2 is amended by the following:

2. Responsibilities of the State. In conformance with approved Work Orders (see paragraph 3), the State shall perform, or cause to be performed, the activities described in the February 13 letter from Mr. Edward G. Schroeder to FHWA Division Traffic Operations Engineer, Mark D. Olson. In addition to on-going ITS activities that were initiated with funds provided in fiscal

years 1993 and 1994, efforts planned by the State and tentatively supported by this Agreement for FY 1995 include projects concerning:

a. Integrated Corridor Transportation Management and Traveler Information System; and
b. Washburn Tunnel Traffic Management and Information System.

This amendment is effective upon execution by both parties.

Texas Department of Transportation

for Assistant Executive Director for Field Operations

Date 6-16-95

Federal Highway Administration

Division Administrator

Date 6/27/95

ATTACHMENT

HOUSTON ITS PRIORITY CORRIDOR

Amendment Number 3
to the
ITS Partnership Agreement
between
The Federal Highway Administration
and
The State of Texas Department of Transportation

Project No. IVH-9348(305)

The purpose of this amendment is to award a grant of Federal assistance to the Texas Department of Transportation (State) for specific Intelligent Transportation Systems (ITS) activities being undertaken as part of the Houston, Texas ITS Priority Corridor Program pursuant to 23 U.S.C. 307. This document hereby replaces section 1 and amends section 2 of the ITS Partnership Agreement executed between FHWA and the State on May 11, 1993 and amended on July 6, 1994 and June 27, 1995. All other sections of the original ITS Partnership Agreement and Amendments 1 and 2 remain in full force.

Section 1 is replaced in its entirety by the following:

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this ITS Partnership Agreement in an amount not to exceed $13,612,000 in Federal ITS funds.

$ 3,105,000	FY 93 (original Agreement)
2,000,000	FY 94 (Amendment Number 1)
2,250,000	FY 95 (Amendment Number 2)
6,207,000	**FY 96 (Amendment Number 3)**
Total $13,562,000	

This amount shall be matched at an 80/20 (Federal/non-Federal) ratio, resulting in a matching share valued at not less than $3,390,500. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

Section 2 is amended by the following:

2. Responsibilities of the State. In conformance with approved Work Orders (see paragraph 3 of the original Agreement), the State shall perform, or cause to be performed, the activities described in the Houston ITS Priority Corridor Program Plan. Efforts planned by the State and tentatively supported by this Agreement for FY96 include the following:

   a. Incident Management and Traveler Information for Critical Roadway Links
   b. ITS Technology for Data Collection and Transportation Planning
   c. Integrating Transit into TranStar
   d. Automatic Traffic Management in High Water Areas through Use of ITS Technologies
   e. Public Information/Project Management

   In addition, an effort to evaluate and/or develop an expert system or preplanned traffic management scenarios which change appropriate traffic control devices in response to freeway incidents may be initiated with these FY96 funds.

This amendment is effective upon execution by both parties.

Texas Department
of Transportation

B.F. Templeton, P.E.
Assistant Executive Director,
Field Operations

Date June 10, 1996

Federal Highway Administration

C.D. Reagan
Division Administrator

Date 6/28/96

Executed for the Executive Director
and approved by the Texas Transportation
Commission under the authority of Minute
Order 100002 and Stand Alone Manual Notice
96-3, for the purpose and effect of activating
and/or carrying out the orders, established
policies or work programs heretofore approved
by the Texas Transportation Commission

ATTACHMENT

HOUSTON ITS PRIORITY CORRIDOR

Amendment Number 4
to the
ITS Partnership Agreement
between
The Federal Highway Administration
and
The State of Texas Department of Transportation

Project No. IVH-9348(305)

The purpose of this amendment is to award a grant of Federal assistance to the Texas Department of Transportation (State) for specific Intelligent Transportation Systems (ITS) activities being undertaken as part of the Houston, Texas ITS Priority Corridor Program pursuant to 23 U.S.C. 307. This document hereby replaces section 1 and amends section 2 of the ITS Partnership Agreement executed between FHWA and the State on May 11, 1993 and amended on July 6, 1994 and June 27, 1995. All other sections of the original ITS Partnership Agreement and Amendments 1,2, and 3 remain in full force.

Section 1 is replaced in its entirety by the following:

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this ITS Partnership Agreement in an amount not to exceed $17,002,000 in Federal ITS funds.

$3,105,000	FY 93 (original Agreement)
2,000,000	FY 94 (Amendment Number 1)
2,250,000	FY 95 (Amendment Number 2)
6,207,000	FY 96 (Amendment Number 3)
3,440,000	**FY 97 (Amendment Number 4)**
Total $17,002,000	

This amount shall be matched at an 80/20 (Federal/non-Federal) ratio, resulting in a matching share valued at not less than $4,250,500. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

Section 2 is amended by the following:

2. Responsibilities of the State. In conformance with approved Work Orders (see paragraph 3 of the original Agreement), the State shall perform, or cause to be performed, the activities described in the Houston ITS Priority Corridor Program Plan. Efforts planned by the State and tentatively supported by this Agreement for FY97 include the following:

   a. System Integration of FY97 Projects into TranStar
   b. Using ITS Technology for Parking Management and Airport Area Traffic Management/Traveler Information
   c. Public Travel Security Infrastructure and Integrating Transit into Houston TranStar Center
   d. AVI System Expansion
   e. Air Quality Monitoring to Evaluate Traffic/Air Characteristics

Section 11 is amended by the following:

11. Additional Requirements. These ITS funds shall be used only in support of, or for research on, intelligent transportation systems and not for construction of buildings. The design and operation of these ITS projects must be consistent with the National ITS Architecture and the purposes of section 6053 (b) of ISTEA. This project shall contribute to the implementation of ITS standards development work and shall promote compatibility interoperability of ITS systems among the states.

This amendment is effective upon execution by both parties.

Texas Department
of Transportation

Robert Cuellar
for B.F. Templeton
Assistant Executive Director,
Field Operations

Date 7-7-97

Federal Highway Administration

C D Reagan
C.D. Reagan
Division Administrator

Date 7/11/97

Certified as being executed for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

HOUSTON ITS PRIORITY CORRIDOR
Addendum
to the ITS Partnership Agreement between
The Federal Highway Administration
and
The State of Texas Department of Transportation
Project No. IVH - 9348(305)

The purpose of this addendum is to clarify the period of performance, modifications, and project completion dates for the work orders issued under this agreement and for this agreement pursuant to 23 USC 307. This addendum replaces Section 4 of the ITS Partnership Agreement executed between FHWA and the State on May 11, 1993 and amended on July 6, 1994; June 27, 1995; June 28, 1996; and July 11, 1997. All other sections of the original ITS Partnership Agreement and Amendments 1, 2, 3, and 4 remain in full force.

Section 4 is replaced in its entirety by the following:

4. Period of Performance, Modifications, and Project Completion

The period of performance and completion date for each task or activity is as stated in the Work Orders. The ITS Partnership Agreement will remain in full force and effect until all approved work orders are completed.

Modifications of this Agreement may be made, but no promise, either expressed or implied, is made at this time that FHWA will provide additional funding beyond the end of fiscal year 1997, which is the last year of ITS funding authority provided to FHWA under PL 102-240 (the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991). The US DOT will make decisions regarding additional funds under this Agreement (per Section 6056 of the ISTEA, ITS Corridors Program) based upon the overall quality of the Corridor's technical and institutional program and the degree to which the proposed activities contribute to achieving the National ITS Program Plan.

A final project evaluation report shall be delivered within six months from the date of completion of the final Work Order and shall constitute completion of the project. The evaluation report is to include a review of the work completed and a discussion of the technical and institutional issues encountered in completing the project.

This addendum is effective upon execution by both parties.

Texas Department of Transportation

Certified as being executed for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

By: Robert Queen for Date 9-3-97
B. F. Templeton, P.E.
Assistant Executive Director, Field Operations

Federal Highway Administration

By: C D Reagan Date 9/15/97
C. D. Reagan
Division Administrator

Houston ITS Priority Corridor

Amendment Number 5
to the
ITS Partnership Agreement
between
The Federal Highway Administration
and
The Texas Department of Transportation
Project No. IVH-9348(305)

The purpose of this amendment is to award an additional grant of Federal assistance to the Texas Department of Transportation (State) for specific Intelligent Transportation Systems (ITS) activities, and to maximize the involvement of the State and other Project participants in the ITS program, as authorized by the Transportation Equity Act for the 21st Century (TEA-21), P.L. 105-178, Sections 5001(a)(6) and 5201-5213 (23 USC 307 note).

This amendment between the State and the Federal Highway Administration (FHWA) hereby supersedes:

1. the original ITS Partnership Agreement executed on September 8, 1993,
2. Amendment Number 1 executed on July 6, 1994,
3. Amendment Number 2 executed on June 27, 1995,
4. Amendment Number 3 executed on June 28, 1996,
5. Amendment Number 4 executed on July 11, 1997, and
6. the Addendum executed on September 15, 1997.

New requirements introduced by this amendment are not retroactive to Projects (Work Orders) previously covered under the above listed agreement, amendments, and addendum, but may be accommodated at the sole discretion of the State. The new requirements apply only to Projects using FY '98 funds.

The parties to this agreement are independent contracting parties, and nothing in this agreement shall be deemed to create a business partnership for purposes of sharing profits and losses.

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this ITS Partnership Agreement in an amount not to exceed $18,502,000 in Federal ITS funds.

	$3,105,000	FY '93 (Original Agreement)
	2,000,000	FY '94 (Amendment Number 1)
	2,250,000	FY '95 (Amendment Number 2)
	6,207,000	FY '96 (Amendment Number 3)
	3,440,000	FY '97 (Amendment Number 4)
	1,500,000	FY '98 (Amendment Number 5)
Total	$18,502,000	

This amount shall be matched at a minimum 80/20 (Federal/non-Federal) ratio, resulting in a matching share valued at not less than $4,625,500. Reimbursement for costs incurred will follow regular Federal-aid billing and payment procedures.

2. Responsibilities of the State. In conformance with approved Work Orders (See Section 9 below), the State shall perform or cause to be performed the following:

   a. Activities as described in the Work Plan (See Section 3)
   b. Ensure National ITS architectural consistency (See Sections 4 and 5)
   c. A local evaluation and a Local Evaluation Report (See Section 7)
   d. Inclusion of the Projects in the metropolitan or Statewide Transportation Improvement Program (STIP), as applicable.
   e. An ITS Deployment Tracking Survey must be completed.

3. Work Plan. The State shall develop an overall Project Work Plan, schedule, and budget including the minimum 20 percent non-Federal match requirement, for approval by the Federal Highway Administration (FHWA) Division and/or Federal Transit Administration (FTA) Regional Office. The Work Plan shall include high-level descriptions of what the Project will accomplish and objectives defining specific actions for determining progress towards the goals.

4. Regional ITS Architecture Consistency. The State shall ensure Regional consistency with the National ITS Architecture by performing or causing to be performed the following:

   a. Within one year of the signing of this agreement, Project managers and technical staff from all key stakeholder groups shall have attended the Using the National ITS Architecture for Deployment training course. If these recipients have not attended the training course, then they shall host an on-site presentation of this course. Project funding may be used to support hosting and attendance at this training course.

   b. In accordance with the Work Plan and schedule, an ongoing process of Regional ITS planning shall be conducted. This planning shall:

      1. Include broad stakeholder participation;
      2. Identify local needs that can be addressed through ITS applications;
      3. Include transit and other multimodal considerations;
      4. Develop descriptions of existing and planned ITS enhancements (physical inventory, sharing of information);
      5. Define a Regional ITS Architecture (to the subsystem and architectural flow level)
      6. Ultimately incorporate ITS in the applicable Regional MPO and Statewide transportation plans.

Regional ITS planning may be carried out in parallel with the development of Project ITS

Architecture(s), provided that Project Work Plans and actions demonstrate a concerted effort is underway, as determined by the FHWA Division and FTA Regional Office.

Development of a Regional ITS Architecture (including subsystems and architecture flows) may have been undertaken through a previous related effort, and no additional work may be necessary. However, the previously developed Regional ITS Architecture shall be reviewed and revised, as required, to include changes and additions resulting from this and other relevant ITS Projects.

5. Project ITS Architecture Consistency.

   a. In accordance with the Work Plan and schedule, detailed Project designs shall document National ITS Architecture consistency by:

      1. Providing a "mapping" of the Project design and terminology to the applicable Regional ITS Architecture or to the National ITS Architecture, if a Regional ITS Architecture is still under development.
      2. Identifying and providing for potential interfaces, including transit and other modal consideration, and providing sound rationale for omitted architecture flows.
      3. Showing use of approved ITS standards, where applicable.

   b. Project designs must be submitted to the FHWA Division and/or FTA Regional Office, as appropriate.

6. Reports. Copies of Project reports, correspondence, meeting announcements, and other documents shall be supplied to the U.S. DOT upon request. The U.S. DOT will provide names and addresses of specific contacts to receive these documents. All interim and final reports submitted to the U.S. DOT shall be in both a hard copy as a reproducible and as microcomputer files. The hard copy shall be done on a laser printer with a resolution of at least 300 dpi.

   Quarterly Progress Reports - Two reproducible hard copies and one electronic file of the quarterly progress report shall be submitted to the U.S. DOT on or before the last working day of the month following the end of the quarter being reported. At a minimum, the quarterly report shall contain a concise report covering the following:

   a. The Federal-aid Project number or contract number, Project name, a brief description of the Project, major Project partners, names and phone numbers of the partners Project contacts, and the reporting period.
   b. Budget and scheduling information including the date the Project was initiated, the estimated completion date, cost estimate, expenditures during reporting period, percent of Project completed, and percent of funds expended.
   c. A brief description of the activities conducted during the reporting period including any milestones attained and/or significant events.

d. A discussion of any problems encountered or anticipated (e.g., scope changes, changes in Project limits, funding requirements, technological constraints, institutional issues, Project schedule delays) together with recommended solutions to such problems.

7. Local Evaluation Report. A Local Evaluation Report shall include a review of how well the Project met the goals and objectives (see Section 3), the work completed, and a discussion of the technical and institutional issues encountered in completing the Project. Analysis of all significant institutional issues that were addressed during the Project, along with discussion of how they were resolved, shall be part of the evaluation report. In addition to the goals and objectives identified for each Project, where applicable, the evaluation should quantitatively assess the following ITS measures:

   - Reduction of crashes.
   - Reduction of fatalities.
   - Increased throughput (both people and goods).
   - Reduction of congestion-related delay.
   - Improved customer satisfaction.
   - Savings in cost to public and private sector.
   - Energy and emissions impacts.

   As appropriate, the Local Evaluation Report shall include a section reporting and analyzing the disposition of significant legal issues, including contract, liability, privacy, regulatory, and intellectual property issues.

   At a minimum the Local Evaluation Report shall contain the following:

   a. A completed Technical Report Documentation form DOT F 1700.7(8-72). This form is necessary to ensure all reports are entered into the National Technical Information Service database. The form is located on http://www.bts.gov/itc/1700-7.pdf);

   b. An executive summary under separate cover.

   c. A camera-ready copy including all work (illustrations, photographs, charts, or tables) ready for printing by photographic or other means;

   d. An electronic version of the report in WordPerfect 6.0.

   e. A one-page description of the report, including the title, why it is important, what it embodies, findings and / or benefits (expected or realized), real-world examples of who is involved (principles, team or other significant participants), and the audience.

   f. A completed ITS Electronic Clearinghouse Document Profile Sheet.

   g. Copies of the items above shall be delivered to the Director of the ITS Clearinghouse in

the U.S. DOT ITS Joint Program Office.

h. Two reproducible hard copies and one electronic file of the Local Evaluation Report shall be submitted as described in the Period of Performance.

The Local Evaluation Report shall be submitted to the FHWA Division and/or FTA Regional Office, as appropriate.

8. Participation in Evaluations of National Interest. Those Projects determined by the U.S. DOT ITS Joint Program Office (JPO) to be unique or nationally significant will cooperate with all phases of the Government's evaluation, from evaluation planning to reporting of evaluation results. Required evaluations are to be conducted using Project funds as appropriate, provided they are identified early in the Project.

9. Work Orders. Individual activities within the Project Work Plan agreed to be performed by the State or caused to be performed by the State shall be incorporated in Work Orders. Each Work Order will specify the work and goals to be accomplished and the type and amount of assistance to be provided by the FHWA. Each Work Order must include a description of the work, completion dates for the work, and the signatures of the FHWA Division Administrator and an authorized representative of the State indicating acceptance of the Work Order prior to initiation of any work described therein. Issuance of a Work Order does not constitute a promise, either expressed or implied, that the FHWA will issue further Work Orders or provide additional assistance pursuant to this ITS Partnership Agreement. Continued funding will be dependent on the successful completion of ongoing tasks.

10. Period of Performance. The period of performance is determined by the Work Orders. This cooperative agreement shall remain in full force and effect until all Work Orders and a final Local Evaluation Report (see section 7 above) is completed and approved. The final Local Evaluation Report documenting lessons learned and how well the Project met the defined goals and objectives shall be submitted within six (6) months from the date of completion of the final Work Order and shall constitute completion of the Project. This report shall be submitted to the FHWA Division and/or the FTA Regional Office, as appropriate.

11. U.S. DOT Participation. The United States Department of Transportation (U.S. DOT) agencies shall be considered full participants in the Project. As such, the U.S. DOT shall be provided the opportunity for membership on all management committees, subcommittees, working groups, task forces, and other such groups related to the Project. The U.S. DOT will provide names, addresses, and phone numbers of U.S. DOT participants to the State Program Manager.

12. Programmatic Changes. The State must obtain the prior approval of the U.S. DOT whenever any significant change is anticipated. These include, but are not limited to:

a. Any revision of the scope, goals or objectives of the consultant contract or related

activities (regardless of whether there is an associated budget revision requiring prior approval).

b. Changes in key personnel, program manager, or prime contractor.

13. Intellectual Property. Intellectual property consists of copyrights, patents, and any other form of intellectual property rights covering any data bases, software, inventions, training manuals, systems design or other proprietary information in any form or medium.

It is the policy of the FHWA to allow the non-Federal partners of an ITS Partnership Agreement to retain all intellectual property rights developed under this agreement with the following limitations:

a. Copyrights. The FHWA, as the contracting U.S. DOT agency, reserves a royalty-free, nonexclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, for Federal Government purposes:

1. The copyright in any works developed under this agreement, or under a subgrant or contract under this agreement; and
2. Any rights of copyright to which the State, its subgrantee, or contractor purchases ownership with Federal financial assistance provided by this agreement.

b. Patents. Rights to inventions made under this agreement shall be determined in accordance with 37 C.F.R. Part 401. The standard patent rights clause at 37 C.F.R. '401.14, as modified below, is hereby incorporated by reference.

1. The terms "to be performed by a small business firm or domestic nonprofit organization" shall be deleted from paragraph (g)(1) of the clause;
2. paragraphs (g)(2) and (g)(3) of the clause shall be deleted; and
3. paragraph (1) of the clause, entitled "Communications" shall read as follows: "(1) Communications. All notifications required by this clause shall be submitted to the FHWA Division Office."

14. Costs. The State shall limit its progress claims and final claims to those costs incurred in accordance with this ITS Partnership Agreement and shall submit its final claim within ninety (90) days after the Project is completed.

15. Additional Requirements. As specified in Section 5210(b) of the Transportation Equity Act for the 21st Century (TEA-21), the ITS funds shall be used primarily for the development of intelligent transportation infrastructure. To the maximum extent practicable, ITS funds shall not be used for the construction of physical highway and transit infrastructure unless the construction is incidental and critically necessary to the implementation of an intelligent transportation system Project.

The design and operation of this ITS Project must be consistent with the National ITS

Architecture and the purposes of Section 5206(e) of TEA-21. This Project shall contribute to the implementation of the ITS standards development work and shall promote interoperability of ITS systems among the States.

Participation of small business concerns owned and controlled by socially and economically disadvantaged individuals is encouraged. The State shall comply with all applicable laws, regulations and the FHWA requirements, including, but not limited, to 49 C.F.R. Parts 18, 20, 21, 27, and 29, and the assurances in OMB SF 424B attached hereto as Appendix A.

16. Certification Regarding Lobbying. The State makes the certification regarding lobbying which is attached hereto as Appendix B.

17. Termination. The State shall notify FHWA immediately of any intent to terminate this ITS Partnership Agreement.

18. Effective Date. This ITS Partnership Agreement is effective upon execution by both parties.

Texas Department of Transportation

Certified as being executed for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation commission.

Carlos A. Lopez, P.E. — 9-28-98

David T. Newbern, P.E. — Date

for Director, Traffic Operations Division

Federal Highway Administration

Mark D Olson PE — 9/28/98

C. D. Reagan — Date

for Texas Division Administrator

ASSURANCES - NON-CONSTRUCTION PROGRAMS

Note:. Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§ 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the nineteen statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§ 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits dis-crimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§ 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§ 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. § 3601 et seq.), as amended, relating to non-discrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply with the provisions of the Hatch Act (5 U.S.C. §§ 1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§ 276a to 276a-7), the Copeland Act (40 U.S.C. § 276c and 18 U.S.C. §§ 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 327-333), regarding labor standards for federally assisted construction . . subagreements

10. Will Comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 176(c) of the Clear Air Act of 1955, as amended (42 U.S.C. § 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended, (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended, (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§ 1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§ 4801 et seq.) which prohibits the use of lead based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1984

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations and policies governing this program

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL:	TITLE:
Carlos A. Lopez, P.E. for David T. Newbern, P.E.	Director, Traffic Operations Divison
APPLICANT ORGANIZATION:	DATE SUBMITTED:
Texas Department of Transportation	9-28-98

CERTIFICATION REGARDING LOBBYING

By execution of this ITS Partnership Agreement, the undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal-appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an office or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any ITS Partnership Agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or ITS Partnership Agreement.

(2) If any funds other than Federal-appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an office or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or partnership agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and partnership agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31 U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

ITS Partnership Agreement
Between
The Federal Highway Administration
And
Texas Department of Transportation (TxDOT)
Project No. ITS-99 (713)

Houston District

The purpose of this agreement is to award a grant of Federal assistance to the State for specific Intelligent Transportation Systems (ITS) activities, and to maximize the involvement of the State and other project participants in the ITS program, as authorized by the Transportation Equity Act for the 21st Century (TEA-21), P.L. 105-178, Sections 5201-5213 (23 USC 307 note). The parties to this agreement are independent contracting parties, and nothing in this agreement shall be deemed to create a business partnership for purposes of sharing profits and losses.

1. **Federal ITS Funds:** By executing this Agreement, the Government agrees, in accordance with TEA-21 Section 5208(f)(1), to reimburse the State with *Federal ITS Deployment Program funds* for a maximum of 50 percent of the allowable costs incurred in the performance of work under this ITS Partnership Agreement. The State shall be reimbursed for allowable costs incurred in the performance of work under this agreement in an amount not to exceed $1,582,939.

1.1 Maximum Federal Share: In accordance with TEA-21 Section 5208(f)(2), the maximum share of *all Federal funding* for this project is not to exceed 80 percent of the cost of the activity. Thus the Federal ITS funds must be matched at a minimum 80/20 (Federal/non-Federal) ratio, resulting in a matching share valued at not less than $633,176. Reimbursement will follow regular Federal-aid billing and payment procedures in accordance with 23 C.F.R. Part 140.

1.2 Matching Share: The State shall match the Federal funds with at least 20 percent of the allowable costs. The 20 percent matching share must be from non-federally derived funding sources and must consist of cash, substantial equipment contributions that are wholly utilized as an integral part of the project, or personnel services dedicated full-time to the ITS Integration project for a substantial period. Such personnel costs are allowable only if not otherwise supported with Federal funds. The non-federally derived funding may come from State, local government, or private sector partners. No fee payable to a project partner shall be allowed as part of the matching share. This provision does not prohibit appropriate fee payments to vendors or others that provide goods or services to the project. It also does not prohibit business relationships with the private sector which result in revenues from the sale or provision of ITS products or services.

1.3 **Other Project Funding:** The State shall arrange for financing of the remaining costs of the project. The remaining costs may be funded from a variety of sources, including State or local government funds, private sector contributions and federally supported projects directly associated with the model deployment.

2. **Goals and Objectives:** The State shall work to accomplish the following goals and objectives (*more detail is provided in Attachment C*):

Goals

- Work with City and County Offices of Emergency Management (OEM) and other partners at he TranStar facility (City of Houston, Harris County and Houston METRO) to determine emergency evacuation, levels of integration and incident management needs for the critical roadway links (bridges) identified.

- Deploy applicable ITS devices (CCTV Cameras, fiber, Dynamic Message Signs (DMS), portable DMS, etc.) at four to five bridges that are critical to evacuation for emergency and traffic management.

- Integrate into TranStar, the devices deployed under this Work Order so that they can be used from the TranStar control floor to manage traffic in the event of an evacuation (for emergencies) and/or incidents.

Objectives

- . Integrate deployed devices and use them to manage incidents and reroute traffic where alternate routes are available

- Determine methods of communication (i.e., Highway Advisory Radio (HAR), pagers, Internet, etc.) to emergency personnel, incident management personnel, police and the public at large for each of the areas identified as critical links (bridges).

3. **Responsibilities of the State:** In conformance with approved Work Orders (See Section 10 below), the State shall perform or cause to be performed the following:

a. Develop the Work Plan and carry out activities as described in the attached Work Plan (See Section 4- detail will be provided upon completion of preliminary engineering)
b. Ensure Regional and Project ITS Architectural Consistency (See Sections 5 and 6)
c. Prepare or cause to be prepared: a local evaluation and a local evaluation report (See Section 7)
d. Inclusion of the project in the metropolitan or Statewide Transportation Improvement Program, as applicable, and in State air quality implementation plans, as appropriate. ***Note: Houston Priority Corridor Projects were included into the TIP in August, 1998 and in the STIP in November, 1998. The TIP and STIP will be updated to include the additional funds for this Work Order.***

4. **Work Plan:** The State shall develop an overall project Work Plan, schedule, and budget including the minimum 20 percent non-Federal match requirement, for approval by the Federal Highway Administration (FHWA) Division and/or Federal Transit Administration (FTA) Regional Office. The Work Plan, schedule, and budget shall become part of this signed agreement and attached as the last appendix, Appendix C.

5. **Regional ITS Architecture Consistency.** A Regional ITS Plan has been provided to the

FHWA and this Plan is in the process of being updated to include changes in this project. Regional ITS Architecture development is underway. Two National ITS Architecture classes "Using the National ITS Architecture for Deployment" classes have been hosted in Houston and the Program Manager and all Project Managers for the Houston Priority Corridor have taken this class. The State shall continue to ensure Regional consistency with the National ITS Architecture by performing or causing to be performed the following:

a. As additional classes are needed, the Houston District Office shall host an on-site presentation of the "Using the National ITS Architecture for Deployment" training course for project managers and technical staff from all key stakeholder groups, or otherwise ensure that they attend the training course. Project funding may be used to support hosting and attendance at this training course.

b. The State shall continue to participate and ensure participation updating the Regional ITS Plan in accordance with the attached Work Plan and schedule. This process shall be ongoing and include all key stakeholder groups. This planning shall continue to:

   1. Include broad stakeholder participation;
   2. Identify local needs that can be addressed through ITS applications;
   3. Include transit and other multimodal considerations;
   4. Develop descriptions of existing and planned ITS enhancements (physical inventory, sharing of information);
   5. Define a Regional ITS Architecture (to the subsystem and architectural flow level)
   6. Ultimately incorporate ITS in the applicable transportation plan.

c. The State shall continue to oversee the Houston Priority Corridor Plan (*identified as Work Order Number 2 of the Houston Priority Corridor program)*, providing updates on strategy and use of ITS applications within the program.

Regional ITS planning will continue to be carried out in parallel with the development of Regional ITS Architecture(s), provided that project Work Plans and actions demonstrate a concerted effort is underway, as determined by the FHWA Division and FTA Regional Office.

Development of a Regional ITS Architecture (including subsystems and architecture flows) may have been undertaken through a previous related effort, and no additional work may be necessary. However, the previously developed Regional ITS Architecture shall be modified, as required, to include changes and additions resulting from this and other relevant ITS projects.

6. Project ITS Architecture Consistency.

Project Architecture for Work Order Number 15 is attached to and made a part of Appendix C. Amendments to this project mapping will be made as needed. In accordance with the attached Work Plan and schedule, amendments to the project architecture shall document National ITS Architecture consistency by:

1. Providing a "mapping" of the project design and terminology to the applicable

Regional ITS Architecture or to the National ITS Architecture, if a Regional ITS Architecture is still under development.

2. Identifying and providing for potential interfaces, including transit and other modal consideration, and providing sound rationale for omitted architecture flows.
3. Showing use of approved ITS standards, where applicable.

National Architecture for this project were submitted for approval in the September, 1998 Priority Corridor Program Report. Any amendment(s) must be approved by the FHWA Division and/or FTA Regional Office, as appropriate.

7. **Self-Evaluation Report:** A local Self-Evaluation Report shall include a review of how well the project met the goals and objectives (see Section 2), the work completed, and a discussion of the technical and institutional issues encountered in completing the project. Analysis of all significant institutional issues that were addressed during the project, along with discussion of how they were resolved, shall be part of the evaluation report. It shall contain quantitative results for the applicable seven standard ITS measures. As appropriate, the local Self-Evaluation Report shall include a section prepared by legal counsel reporting and analyzing the disposition of significant legal issues, including contract, liability, privacy, regulatory and intellectual property issues. The report will contain an executive summary.

8. **Participation in Evaluations of National Interest:** Those Projects determined by the U.S. DOT ITS Joint Program Office (JPO) to be unique or nationally significant will cooperate with all phases of the Government's evaluation, from evaluation planning to reporting of evaluation results. Any required evaluations are to be conducted using project funds.

9. **ITS Deployment Tracking Surveys:** ITS Deployment Tracking Surveys have been completed for the Houston area. The District will continue to assure that ITS Deployment Tracking Surveys be completed pursuant to FHWA requirements.

10. **Work Orders:** Individual activities within the project Work Plan agreed to be performed by the State or caused to be performed by the State shall be incorporated in Work Orders. Each Work Order will specify the work and goals to be accomplished and the type and amount of assistance to be provided by the FHWA. Each Work Order must include a description of the work, completion dates for the work, and the signatures of the FHWA Division Administrator and an authorized representative of the State indicating acceptance of the Work Order prior to initiation of any work described therein. Issuance of a Work Order does not constitute a promise, either expressed or implied, that the FHWA will issue further Work Orders or provide additional assistance pursuant to this ITS Partnership Agreement. Continued funding will be dependent on the successful completion of ongoing tasks.

11. **Period of Performance:** The period of performance is as stated in the Work Orders. A final Local Evaluation Report (see section 7 above) documenting lessons learned and how well the project met the defined goals and objectives shall be submitted within six (6) months from the date of completion of the final Work Order and shall constitute completion of the project. This report shall be submitted to FHWA Division and/or FTA Regional Office, as appropriate.

12. **U.S. DOT Participation:** The United States Department of Transportation (U.S. DOT) agencies shall be considered full participants in the project. As such, the U.S. DOT shall be

provided the opportunity for membership on all management committees, subcommittees, working groups, task forces, and other such groups related to the project. The U.S. DOT will provide names, addresses, and phone numbers of DOT participants to the State Program Manager.

13. **Reporting Requirements:** Copies of all project reports, correspondence, meeting announcements, and other documents shall be supplied directly to the U.S. DOT. The U.S. DOT will provide names and addresses of specific contacts to receive these documents. All interim and final reports submitted to the U.S. DOT shall be in both a hard copy as a reproducible and as microcomputer files. The hard copy shall be done on a laser printer with a resolution of at least 300 dpi. All final reports developed under this agreement shall include:

1. A completed Technical Report Documentation form DOT F 1700.7(8-72). This form is necessary to ensure all reports are entered into the National Technical Information Service database.
2. The form is located on http://www.bts.gov/itc/1700-7.pdf);
3. An executive summary under separate cover.
4. A camera-ready copy including all work (illustrations, photographs, charts, or tables) ready for printing by photographic or other means;
5. An electronic version of the report in WordPerfect 6.0.
6. A one-page description of the report, including the title, why it is important, what it embodies, findings and / or benefits (expected or realized), real-world examples of who is involved (principles, team or other significant participants), and the audience.
7. A completed ITS Electronic Clearinghouse Document Profile Sheet.
8. Copies of items 2, 4, 5, and 6 above shall be delivered to the Director of the ITS Clearinghouse in the U.S. DOT ITS Joint Program Office.

a. **Quarterly Progress Reports.** Reporting for this project will be provided with the current Houston Priority Corridor Quarterly Report. Two reproducible hard copies and one electronic file of the quarterly progress report shall be submitted to the FHWA on or before the 20th of the month following the end of the quarter being reported, for submittal to U.S. DOT. At a minimum, the quarterly report shall contain a concise report covering the following:

1. The Federal-aid Project number or contract number, project name, a brief description of the project, major project partners, names and phone numbers of the partners project contacts, and the reporting period.
2. Budget and scheduling information including the date the project was initiated, the estimated completion date, cost estimate, expenditures during reporting period, percent of project completed, and percent of funds expended.
3. A brief description of the activities conducted during the reporting period including any milestones attained and/or significant events.
4. A discussion of any problems encountered or anticipated (e.g., scope changes, changes in project limits, funding requirements, technological constraints, institutional issues, project schedule delays) together with recommended solutions to such problems.

b. **Final Report.** Two reproducible hard copies and one electronic file of the Local Evaluation Report shall be submitted as described in the Period of Performance (See Section 11).

14. **Programmatic Changes:** The State must obtain the prior approval of the U.S. DOT whenever any significant change is anticipated. These include, but are not limited to:

    a. Any revision of the scope, goals or objectives of the consultant contract or related activities (regardless of whether there is an associated budget revision requiring prior approval).

    b. Changes in key personnel, program manager, or prime contractor.

15. **Intellectual Property:** Intellectual property consists of copyrights, patents, and any other form of intellectual property rights covering any data bases, software, inventions, training manuals, systems design or other proprietary information in any form or medium.

    It is the policy of the FHWA to allow the non-Federal partners of an ITS Partnership Agreement to retain all intellectual property rights developed under this agreement with the following limitations:

    a. Copyrights. The FHWA, as the contracting U.S. DOT agency, reserves a royalty-free, nonexclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, for Federal Government purposes:

        1. The copyright in any works developed under this agreement, or under a subgrant or contract under this agreement; and
        2. Any rights of copyright to which the State, its subgrantee, or contractor purchases ownership with Federal financial assistance provided by this agreement.

    b. Patents. Rights to inventions made under this agreement shall be determined in accordance with 37 C.F.R. Part 401. The standard patent rights clause at 37 C.F.R. §401.14, as modified below, is hereby incorporated by reference.

        1. The terms "to be performed by a small business firm or domestic nonprofit organization" shall be deleted from paragraph (g)(1) of the clause;
        2. paragraphs (g)(2) and (g)(3) of the clause shall be deleted; and
        4. paragraph (1) of the clause, entitled "Communications" shall read as follows: "(1) Communications. All notifications required by this clause shall be submitted to the FHWA Division Office."

16. **Costs:** The State shall limit its progress claims and final claims to those costs incurred in accordance with this ITS Partnership Agreement and shall submit its final claim within ninety (90) days after the project is completed.

17. **Additional Requirements:** These ITS funds shall be used only in support of, or for research on, intelligent transportation systems and not for construction of buildings. The design and operation of this ITS project must be consistent with the National ITS Architecture and the

purposes of section 5206(e) of TEA-21. This project shall contribute to the implementation of the ITS standards development work and shall promote interoperability of ITS systems among the States. Participation of small business concerns owned and controlled by socially and economically disadvantaged individuals is encouraged. The State shall comply with all applicable laws, regulations and the FHWA requirements, including, but not limited, to 49 C.F.R. Parts 18, 20, 21, 27, and 29, and the assurances in OMB SF 424B attached hereto as Appendix A.

18. **Certification Regarding Lobbying:** The State makes the certification regarding lobbying which is attached hereto as Appendix B.

19. **Termination:** The State shall notify FHWA immediately of any intent to terminate this ITS Partnership Agreement.

20. **Effective Date:** This ITS Partnership Agreement is effective upon execution by both parties.

IN WITNESS WHEREOF, State and the Government have executed these presents in duplicate counterparts..

THE GOVERNMENT
THE FEDERAL HIGHWAY ADMINSTRATION

By: Mark D Olson . Date: 9/24/99 .
Mark Olson, Traffic Operations Engineer
FHWA, Texas Division

THE STATE OF TEXAS
TEXAS DEPARTMENT OF TRANSPORTATION

Executed for the Executive Director and approved for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

By: Carlos A. Lopez, P.E. . Date: 9-21-99 .
Carlos A. Lopez, P.E. Director of Traffic Operations
Texas Department of Transportation

APPENDIX B. PRIORITY CORRIDOR PROJECT DESCRIPTIONS

APPENDIX B. PROJECT DESCRIPTIONS LISTED BY INTELLIGENT TRANSPORTATION INFRASTRUCTURE CATEGORY

0. ADMINISTRATIVE/PLANNING

- 0-1 Development of ITS Priority Corridor Program Plan (Work Order 2)
- 0-2 Public Information/Program Administration (Work Order 5)
- 0-3 Program Administration/Public Information/Project Development (Work Order 18)
- 0-4 ITS Technology for Data Collection and Transportation Planning (Work Order 16)
- 0-5 Integration of Priority Corridor Projects into Houston TranStar (Work Order 26)

1. REGIONAL MULTIMODAL TRAVELER INFORMATION CENTER

- 1-1 Real-Time Information Kiosks (Work Order 7)
- 1-2 On-Vehicle Navigation/Information Applications (Work Order 10)
- 1-3 Monitoring and Information Systems for Environmental Conditions (Work Order 11)
- 1-4 Dissemination of Traveler Information (Work Order 22)
- 1-5 Condition Responsive Uptown Traveler Information System (Work Order 24)

2. TRAFFIC SIGNAL CONTROL SYSTEMS

- 2-1 Changeable Lane Assignment System (CLAS) on Frontage Roads (Work Order 4)
- 2-2 Changeable Lane Assignment System (CLAS) at Selected Intersections (Work Order 12)

3. FREEWAY MANAGEMENT SYSTEMS

- 3-1 Monitoring Traffic and Transit Conditions and Incident Detection with AVI Technology (Phase 4) (Work Order 3)
- 3-2 Truck Monitoring and Warning Systems for Freeway to Freeway Connections (Work Order 6)
- 3-3 Integrated Corridor Transportation Management and Traveler Information System (Work Order 13)
- 3-4 Coordinated Ramp Metering and Intersection Traffic Signal Control (Work Order 23)

4. TRANSIT MANAGEMENT SYSTEMS

- 4-1 En-Route Transit Information System (Work Order 19)

5. INCIDENT MANAGEMENT PROGRAM

- 5-1 Closed Circuit Television Surveillance System Lease for Astrodome Area (Work Order 1)
- 5-2 Automatic Vehicle Locator System for Incident Management (Work Order 9)
- 5-3 Washburn Tunnel Traffic Management and Information System (Work Order 14)
- 5-4 Traffic Management and Traveler Information for Critical Roadway Links (Work Order 15)
- 5-5 ITS Enhanced Incident Management (Work Order 20)
- 5-6 Automatic Traffic Management in Flood Prone Areas through the Use of ITS Technologies (Work Order 21)
- 5-7 Automated Incident Management Strategies and Support Systems (Work Order 25)

6. ELECTRONIC FARE PAYMENT (no projects)

7. ELECTRONIC TOLL COLLECTION

- 7-1 Priority Lane Pricing Using AVI (Work Order 17)

8. RAILROAD GRADE CROSSING CONTROLS

- 8-1 Railroad Grade Crossing Monitoring System (Work Order 8)

9. EMERGENCY MANAGEMENT SERVICES (no projects)

0. ADMINISTRATIVE/PLANNING

0-1 Development of ITS Priority Corridor Program Plan (Work Order 2)

Problem: USDOT requires each Priority Corridor to develop a plan which provides a 20-year ITS vision and identification of deployment projects, schedules, and estimated costs. The plan will need guide funding and project implementation decisions.

Description: The objective of this study is to develop the Corridor Program Plan for the Houston ITS Priority Corridor. The study is a multi-year planning effort with initial activity and major effort focused on initial development of the plan. Periodic updates of the plan will occur as deployment activities progress, new applications occur, and schedule revisions are made. This review and update is important in maintaining a viable Priority Corridor Program Plan.

Development of the Priority Corridor Program Plan will result from a cooperative effort of local governmental organizations, the private sector, and TTI. The Priority Corridor Program Plan is a "living document," which will be periodically reassessed and updated based on experience with deployed projects and the evolving state-of-the-art of ITS.

Lead Agency: TxDOT
Estimated Cost: $600,000

0-2 Public Information/Program Administration (Work Order 5)

Problem: Administrative support is needed to manage the multi-year Priority Corridor Program with its many individual projects. Similarly, a public information program will be needed to foster understanding and acceptance of the program and individual projects.

Description: In conjunction with the planning and deployment of ITS Priority Corridor projects, there is a need for an ongoing program administration and continuing public information effort by TxDOT. A Priority Corridor Program Office will be established with a project coordinator.

The coordinator will be responsible for providing support for the various ITS deployments, informing the participating agencies and sponsors of the progress of the Priority Corridor Program, and working with the news media to provide information to the general public. The coordinator will also be responsible for coordinating proposals for the continued efforts in the Priority Corridor Program.

Lead Agency: TxDOT
Estimated Cost: $200,000

0-3 Program Administration/Public Information/Project Development (Work Order 18)

Problem: Administrative support is needed to manage the multi-year Priority Corridor Program with its many individual projects. Similarly, a public information program will be needed to foster

understanding and acceptance of the program and individual projects. Pre-engineering support is needed to refine individual projects into work orders and definitive project concepts.

Description: In conjunction with the planning and deployment of ITS Priority Corridor projects, there is a need for an ongoing program administration and continuing public information effort by TxDOT. A Priority Corridor Program Office has been established with a project coordinator. The coordinator is responsible for providing support for the various ITS deployments, informing the participating agencies and sponsors of the progress of the Priority Corridor Program, and working with the news media to provide information to the general public. The coordinator will also be responsible for coordinating proposals for the continued efforts in the Priority Corridor Program.

Project development activities will be supported as part of this project. It is expected that this project will support agencies with project refinement/pre-engineering services which would lead to later project deployment (design and implementation).

Lead Agency: TxDOT/METRO
Estimated Cost: $790,000

0-4 ITS Technology for Data Collection and Transportation Planning (Work Order 16)

Problem: The regional transportation planning process, coordinated by H-GAC, requires extensive traffic data to define travel characteristics and system performance. With the introduction of ISTEA's management systems, effective methods to capture and collect data with flexible methods are needed for monitoring and evaluation of the transportation infrastructure and to determine the effects of transportation control measures within the region. Data sources available through Houston TranStar will be useful to H-GAC's continuing planning, evaluation, and monitoring process.

Description: This project will develop a computer system to facilitate use of the database at Houston TranStar in planning efforts. Data assembly and analysis could include historical trends in traffic characteristics, traffic sampling for special studies, summaries of operational measures, and before and after data for performance verification.

Lead Agency: H-GAC
Estimated Cost: $300,000

0-5 Integration of Priority Corridor Projects into Houston TranStar (Work Order 26)

Problem: Development of Houston TranStar has created a unique operational facility upon which to overlay the Priority Corridor deployment efforts. Houston TranStar permits coordinated operation and maintenance of ITS facilities by the four local transportation agencies from this common location. Concurrent with most priority corridor project deployment is the need to integrate them with Houston TranStar systems.

Description: This project assures that Priority Corridor deployments are designed and integrated to assure compatibility, inter-connectivity, and operational efficiency. Houston TranStar's information systems manager and "principal integrator" will be responsible for the overall development of Houston TranStar computer systems and will coordinate Houston TranStar integration and system development performed by others to ensure that all systems can function within the standards, guidelines, and established architecture.

Lead Agency: TxDOT
Estimated Cost: $1,365,500

1. REGIONAL MULTIMODAL TRAVELER INFORMATION CENTER

1-1 Real-Time Information Kiosks (Work Order 7)

This work order was classified as completed following completion of the preliminary engineering study. Remaining project funding shifted to Work Order 19 and Work Order 24.

Lead Agency: TxDOT
Estimated Cost: $84,943

1-2 On-Vehicle Navigation/Information Applications (Work Order 10)

This project was eliminated from the Priority Corridor Plan with efforts for on-vehicle systems considered to be in the domain of the private sector.

Lead Agency: TxDOT
Estimated Cost: $0

1-3 Monitoring and Information Systems for Environmental Conditions (Work Order 11)

Problem: The Houston area is subject to unpredictable and severe weather conditions that can result in extensive roadway flooding during periods of intense rainfall. Several freeways, frontage roads, and major arterials have a history of being closed due to flooding conditions during severe storms. The technology is currently available to provide real-time monitoring of these conditions to Houston TranStar, and this information could be used by Houston TranStar personnel to make control decisions and distribute traveler information.

Description: This project monitors water levels at roadway locations that historically experience roadway flooding and the status of pumps that are automatically activated to pump low roadway areas (typically underpasses) that cannot be drained through gravity flow systems. Harris County Flood Control District has 80 stream-level and rainfall gages that are continuously monitored and could be integrated into Houston TranStar's database, as well as correlated with flooding at critical roadway locations. In addition to monitoring roadway and waterway conditions, the availability of real-time weather radar and National Weather Service alerts would provide for advanced warning of severe conditions that may impact roadways. Because unpredictable and variable weather

conditions occur at all times of the year, the implementation of such a system could be a useful component of an Advanced Traveler Information System (ATIS).

This project will integrate the electronic data stream from an existing Harris County Flood Control District network of stream-level and rainfall gages with a proposed system of devices that monitor roadway environmental conditions and the operational status of TxDOT's storm water pumping facilities.

Using these sources of real-time information on the status of general weather conditions and location-specific data, ATIS services will assist motorists in pre-trip planning and en-route response to advisory information on flooding.

Lead Agency: TxDOT
Estimated Cost: $725,000

1-4 Dissemination of Traveler Information (Work Order 22)

Problem: Houston TranStar has initiated a variety of programs that produce data and information supporting traveler information systems. This information includes travel speed, incident locations, construction activities, and flooding locations. Information regarding each element is produced in real time, which can be integrated into the Houston TranStar system and then distributed to users in a variety of user-compatible forms including graphics, text, and video.

Description: Distribution of several information types and delivery modes is envisioned for the project, and traveler information would be provided to the private sector as well as to public sector organizations. Typical information processing/delivery systems envisioned include:

- Freeway Travel Speed Map–Houston TranStar currently provides the map on the Internet. A system is to be developed to convert the map information into a format compatible with television equipment for use by the media (including the Municipal Channel).
- Text Information–Travel speed, incident, and construction information will be provided in a text scroll bar format, which will provide more detailed information than can be provided in graphic formats.
- Flood Control Map–Harris County Flood Control District operates a real time monitoring system of rain gages and stream flow meters. This "Alert System" is now located in Houston TranStar and will be integrated into Houston TranStar computer and traveler information systems.
- Internet Site Enhancement–Houston TranStar has an Internet site that posts real time data and travel time information. The information will be supplemented, and other improvements in the site will be made.

Lead Agency: TxDOT
Estimated Cost: $1,508,750

1-5 Condition Responsive Uptown Traveler Information System (Work Order 24)

Problem: The uptown area of Houston is the largest suburban business center in the United States. The resulting travel to and through uptown now significantly influences the traffic operations of freeways and arterials in the area. Existing freeway and arterial traffic control and information signs do not provide the ability to fully manage traffic conditions and mobility in the uptown area. The development and implementation of improved signing and information systems could enhance uptown mobility and traffic operations by identifying and communicating the most advantageous routes.

Description: This joint public/private sector project will develop improved wayfinding systems to enhance the mobility and convenience of traveling for workers, shoppers, and visitors. Uptown's private sector would develop and participate in the implementation of this system. The City of Houston has identified the need to better inform motorists and TxDOT in working to increase the effective utilization of the freeway network.

This project will include ITS applications, surveillance, and other components that can be integrated into Houston TranStar. It ranges from static (traffic, transit, pedestrian) signing to real time travel information kiosks which communicate with Houston TranStar. The project's purpose is to: 1) inform travelers of the quickest available routes or facilities, 2) provide transit schedules and stop locations, and 3) communicate travel conditions and facilitate mobility by effective usage of available transportation facilities and services. Project boundaries will generally be Memorial Drive, the Southern Pacific Railroad tracks, Gulfton, and Chimney Rock. Infrastructure components could include static signing, closed circuit television (CCTV) surveillance, variable message signing, traveler information kiosks, cellular phone hotline, highway advisory radio (HAR), and traveler information via Internet.

Lead Agency: Harris County Improvement District #1 and City of Houston
Estimated Cost: $1,268,890

2. TRAFFIC SIGNAL CONTROL SYSTEMS

2-1 Changeable Lane Assignment System (CLAS) on Frontage Roads (Work Order 4)

Problem: Frontage roads are an essential element of design and operation on urban freeways in Texas. Double turns from the frontage road are often permitted because of high interchanging traffic demands. However, turning traffic demands are often highly variable throughout the day. In addition, freeway incidents often create high frontage road demands, as traffic diversion occurs from the mainlanes to the frontage roads.

Description: The objective of this project is to design, install, and evaluate 11 changeable lane assignment control systems that can alter the permissive double turns at frontage road intersections based on traffic demands. TTI developed a Changeable Lane Assignment System (CLAS) concept that uses fiber optic lane use signing. These changeable (dynamic) lane use signs permit double turns when needed and then change to indicate normal lane use (turns permitted only from outer

lanes) when appropriate. TxDOT installed a prototype CLAS system in Houston on the inbound frontage road of I-10 at Bingle/Voss. This CLAS installation provides reliable, effective control, and it is this lane use control system with certain improvements proposed for implementation on U.S. 290, as well as for replacement of the prototype installed on I-10. The proposed locations for the installations are 10 outbound intersections on U.S. 290 Northwest Freeway and one intersection on I-10 Katy Freeway. The system will operate in both pre-timed and responsive control modes, with monitoring and control from Houston TranStar.

Lead Agency: TxDOT
Estimated Cost: $750,000

2-2 Changeable Lane Assignment System (CLAS) at Selected Intersections (Work Order 12)

Problem: In the system of urban highway transportation facilities, the arterial street network is the backbone of the regional transportation infrastructure. Operation of an arterial's signalized intersections directly affects the capacity of an arterial street and the level of traffic service offered to its users. Development of an advanced traffic control technology will allow the signalized arterial street intersections to dynamically respond to the changing demand of turning traffic existing at these locations.

Description: A priority corridor project has been proposed to deploy CLAS at arterial/arterial street intersections in Harris County. It is also the objective of this project to expand the deployment strategy to include traffic responsive operation of the traffic signal control system as well as CLAS. Harris County will select two or three intersections to test CLAS deployment in operational treatments not included in the earlier CLAS deployment along freeway frontage roads. There are four potential CLAS applications that may be tested in this project: arterial/arterial intersections; interior approaches of arterial streets with wide median separations; arterial network to provide capability of dynamic traffic diversion as an incident traffic management alternative; and explore the possibility of developing traffic responsive algorithm and guidelines for a real-time integrated CLAS and signal control system.

Lead Agency: Harris County
Estimated Cost: $1,050,000

3. FREEWAY MANAGEMENT SYSTEMS

3-1 Monitoring Traffic and Transit Conditions and Incident Detection with AVI Technology (Phase 4) (Work Order 3)

Problem: The Houston Priority Corridor has been instrumented with AVI systems designed to measure travel times and average speeds on the freeway mainlanes and HOV lanes. The monitoring stations have an average spacing of 4.8 km (3 mi) and do not provide sufficiently detailed travel time information for use in automatic incident detection/management. In addition, there is a need for the AVI system to monitor transit activity at major transit facilities.

Description: This project proposes to provide a traffic monitoring system using AVI technology to monitor the following applications: transit vehicle schedules from HOV lanes' access points to park-and-ride facilities and from transit terminal facilities for shuttle bus operations; traffic conditions on arterial streets that serve as alternate routes to the freeway system; and freeway incident detection for traffic incidents that block one or more lanes.

The traffic data collected from the ramps and roadways with the expanded AVI coverage will enhance the travel time information used to advise motorists of alternate routes, assist emergency response agencies in incident management procedures, and inform transit agencies and HOV lane users of travel conditions.

Lead Agency: TxDOT
Estimated Cost: $2,231,250

3-2 Truck Monitoring and Warning Systems for Freeway to Freeway Connections (Work Order 6)

Problem: Direct connections in freeway-to-freeway interchanges are a major source of traffic congestion and safety concerns. Because the design speeds on these connections are usually lower than the design speeds on the mainlane roadways and approaches, traffic tends to enter the connection curves at higher than desired speeds. High speed vehicles, particularly trucks, can lose control or turn over in these connections. An active detection/warning system could serve to reduce the occurrence of truck accidents on freeway-to-freeway connections.

Description: The project proposes to apply speed measurement and vehicle classification technologies on the approaches to and within freeway-to-freeway connectors that have sections with low design speeds. These monitoring systems will detect large trucks and determine their spot speeds. A data processor will identify trucks and determine if the conditions are critical for maintaining control of the vehicle through the connection. If the spot speed is too high for conditions, warning systems are activated to advise the driver to reduce his speed. The warning systems proposed would be dynamic to increase the target value and the compliance to what will be an advisory speed limit. New techniques for displaying messages on roadsides may be enhanced by also exploring methods of communicating to the driver within the vehicle.

Lead Agency: TxDOT
Estimated Cost: $220,000

3-3 Integrated Corridor Transportation Management and Traveler Information System (Work Order 13)

Problem: The Houston Priority Corridor program has proposed a number of deployment projects in the Integrated Corridor Project area (Northwest Corridor). There is an opportunity and a need to integrate these projects and build upon them with additional system deployment to provide an "integrated" approach to multimodal transportation operations, incident management, and traveler information in a single geographic corridor (U.S. 290/Hempstead Road). The operational concept

of the Integrated Corridor Project is to focus a number of ITS concepts and technologies, most of which are complementary and synergistic within one geographic corridor. The core infrastructure developed in the integrated corridor will provide the ability to monitor traffic conditions, operate traffic control systems, and communicate current operational conditions to travelers.

Description: The project proposes to deploy, operate, and evaluate various traffic and transit monitoring, transportation management, and traveler information systems on: U.S. 290 Northwest Freeway mainlanes, HOV lanes, and frontage roads; the parallel Hempstead Road; and other arterial streets in the Northwest Corridor from FM 1960 to I-610 West Loop.

The proposed integrated corridor approach will apply ITS technologies and applications individually and on a system basis. These technologies include: CCTV, automatic vehicle location (AVL), vehicle and railroad monitoring with AVI, variable message signs, HAR, and in-vehicle communications.

Lead Agency: TxDOT/METRO
Estimated Cost: $1,862,500

4. TRANSIT MANAGEMENT SYSTEMS

4-1 En-Route Transit Information System (Work Order 19)

Problem: The National Program Plan for ITS has established a need for providing travel-related information on traffic, transit, and roadway conditions by wayside communication's infrastructure. While the technology exists in component pieces, no experience from a full implementation on a transit fleet exists.

Description: This project will provide an infrastructure capable of identifying a moving transit vehicle by a roadside transponder and using the vehicle's identity to trigger an appropriate bi-directional exchange of transit rider information and vehicle data with the roadside device. The service would include real-time information on traffic, transit, and roadway conditions by this device. The system could include traveler information for riders, next bus arrival kiosks at selected bus stops and transit centers, and transit fleet management information.

Lead Agency: METRO
Estimated Cost: $1,046,167

5. INCIDENT MANAGEMENT PROGRAM

5-1 Closed Circuit Television Surveillance System Lease for Astrodome Area (Work Order 1)

Problem: Transportation agencies traditionally install their own communications medium for transmission of video signals from CCTV cameras located in the field. The installation of such systems requires lengthy design periods, tedious approval processes, extensive field testing, and

software development. As a result, the minimum construction period for such projects is two years. There is a need to find expedient approaches to development, operation, maintenance, and use of CCTV.

Description: The objective of this project is to expeditiously lease a turnkey CCTV system from a private organization utilizing existing communications media installed by the organization for other purposes. A survey of three potential bidders determined that a minimum lease of five years is required for such an arrangement to be feasible relative to public sector costs and private industry needs. The project will include the lease of a 10-camera CCTV in the Astrodome area to be used for transportation management of special events. An evaluation will be made of procedures used to secure the leased fiber optic system and services.

Lead Agency: TxDOT
Estimated Cost: $480,000

5-2 Automatic Vehicle Locator System for Incident Management (Work Order 9)

Problem: TxDOT and Harris County, through the Motorist Assistance Program (MAP), currently operate a fleet of vans to patrol freeways and respond to incidents and disabled vehicles. The application of a fleet management system is essential for coordinated and effective operation. Quick response and effective dispatching of these units can reduce the time for emergency response and the time needed to restore normal traffic operations. The objective of this project is to increase the effectiveness of incident management by implementation of an AVL system that identifies vehicles and locations on a real-time basis.

Description: The project proposes to implement one of a number of available AVL systems that would provide the management information needed for vehicle dispatch, patrol assignments, and automatic information collection and storage. The project will increase the effectiveness of the program by providing dispatchers in the transportation management center with continuous and accurate vehicle location information. With this information, dispatchers can quickly access availability and location of the nearest MAP vehicle, as well as being able to provide guidance on the best route to use when responding to an incident. The use of the AVL information as a traffic monitoring source will also be tested.

Lead Agency: TxDOT
Estimated Cost: $100,000

5-3 Washburn Tunnel Traffic Management and Information System (Work Order 14)

Problem: Harris County constructed the Washburn Tunnel under the Houston Ship Channel in 1950 to connect the cities of Pasadena and Galena Park. The tunnel provides access to area industries as well as important linkage between major employers and the residential areas on both sides of the Ship Channel. Weekday traffic volumes through the tunnel are approximately 30,000 vehicles per day with directional (one lane) peak hour volumes of 1,400 vehicles per hour. These peak period traffic volumes approach capacity for the 6.7 m (22 ft) wide roadway. The tunnel is approximately

1220 m (4000 ft) long and has a maximum grade of 6 percent. Truck traffic comprises approximately 20 percent of the tunnel traffic, even though those carrying hazardous materials are prohibited. When incidents occur in the tunnel or its approaches, severe congestion results, and diversion to alternate routes is severely limited. The objective of this project is to implement automatic incident detection and closure systems for the tunnel and develop traveler information services to advise travelers of conditions at the tunnel.

Description: The proposed integrated, areawide traffic management and traveler information systems would extend over a large area in order to minimize the user impacts of tunnel closures. The project will include four implementation components: an incident detection system, automatic tunnel closure, areawide traveler information, and an AVI-based commercial vehicle operations permitting process. It is anticipated that visual imaging technology, such as the Mobilizer Advanced Tracking System, will be used for incident detection at three detection locations in the tunnel. Automatic gates will replace manually operated gates at the tunnel entrances.

Lead Agency: Harris County
Estimated Cost: $1,220,000

5-4 Traffic Management and Traveler Information for Critical Roadway Links (Work Order 15)

Problem: There are some roadway system links in the Greater Houston and surrounding areas that when road closures or capacity reductions occur, result in significant motorist delay and inconvenience. Typically, these critical links have no reasonable alternative routes, and diversion routes may be long and create extensive travel delays to the motorist. Many of the critical links in the area serve as evacuation routes in the event of a hurricane that approaches the Texas Gulf coast.

Description: This project will focus ITS technologies on critical roadway system links (e.g., Baytown Bridge, IH 45/SH 146 Interchange, SH 6, Galveston Causeway, IH 10 at the San Jacinto River Bridge, and US 59 South) where incidents and construction can have a severe impact on the traveling public. Each potential critical link serves as an evacuation route for hurricane evacuation, and incidents during evacuations can severely impact that process. These critical links would be equipped with CCTV, vehicle detection, changeable message signs, AVI, and HAR. In addition to the permanent ITS technology implemented in the field, a portable ITS Freeway Traffic Management System (FTMS) would be used for evacuation, major incidents, and during construction as a temporary FTMS. The portable FTMS that include CCTV, change message signs (CMS), video vehicle detection, and a portable HAR. By implementing some new infrastructure and a portable FTMS, traffic management through these critical roadway links will provide a safer and more efficient system to the traveling public.

Lead Agency: TxDOT
Estimated Cost: $4,890,878

5-5 ITS Enhanced Incident Management (Work Order 20)

Problem: Accidents, stalled vehicles, and other incidents create a significant amount of vehicle and passenger delay on freeways. Effective management of these freeway incidents could significantly reduce delays and restore the freeway to normal operation sooner. Management systems could include rapid notification and deployment of special personnel and equipment needed for incident removal. Accident investigation and reporting are a routine part of incident management, yet the process has changed little in the last 50 years. The accuracy of information and reducing the time to complete accident investigations can be improved by using ITS technologies.

Description: This project will develop incident response, clearance, and traffic management strategies and the automated systems to support them. A communication system will be developed to transmit real-time data collected system-wide at the traffic management center to TxDOT traffic operations and maintenance personnel, law enforcement agencies, fire departments, and emergency medical services (EMS) that may be responsible for managing or responding to an incident that impacts a regional arterial or freeway. These responsible agencies/persons will receive needed information (e.g., CCTV, AVI, traffic data) in their office or home (if on quick response team) to permit fast decisions and response to major incidents. Innovative driver communications, such as truck/trailer mounted CMS, CCTV camera, HAR, and traffic signals, will be deployed as a mobile unit for on-site incident management.

On-site incident management for major incidents will utilize a mobile command vehicle. This vehicle will allow for all the decision makers from the various agencies to assemble at a technical focal point. ITS technology, such as HAR for public traffic information and real time video, will be incorporated for instantaneous communication with Houston TranStar.

In addition, advanced ITS-equipped police vehicles will be deployed for the accurate and timely collection and dissemination of traffic accident information. Using AVL, investigating officers can transmit accurate accident location information directly to Houston TranStar. Pen-based notebook computers with wireless communication capability will be used to record and transmit the accident report. This real-time accident reporting with accurate location information will be valuable in traffic management decisions by Houston TranStar staff.

Lead Agency: TxDOT/METRO
Estimated Cost: $787,500

5-6 Automatic Traffic Management in Flood Prone Areas through Use of ITS Technologies (Work Order 21)

Problem: The coastal areas of Texas are flat lands at low elevations and receive 138-150 cm (55-60 in) of rain per annum. During these rain storms, Houston and Harris County areas become a parking lot of stalled cars in high water and commuters trying to find passable routes. Freeway underpasses are especially plagued by these problems. The objective of this project is to significantly reduce major congestion problems in the Houston and Harris County area by using ITS technologies when major arterials are blocked by high water.

Description: It is anticipated that all of the intersections at major reroute nodes (15) will be updated to spread spectrum radios, microwave video with cameras, advanced traffic controllers (ATC) and CLAS in one electronic backplane. Existing and new water level detectors, operated by the Harris County flood control district, will be integrated with the traffic management center. These devices will need to be interconnected with wireless radio equipment to fit the Traffic Operations Center (TOC). The water level detectors on the reservoir and upstream will signal when the arterials are submerged. The video surveillance system that is existing on the I-10 corridor will confirm these alarms. The traffic control operator can then initiate the contingency plan for the affected area.

Lead Agency: Harris County
Estimated Cost: $2,000,000

5-7 Automated Incident Management Strategies and Support Systems (Work Order 25)

Problem: Freeway Management Systems (FMS) are operational or planned on essentially the entire Houston area urban freeway system. These systems include CCTV, vehicle detection, ramp metering, HOV lane control signals, and variable message signs. In addition, AVI systems monitor travel time/speed information for freeway segments. FMS are monitored and operated from Houston TranStar, which became operational in April 1996. The primary mission of Houston TranStar is the detection, management, and removal of freeway incidents.

Incident detection and management currently rely primarily on operators and traffic engineers in the center. There is a need to develop automated monitoring and traffic management tools that can guide and assist Houston TranStar operating staff in managing incidents in the safest, fastest, and most efficient manner.

Description: This project will develop incident response, clearance, and traffic management strategies and automated systems to support them. This project will pre-plan "response scenarios" for a wide range of incident types, locations, and traffic conditions that occur on the freeway system. These scenarios, tailored for specific incident types and locations, will identify at-site traffic control, ramp/lane closures, messages for variable signs, ramp metering strategies, and adjustment to frontage road traffic signals. By having these pre-planned "response scenarios," Houston TranStar staff can provide quicker, more accurate, and responsive incident management.

Lead Agency: TxDOT
Estimated Cost: $1,650,000

6. ELECTRONIC FARE PAYMENT (no projects)

7. ELECTRONIC TOLL COLLECTION

7-1 Priority Lane Pricing Using AVI (Work Order 17)

Problem: One of the criticisms of HOV lane operations and an inherent inefficiency is that unused capacity often exists, particularly under the 3+ persons per vehicle regime. One of the means of gaining higher usage of HOV lanes is the tolling or congestion pricing of the unused available capacity. Through congestion pricing, the tolls could be set to optimize usage of the HOV (priority) lanes.

Description: Priority pricing is the selling of available capacity on a priority lane during the restricted hours of operation. The technology proposed is the AVI transponder system similar to that used to measure travel times on the freeways and HOVs. Special traffic monitoring software will be provided that will identify the authorized vehicles in the field so METRO Police can be notified of a non-conforming vehicle using the HOV lane. The project will investigate the operational effectiveness of providing selective use of the HOV lane by pre-approved, non-conforming carpools, or single-occupancy vehicles.

Lead Agency: METRO/TxDOT
Estimated Cost: $462,500

8. RAILROAD GRADE CROSSING CONTROLS

8-1 Railroad Grade Crossing Monitoring System (Work Order 8)

Problem: Railroad grade crossings represent a major source of delay in Houston. There are numerous at-grade crossings that can affect traffic flow and safety on the arterial street system. The objective of this project is to examine how information systems and traffic control systems can be used to monitor the movements of trains and to adjust traffic patterns and advise emergency vehicles in the corridor to reduce delays at railroad at-grade crossings. On major bus routes and on routes frequently used by emergency vehicles, the additional travel times can be critical to their operations.

Description: This project proposes to monitor railroad train movements along one or more of these corridors: the Union Pacific rail line that parallels I-10 Katy Freeway and the Southern Pacific rail lines that parallel the I-610 West Loop Freeway and the US 290 Freeway/Hempstead Road. The monitoring systems will use AVI readers at selected locations to determine the position and identification of the train and to measure the travel times of trains moving along the lines. Advanced warning/information systems will be developed and implemented on approaches to selected intersections.

Lead Agency: TxDOT
Estimated Cost: $700,000

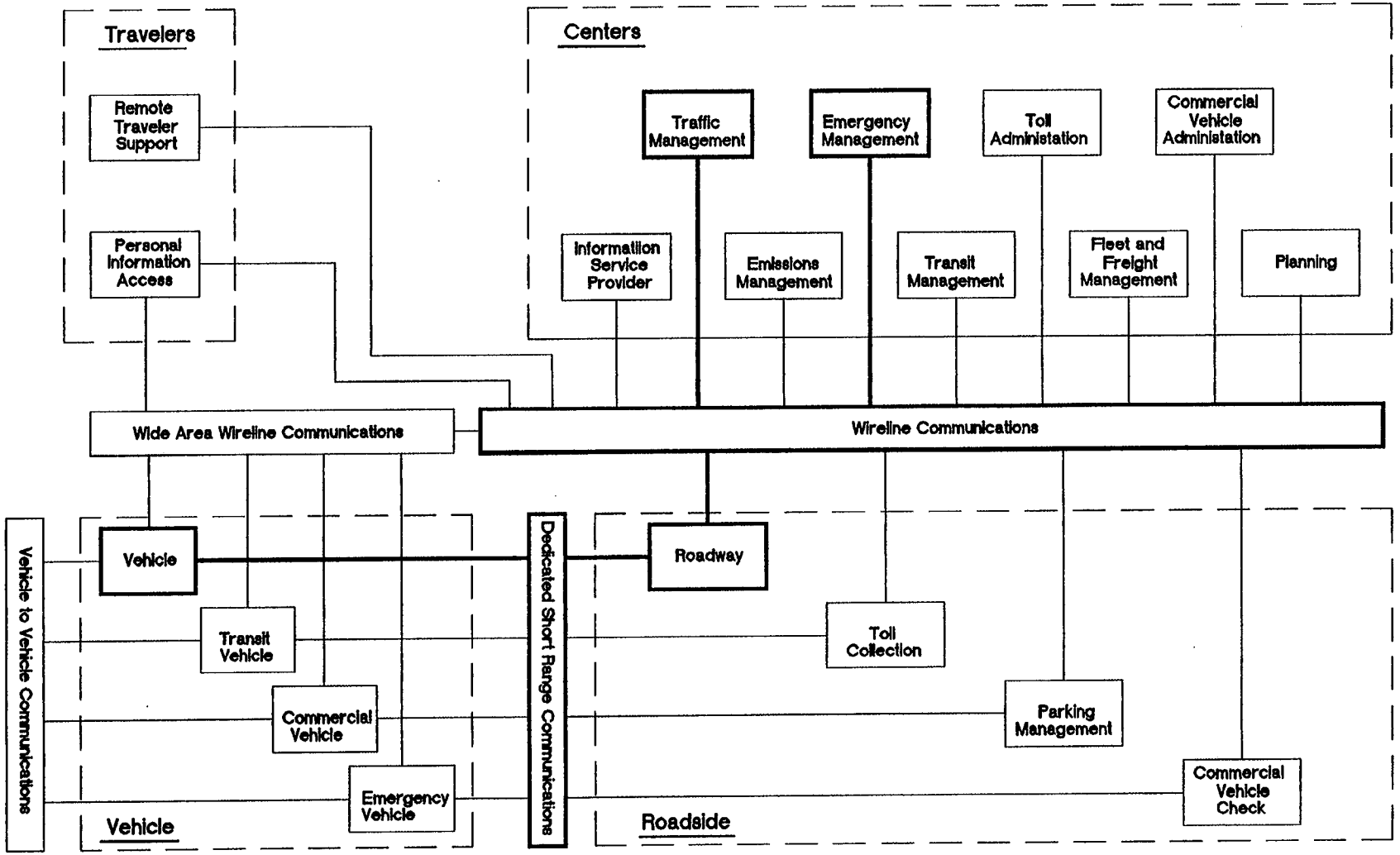
9. EMERGENCY MANAGEMENT SERVICES (no projects)

APPENDIX C. PROJECT ARCHITECTURE DIAGRAMS

Work Order 8

Description: The objective of this project is to examine how information systems and traffic control systems can be used to monitor train movements for adjusting traffic patterns and to advise travelers and emergency vehicles accordingly in the corridor to reduce delays at railroad grade crossings.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #8 Railroad Grade Crossing Monitoring System

Lead Agency: Texas Department of Transportation

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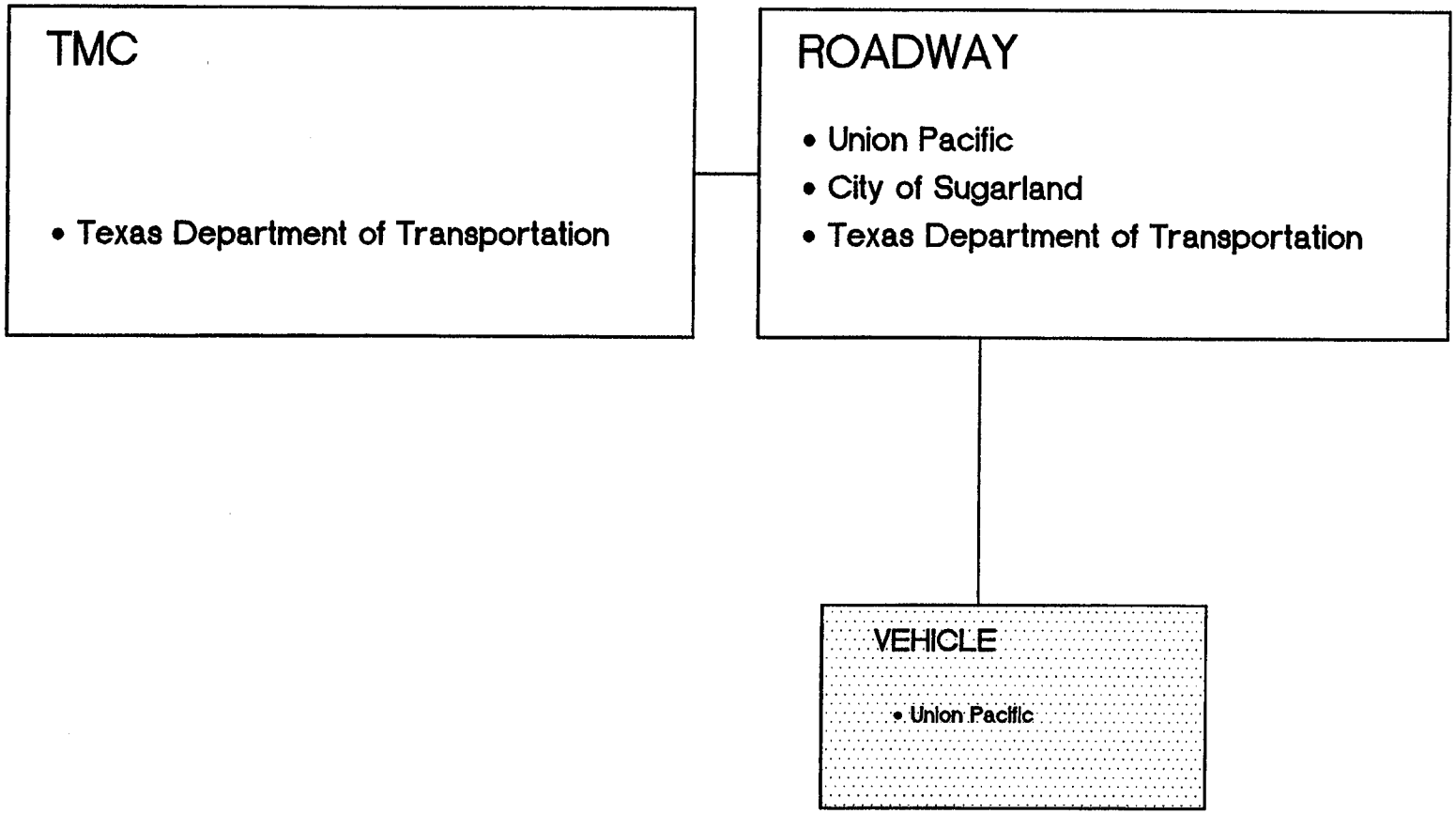
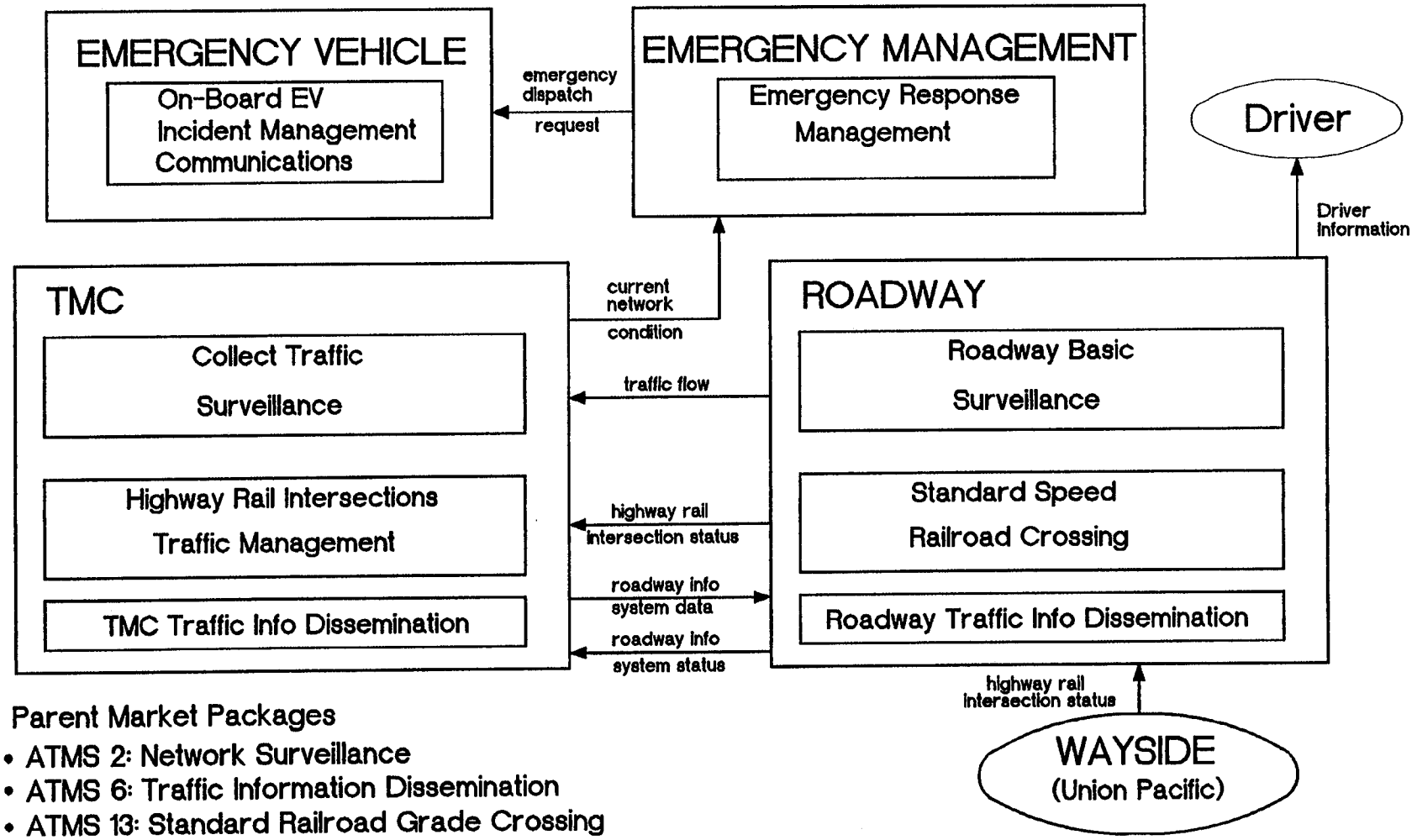


Priority Corridor W.O. #8 Railroad Grade Crossing Monitoring System

Lead Agency: Texas Department of Transportation

IDENTIFICATION OF EQUIPMENT PACKAGES



Parent Market Packages

- ATMS 2: Network Surveillance
- ATMS 6: Traffic Information Dissemination
- ATMS 13: Standard Railroad Grade Crossing
- EM 1 Emergency Response

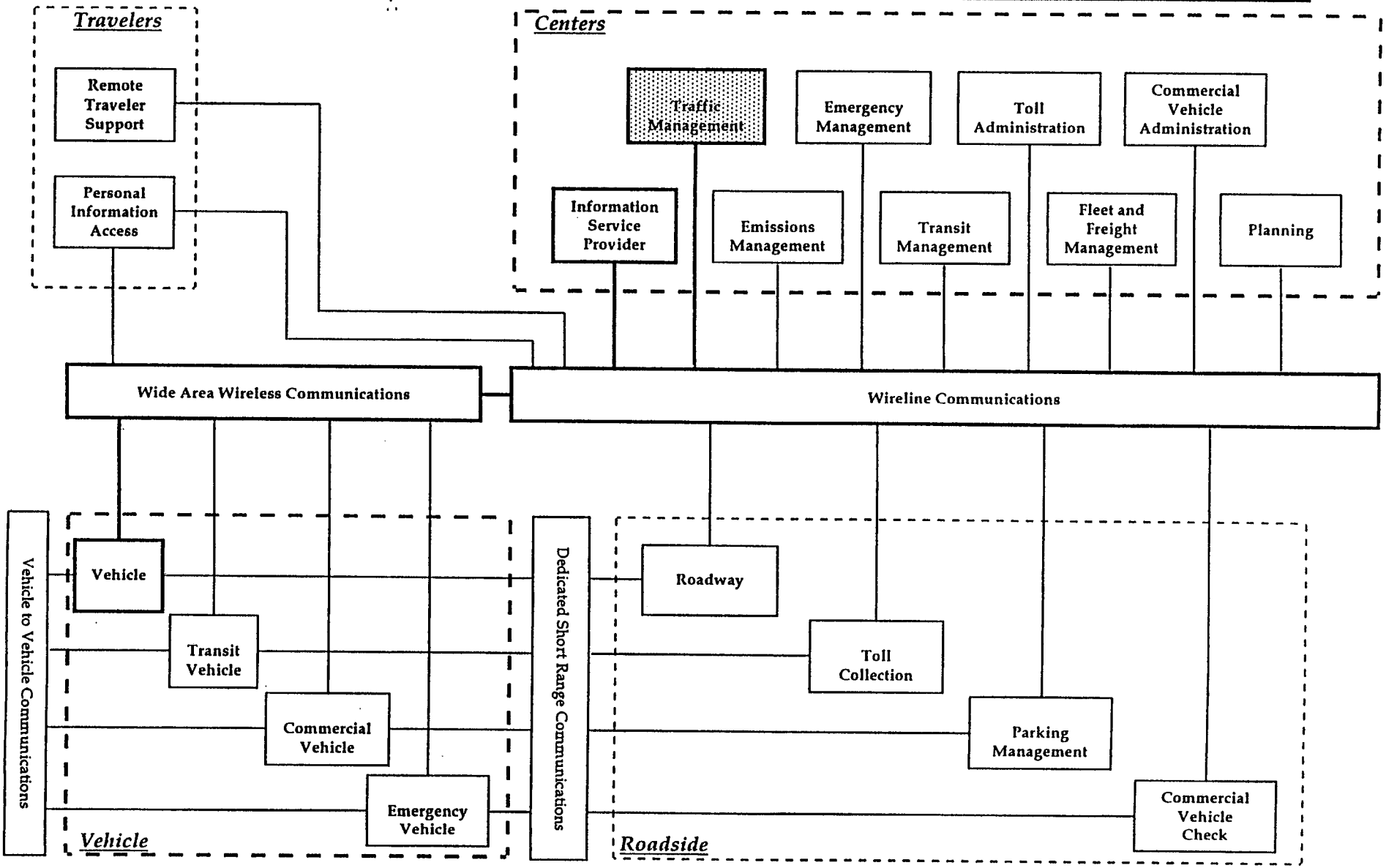
Priority Corridor W.O. #8 Railroad Grade Crossing Monitoring System

Lead Agency: Texas Department of Transportation

Work Order 10

Description: The project objective is to provide real-time information on travel conditions to travelers at all stages of their trip. Travel to any part of the Houston metropolitan area can be facilitated if travel conditions on these roadways are known in advance of the trip. Decision points for the alternate routes exist at several points in the corridor - two of which are within the George Bush Houston Intercontinental Airport. At this time, the scope would include simple map information, selection of the best major route to use, and an update of travel conditions on selected freeways and at critical decision locations. Through integration into TranStar, Automated Travel Information Systems (ATIS) mapping would be available on any in-vehicle navigation system to help re-route the recipient around congestion.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #10: On-Vehicle Navigation/Information Applications

Lead Agency: Texas Department of Transportation

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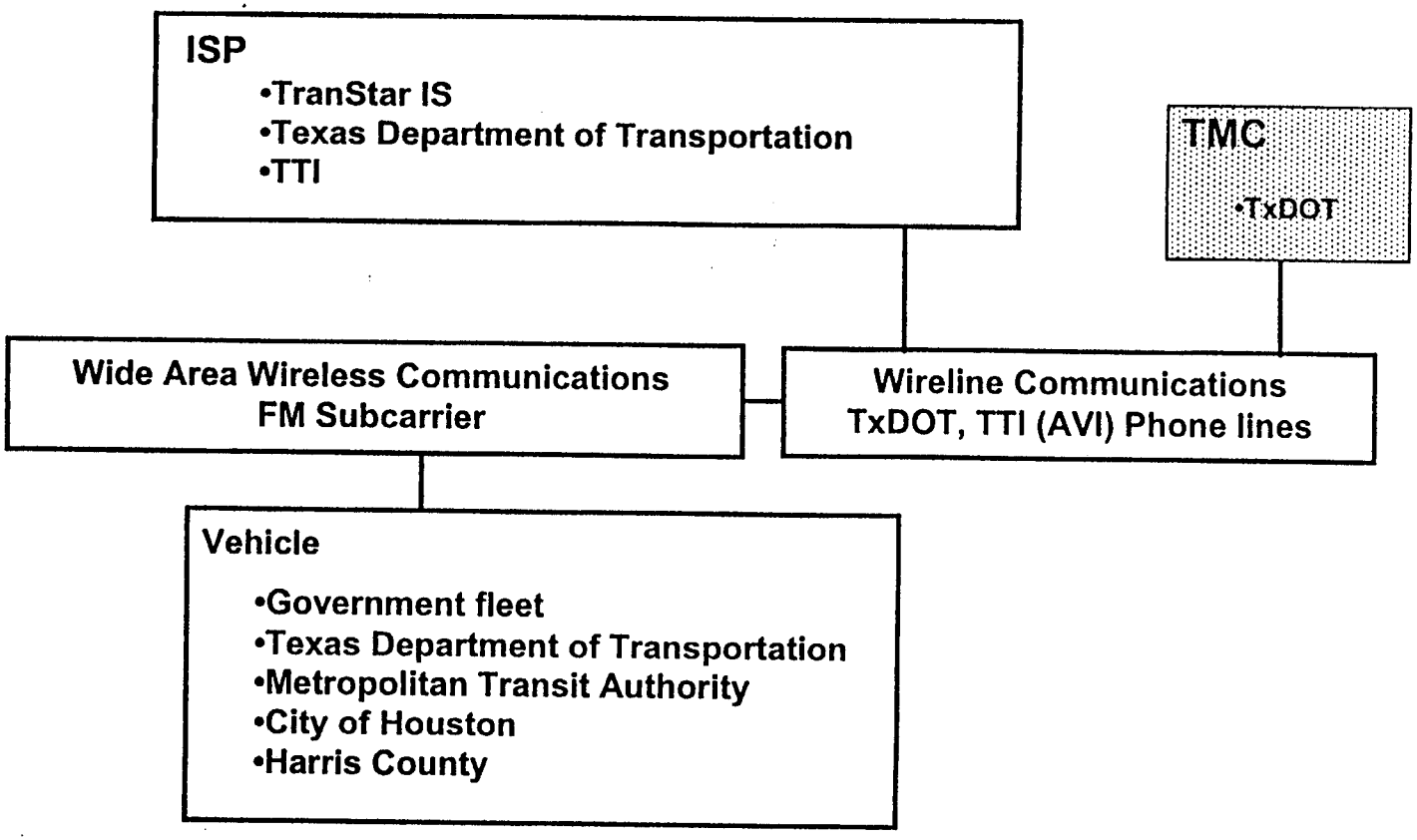

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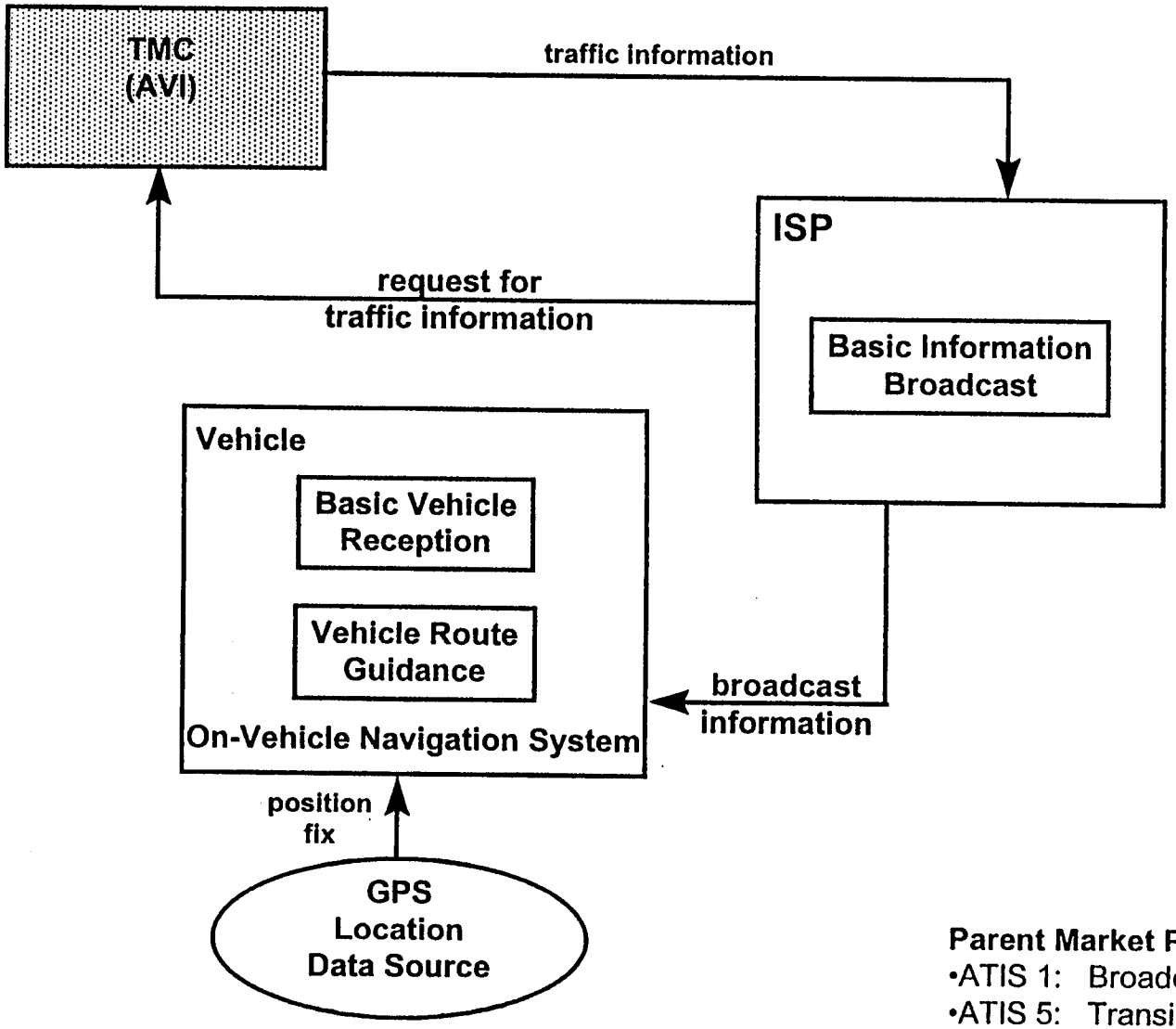
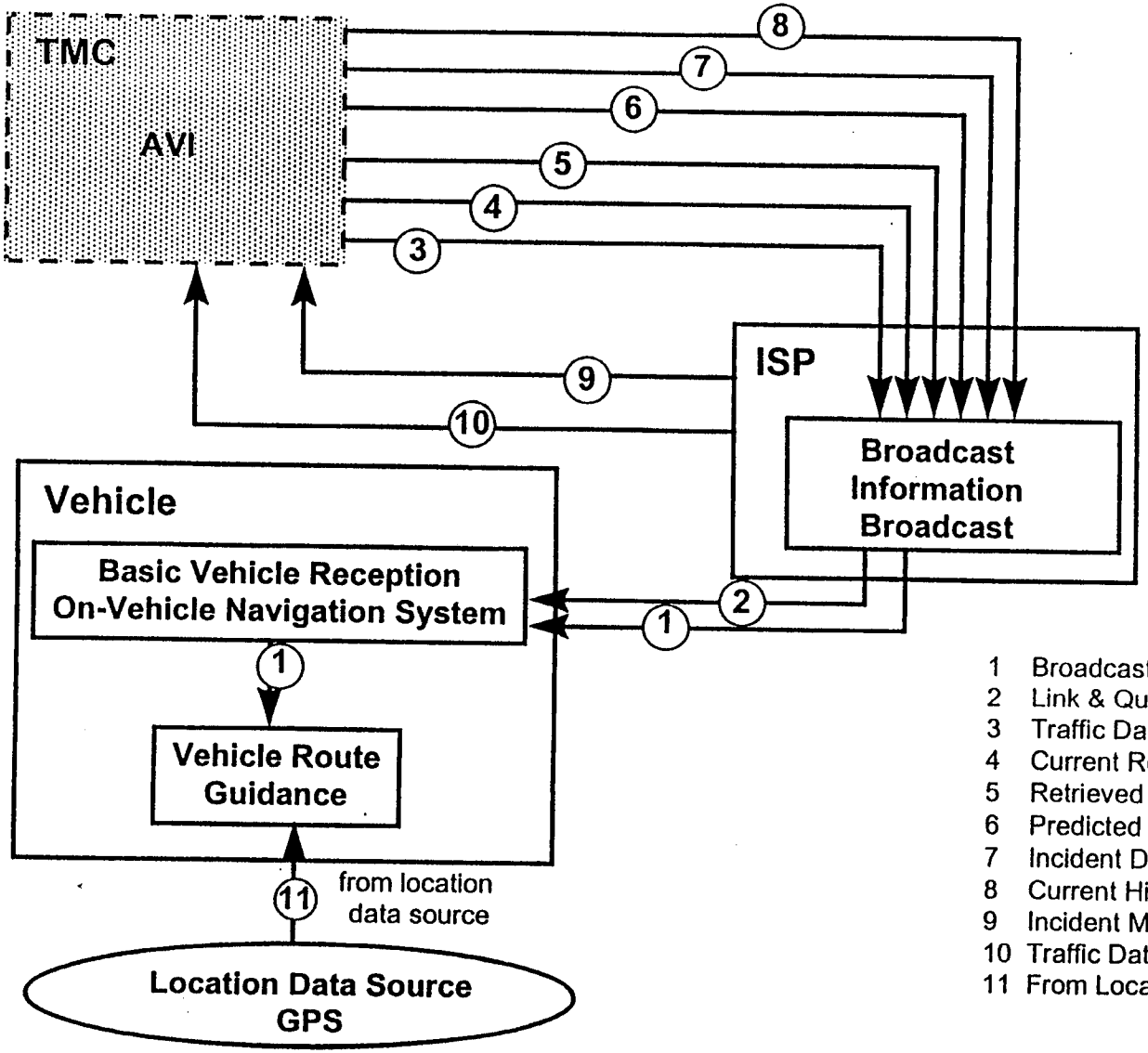


Parent Market Packages
- ATIS 1: Broadcast Traveler Information
- ATIS 5: Transit Security

Priority Corridor W. O. #10: On-Vehicle Navigation/Information Applications

Lead Agency: Texas Department of Transportation

IDENTIFICATION OF DATA FLOWS

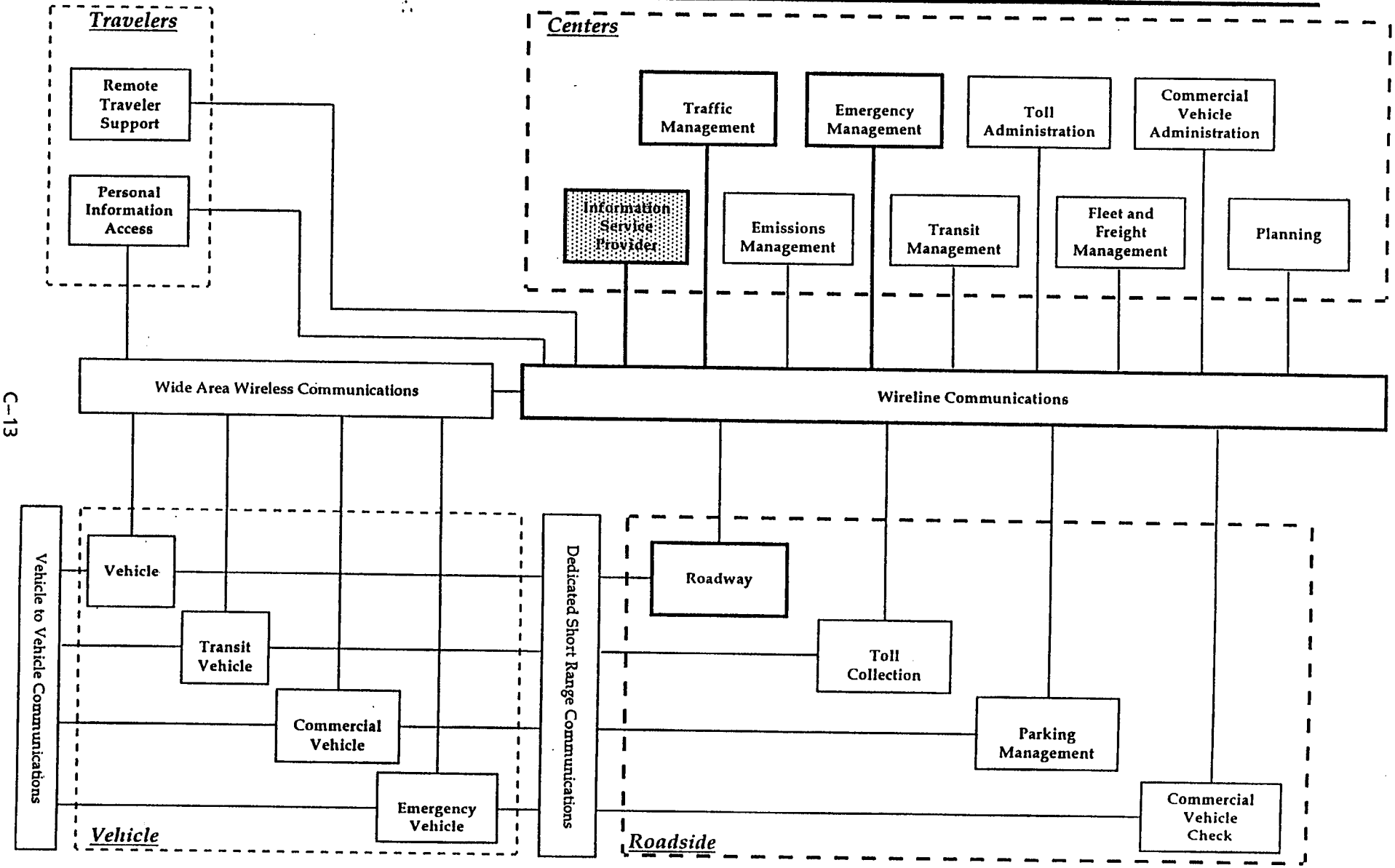


1 Broadcast Data
2 Link & Queue Data
3 Traffic Data for Media
4 Current Road Network State
5 Retrieved Incident Media Data
6 Predicted Incidents
7 Incident Data Output
8 Current Highway Network State
9 Incident Media Data Request
10 Traffic Data Media Request
11 From Location Data Source

Work Order 11

Description: The objective of this project is to investigate the potential of integrating weather, stream level monitoring, and roadway flooding information into the Advanced Travelers Information System (ATIS) at TranStar. This project proposes to develop monitoring systems for flooding conditions with computer programs that use GIS applications for traffic control plans. The programs would also include evacuation routes designated in the hurricane emergency plans.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #11: Monitoring & Information System

Lead Agency: Texas Department of Transportation

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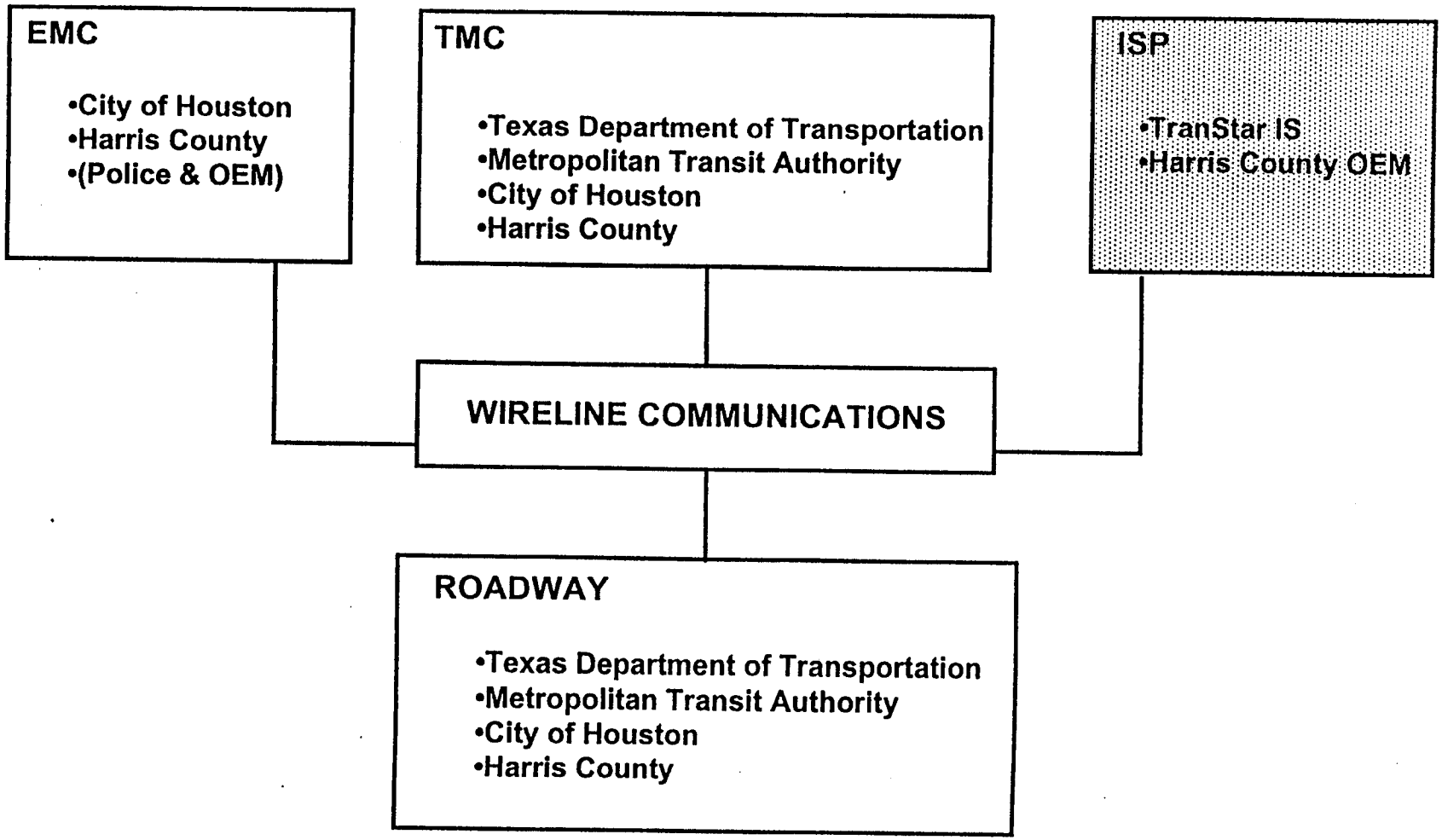

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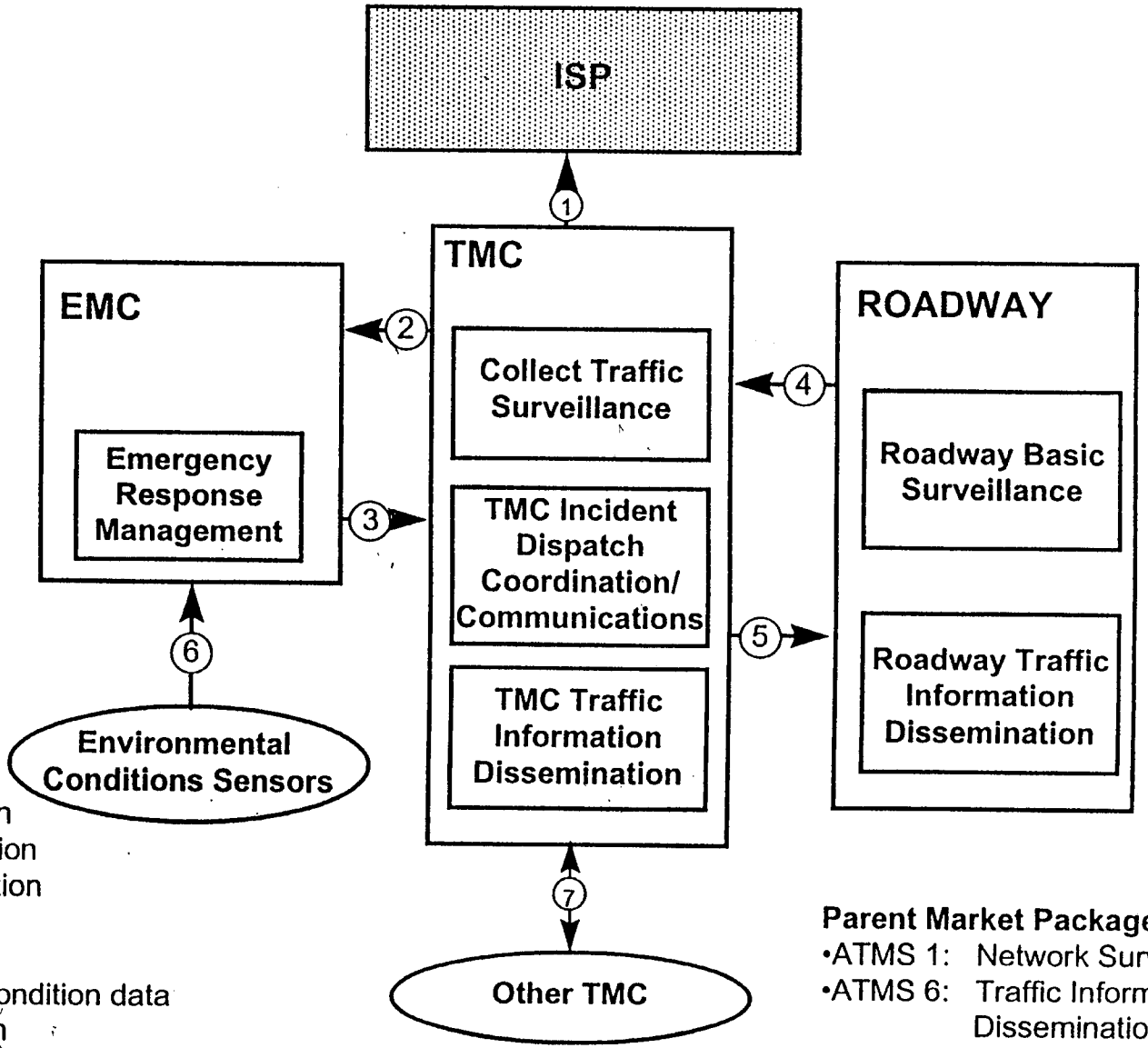


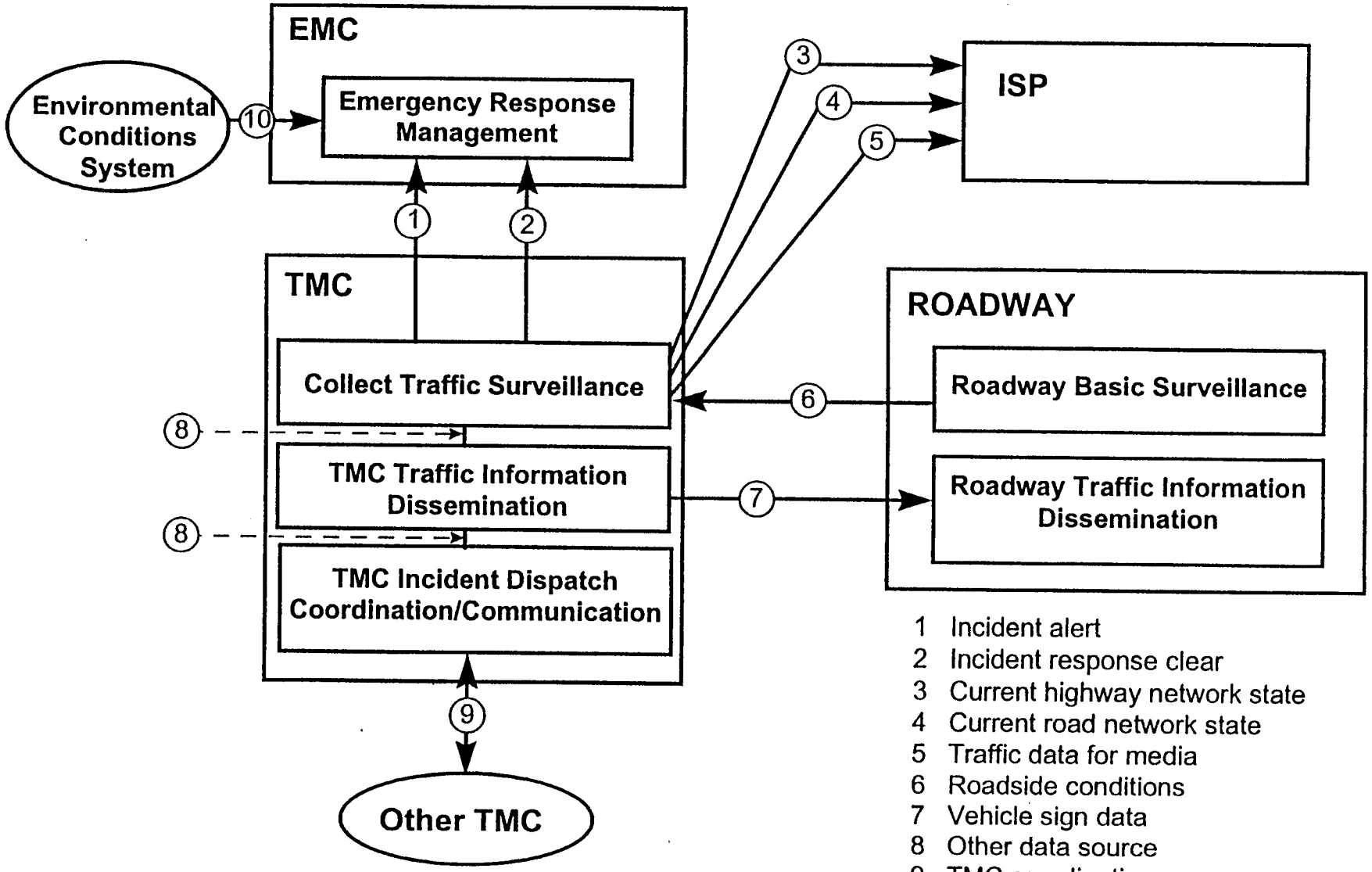
1 Traffic information
2 Incident notification
3 Incident information
4 Local traffic flow
5 Signage data
6 Environmental condition data
7 TMC coordination

Parent Market Packages
- ATMS 1: Network Surveillance
- ATMS 6: Traffic Information Dissemination
- ATMS 8: Incident Management System

Priority Corridor W.O. #11: Monitoring & Information System

Lead Agency: Texas Department of Transportation

IDENTIFICATION OF DATA FLOWS

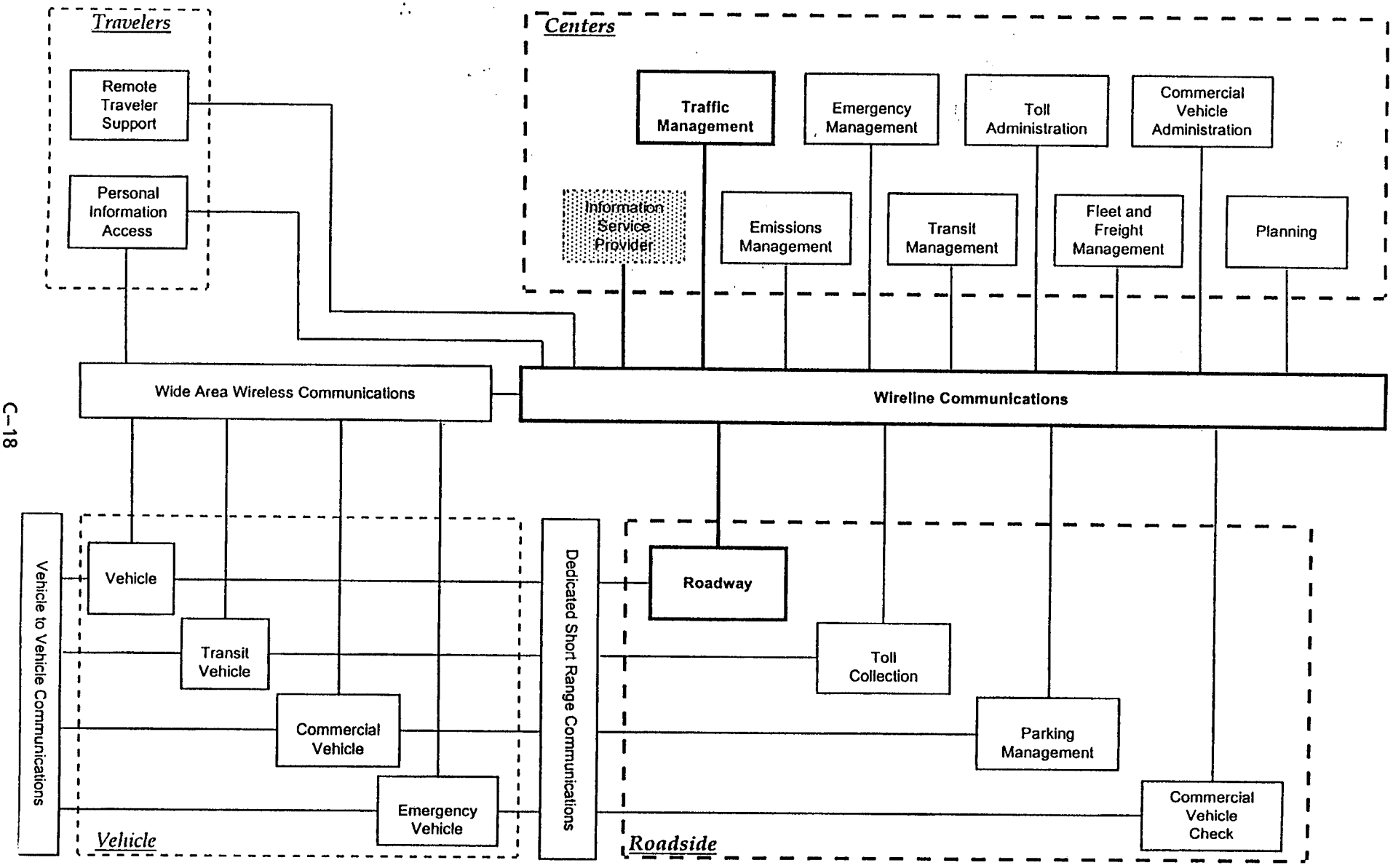


1 Incident alert
2 Incident response clear
3 Current highway network state
4 Current road network state
5 Traffic data for media
6 Roadside conditions
7 Vehicle sign data
8 Other data source
9 TMC coordination
10 Environmental data

Work Order 12

Description: The objective of this project is to expand the deployment strategy to include traffic responsive operation between the traffic signal control system and the Changeable Lane Assignment System (CLAS). An advanced traffic control technology needs to be developed which would allow the signalized arterial street intersections to dynamically respond to the changing demand of high-level interchanging traffic patterns existing at these locations.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #12: Changeable Lane Assignment System at Arterial Streets

Lead Agency: Harris County

houston transtar

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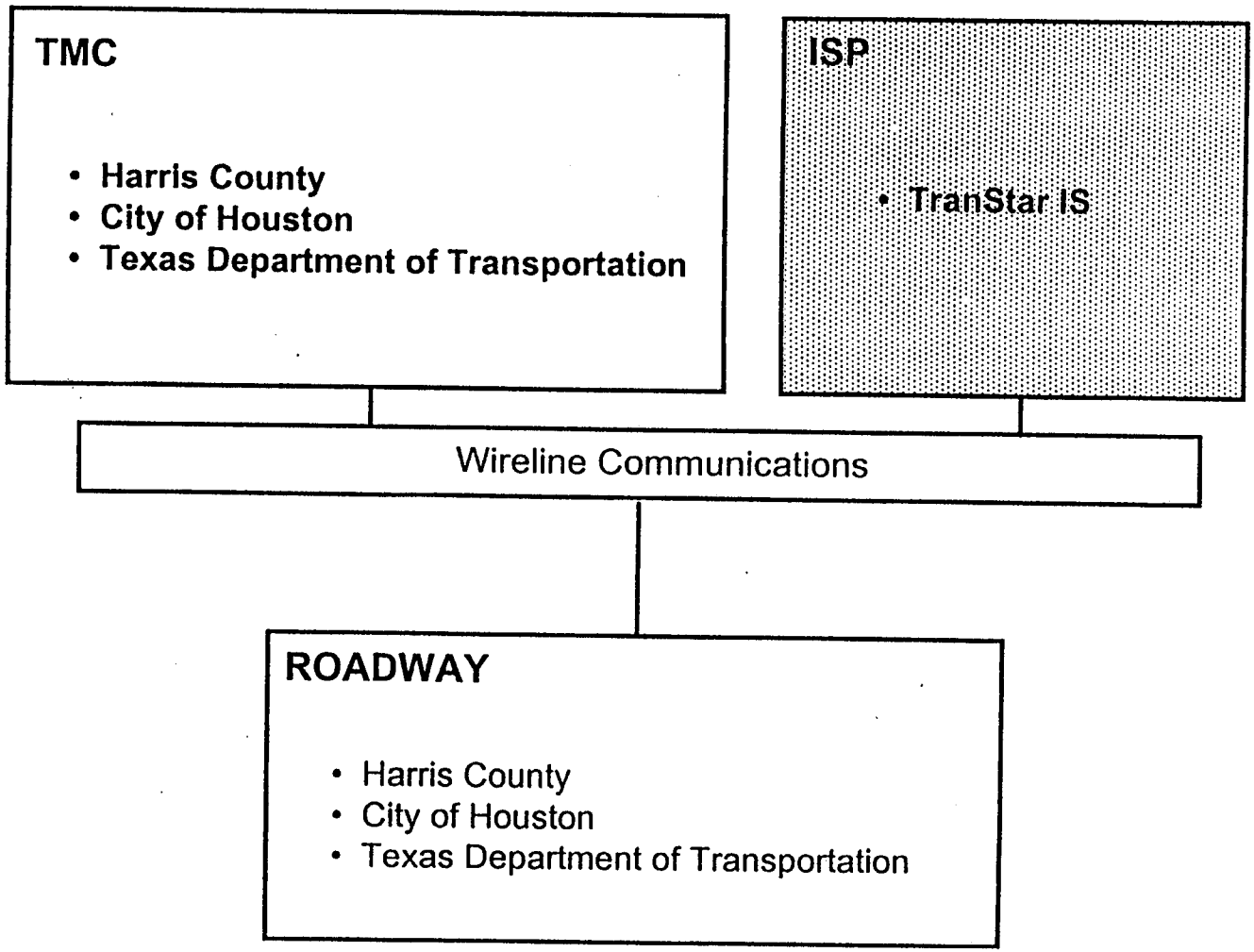
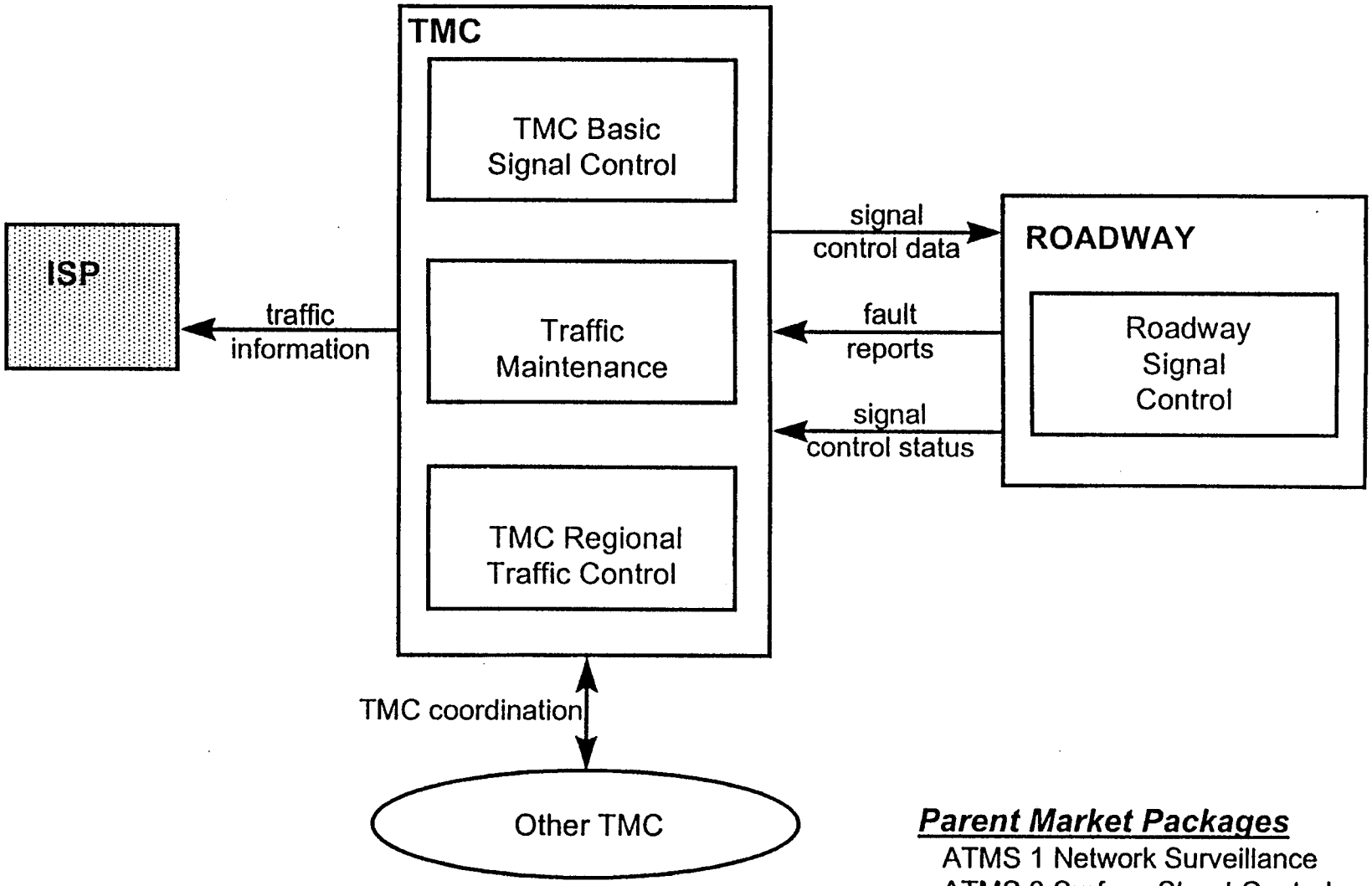


Priority Corridor W.O. #12: Changeable Lane Assignment System at Arterial Streets

Lead Agency: Harris County

HOUSTON TRANSTAR

IDENTIFICATION OF EQUIPMENT PACKAGES



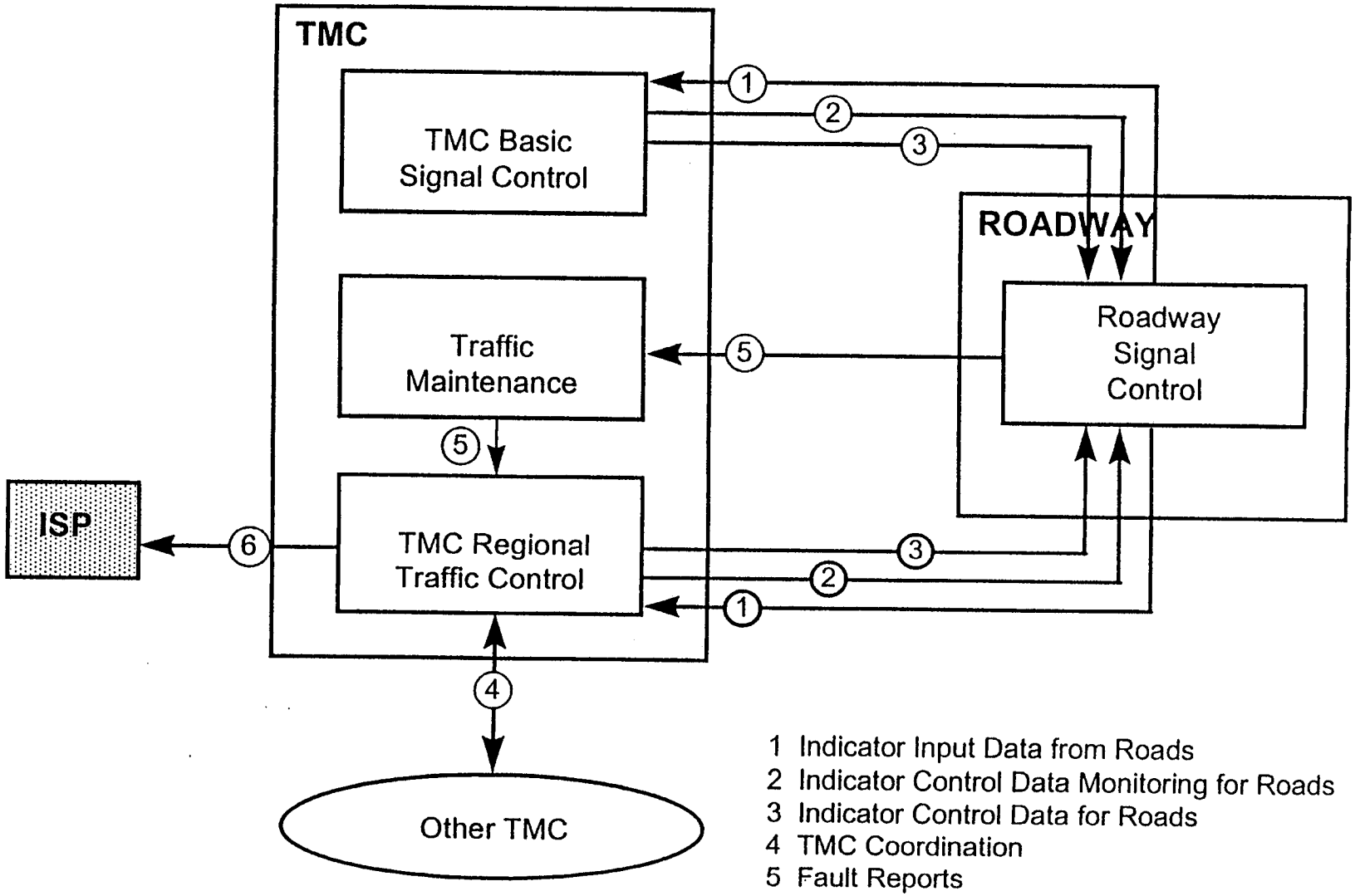
Parent Market Packages

ATMS 1 Network Surveillance
ATMS 3 Surface Street Control
ATMS 7 Regional Traffic Control

Priority Corridor W.O. #12: Changeable Lane Assignment System at Arterial Streets

Lead Agency: Harris County

IDENTIFICATION OF DATA FLOWS



Priority Corridor W.O. #12: Changeable Lane Assignment System at Arterial Streets

Lead Agency: Harris County

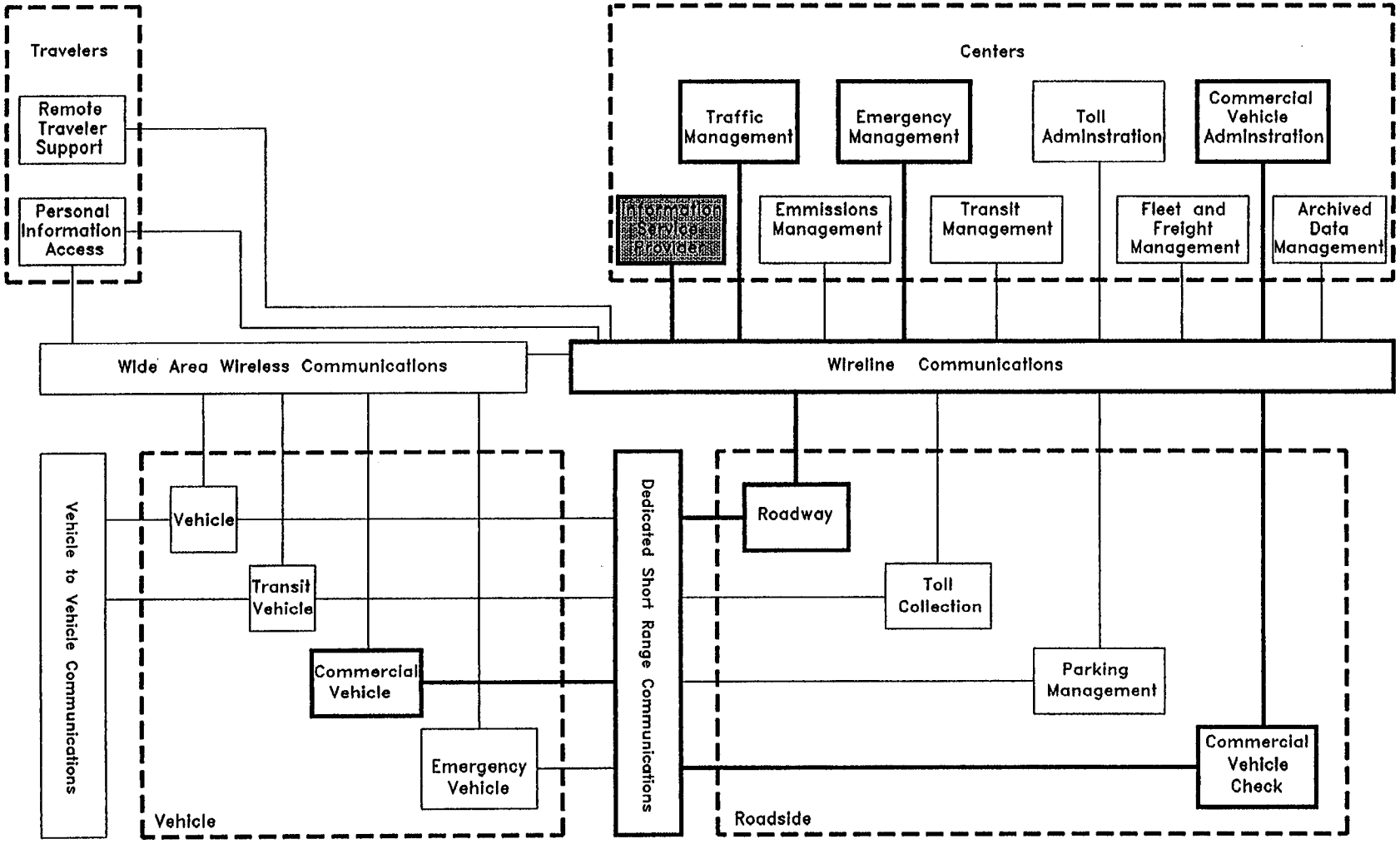
Work Order 14

Description: The Washburn Tunnel was constructed under the Houston Ship Channel in 1950 to connect the cities of Pasadena and Galena Park. The area adjacent to the Houston Ship Channel is one of the most intensely developed areas in the United States, dominated by large oil refineries, chemical plants, and related industries. The Washburn Tunnel provides access to area industries as well as important linkage between these major employers and the residential areas on both sides of the ship channel. An intergrated, area wide traffic management and traveler information system is proposed, with traveler information systems extending over a large area in order to minimize the user impacts of tunnel closures. The objective of this project is to implement automatic incident detection and closure systems for the tunnel and develop traveler information services to advise travelers of conditions at the tunnel.

Priority Corridor W.O. #14: Washburn Tunnel Traffic Management and Information System

Lead Agency: Harris County

NATIONAL ARCHITECTURE ELEMENTS



Priority Corridor W.O. #14: Washburn Tunnel Traffic Management and Information System

Lead Agency: Harris County

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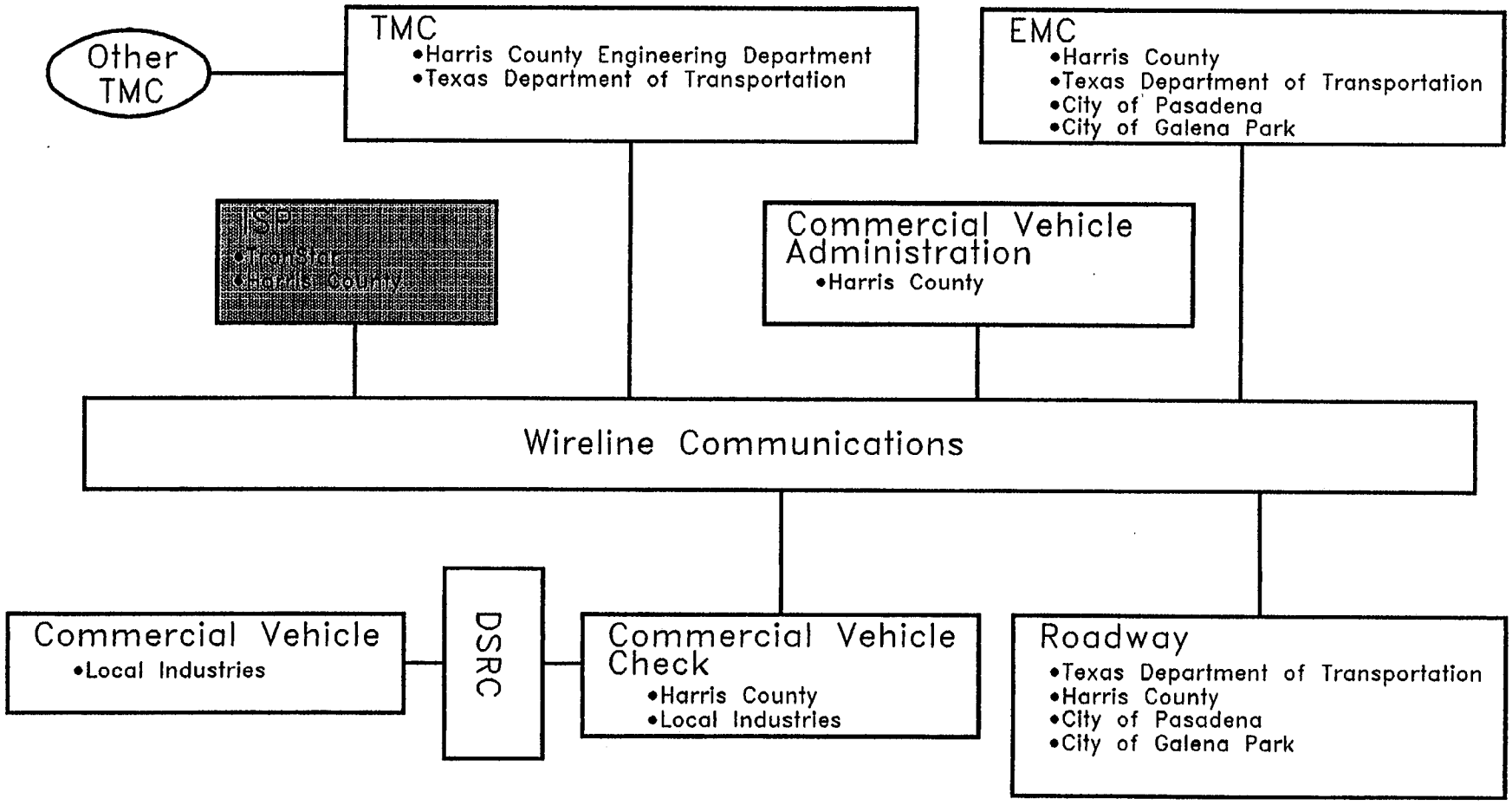
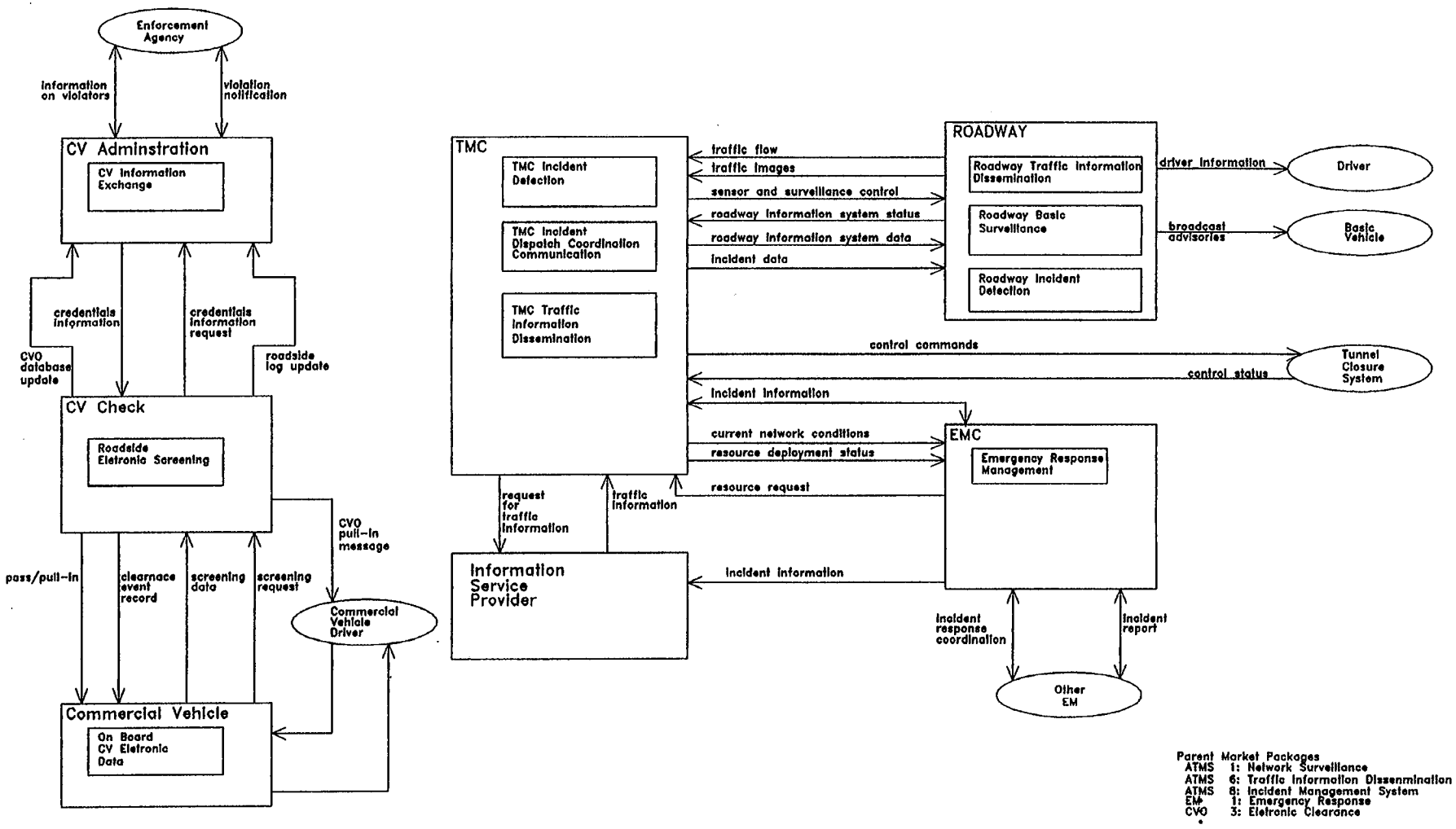


Priority Corridor W.O. #14: Washburn Tunnel Traffic Management and Information System

Lead Agency: Harris County

EQUIPMENT PACKAGES AND ARCHITECTURE FLOWS



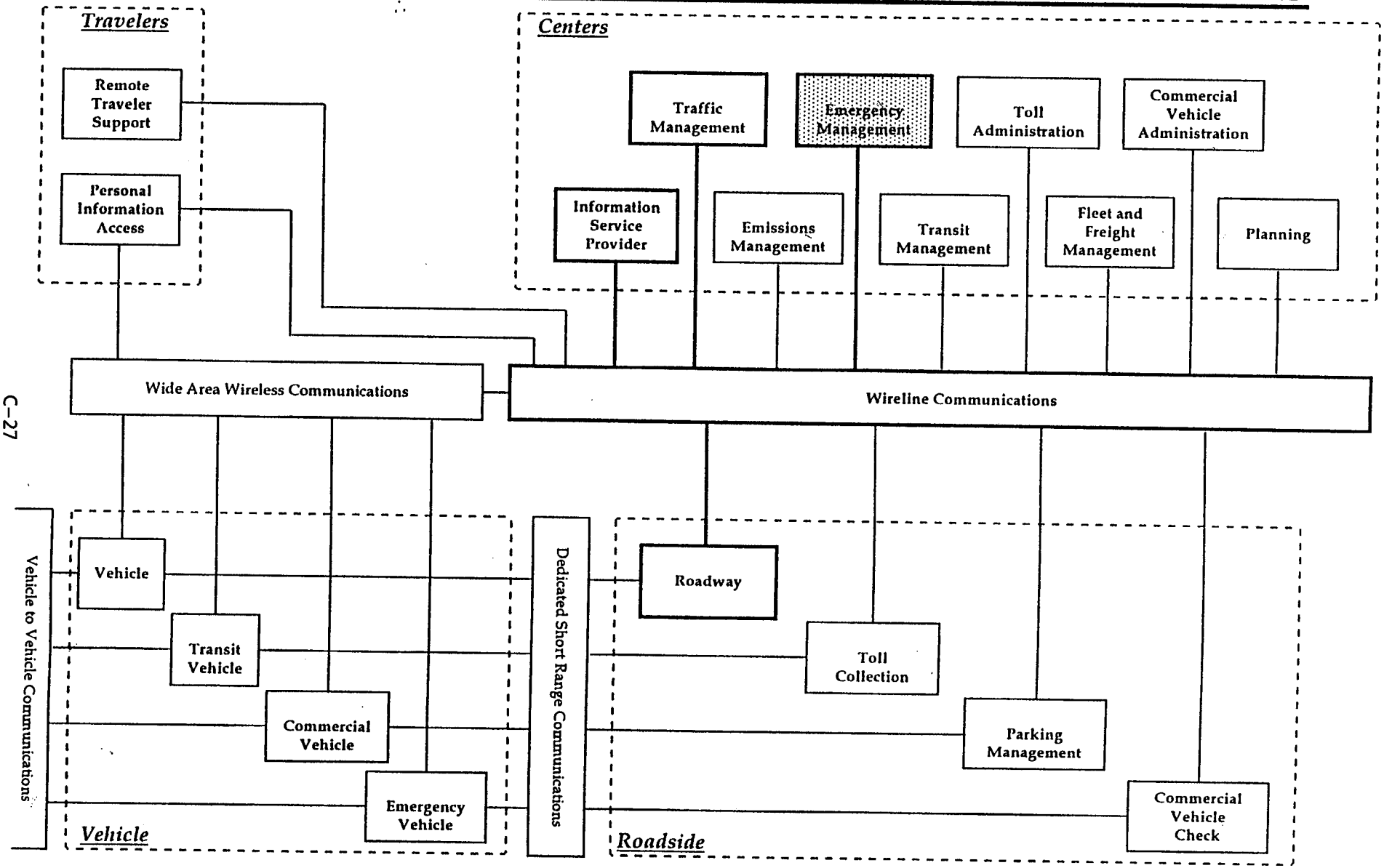
Priority Corridor W.O. #14: Washburn Tunnel Traffic Management and Information System

Lead Agency: Harris County

Work Order 15

Description: This project will focus ITS technologies on critical roadway system links (i.e. Baytown Bridge, I.H. 45/S.H. 6 Interchange, Galveston Causeway, I-10 at the San Jacinto River bridge, and U.S. 59 South) where incidents and construction can have a severe impact on the traveling public. Each suggested critical link serves as an evacuation route for hurricanes and incidents during evacuations can severely impact that process. These critical links would be equipped with CCTV, vehicle detection, changeable message signs, and AVI, and HAR. Environmental monitoring equipment (wind, ice, rain measurements) would be used on the major bridges along the critical links.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #15: Traffic Management & Traveler Information

Lead Agency: Texas Department of Transportation

houston transtar

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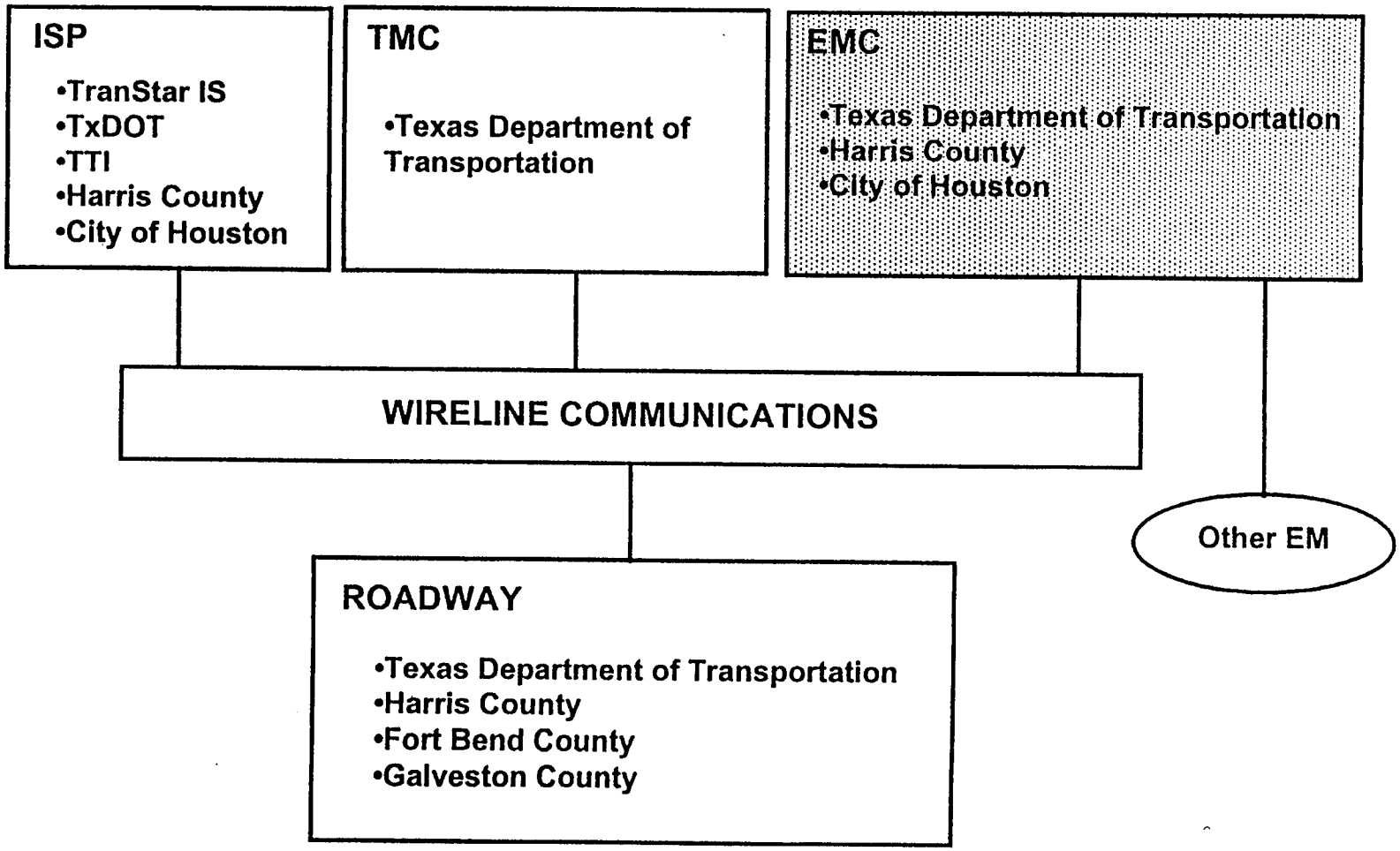

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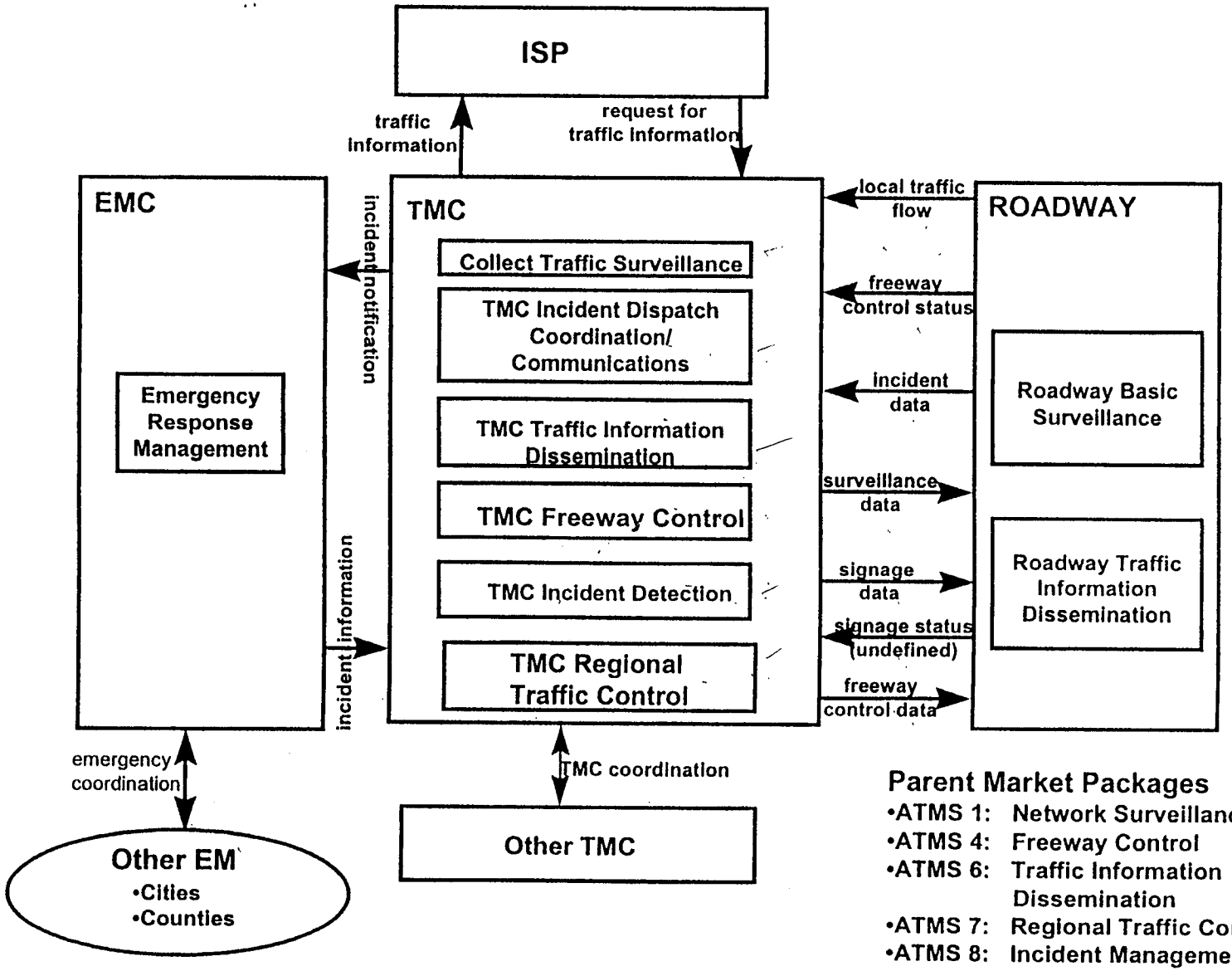
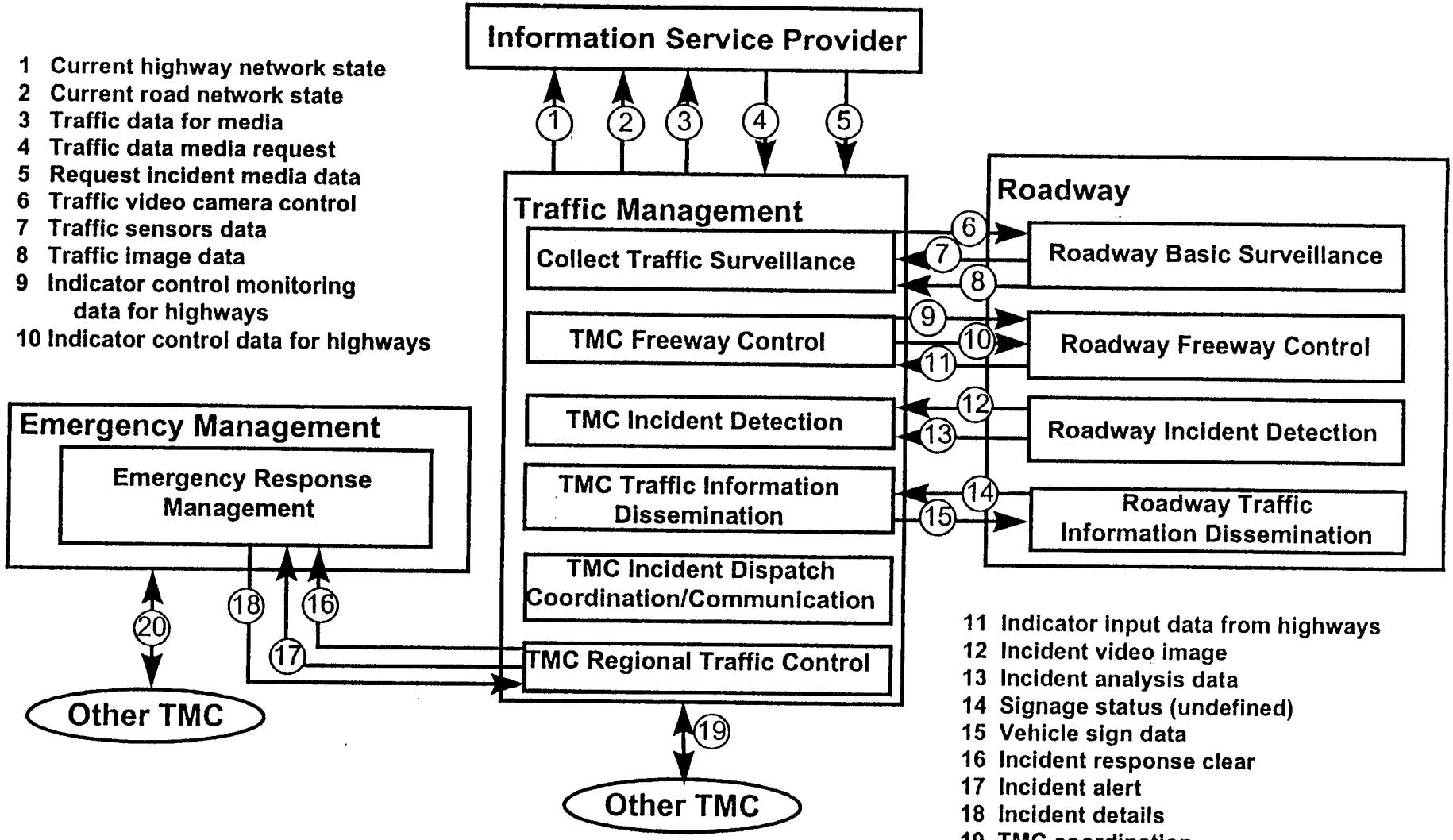


Parent Market Packages

- •ATMS 1: Network Surveillance
- •ATMS 4: Freeway Control
- •ATMS 6: Traffic Information Dissemination
- •ATMS 7: Regional Traffic Control
- •ATMS 8: Incident Management System
- •EM 1: Emergency Response

IDENTIFICATION OF DATA FLOWS



1 Current highway network state
2 Current road network state
3 Traffic data for media
4 Traffic data media request
5 Request incident media data
6 Traffic video camera control
7 Traffic sensors data
8 Traffic image data
9 Indicator control monitoring data for highways
10 Indicator control data for highways

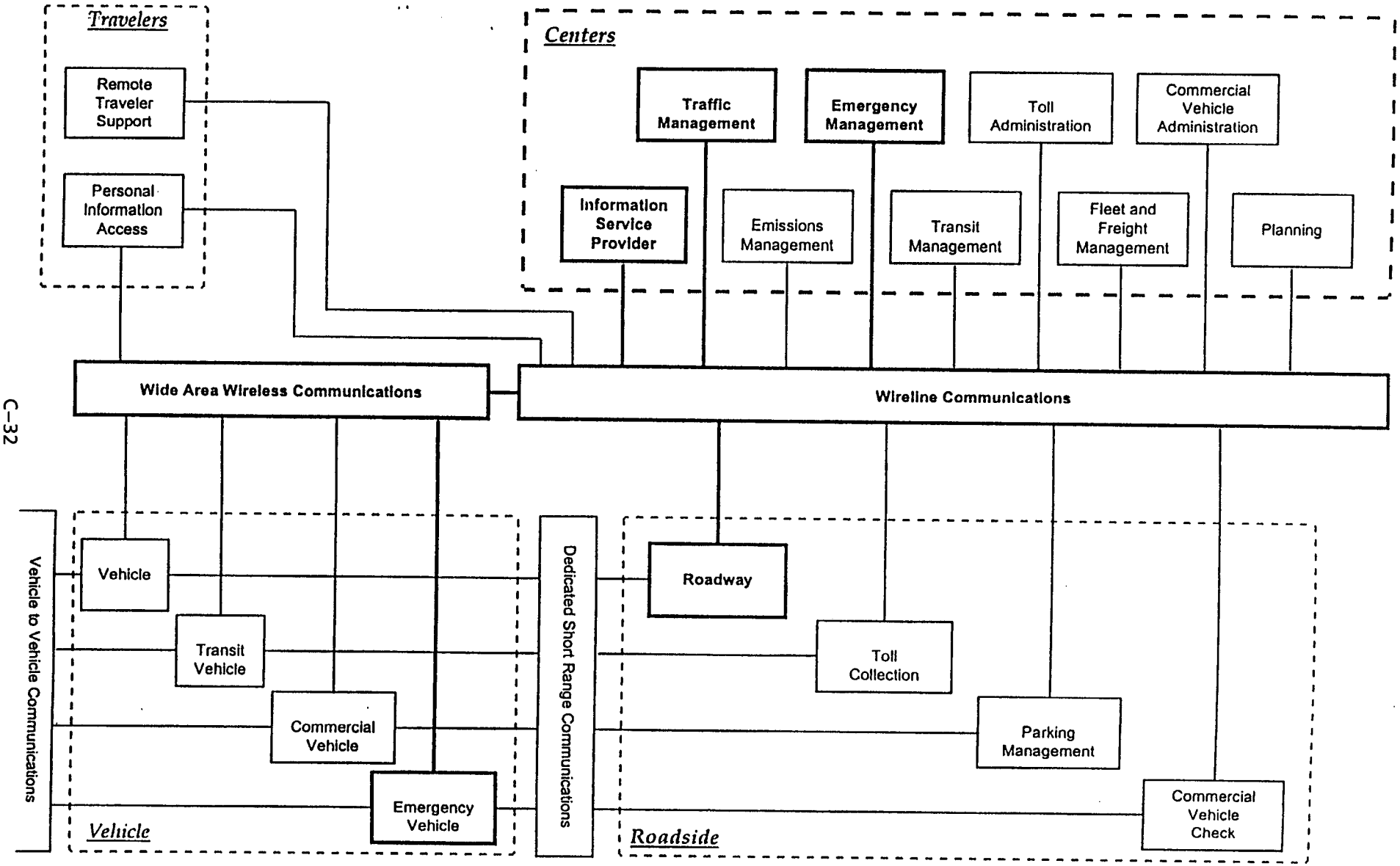
11 Indicator input data from highways
12 Incident video image
13 Incident analysis data
14 Signage status (undefined)
15 Vehicle sign data
16 Incident response clear
17 Incident alert
18 Incident details
19 TMC coordination
20 EMC coordination

Work Order 20

Description: This project consists of four components:

- "Total Station Accident Investigation Serving Devices", use computerized surveying equipment for accident investigation.
- "Development of Incident Management Command Vehicle" depends on the teamwork of responding agencies reporting to a centrally located command post to receive instructions.
- "Laptop Computers with CAD Software," allows immediate field facilitation of accident investigation, reporting and reducing investigation time and
- "Live Video sent to Responder Agencies Dispatch Centers," mean that the responders would get pre-arrival information on exactly what they are responding to and what equipment is necessary.

NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #20: ITS Enhanced Incident Management

Lead Agency: Metropolitan Transit Authority

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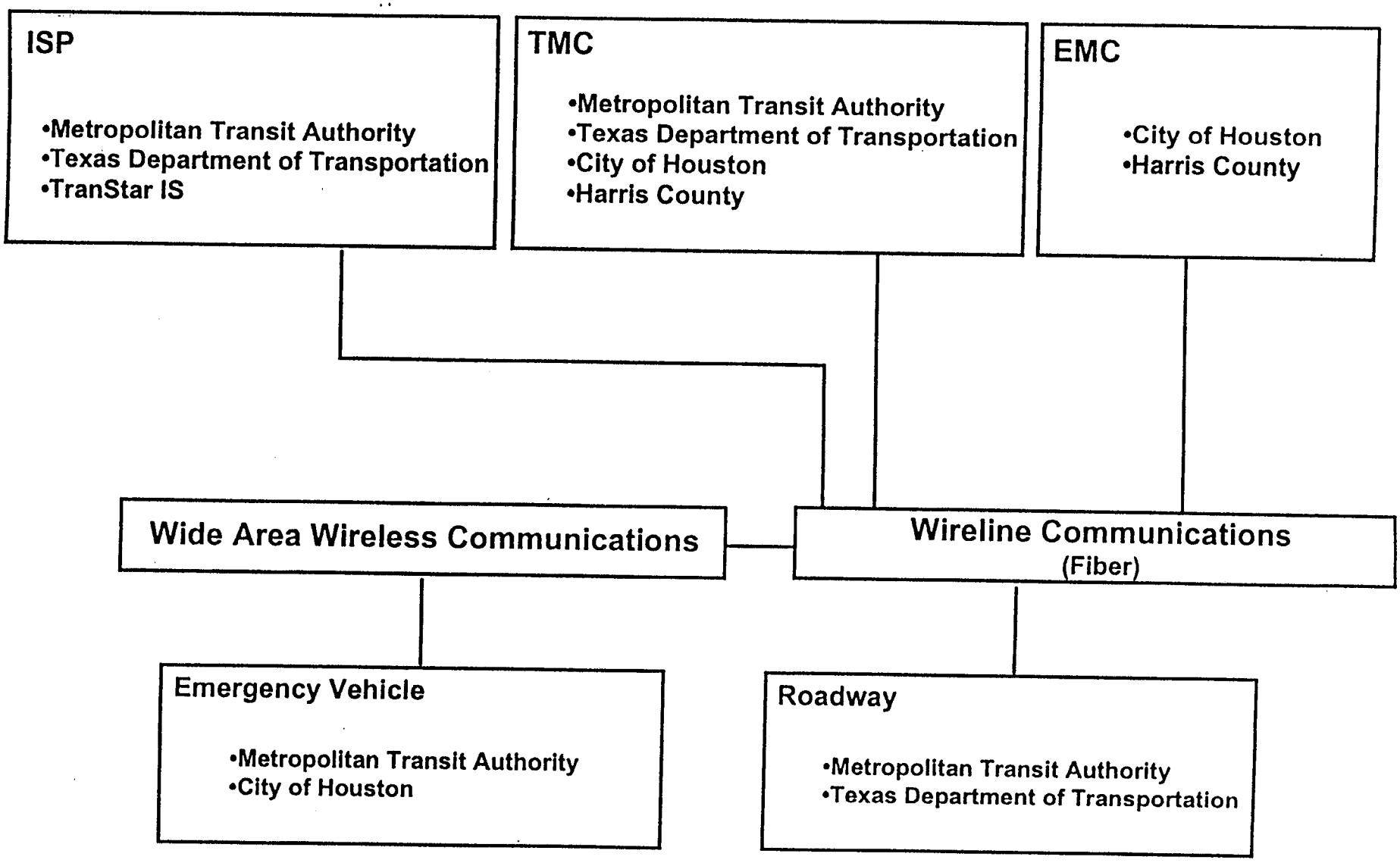

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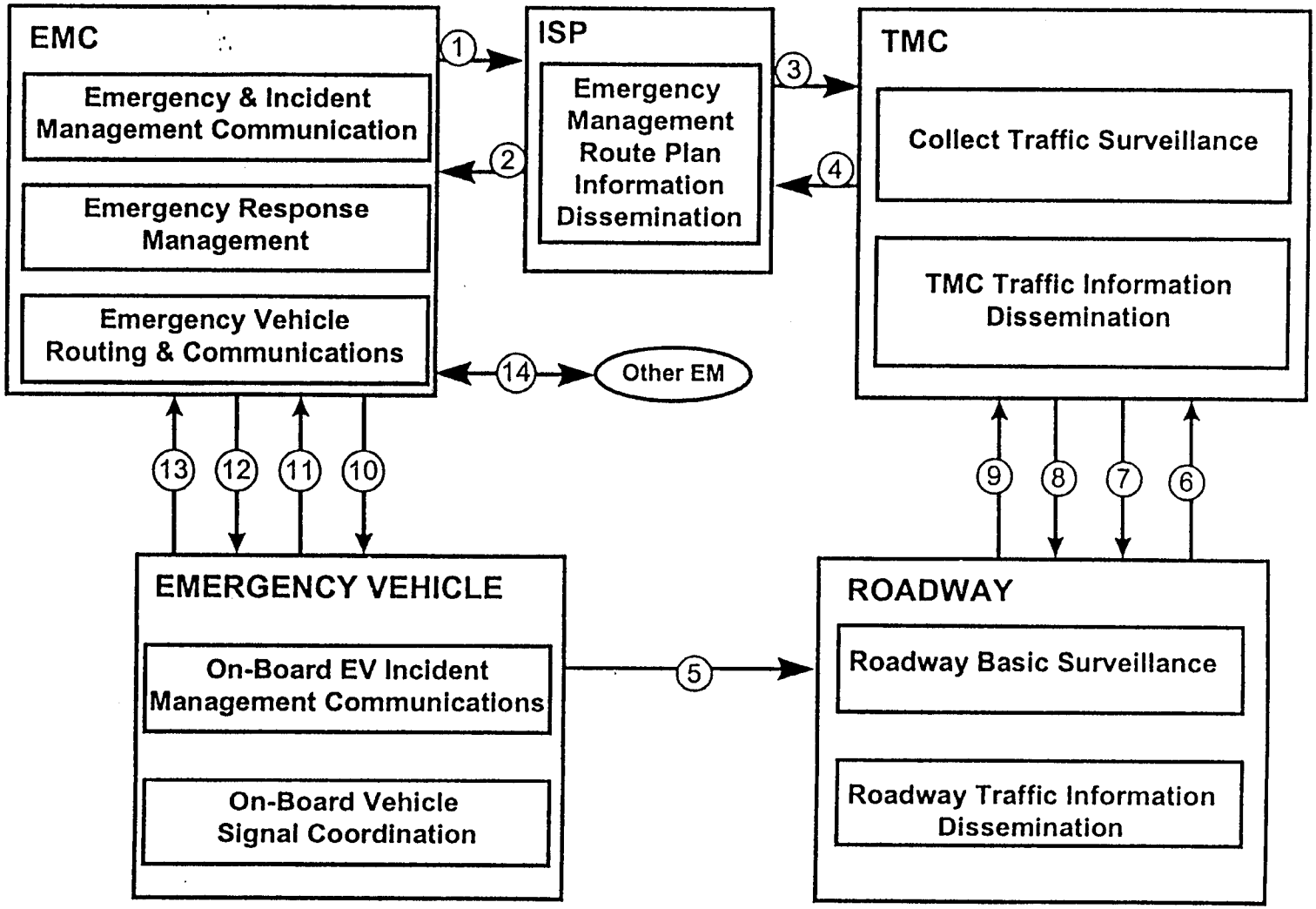


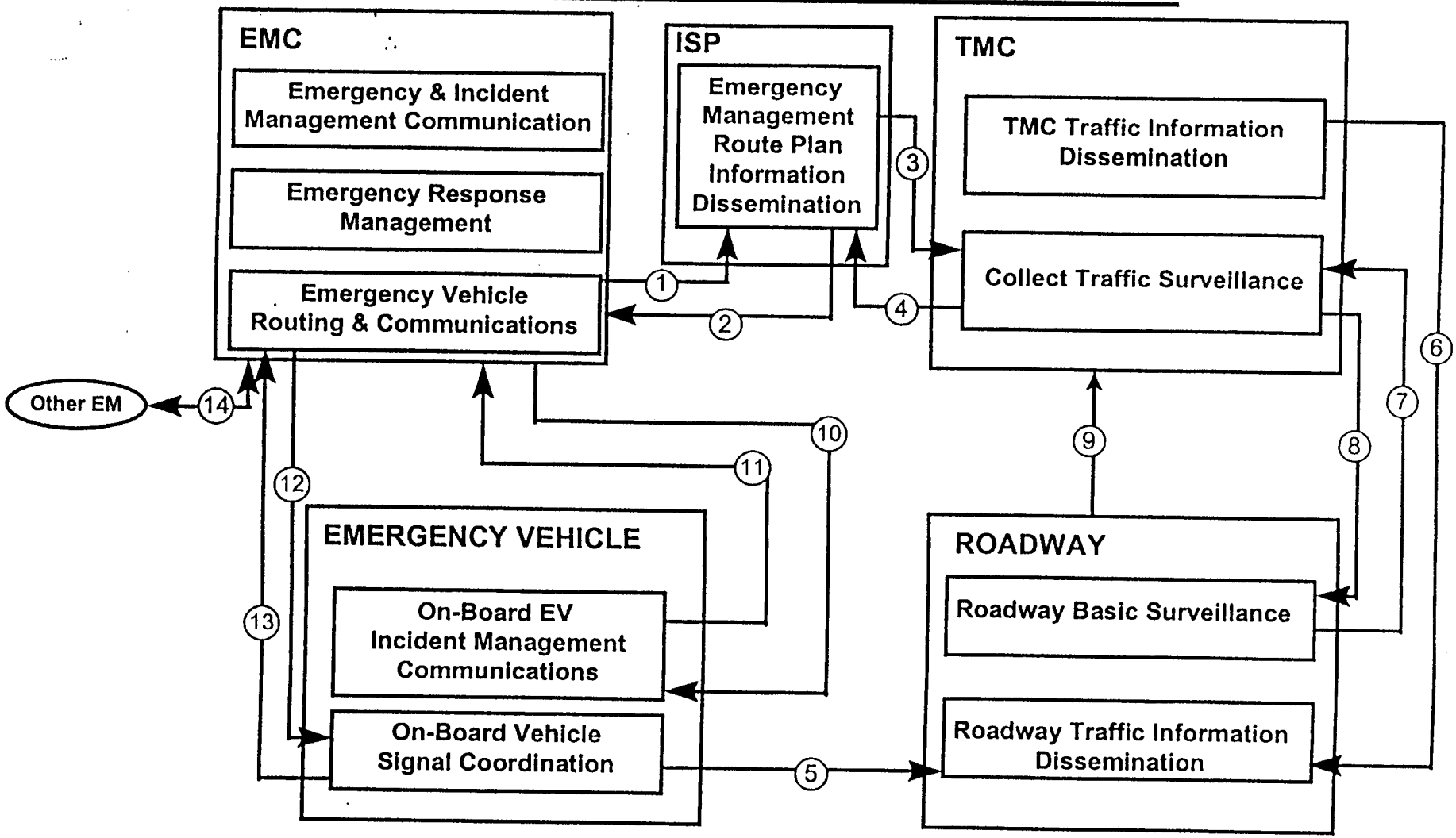
1 Emergency vehicle route request
2 Emergency vehicle route
3 Request for traffic information
4 Traffic information
5 Emergency vehicle preempt request
6 Local traffic flow
7 Surveillance control
8 Signage data
9 Signage status (undefined)
10 Emergency dispatch request
11 Emergency vehicle driver status update
12 Assigned route
13 Emergency vehicle tracking data
14 Emergency coordination

Parent Market Packages
- ATMS 1: Network Surveillance
- ATMS 6: Traffic Information Dissemination
- EM1: Emergency Response
- EM2: Emergency Routing

Priority Corridor W.O. #20: ITS Enhanced Incident Management

Lead Agency: Metropolitan Transit Authority

IDENTIFICATION OF DATA FLOWS



1 Emergency vehicle route request
2 Emergency vehicle route
3 Request incident media data, traffic data media request
4 TM traffic information
5 Emergency vehicle preemptions
6 Vehicle sign data
7 Traffic sensor data, traffic image data
8 Incident video image control, traffic video camera control
9 Signage status (undefined)
10 Emergency vehicle driver outputs, emergency vehicle status data for priority
11 Emergency driver status update
12 Emergency vehicle driver outputs
13 Emergency vehicle tracking data
14 TOEC emergency telephone service identity, TOEC incident details

Priority Corridor W.O. #20: ITS Enhanced Incident Management

Lead Agency: Metropolitan Transit Authority

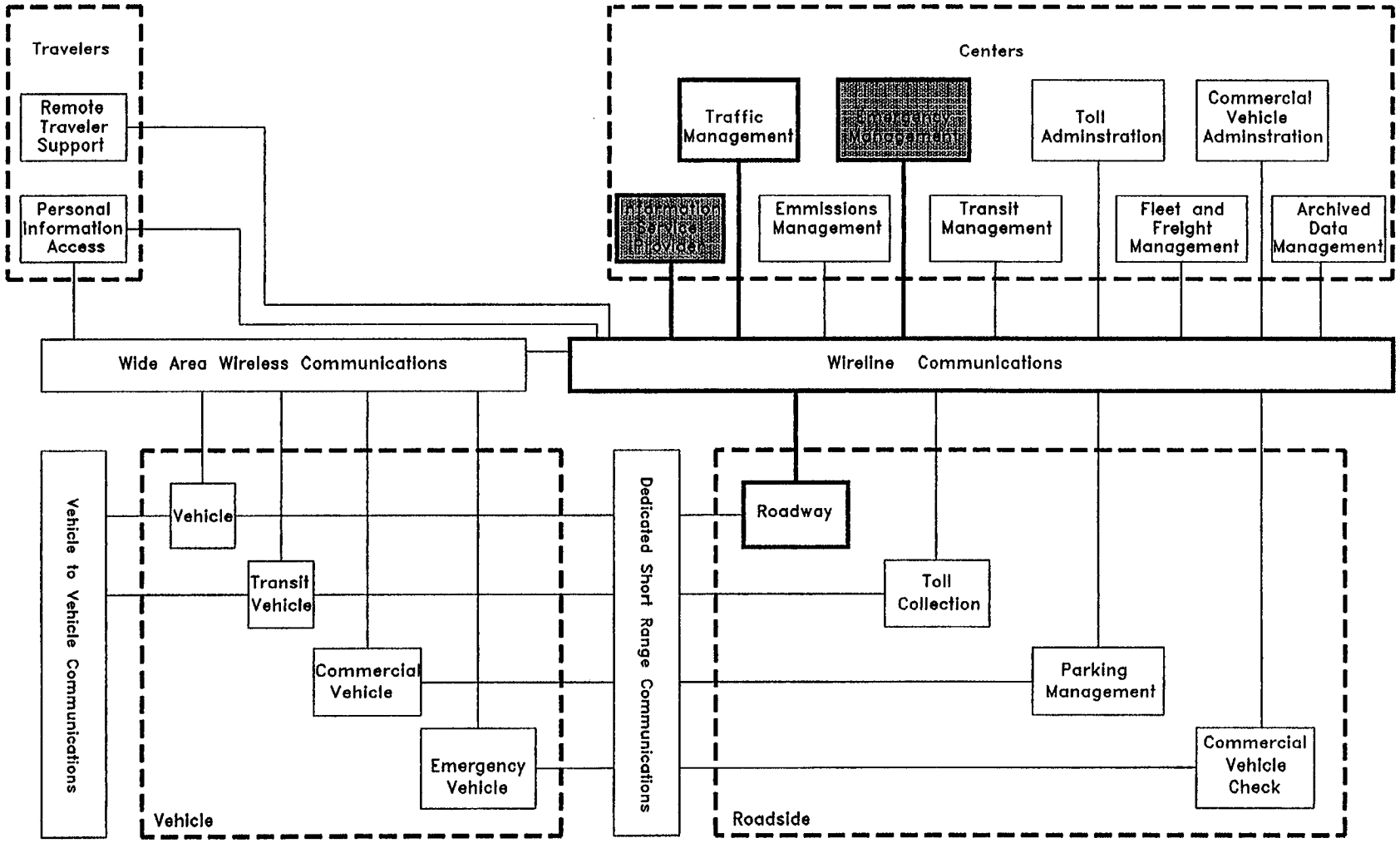
Work Order 21

Description: The coastal areas of Texas are flat lands at low elevations and receive 55–60 inches of rain per annum. During these rain storms, Houston and Harris County areas can become a parking lot of stalled cars in high water, with commuters vainly trying to find passable routes. Freeway underpasses are especially plagued by these problems. The objective of this project would be to significantly reduce major congestion problems in the Houston and Harris County area when major arterials are blocked by high water, by using ITS technologies.

Priority Corridor W.O. #21: Automatic Traffic Management in Flood Prone Areas

Lead Agency: Harris County

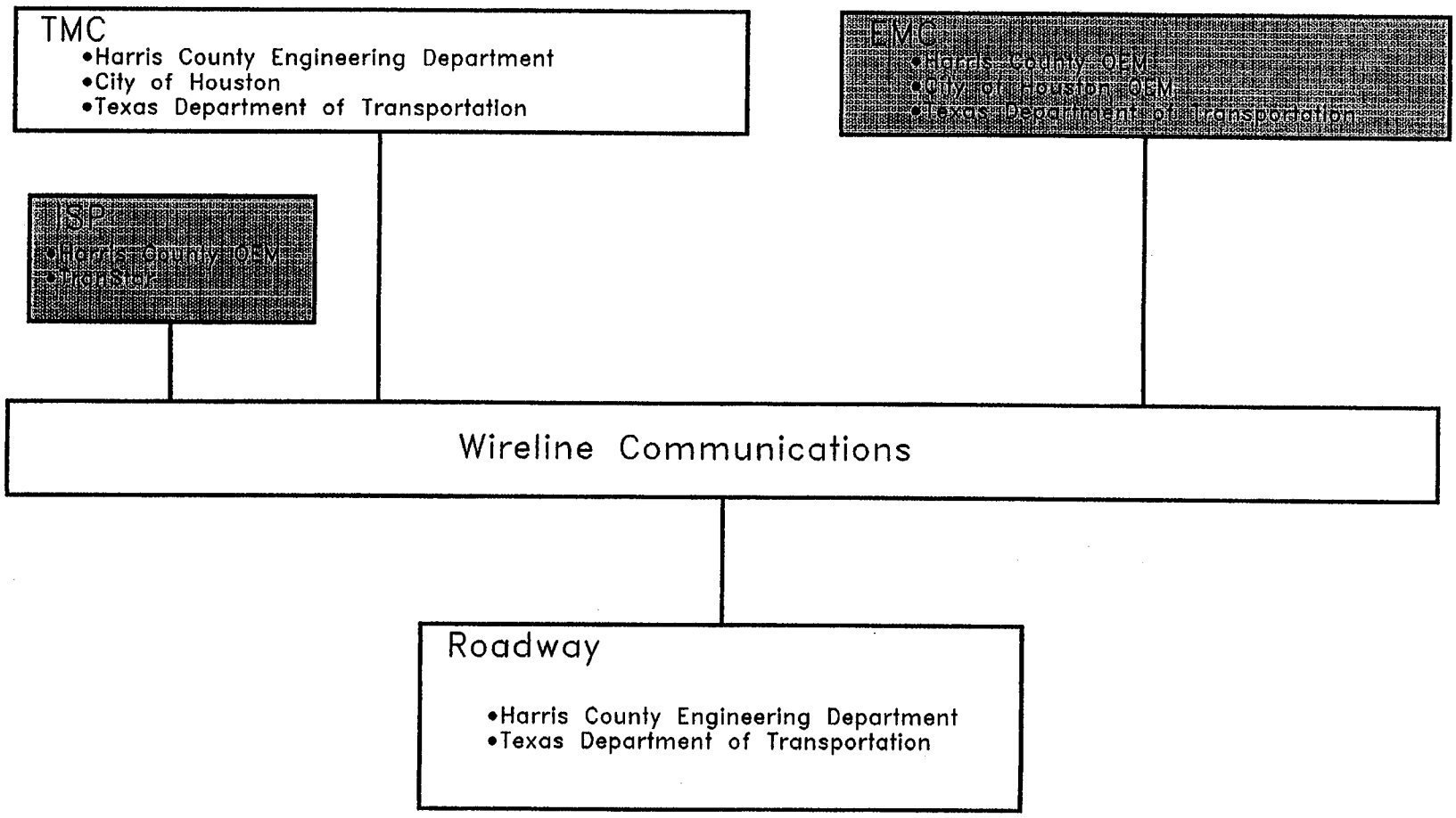
NATIONAL ITS ARCHITECTURE ELEMENTS



Priority Corridor W.O. #21: Automatic Traffic Management in Flood Prone Areas

Lead Agency: Harris County

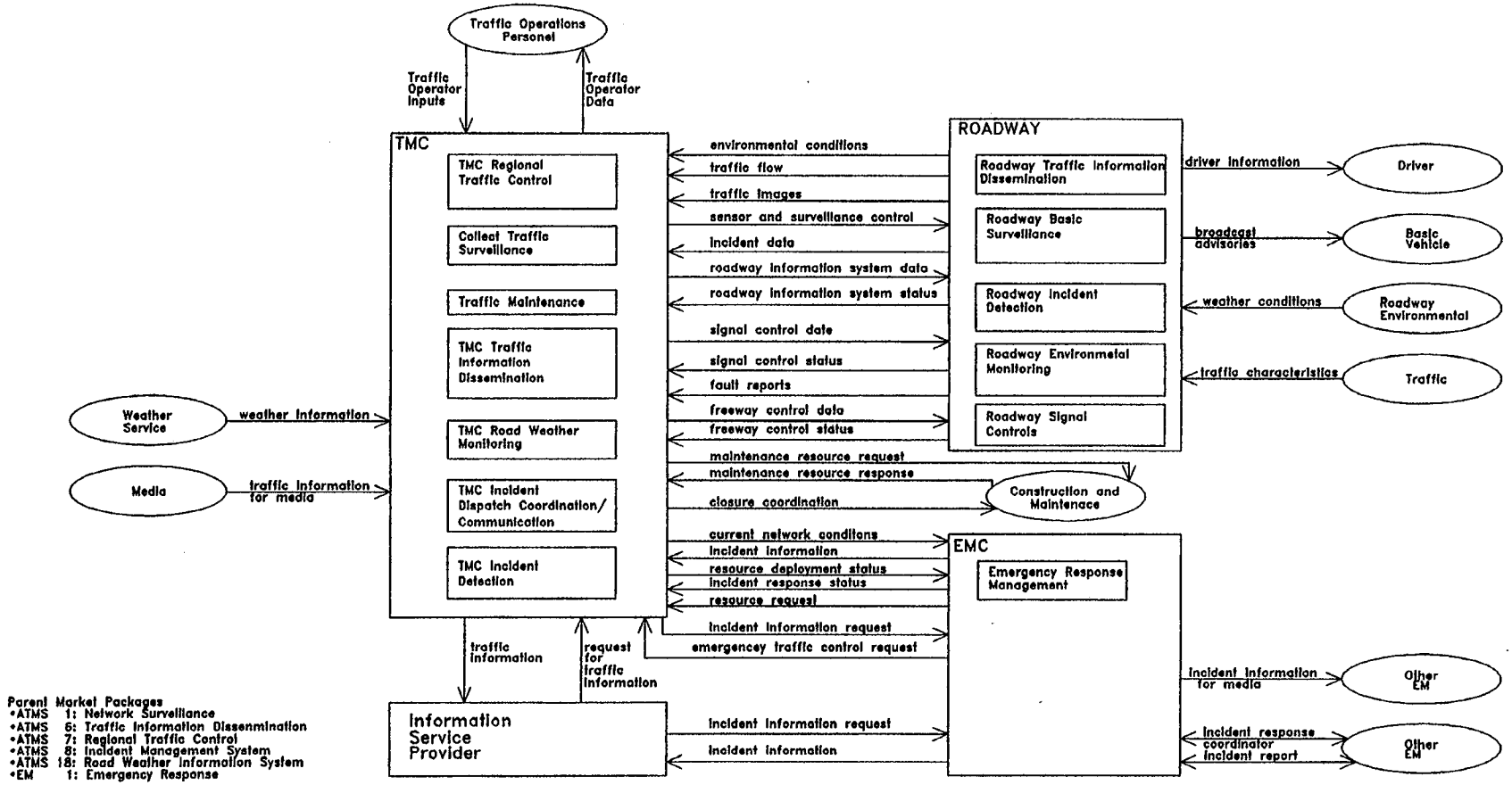
STAKEHOLDERS



Priority Corridor W.O. #21: Automatic Traffic Management in Flood Prone Areas

Lead Agency: Harris County

EQUIPMENT PACKAGES AND ARCHITECTURE FLOWS



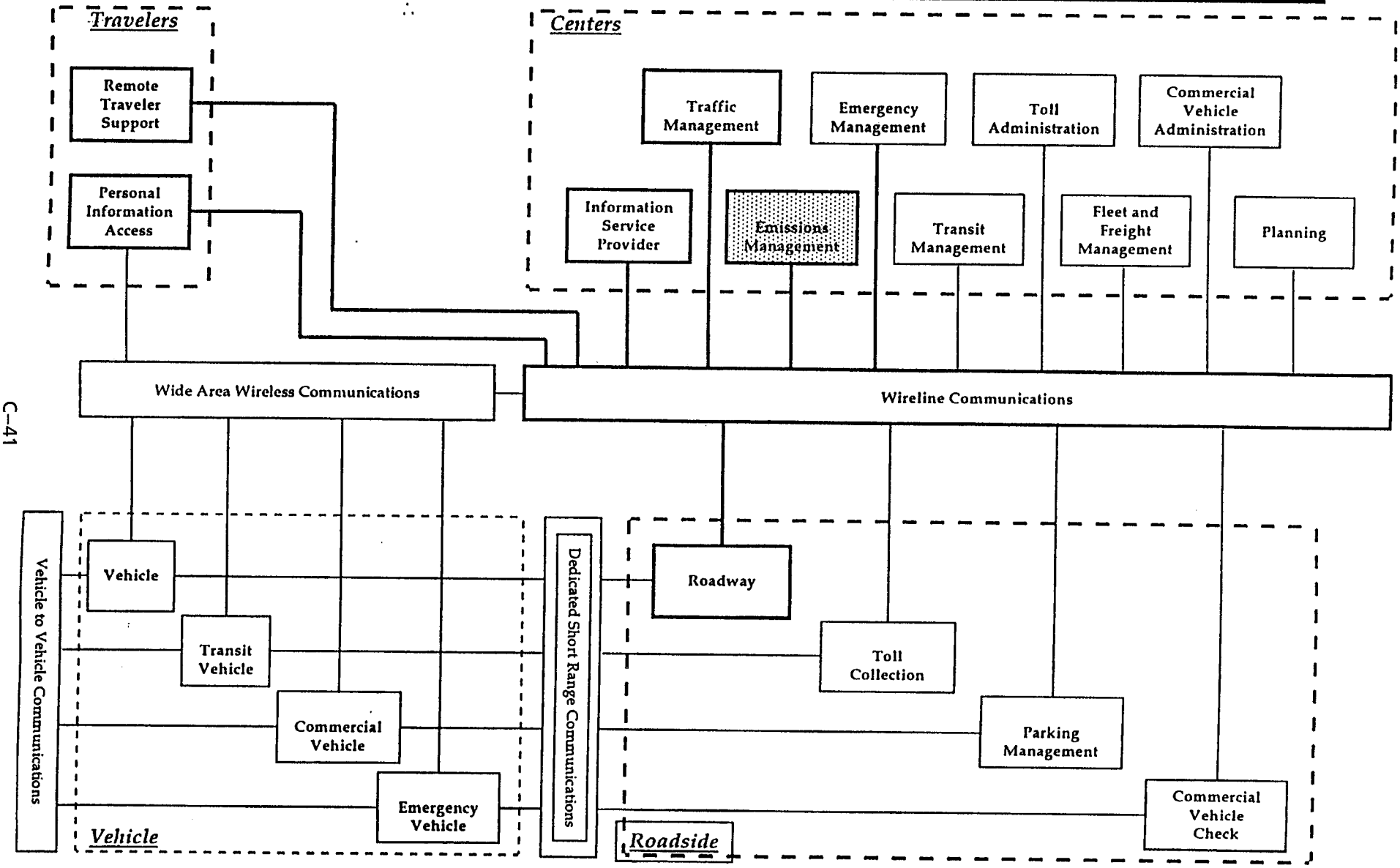
Priority Corridor W.O. #21: Automatic Traffic Management in Flood Prone Areas

Lead Agency: Harris County

Work Order 22

Description: Houston TranStar has initiated a variety of programs that produce specific products associated with traveler information. This information includes travel speed, incident locations, construction activities and flooding locations. Information regarding each element is produced in real time. That information can be integrated into the TranStar system and then distributed to end users in a variety of user-compatible forms including graphics, ext, and video. Specific projects include freeway travel speed map, distribute text information on travel speed map and flood control map.

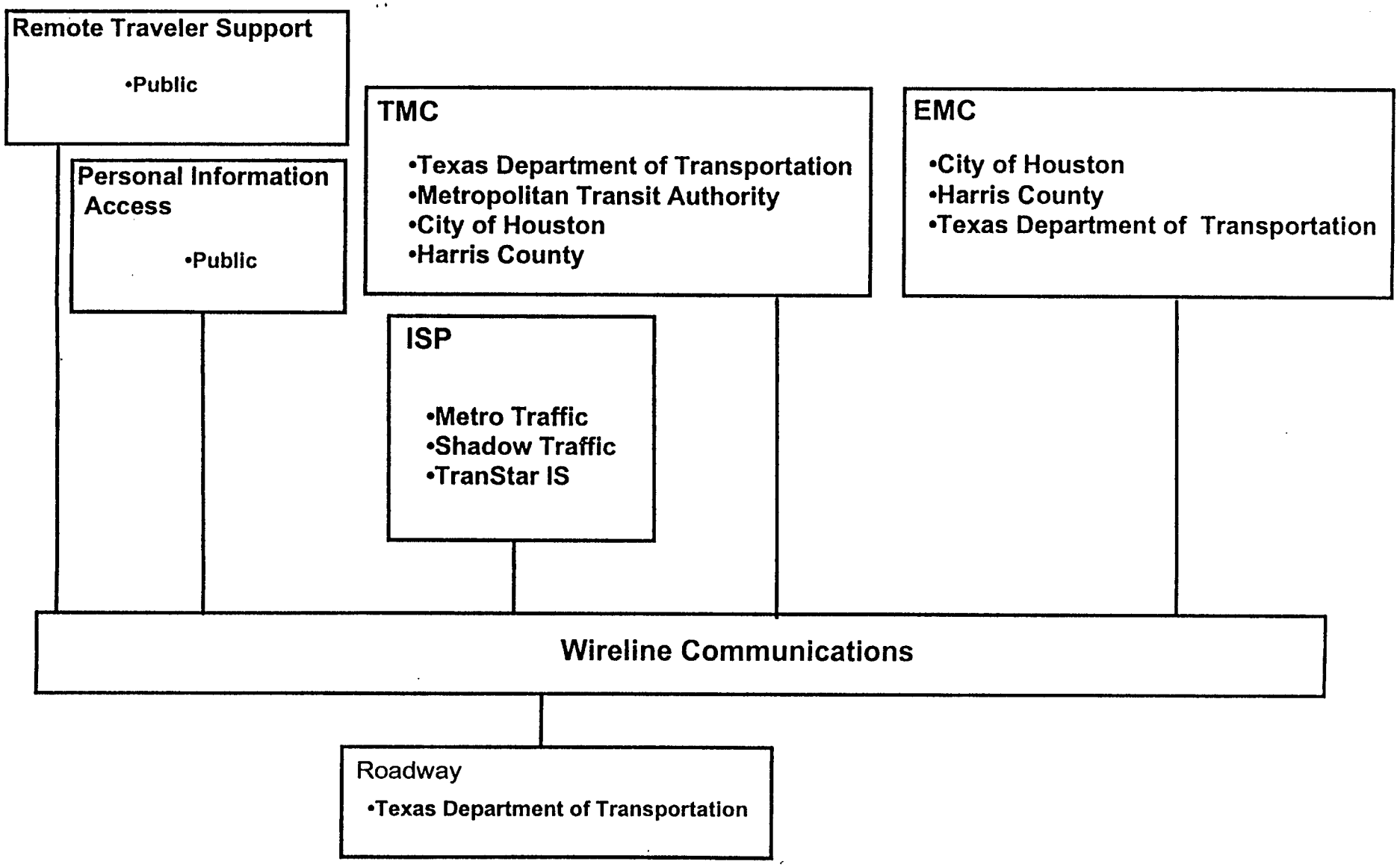
NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



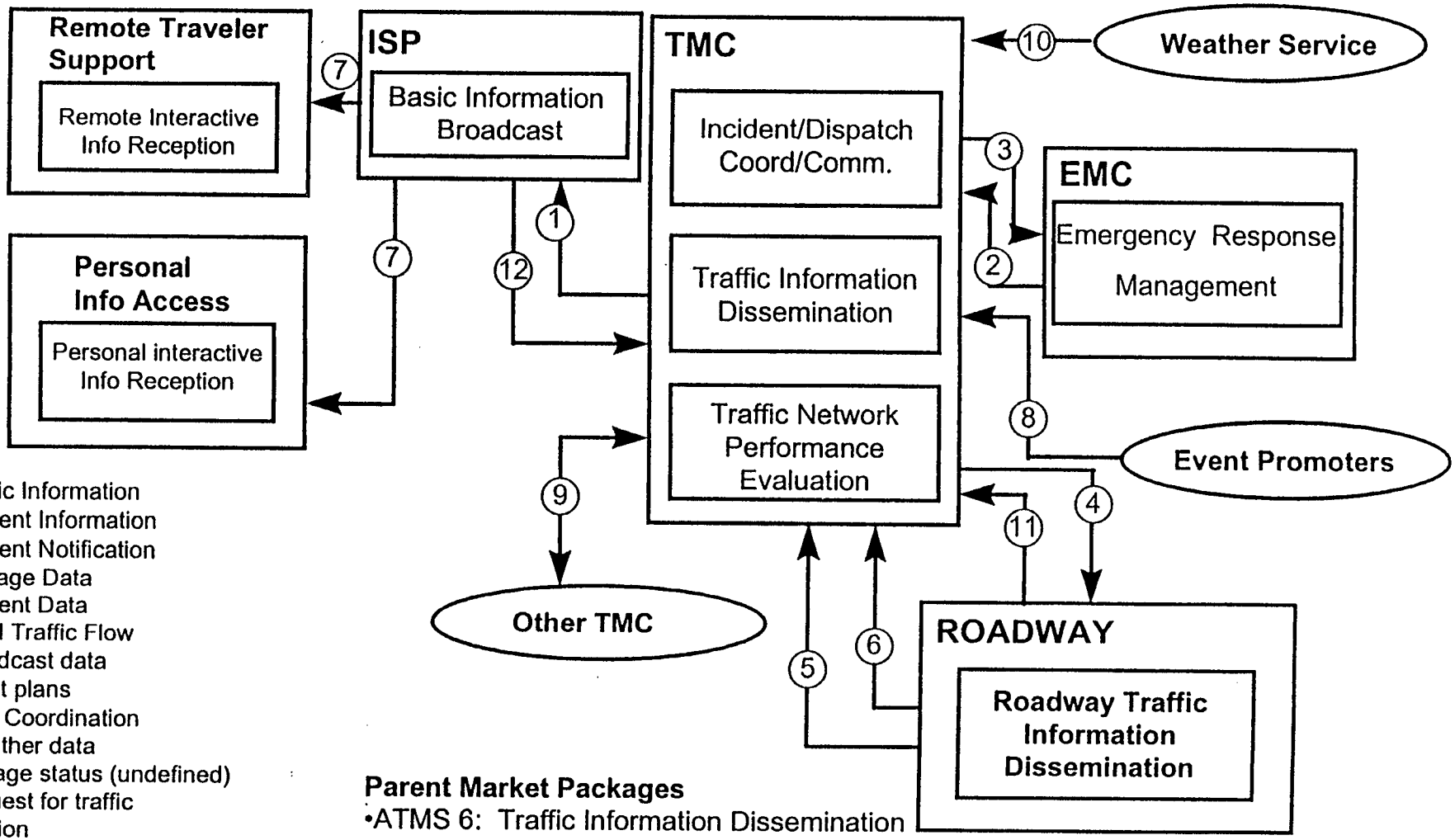
Priority Corridor WO #22: Dissemination of Traveler Information

Lead Agency: Texas Department of Transportation

STAKEHOLDERS



IDENTIFICATION OF EQUIPMENT PACKAGES



1 Traffic Information
2 Incident Information
3 Incident Notification
4 Signage Data
5 Incident Data
6 Local Traffic Flow
7 Broadcast data
8 Event plans
9 TMC Coordination
10 Weather data
11 Signage status (undefined)
12 Request for traffic information

Parent Market Packages

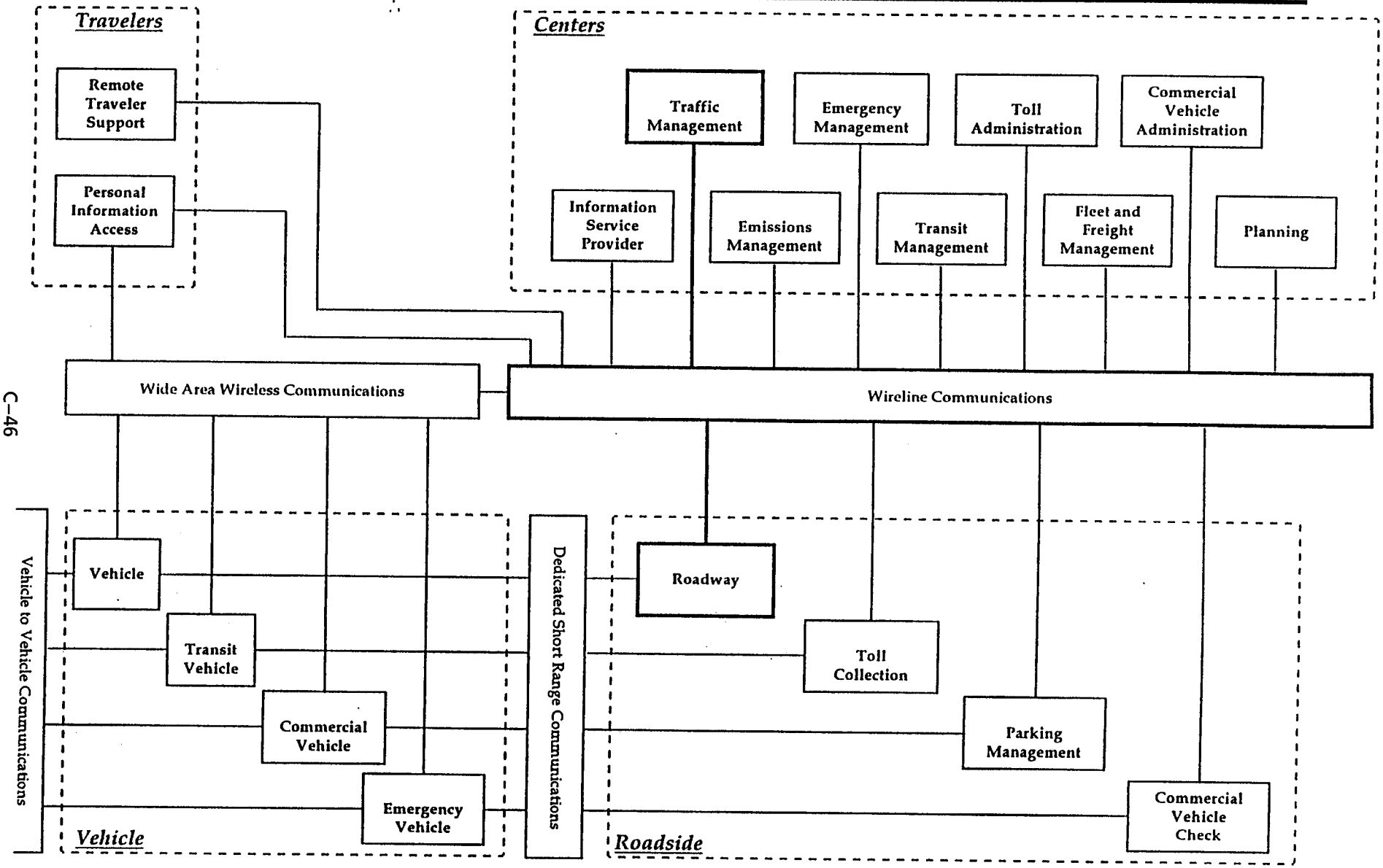
- ATMS 6: Traffic Information Dissemination
- ATMS 8: Incident Management System
- ATMS 9: Traffic Network Performance Evaluation
- ATIS 1: Broadcast Traveler Information

IDENTIFICATION OF DATA FLOWS

Work Order 23

Description: Ramp metering or flow signals are being implemented along the Houston freeway corridors as part of the Computerized Traffic Management System (CTMS). Currently, signalized intersections including the frontage road signals and the ramp flow signals are not coordinated. The lack of coordination between the systems does not provide for the efficient management of traffic during the peak periods or in the event of an incident that would require the metering of traffic entering the freeway. This project will develop, deploy and evaluate an advanced corridor signal control system for coordinating and controlling ramp meters and frontage road signalized intersections.

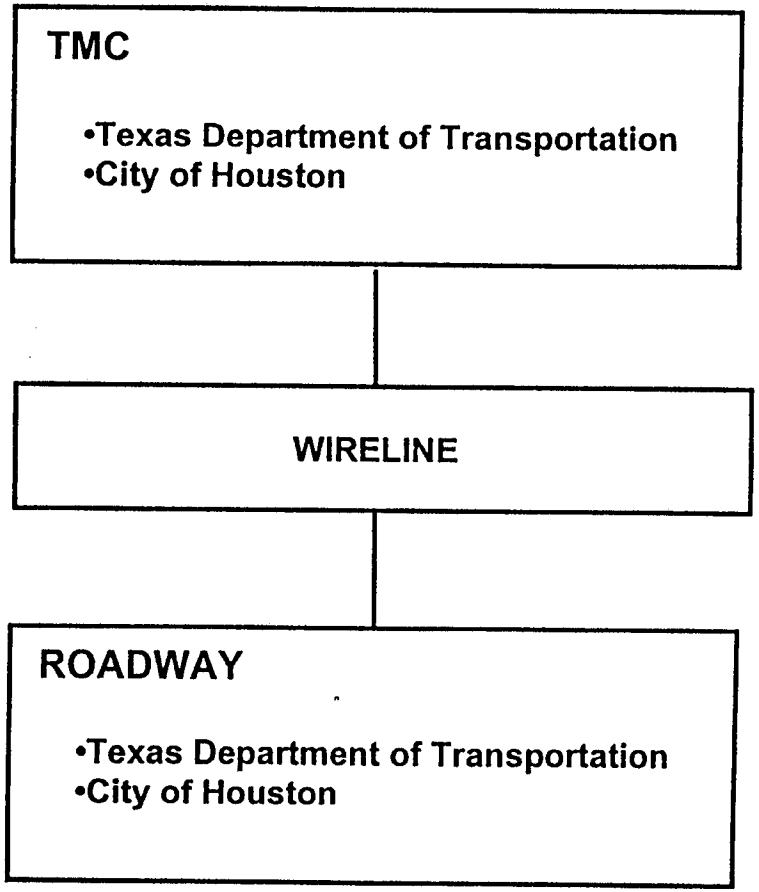
NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



Priority Corridor W.O. #23: Coordinated Ramp Metering

Lead Agency: Texas Department of Transportation

STAKEHOLDERS



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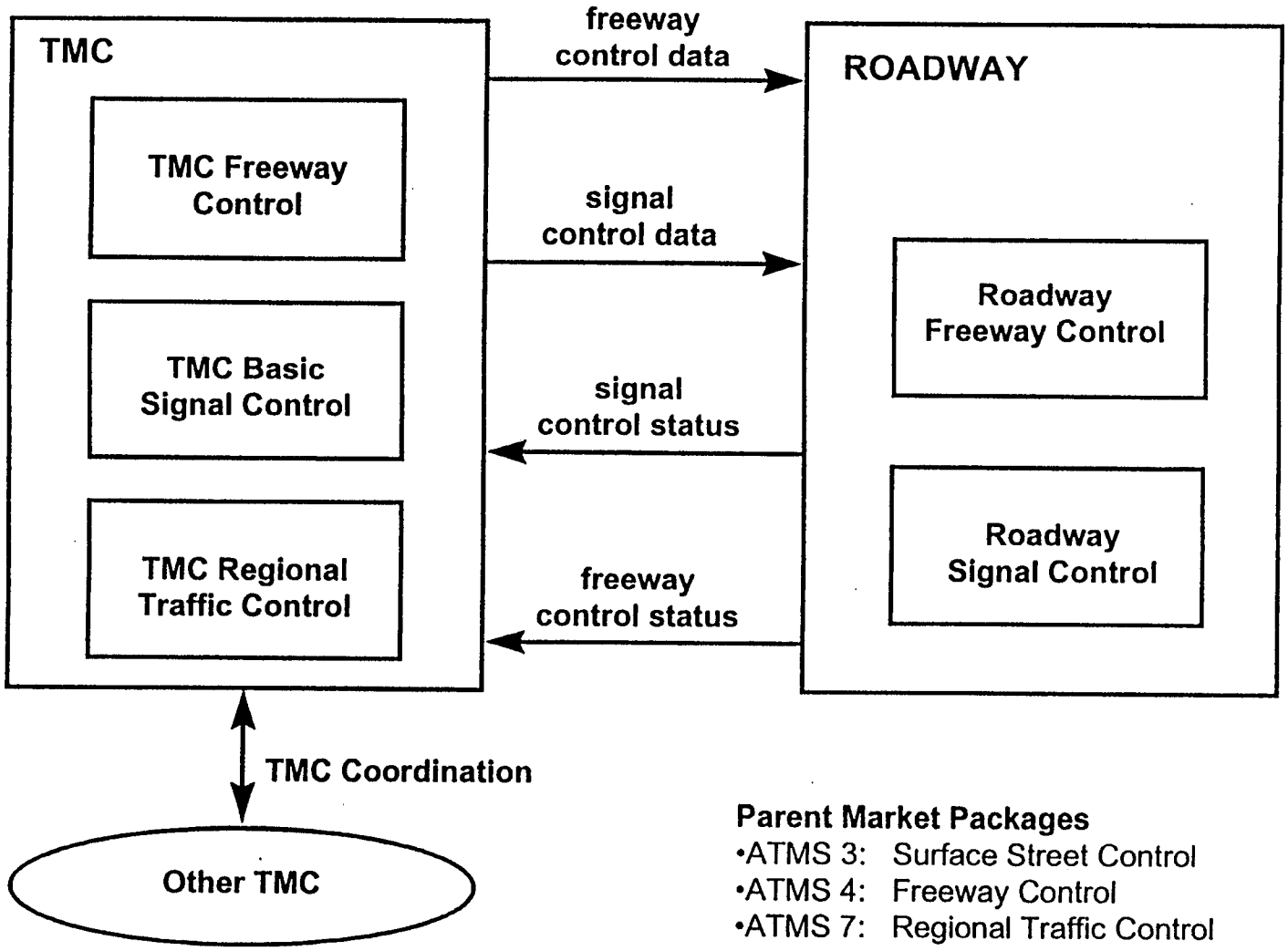


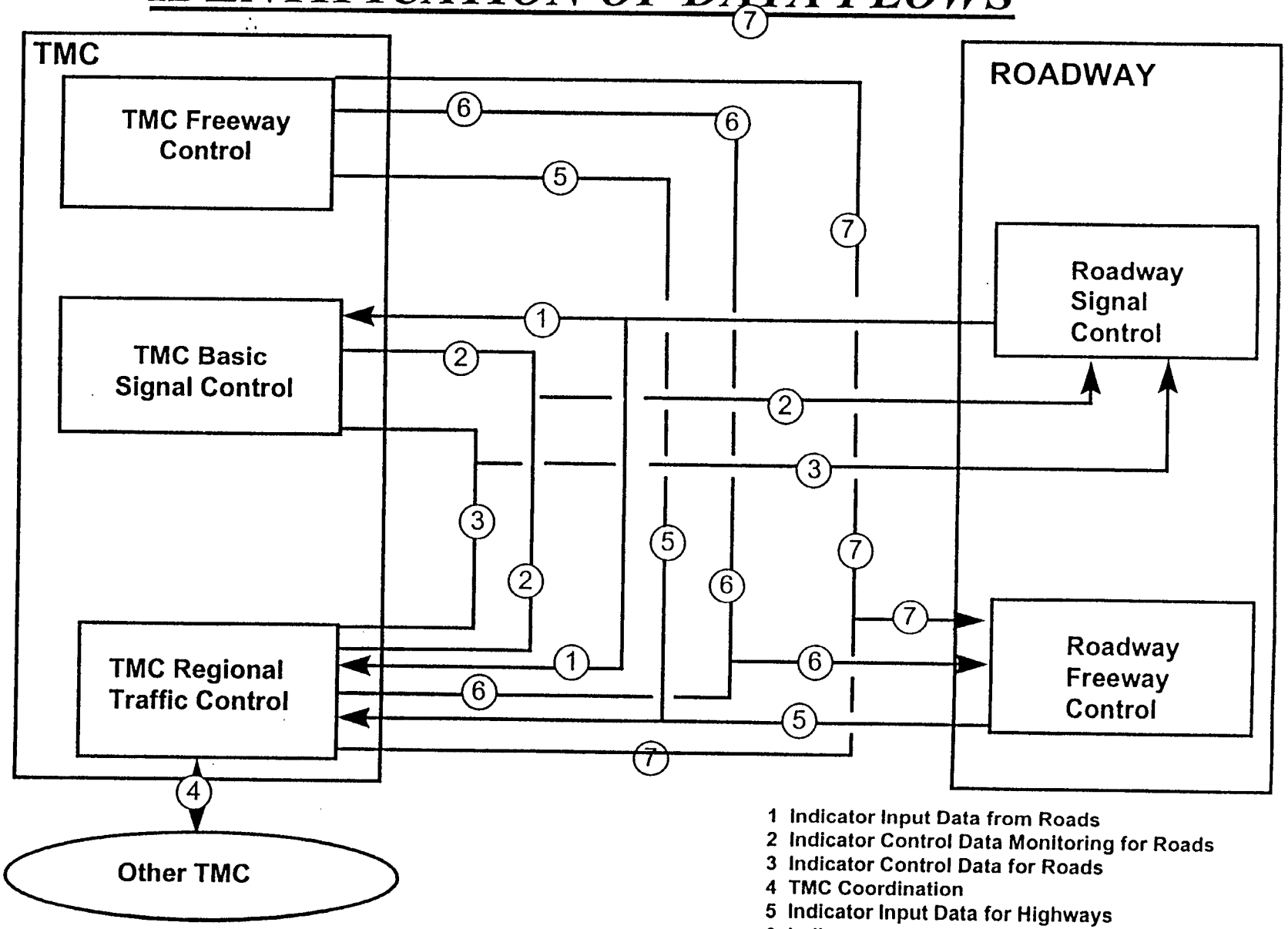
Parent Market Packages

- ATMS 3: Surface Street Control
- ATMS 4: Freeway Control
- ATMS 7: Regional Traffic Control

Priority Corridor W.O. #23: Coordinated Ramp Metering

Lead Agency: Texas Department of Transportation

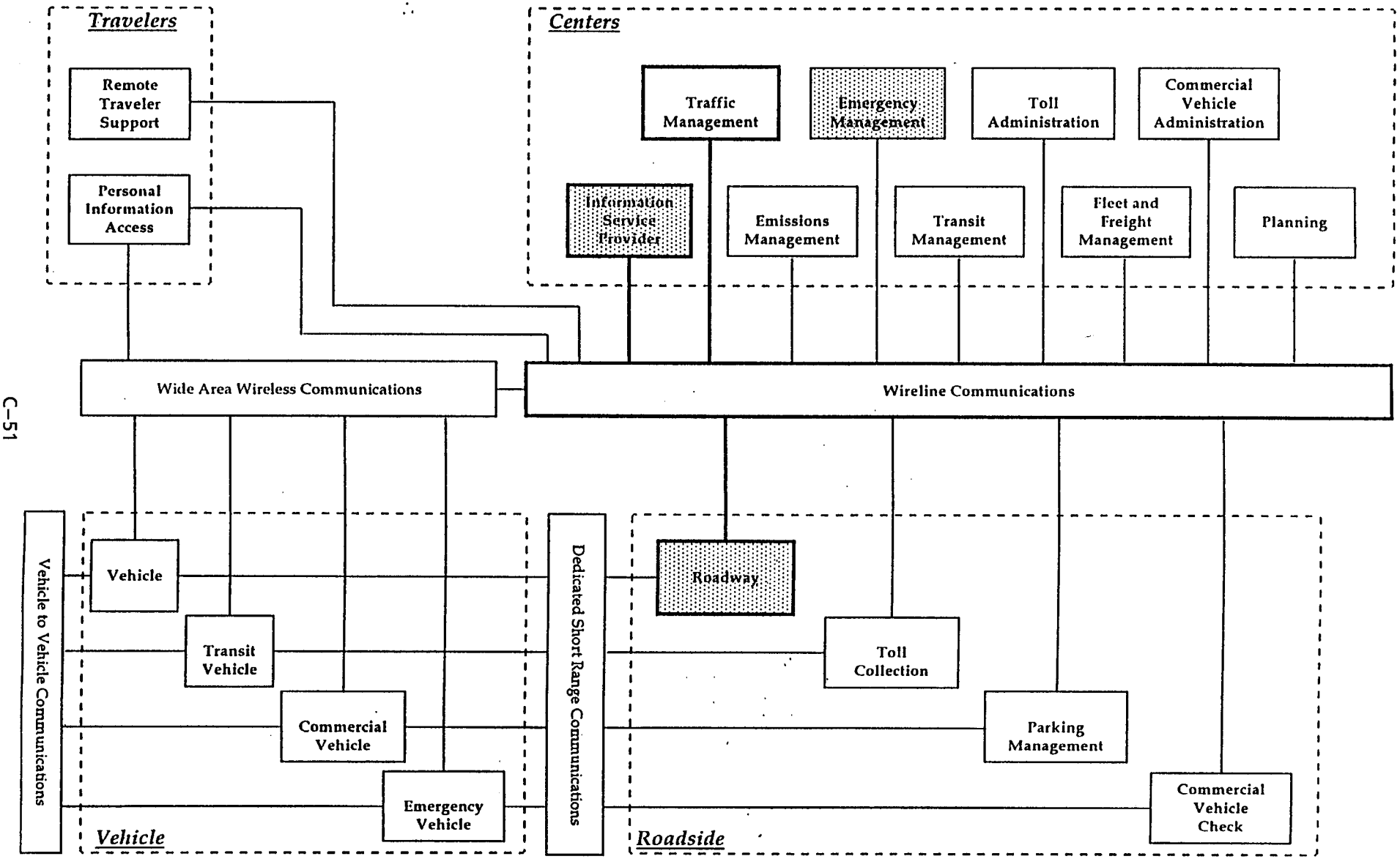
IDENTIFICATION OF DATA FLOWS



Work Order 25

Description: Operators and traffic engineers at TranStar currently do all incident detection and management. There is a need to develop automated monitoring and traffic management tools that can guide and assist the operating staff in managing incidents in the safest, fastest, and most efficient manner throughout the corridors. This project will develop corridor-based incident response, clearance, and traffic management strategies and the automated systems to support them. The project will pre-plan "response scenarios" for the wide range of incident types, locations and traffic conditions which are possible on the freeway system. By having these pre-planned "response scenarios" TranStar staff can provide quicker, more accurate and responsive incident management.

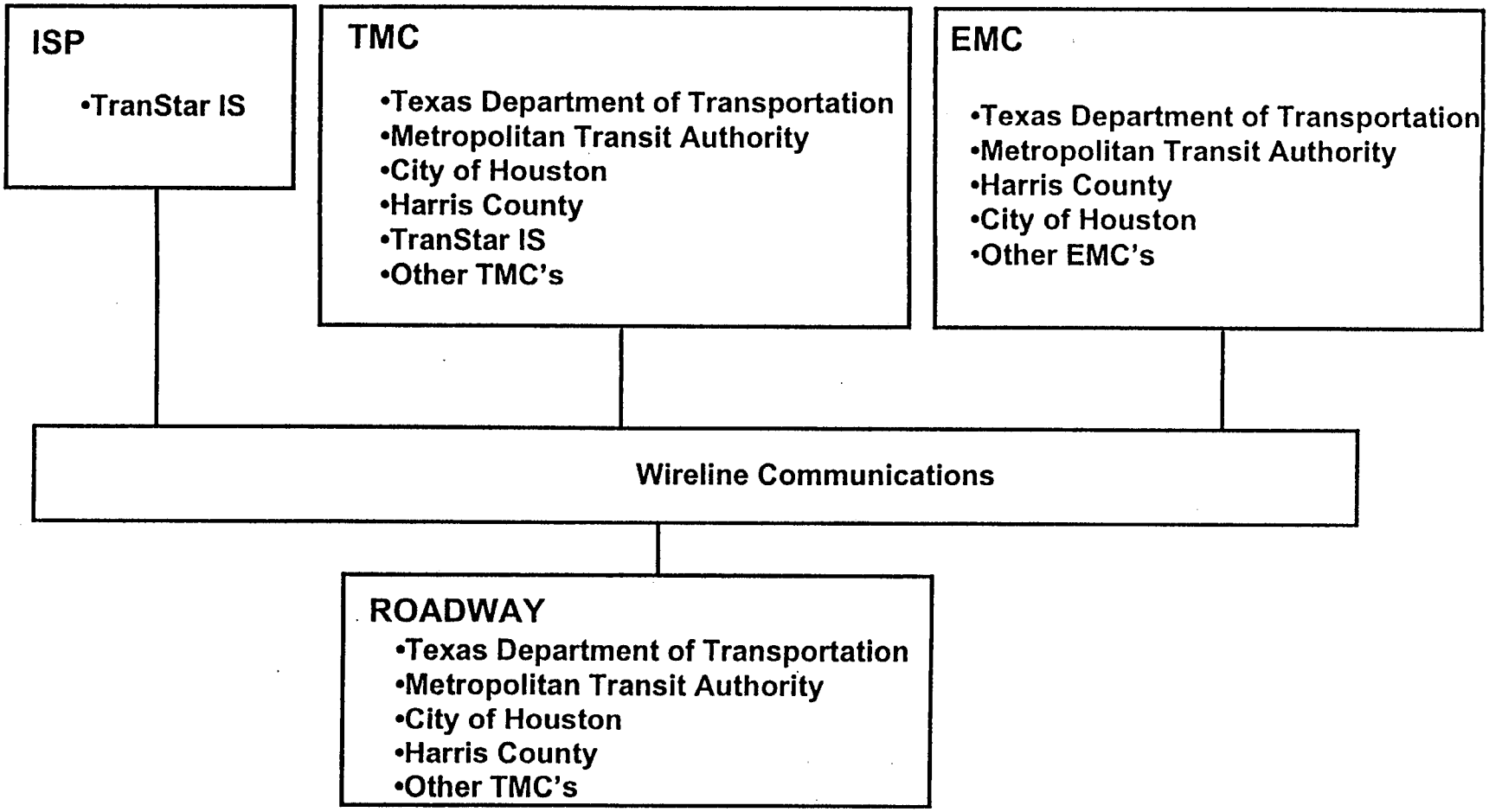
NATIONAL ITS SYSTEM ARCHITECTURE ELEMENTS



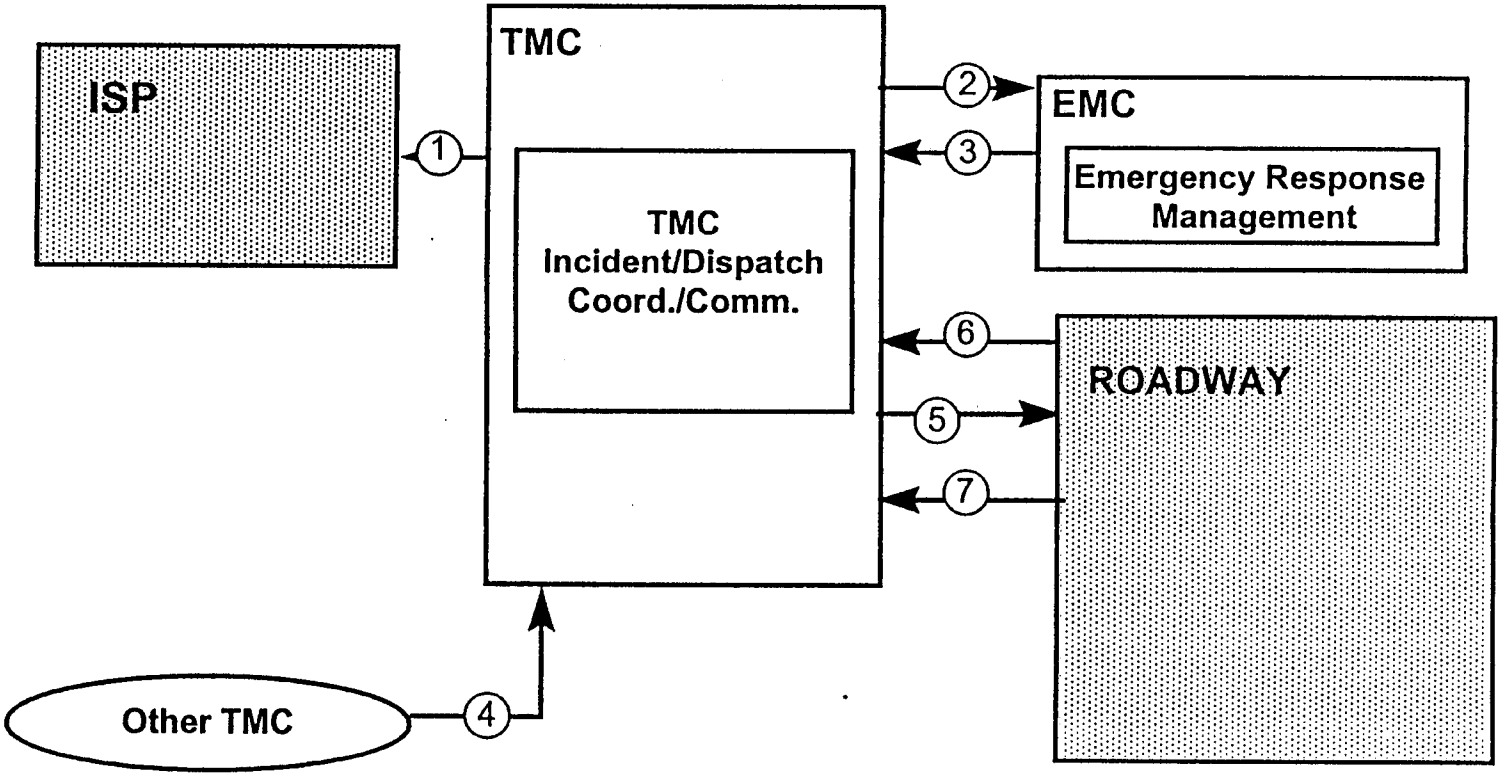
Priority Corridor W.O. #25: Automated Incident Management Strategies

Lead Agency: Texas Department of Transportation

STAKEHOLDERS



IDENTIFICATION OF EQUIPMENT PACKAGES



Parent Market Packages
- ATMS 8: Incident Management System

1 Traffic information
2 Incident notification
3 Incident information
4 TMC coordination
5 Signage data
6 Incident data
7 Signage status (undefined)