ITS Strategic Plan

for

Metropolitan New Orleans

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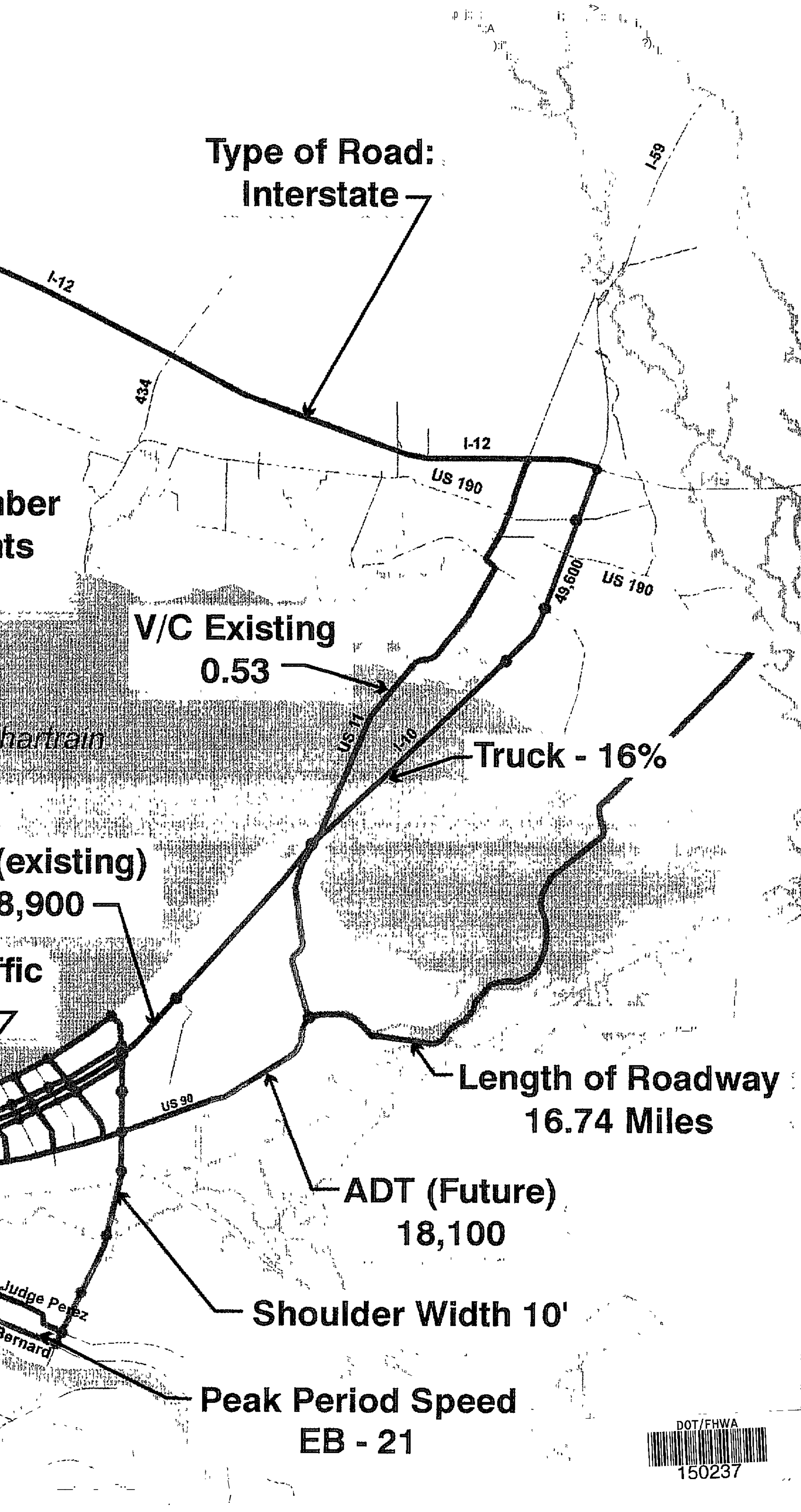

ITS Strategic Plan for

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Metropolitan New Orleans

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Prepared for

Regional Planning Commission
for Jefferson Orleans, Plaquemines, St. Bernard and St. Tammany Parishes

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EXECUTIVE SUMMARY

Introduction

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) established new priorities in transportation system policy in the United States. Recognizing that accommodating increased demand by building new roads is no longer the most viable option in an era of limited funding and increased concern about air pollution, this legislation emphasized the need to increase the safety and efficiency of existing transportation facilities through the application of advanced communication, detection and monitoring technology.

In response to ISTEA, agencies in the New Orleans Metropolitan Area conducted a preliminary assessment of traffic operations on the Interstate and primary arterial systems, resulting in the following listing of findings. Roadways are operating at insufficient levels of service during peak traffic periods. Incidences of accidents are high at congested locations. Peak hour congestion seriously affects emergency response time. Traffic signals and traffic signal systems are in need of upgrading. Congestion to and from the Interstate system during peak traffic periods is impacting the surface streets in the area and the surface street congestion is in turn impacting the Interstate system. Traffic signal systems are inadequate to handle congestion associated with emergency evacuation.

Purpose

The purpose of this ITS Deployment Study is to identify where and how ITS technologies can be applied to improve the safety, efficiency and capacity of the New Orleans regional transportation network. The end result will be an ITS Strategic Deployment Plan, that will guide the metropolitan area in its efforts to improve transportation throughout the region.

Role of ITS

ITS primarily considers the hardware and software used to manage traffic and inform motorists. However, ITS also demands an overall strategy aimed at increasing the efficiency of the transportation system. This requires the cooperation and coordination of the agencies providing these transportation services. Management techniques are also utilized to monitor operations and conditions and improve communication with the system users.

Study Area Network

The study was originally defined by the Regional Planning Commission (RPC) for the following Interstate and primary arterial pairs:

- I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway
- I-10 East New Orleans and I-1O East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard
- I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway
- I-10 Interstate and 1-610 Interstate
- Interstate and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue/U.S. 90 East
- I-10 West, Jefferson Parish, and Veterans Boulevard
- I-10 West, St. Charles Parish and US 61, Airline Highway
- Causeway Toll Bridge
- US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches
- LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue
- US 61, Airline Highway and LA 3139, Earhart Expressway / Claiborne Avenue
- US 90, Jefferson Highway / Claiborne Avenue and LA 3139, Earhart Expressway / Blvd.

An initial review of these interstate routes and arterial pairs indicated that consideration should be given to other primary routes. At an initial Steering Committee meeting, several of these other routes were discussed and evaluated including:

• I-310	St. Charles Parish
• US 90 West	St. Charles Parish
• W.B. Expressway	Jefferson Parish
• I-510/Paris Road	Orleans Parish/St. Bernard Parishes
• I-55	St. John The Baptist/Tangipahoa Parishes
• I-12	Tangipahoa/ St. Tammany Parishes

Steering Committee

The Steering Committee's responsibilities are to oversee the Consultant project and become the focus for regional cooperation and coordination.

Existing Conditions

The greatest commuting demand is into the City from outlying areas. With additional significant traffic flowing from the City to the chemical plants, refineries and other industries along the Mississippi River.

Traffic Volume, LOS, Speed, Accident Data, Congestion

Freeway traffic congestion can be estimated in different ways. Volume, speed, and freedom to maneuver (a function of density) have all been used to describe freeway operation. Although speed (and its derivative, travel time) is a major indication of service quality to drivers, it is not an adequate measure of service **level** for engineering purposes.

Existing traffic volumes and V/C (Volume/Capacity) ratios were obtained primarily from the transportation network model maintained by the RPC. For those routes outside of the model limits, the Louisiana Department of Transportation (LDOTD) Highway Needs Summary was utilized. Truck percentages for the study routes were provided by the LDOTD Traffic and Planning Division.

Because modern freeway operating characteristics show that speed is nearly constant over a wide range of flow rates, speed alone is not an adequate measure of performance. Both freedom to maneuver within the traffic stream and proximity to other vehicles have a major impact. These two qualities are related to the density of the traffic stream. Density is therefore the parameter of choice for defining the level of service (LOS) for a freeway section. The LOS ranges from A (free-flow operation) through D (traffic stream has little space to absorb disruptions) and E (the density at which capacity occurs for different free-flow speeds and different widths of freeway) to F (congestion, breakdown, queue formation).

Accident data was gathered from several different sources for this project. Of the 59 locations cited as the intersections with the highest accident rates for 1992 on the State and Federal highway system in the metropolitan area, 75 percent are part of the study roadway network.

Recurring congestion is associated with roadway segments that experience the same **type** of congestion at the same location, usually during the peak periods. Recurring congestion occurs when the facility experiences Levels of Service E/F. Nonrecurring congestion is associated with accidents and is less predictable than recurring congestion. In order to determine the amount of delay associated with nonrecurring congestion, the frequency of accidents was used. The volume criteria was lowered to a Level of Service D, because accidents have an affect on traffic at Level of Service D as well as E/F.

Public Transit

The City of New Orleans is one of the largest transit properties in the nation with approximately 500 buses and 35 light rail vehicles in the system. The Regional Transit Authority (RTA) operates a rail and busway system, carrying over 23,000 riders per day, within the Central Business District (CBD). Jefferson Parish Transit System is comprised of 13 fixed transit routes with the most recent counts indicating slightly over 16,000 riders per day. On the seventeen corridors being evaluated for ITS service, Canal Street carries the most buses a day, averaging over 530 bus trips per day.

Existing Initiatives

Transportation Systems Management

Several traffic signal improvements are programmed for completion in Jefferson and Orleans Parishes as part of the regional Transportation Improvement Program (TIP). Also, signal controller upgrades, intersection interconnection and telephone line improvements, new signal installations and intersection redesigns in Jefferson Parish are anticipated over the next three to four years, as well as expansion of the closed loop signal systems in Jefferson Parish along major arterial routes. Within the City of New Orleans, there are plans to design and implement a computerized signal system for 400 signalized intersections throughout the City of New Orleans. This project is under the direction of the City of New Orleans Department of Streets.

Incident Management

When icing, flooding or a major incident requiring closure occurs, the responsible agencies contact the Louisiana Department of Transportation and Development (LDOTD) for support. The LDOTD provides support in effecting road closures and in supplying equipment or materials necessary for clean up or clearing of the incident.

The Louisiana State Police provide special training to their troopers in the identification and handling of hazardous materials.

Local media play an important role in providing information on current traffic conditions to motorists who are either planning their commute or who are en-route to their destination.

Intelligent Transportation Systems (ITS)

There are many local ITS systems being studied or implemented. These include: Crescent City Connection Toll System, Bus Priority Control System technologies, the New Orleans Regional ITS Action Program (TIP), The Transportation Plan for Year 2015 (Financially Constrained) for the New Orleans Urbanized Area, the Crescent City Connection HOV Lane, ITS Feasibility Planning Study, various studies for moving trucks and delivery vehicles, and existing transponders at the North and South Plazas of the Causeway.

Future Conditions

Because deployment of ITS technology will take place over a long period of time, future conditions have a major role in determining the method of such deployment. Traffic volumes have to be estimated for twenty years into the future. Since it is beyond the scope of this study to predict traffic growth in detail, existing available estimated traffic volume information was utilized.

Traffic Volume, LOS, Congestion

Most corridors are expected to see positive growth in traffic volumes. The future level of service (LOS) on the study area roadways worsens on the roads with increased volumes since no capacity improvements are assumed. The roads with high growth forecast will experience a deterioration to LOS F. The increased future volumes and corresponding decreased speeds create approximately 42 additional miles of recurring congestion over the existing condition. This indicates that in the year 2015, approximately 38.9% of the study area roads will be experiencing recurring congestion. In the year 2015, approximately 2 additional miles of nonrecurring congestion over the existing condition will exist, indicating that approximately 6.7% of the study area roads will be experiencing nonrecurring congestion.

Characteristics	Existing		Future	
	Miles	% of Study Area	Miles	% of Study Area
Recurring Congestion	97.72	27.2%	139.97	38.9%
ADT Exceeding 15,000 veh/lane	14.56	4.1%	64.12	17.8%
Nonrecurring Congestion	22.37	6.2%	24.15	6.7%

Local Institutional Issues and Needs

All of the responders agreed that there is a significant existing congestion problem due to inadequate capacity and that this problem will become worse in the future.

A composite of all the individual agency rankings indicated that incident management and traffic control were identified as the most important user services for the region.

Issues foreseen to have the potential to derail or slow down the development of a future regionally coordinated transportation management and information system include funding, communication, political boundaries, cooperation, coordination, inadequate staffing, maintenance, differing goals, and public acceptance.

There is a feeling throughout each agency that the staff is very capable of handling any high tech system.

Institutional Issues

The field of ITS is growing rapidly in response to the public's increased demand and need for improved transportation efficiency. Many of the changes that the deployment of ITS technology will generate have political implications. Accordingly, some of these issues could have widespread impact on governmental agencies at all levels, on private companies, and ultimately, on the traveling public.

Coordination and Cooperation

Many of the transportation officials interviewed for this report believe that cooperation and coordination can be achieved among agencies and political jurisdictions without far-reaching changes to established laws, regulations, or policies.

Relationship with Emergency Response Agencies

In order to maintain a conflict free working relationship among the various participants, it should be stressed that each local emergency response agency maintains autonomy over their own traffic management operations.

Political and Legal Concerns

Forming partnerships between public and private agencies will require the resolution of legal, regulatory, technical, and user application issues.

The legality of granting access to others for the use of state, Parish and local highway rights-of-way is still open. Application of existing laws to this issue is subject to differing interpretation.

Operating and maintaining ITS facilities will require a continuous stream of revenue. It is therefore necessary to accept new annual operating costs that did not exist previously, or to find a way to fund these operations.

There is still disagreement as to whether anti-trust concern is a real obstacle or just a perceived one. The risk of creating a monopoly has to be balanced against the resources that will be available to address the issue.

Proprietary technology and its associated intellectual property rights serve as motivation for private investment. It will require careful planning and negotiation for both sides to foster a successful implementation.

If the public perceives that ITS technology invades their privacy, there could then be a backlash against ITS.
Related to privacy issues is the matter of information discrimination. Information needs to be disseminated fairly among all interested users.

The dissemination of travel information entails possible liabilities related to the accuracy and timeliness of that information. If public agencies assume responsibility for operations and maintenance of ITS technologies, then the status quo persists. Since private firms may also operate and maintain these technologies under contracts, apportionment of responsibilities should be negotiated and incorporated in the contract.

Public Involvement

The key to integration and coordination is communication, not only among the agencies carrying out the work, but with the customers as well. In this case, the customers can be broadly defined as anyone who uses the public highways. Thus, communication will include direct and indirect links to the public.

Funding

The ITS program is not envisioned to be funded primarily by the federal government. In fact, 80 to 90 percent of ITS deployment costs over the next twenty years are expected to be borne by the private sector and individuals.

Public Funding Impediments

Inexperience with High Technology Procurements, Contracting Regulations, and Organizational Conflict of Interest Limitations all provide potential barriers to effective funding of ITS.

Procedures for Private Participation

Properly structured, partnerships between public agencies and private enterprises can blend the best features of both, and provide something for everyone. The public sector taps **new** sources of capital without raising taxes, and the private sector gains investment opportunities and the work activity it needs to stay in business. The public at large gains as well, from new jobs and needed infrastructure. No established procedural model exists for the purpose of carrying out such arrangements.

Procedures for User Fees

Most people resist paying user fees for roads. Economist Winston Clifford of the Brookings Institute has designed a series of infrastructure user fees that could raise as much as $60 billion a year. The fees would promote efficiency by discouraging unnecessary travel, pay for maintenance, and provide revenue for other essential public works.

Policy Decisions

Because deployment of ITS technology will take place over a long period of time, future conditions have a major role in determining the method of such deployment. Therefore, major elements of this plan will have to be in place before funding sources are identified. Consequently, the plan will need to be iterative as these sources are identified and refined.

Policy Adoption Requirements

Even in the presence of adequate funding, lack of cooperation and coordination can hinder the deployment of ITS technology. It is therefore important to define a methodology for funding allocation and project prioritization that is acceptable to all interested parties, so that deployment can proceed efficiently.

Recommendations

This report cannot recommend an optimal ITS operating environment. Advanced transportation technologies are currently being operated under a multitude of different institutional arrangements and operating environments. What works in one area may not necessarily work in another. There are two approaches to solving this conundrum. starting from the ground up, or modifying an existing structure.

Transportation System Characteristics

Agency Involvement

New Orleans operates under a home-rule charter, meaning the State must get the consent from the city/parish for anything the state wants within the boundaries of the incorporated area. The reverse also applies. The local jurisdiction must get the State's consent for anything it wants.

Transportation System Operating Characteristics

Overall, there were nearly 360 miles of roadway evaluated in the freeway network. Over 27% of the network experiences recurring congestion while over 6% would be significantly impacted by an incident resulting in nonrecurring congestion.

Existing ITS Initiatives

The existing and planned ITS projects involve traffic signal systems and incident management plans as well as electronic payment.

Regional Goals and Objectives

These include: improve safety, increase efficiency, reduce energy and environmental impacts, enhance productivity, and enhance mobility.

User Services Plan

Description

The national ITS program has defined twenty-nine interrelated user services. The users include the entire spectrum of transportation providers, operators and travelers as well as other fringe groups involved in these transportation services or who may benefit from improved transportation services.

Agency Perspective

It is clear that the user services contained within the Travel and Transportation Management and Emergencies Management bundles were the priority of the local agencies.

Examples

Travel and Transportation Management Bundle:
Incident Management; Traffic Control; Route Guidance; En-Route Driver Information (only external Driver Advisory is included).

Travel Demand Management Bundle:
Pre-Trip Travel Information; Demand Management and Operations.

Public Transpottation Operations Bundle:
Public Transportation Management; Public Travel Security.

Emergency Management Bundle:
Emergency Notification and Personal Security; Emergency Vehicle Management.

Core Infrastructure

FHWA has defined seven elements that contribute to the deployment of Intelligent Transportation Systems (ITS) and establish a foundation for the deployment of future ITS user service: Regional Multimodal Travel Information Center (RMTIC); Traffic Signal Control Systems; Freeway Management Systems; Transit Management Systems; Incident Management Program; Electronic Fare Payment; and Electronic Toll Collection.

Implementation Time Frame

In general, the specified implementation time frame corresponds to the priority indicated by the local agencies unless there are other limiting factors, such as available technology.

Functional Requirements

Introduction

The Federal ITS Program has defined seven technical functional areas: surveillance, communications, traveler interface, control strategies, navigation/guidance, data processing, and in-vehicle sensors.

Functional Areas

Surveillance is the mechanism that permits the collection of a range of transportation data including speed, volume, density, travel time, queue length, and, in some cases, vehicle positions for buses and transit. Without surveillance capabilities, however primitive or sophisticated, there is no knowledge of the current operating conditions, there is no information for operational decisions, and ultimately there is no information to provide to the users.

Communications include all transmissions (including voice, video, and data transmissions) between the elements of the transportation system, both the vehicles and the infrastructure. Communications is another one of the most important technical functional areas, because it is necessary to transmit data for surveillance, and to transmit information to operating agencies and transportation consumers.

The traveler interface allows the traveler to interact with the ITS system to obtain traffic management center updates or information from the database. In general, the traveler interface technologies vary from the communications technologies in that they can allow interaction with the user.

Control strategies include those strategies that the TMC can implement to help control demand on the infrastructure, smooth traffic flow, or help to improve traveler safety. Control strategies may focus on either the freeway or the surface streets, or they may manage traffic on the entire system.

On-board navigation systems assist the traveler in route planning and route following. Technologies in the Navigation/Guidance technical functional area may be used in conjunction with the provision of the Incident Management Emergency Vehicle Management, Public Transportation Management, En-Route Driver Information, Pre-Trip Travel Information, and Demand Management user services.

Data processing includes the management and quality control of all data pertaining to ITS. The data processing function includes all in-vehicle, roadside, and central computer processing. This functional area also includes the algorithms that are used for navigation and for making traffic management decisions. Data processing becomes increasingly critical as the volume of data (provided by the surveillance technologies) increases.

In-Vehicle sensors include all in-vehicle devices that monitor the individual vehicle and driver. In-vehicle sensors also include sensors that monitor elements of the driving environment that pertain to individual vehicle operation. Technologies in the in-vehicle sensors technical functional area may address a variety of user services, including Emergency Notification and Personal Security, En-Route Driver Information, Public Transportation Management, Traveler Information Services and Demand Management and Operation.

Technical Functional Area Priorities

The technical functional areas that appear most important in the short and medium term for the Metropolitan New Orleans area are:
Surveillance, which is needed to monitor traffic flow and detect incidents; Communications, which are needed to convey traffic information to the appropriate operating agencies as well as to the public; Control Strategies, which are needed to optimize the efficiency of freeways and arterials, during typical conditions and in response to incidents; Traveler Interface, which is need to communicate with the public; and Data Processing, which becomes increasingly important as the amount of data to be processed increases.

Functional Assessment of Technologies

There are three main technology components of an Intelligent Transportation System; Surveillance, Traveler Interface and System Communications.

Surveillance

Advanced Traffic Management Systems (ATMS) typically provide two different sub-systems for roadway surveillance: vehicle/traffic flow detectors, and closed circuit television (CCTV) cameras. These two subsystems provide different functions, and operate together to provide the traffic operations center (TOC) with real-time status of traffic conditions.

Traveler Interface

Variable Message Signs (VMS), both fixed and portable, are widely used to provide motorist information during an incident. The ability to quickly alert motorists of a problem ahead, and provide for diversion to an alternate route, is a successful strategy for minimizing the impact of an incident.

Highway advisory radio (HAR) is widely used to provide motorist information to travelers in a limited geographic area. Non-commercial information services include construction and traffic congestion information, possible alternate routes, traveler advisories, parking information at major destinations safety information, availability of lodging, rest stops and local points of interest.

Another medium for traveler information is the use of kiosks. Kiosks, in this instance, are video screens that display maps and/or text information regarding traffic, incident and transit information. Placed strategically at shopping malls, schools or large places of business; kiosks can provide pre-trip information.

A useful pre-trip informational tool is the Dial-In System. A telephone number is established for the public to call for current traffic conditions for the ATMS.

The World Wide Web (WWW) portion of the Internet computer network has become the latest medium that some agencies are using to provide real-time traffic information to the public. Users are able to view a regional map that is color-coded to reflect various levels of congestion, view a list of estimated travel times from various origins to various destinations within an area under traffic surveillance, obtain construction delay information, and/or may allow users to directly link to other related WWW sites, including those for transit, weather, and/or tourist information.

System Communications

Commercial circuits and agency-owned circuits are the two primary alternatives available for system communications. Typical ITS use both of these alternatives, with the chosen mix of types being driven by cost constraints and other technical- and system-specific requirements. It is of utmost importance that the communications system architecture be designed around common and commercially supported standards so that it has sufficient flexibility to respond to the rapid changes in communications technology.

Commercially-owned facilities are the local telephone, cable, cellular and other communications providers. These services include dial-up analog service, dedicated voice-grade analog circuits, digital carrier circuits, dataphone digital service, integrated services digital network, packet radio, cellular services, satellite communications and microwaves.

Agency-owned facilities include cabled based land line systems, network configurations, data transfer standards - SONET, and wireless spread spectrum radio.

Miscellaneous

Weigh-in motion systems provide data that is used to monitor trends in weight regulation compliance, truck dimension compliance, safety analyses, speed and headway distributions, traffic operation and control and bridge load level analyses.

Roadway/Runway Weather Information Systems (RWIS) are finding increasing use in locations where localized temperature or precipitation conditions can disrupt traffic, or require roadway maintenance activities. Roadway weather information is also useful to monitor subsurface conditions that may be cause to restrict the travel of heavy vehicles. Weather monitoring systems can provide roadway surface temperature, surface condition (dry, wet, ice, dew, frost), chemical concentration on roadway surface, sub-surface temperature, air temperature, relative humidity and dew point, wind speed and direction, precipitation rate and type, and visibility. This data, when monitored locally and tracked over time, provides additional information for effective management and decision making.

Selection of Individual Functional Elements

Based on local priorities and examination of the technologies that have been successfully implemented in other cities, the specific technologies that appear most important in the short and medium term are surveillance, communications, control strategies, traveler interface and data processing.

National Architecture

While the National Architecture of ITS is not totally defined, it is sufficiently developed to provide general direction and guidance in formulating solutions to transportation issues and the provision of the core user services. There are four basic elements of the architecture, users, external systems, system environment and internal subsystems,

New Orleans Architecture

User Services Requirements

Those services deemed a high priority are incident management, traffic control, route guidance and en-route driver information are intended to be implemented in a short time frame.

The services described as having a medium-high and medium priority would be implemented on a medium time frame. These services are emergency notification and personal security, emergency vehicle management, hazardous material incident response, public transportation management, pre-trip travel information, demand management and operations, public travel security, freight mobility, travel services information and electronic payment services.

ITS Sub System Definition

ITS subsystems are categorized into four functional classes: centers which collect, process and store information; roadsides which include elements along the roadway; vehicles which travel the roadway and remote access.

Design Alternatives

The three design alternatives provided in this document, Centralized, Distributed and Hybrid, are based on operational scenarios that are viable for the Metropolitan New Orleans area. The basic premise of the all three designs is that sensor information (volume, speed, occupancy, video, device status, etc.) from the roadway will be gathered and analyzed either manually or via computer algorithms in order to assess current roadway status and/or determine if there **is** an incident.

Alternatives Evaluation

Even though each of the three design alternatives are equivalent from the perspective of satisfying User Service requirements, it is still necessary to determine which one of them implements the User Service requirements most efficiently, and most effectively. The categories used to assess the alternatives were: cost, system availability, flexibility, expandability, potential for staged deployment, potential for arterial diversion and institutional considerations.

Long Term Vision Statement

Basic Elements of the Vision

The Advanced Transportation Management System (ATMS) for Metropolitan New Orleans should provide an integrated system for the movement of people and goods on the freeway and arterial highways and transit system. Through partnering among agencies use of existing resources can be maximized to improve regional transportation operations and responses to incident conditions.

Goals for the ATMS System in the Metropolitan New Orleans Area

1. Implement an Advanced Transportation Management System (ATMS) for the New Orleans region that strikes a cost-effective balance.
2. Establish an Advanced Traveler Information System **(ATIS).**
3. Continually improve emergency response on the transportation network.
4. Promote private/public partnership opportunities.
5. Promote feedback and ongoing evaluation of the performances of all **ATMS/ATIS** components.

Highlights of the Vision

LDOTD should build, maintain and operate an ATMS on the entire freeway network in the Metropolitan New Orleans Area.

Detailing the Vision

A vision statement includes a set of indicators of where policy should be developed to further agreed-upon goals.

Needs of the Relevant Agencies

Agencies which have a direct interest in the establishment of the ATMS have been identified and encouraged to participate in the establishment of the ATMS.

Customers and the Benefits Received

Benefits will be afforded to three sets of users: End User Customers, Interim Customers and Regional Residents and Businesses.

Roles and Responsibilities of the Relevant Agencies

LDOTD will build, maintain and operate an ATMS/ATIS on the entire freeway network in the Metropolitan New Orleans area. The City of New Orleans and the area parishes should upgrade any existing traffic control systems to a system that can be totally traffic responsive and would have integration capabilities with a large regional system on a PC based multi-tasking platform with a geographic information system (GIS) based computerized graphical map display (compatible with other agencies). The State Police should be located in the Intelligent Transportation Systems Center (ITSC) with LDOTD, City of New Orleans and any of the area Parishes interested in being physically located in the ITSC. The Greater New Orleans Expressway Commission/Crescent City Connection would have dial up remote access to the ATMS information and status display. The Regional Transit Authority/Jefferson Parish Transit should have a link to the ITSC for direct access to the recurring and non-recurring congestion traffic information. The 911 Center/Office of Emergency Preparedness should have two way communication with the ITSC. The City of New Orleans department of Streets will also have a link established from the ATMS.

Issues in Implementation

Agencies participating in the ATMS should have develop clear guidelines on the maintenance and operation of the elements of the system. Other issues which need to be addressed include roles for the private sector, funding sources, policy on CCTV use, open architecture for in-vehicle navigation systems and modifications to allow for new technologies.

Intelligent Transportation Systems Center

Background

The Intelligent Transportation System Center (ITSC) will serve as the centerpiece of the New Orleans ATMS. Most of the ATMS functions will occur in the **ITSC** and the Center will play a major role in the success and public image of the New Orleans ITSC.

ITS Center Evaluation

The potential site needs to meet several criteria in a number of categories: ownership, space availability, highway access, emergency/alternate access, costs, communication link potential, site utilities and site security. The preferred location for the ITS Center is within state right-of-way at the intersection of Veteran's Memorial Boulevard and Pontchartrain Boulevard. This site was chosen because of its central location and access to Interstates IO and 610.

Implementation Plan

The database developed for this project was used to define which routes and the limits of the routes where ITS elements would be deployed. The location of these elements which consist of Variable Message Signs (VMS), Closed Circuit Television Cameras (CCTV), Traffic Detection Systems and Highway Advisory Radio (HAR) are displayed on maps shown in Chapter 7.

Figure 7-1 shows the segmentation or phasing of ITS implementation. The segmentation is based upon logically managed routes which eventually will become one cohesive and comprehensive system.

Near-Term (Early Action Items) - Initial projects and/or actions which can be implemented within two years from the decision to proceed.

Shod-Term (First Phase) - Projects and/or actions planned to be implemented in a time frame of two to five years from the decision to proceed.

Medium-Term (Second Phase) - Projects and/or actions to be implemented in a five to ten year time frame from the decision to proceed.

Long-Term (Third Phase and Fourth Phase) - Projects and/or actions to be implemented more than ten years into the future.

Early action items are designed to deliver the maximum benefit fir the least amount of initial investment. These items are summarized below.

- **Near-Term Implementation (Early Action Items - Within 2 Years)**
    - *Freeway Milepost, Route/Direction Signing & Call 91 I Signs*
    - *Public Education Program*
    - *Incident Response Procedures*
    - *Temporary ITS Center*
    - *Portable VMS & Permanent HAR for Pre-Planned Incidents*
    - *Establish CCTVat High Accident Locations via Low Speed Communication*
    - *Prepare Design Packages for First Phase Routes*
    - *Begin Real-Time Management of Incidents*
    - *Implement Roadway/Weather Information System (RWIS)*
    - *Develop Standards for ITS Elements for Construction Projects*
    - *Finalize ITS Center Location*
    - *Upgrade Traffic Signal Systems & Establish Incident Timing Plans*

Short-Term or Phase I implementation includes the completion of the ITS elements within the core urban area primarily along I-l0 and I-610 from the I-IO/Veterans Interchange to the I-lO/Chef Menteur interchange. A summary of the elements included in Phase I is shown below.

- **Short-Term Implementation (First Phase - 2 to 5 Years)**
    - *Complete CCTV Locations*
    - *Establish Traffic Detection for Phase I Routes*
    - *Establish Fixed VMS*
    - *Upgrade CCTV Communication System*
    - *Implement Traveler Information Kiosks*
    - *Develop the Permanent ITS Center*
    - *Incorporate and Establish Links to Affected Agencies*

Medium-Term Implementation or Phase II would concentrate on the remaining interstate and arterial routes within Jefferson and Orleans Parishes. The items include establishing CCTV, VMS, Traffic Detection and plans for the ITS Center expansion.

- **Medium-Term Implementation (Second Phase - 5 to 10 Years)**
    - *Establish CCTV,VMS and Traffic Detection on Routes Outside the Urban Area*
    - *Develop Plans for the ITS Center. Expansion*

Long-Term or Phases III and IV would concentrate on the area west and north of New Orleans. This would include I-IO, U.S. 61, I-310 and U.S. 90 in St. Charles Parish as well as I-55, I-l2 and I-l0 surrounding Lake Pontchartrain.

Benefit:Cost Ratios

To calculate the benefits of implementing ITS in the New Orleans region, the amount of time saved per vehicle was estimated and used in the following formula.

Peak Hour Benefit = Peak Hour Traffic Volume x Peak Hour Accident Frequency x Delay Saved Per Vehicle Per Accident x Dollar Value of Time Per Vehicle x Number of Peak Hours Per Day

The smallest cost of implementing the equipment for each roadway segment was calculated upon 5 percent annual rate of interest over a 10 year period. The total annual benefit was divided by the annualized cost to compute the annual benefit:cost ratio for each segment of roadway. A summary of the total benefit:cost ratio by phase is shown below.

	Fully Instrumented Annual Benefit	Less than Fully Instrumented Annual Benefit. Cost	Fully Instrumented Annual Benefit (B)	Less than Fully Instrumented Annual Benefit Cost	Length (miles)	Fully Instrumented Annual Benefit/Mile	Less than Fully Instrumented Annual Benefit/Mile
First Implementation Phase	10.30	12.54	$18,192,320	$9,096,160	47.2	$3,196,258	$1,598,129
Second Implementation Phase	14.89	20.79	$29,182,926	$14,591,463	140.8	$3,643,791	$1,821,896
Third Implementation Phase	6.70	6.33	$2,411,681	$1,205,841	56.4	$295,383	$147,692
Fourth Implementation Phase	18.16	9.59	$5,515,987	$2,757,993	124.7	$275,825	$137,912
Overall Total Deployment	12.60	14.51	$55,302,913	$27,651,457	369.1	$149,824	$74,912

. * Detection Systems, CCTV and Fiber Optic Communication NOT included in the "Less Than Fully Instrumented"
"Less Than Fully Instrumented" Benefit equals 50% of "Fully Instrumented" Benefits — Annualization Factor for 10 years 0.1295
Delay saved/incident assumed 5 minutes

Operations Plan

The key to a successful Center will be an effective program of operations and maintenance.

Agreements and Memorandums of Understanding

The general purpose of the Center will be to responsive to traffic and incident conditions without regard for jurisdictional boundaries. Agreements between the agencies involved should address agency support, system construction, operations and maintenance, emergency response and specialized control plans.

ITS Center

The ITS Center serves as the main facility from which ITS activities such as incident management, are operated and coordinated. Schematic drawings have been developed to illustrate potential floor plans for the ITS Center. These drawings indicate a possible phasing option for the Center which would allow for the future growth of ITS.

Hours of Operation

The Center should be fully staffed at least from the morning rush hour to the evening rush hour, that is from the hours of 6 AM to 7 PM. Weekends should be staffed for special functions or during inclement weather.

Intelligent Transportation Systems Center Operators

Operators would have a variety of tasks including monitoring CCTV displays, changing variable message displays, responding to alarm messages from the computers when incidents are detected or equipment fails, Using telephone or radio equipment to inform police, fire or rescue personnel responding to an incident, working with the media and public regarding an incident or traffic conditions, operating recording equipment, perform simple equipment maintenance and/or replacements in the ITSC and maintain logs and required accounts of activities.

Equipment Maintenance

Maintenance and repair of equipment should be completed in a timely and efficient manner. Therefore, the maintenance technician should be well versed in a range of skills including electronics, communications, power distribution, cable installation and repair, portable generators and general small scale mechanical repairs. Troubleshooting and problem isolation techniques will be invaluable, as well as proper record keeping skills.

Operations and Maintenance Costs

System Management

A manager of the operators and the maintenance technician will be required. It is desirable that this individual also have an engineering background so that broader system support and long range upgrades can be handled. The manager will **be** available to support the operator during a major incident, to provide higher level liaison with other agencies and the media, and to serve as back up person if regular operators are not available. The manager will also be responsible for training new personnel, keeping personnel current on new equipment, and the supervision of maintenance activities.

Procurement Methods

Sole Source procurement is not advised for an initial start-up of the entire system. Sole source procurement is utilized in later project phases to maintain compatibility for certain devices such as CCTV camera controllers.

The Engineering/Contractor procurement method is based on the concept that all critical system parameters can be fully specified and documented in a single set of contract documents and that a single contractor is best suited to implement the project.

Design/Build is an option in which a single entity is selected to handle all the work associated with implementing the project.

The Systems Manager/System Integrator procurement method divides the project into various subsystems, with the work overseen by a system manager who administers each contract and is responsible for integrating the various subsystems into an overall operating system.

Chapter 1
Introduction

1.1 Need for ITS

The intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) established new priorities in transportation system policy in the United States. Recognizing that accommodating increased demand by building new roads is no longer the most viable option in an era of limited funding and increased concern about air pollution, this legislation emphasized the need to increase the safety and efficiency of existing transportation facilities through the application of advanced communication, detection and monitoring technology.

Several initiatives were launched under Title VI, Part B of ISTEA, to research, develop, test, and promote Intelligent Transportation Systems (ITS), formerly IVHS (Intelligent Vehicle-Highway Systems) in the United States. In response to this legislation, the FHWA has developed guidelines and support for planning and deployment of ITS technology. Many urban areas now recognize that ITS can be a viable solution to traffic problems.

In response to ISTEA, agencies in the New Orleans Metropolitan Area conducted a preliminary assessment of traffic operations on the Interstate and primary arterial systems, resulting in the following listing of findings:

- Many of these roadways are operating at insufficient levels of service during peak traffic periods.
- Incidences of accidents are high at congested locations.
- Peak hour congestion seriously affects emergency response time.
- Traffic signals and traffic signal systems are in need of upgrading due to the age of much of the equipment, the availability of more reliable and more sophisticated equipment and more modern systems.
- The congestion involving the ingress and egress of vehicles to and from the Interstate system is impacting the surface streets of the area, causing them to break down operationally during peak traffic periods. Correspondingly, the congestion on the surface streets is impacting the Interstate system causing operational problems during peak traffic periods.
- Traffic signal systems are inadequate to handle congestion associated with emergency evacuation.

In the New Orleans metropolitan area, the Regional Planning Commission (RPC) has taken the lead in the planning for ITS deployment. This project will provide the framework upon which to base the design of an Intelligent Transportation System for the metropolitan area.

1.2 Purpose

The purpose of this ITS Deployment Study is to identify where and how ITS technologies can be applied to improve the safety, efficiency and capacity of the New Orleans regional transportation network. In order to streamline the process, a series of Technical Memorandums were produced to document the results in a timely manner, and solicit feedback from the stakeholders to guide further efforts. The Technical Memorandums addressed the following areas:

- Baseline Conditions and Problem Areas
- Institutional Framework
- ITS User Service Plan / Performance Criteria
- Functional Areas / Technology Assessment and Recommendations
- System Architecture Alternatives / TOC Plan
- Deployment Plan / Operations Plan

The end result is an ITS Strategic Deployment Plan, combining the results of the various Technical Memorandums into a comprehensive document that will guide the metropolitan area in its efforts to improve transportation throughout the region.

1.3 The Role of ITS

The generally accepted concept of ITS primarily considers the hardware and software that is used to manage traffic and inform motorists. However deployment of an ITS system involves more than installing the latest technology. It demands an overall strategy which reaches beyond vehicles and highways, and is aimed at increasing the efficiency of the entire transportation system. It requires improved cooperation and coordination among the agencies providing transportation services. It also requires the application of effective management techniques to improve operations, real-time monitoring of traffic conditions, and effective communication with the system users.

Identifying the appropriate user services is basic to the ITS planning process as defined by the FHWA. No plan will be effective unless it addresses the actual needs specific to the area where it is to be implemented. An accurate inventory of the existing transportation system forms the foundation for determining how, when, and where ITS technologies can be applied to improve the safety, efficiency, and capacity of the New Orleans regional transportation network.

The Metropolitan New Orleans transportation network and planned improvements must continue to serve the needs of the community well into the future. But even as planned improvements are completed, they will not be adequate to satisfy all of the capacity demands of the region. Through the use of advanced surveillance and communication technology, ITS offers alternatives to improve the carrying capacity and efficiency of the transportation without the construction of additional pavement.

1.4 Study Area Network

The New Orleans Metropolitan Area is primarily served by the I-10 Interstate Corridor and a network of major arterial State, City and Parish highways used to transport people and goods in and around the City of New Orleans, Louisiana. The surrounding parishes, such as St. Bernard, St. Charles, St. Tammany and Jefferson, use these corridors for commuting and for transporting goods for interstate and international commerce. The corridor is fed from the north by I-55 and I-59, from the east and west by I-10, US 90 and US 61, thereby enabling New Orleans to serve as a regional hub center for much of the area's commerce. The New Orleans Metropolitan study area will thus be defined as the City of New Orleans, Jefferson Parish, Slidell / St. Tammany Parish, St. Bernard Parish and the St. Charles Parish eastbank.

As described in the original proposal request, this study will primarily address major points of congestion in the Interstate System and the principal arterials adjacent to and connecting with the Interstate System. The arterials were included to develop a parallel arterial traffic control routing and traffic management plan which can be implemented when Interstate incidents result in a shut-down or loss of capacity during peak traffic or off-peak traffic periods. The unique nature of the New Orleans Metropolitan Area, with its rivers, lakes, canals and intracoastal waterways setting up frequent boundaries, also requires the inclusion of other primary arterials vital to the local and commercial transportation network of the area.

The study was originally defined by the Regional Planning Commission (RPC) for the following Interstate and primary arterial pairs:

- I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway
- I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard
- I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway
- I-10 Interstate and I-610 Interstate
- Interstate and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue/U.S. 90 East
- I-10 West, Jefferson Parish, and Veterans Boulevard

- I-10West, St. Charles Parish and US 61, Airline Highway
- Causeway Toll Bridge
- US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches
- LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue
- US 61, Airline Highway and LA 3139, Earhart Expressway / Claiborne Avenue
- US 90, Jefferson Highway / Claiborne Avenue and LA 3139, Earhart Expressway / Blvd.

An initial review of these interstate routes and arterial pairs indicated that consideration should be given to other primary routes. At an initial Steering Committee meeting, several of these other routes were discussed and evaluated including:

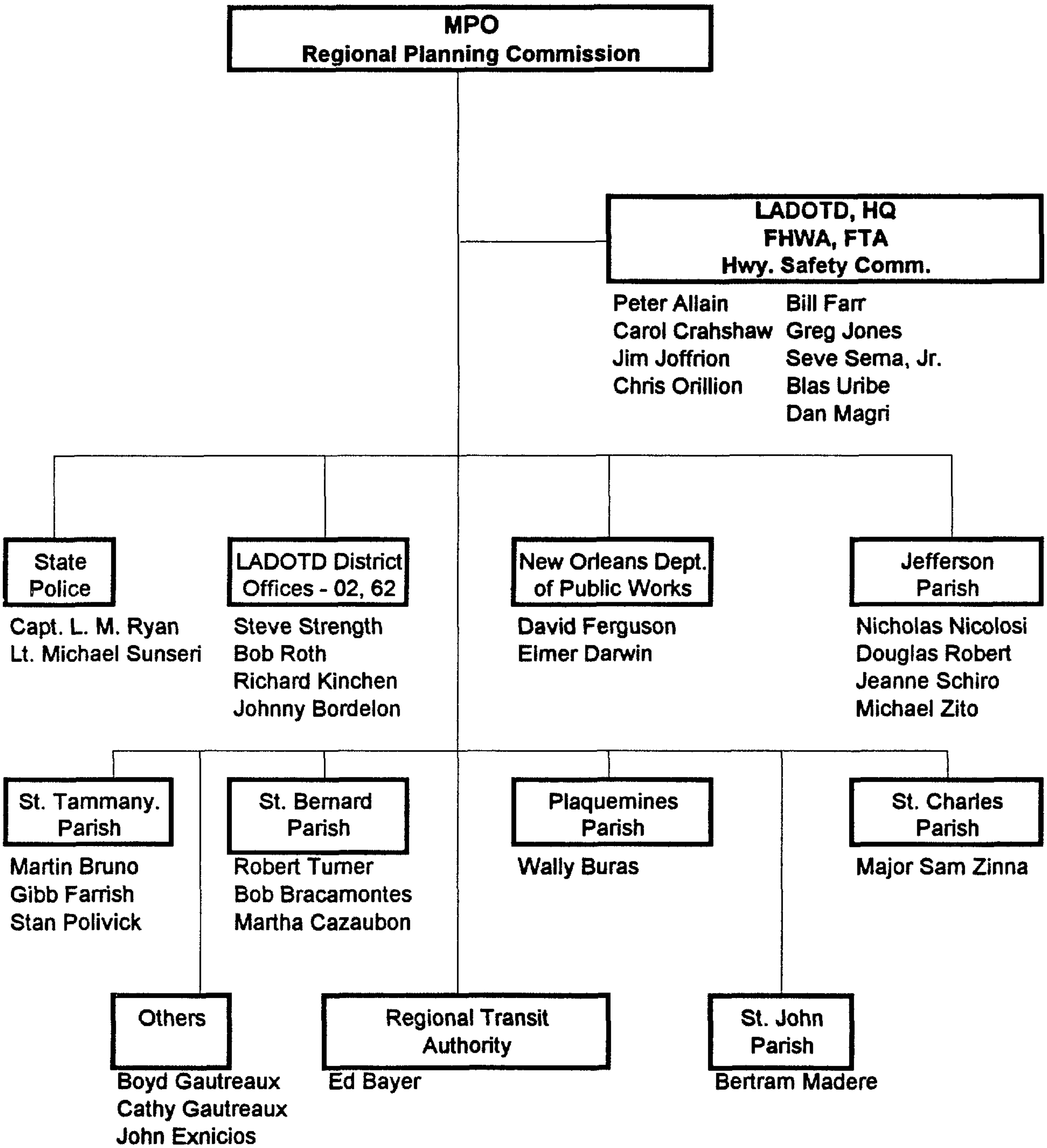
• I-310	St. Charles Parish
• US 90 West	St. Charles Parish
• W.B. Expressway	Jefferson Parish
• I-510/Paris Road	Orleans Parish/St. Bernard Parishes
• I-55	St. John The Baptist/Tangipahoa Parishes
• I-12	Tangipahoa/ St. Tammany Parishes

For the purposes of this study, all of the routes listed above were organized into eighteen separate corridors and are shown Figure l-1. The individual study routes within the corridors are shown in Figures 1-2 and l-3. Figures 1-4 and I-5 show the actual link locations for the study routes.

1.5 Steering Committee

In order to guide the development of this regional ITS plan, a Steering Committee was formed. The responsibility of this group was to oversee the Consultant project and become the focus for regional cooperation and coordination. Figure l-6 shows the ITS Program Steering Committee.

Figure 1-6. ITS Program Steering Committee



Chapter 2
Baseline Conditions and Problem Areas

2.1 Existing Conditions

The I-10 Corridor serves as an expressway for commuter traffic as well as a regional interstate serving east-west traffic from Florida to California. The greatest commuting demand is into the City from outlying areas. There is also a significant amount of commuting outbound from New Orleans to the chemical plant and oil refining industries located up and down the Mississippi River as well as the shipbuilding industry. I-55 and I-59 also serve as both commuter routes as well as Interstate connectors from the Port of New Orleans to the heartland of the United States, north of the metropolitan area. Various other highway systems, such as US 90, US 61 (Airline Highway), Veterans Boulevard, LA 39 (Claiborne Avenue), Canal Boulevard, LA 46 (St. Claude Avenue) and LA 3139 (Earhart Expressway), supplement **I-10** in an east-west direction while some major routes such as LA 49 (Williams Boulevard}, LA 3152 (Clear-view Parkway), Causeway Boulevard and Carrollton Avenue, serve as north-south collectors.

2.1.1 Existing Traffic Volumes

A data base was created for this study using Microsoft's Excel spreadsheet. All the routes evaluated for this study were broken down into sections containing information used to assess existing conditions (such as traffic volume, number of lanes, percent of trucks, bus volume, annual number of accidents, directional peak hour speed and volume/capacity ratio), as well as estimates of future conditions. A summary listing is contained in Appendix A.

Existing traffic volumes and V/C (Volume/Capacity) ratios were obtained primarily from the transportation network model maintained by the RPC. For those routes outside of the model limits, the Louisiana Department of Transportation (LDOTD) Highway Needs Summary was utilized. Truck percentages for the study routes were provided by the LDOTD Traffic and Planning Division. Figures 2-l and 2-2 show the existing Average Daily Traffic (ADT) on the study area links for 1995.

A summary of the existing traffic volumes by corridor is given below:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - In this corridor, the segment of I-10 from east of I-510 to US 11 has six lanes with an ADT of 49,600. From US 11 to Oak Harbor, I-10 is four lanes across Lake Pontchartrain with an ADT of

47,900. From Oak Harbor to I-12, I-10 has six lanes with an ADT varying from 44,600 to 49,600. US 11 between I-12 and I-10 varies from two to four lanes with an ADT of 17,900. The remaining segment of US 11 between I-10 and US 90 has two lanes with an ADT of 3,500. In this corridor, US 90 (Chef Menteur Highway) between US 190 and **US** 11 varies from two to four lanes with an ADT of 2,600.

- **I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard (Corridor** #2) - In this corridor, I-I 0 has six lanes with an ADT varying from 110,100 at US 90, to 48,900 just east of I-510. The I-10 service roads are two lane two-way frontage roads servicing businesses on either side of the freeway. US 90 (Chef Menteur Highway) from US 11 to I-510 has four lanes with an ADT of 6,700. The section of US 90 from I-510 to I-10 varies from four to six lanes with an ADT of 42,700. Hayne Boulevard has four lanes with an ADT varying from 1,900 at Paris Road to 6,500 at Dowman Road. Leon C. Simon has an ADT of 12,800 at Elysian Fields.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor** #3) - In this corridor, I-10 varies from six to eight lanes with an ADT of 107,300 between I-610 and Louisa Drive. The Industrial Canal Bridge section of I-10 between Louisa Drive and Downman Road has six lanes with an ADT of 94,500. I-10 continues as six lanes between Downman Road and US 90 with an ADT of 71,800. US 90 (Chef Menteur Highway) has six lanes between I-10 and Franklin Avenue with and ADT varying from 32,000 to 39,000.

- **I-610 Interstate (Corridor #4)** - I-610 is a six lane roadway with an ADT ranging from 51,400 at the eastern end near I-10, to 81,300 near Canal, to 73,500 at the western end near I-10.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue I Elysian Fields Avenue (Corridor #5) -** I-10 between I-610 and Canal Street has six lanes with an ADT varying from 61,100 to 80,000. On I-10 from Canal Street to US 90B, the roadway has six lanes with an ADT ranging from 29,000 to 36,000. Between US 9OB and Metairie Road, I-10 varies from six to nine lanes with an ADT from 93,100 to 68,100. Between Metairie Road and I-610, I-10 varies from four to six lanes with an ADT of 82,000. US 90 (Gentilly Boulevard) between Franklin and Elysian Fields has six lanes with an ADT of 28,100. Between Elysian Fields and St. Bernard, US 90 varies from four to six lanes with an ADT of 27,500. Between St. Bernard and Esplanade, US 90 has four lanes with an ADT of 26,900. Between Esplanade and Canal, US 90 varies from four to six lanes with an ADT of 29,600. From Canal to l-10, **US** 90 has six lanes and an ADT of 29,000. Canal is a six lane roadway from City Park to the Convention Center with an ADT ranging from 12,400 to 25,000. Poydras Avenue from I-10 to Convention Center Boulevard is ,a six lane road with an ADT ranging from 30,000 to 20,000. Elysian Fields Avenue is six lanes from Leon C. Simon to N. Peters, with an ADT ranging from **5,400** to 19,700.

- **I-l0 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** l-10 from l-610 to Loyola is a six lane roadway with ADT ranging from 130,700 to 67,400. Between Loyola and l-31 0, l-10 widens to an eight lane section with an ADT of 67,400. Veterans Boulevard from West End to I-10 is a six lane roadway with an ADT ranging from 49,800 to 40,400. Between I-10 and Williams, Veterans Boulevard ranges from four to six lanes with and ADT of 28,300. Between Williams and Loyola, Veterans Boulevard is four lanes with an ADT of 12,800. Between Loyola and the Jefferson / St. Charles Parish line, Veterans Boulevard varies from two to four lanes with an ADT of 6,800.

- **I-l0 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - I-l0 between l-310 and US 51 is six lanes with an ADT of 42,500. Airline Highway (US 61) varies from four to five lanes from I-310 to US 51 with an ADT ranging from 18,000 to 20,000.

- **Causeway Toll Bridge (Corridor** # 8) - The Causeway varies from four to six lanes with an ADT ranging from 21,300 to 36,500. The approximately 28 mile section from l-12 to the Toll Plaza is four lanes with an ADT of 21,300. From the Toll Plaza to West Esplanade, Causeway is six lanes with an ADT of 25,200. From West Esplanade to Veterans, Causeway varies from four to six lanes with an ADT of 36,500. The last section in this Corridor, from Veterans to I-10 contains four lanes with an ADT of 35,600.

- **US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor #9) -** US 90B between I-10 and Claiborne varies from four to six lanes with an ADT of 47,600. From Claiborne to Camp, US 90B varies from four to six lanes with an ADT ranging from 91,500 to 83,000. From Camp to the Mississippi River, US 90B is six lanes with an ADT of 98,100. The Crescent City Connection crossing the Mississippi River has ten lanes with an ADT of 110,800. From the Connection, the West Bank (WB) Expressway continues with six lanes to Ames with an ADT ranging from 61,200 to 38,200. From Ames to Westwood, the WB Expressway varies from six to eight lanes with an ADT of 57,400. From Westwood to Louisiana, the WB Expressway has six lanes with an ADT ranging from 47,000 to 34,900. From Louisiana to US 90, the WB Expressway has four lanes with an ADT ranging from 34,900 to 33,000. The WB Expressway frontage roads from Westwood to Terry Parkway have ADT ranging from 57,400 to 17,900. US 90 between the WB Expressway and LA 18 is four lanes with an ADT of 36,200. On US 90, the Huey P. Long Bridge between LA 18 and Jefferson Highway has four lanes with an ADT of 46,400.

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor** #10) - LA 39 (North Claiborne Avenue) from I-10 to Elysian Fields is six lanes with an ADT of 31,700. From Elysian Fields to Paris Road, LA 39 is four lanes with an ADT ranging from 34,300 to 38,400. LA 46 (St. Claude Avenue) from Elysian Fields to Paris Road is four lanes with an ADT ranging from 31,600 to 36,600.

- **US 61, Airline Highway and LA 3139, Earhart Expressway (Corridor #11)** - Airline Highway (US 61) varies from four to eight lanes between I-10 and I-310. Specifically, US 61 is eight lanes between I-10 and the Causeway with an ADT of 49,800. Between the Causeway and Cleat-view, US 61 is six lanes with an ADT of 45,400. Between Cleat-view and David, US 61 varies from four to six lanes with an ADT of 39,200. Between David and Williams, US 61 is four lanes with an ADT of 25,900. Between Williams and I-310, US 61 varies from four to five lanes with an ADT of 34,700. LA 3139 between David and Cleat-view varies from four to six lanes with an ADT of 37,700. From Clearview to Causeway, LA 3139 is six lanes with an ADT of 43,700. From Causeway to Monticello, LA 3139 varies from four to six lanes with an ADT of 49,800. From Monticello to Claiborne, LA 3139 is four lanes with and ADT ranging from 30,700 to 10,800.

- **US 90, Jefferson Highway / Claiborne Avenue - (Corridor #12) -** US 90 between Jefferson Highway and US 90B is six lanes with an ADT ranging from 49,300 to 20,200.

- **US 90 West - St. Charles Parish (Corridor** # **13)** - US 90 from I-310 to the Jefferson / St. Charles Parish Line varies from four to five lanes with an ADT of 24,400. From the Parish Line to the West Bank Expressway, US 90 has four lanes with and ADT of 39,800.

- **I-310 North - St. Charles Parish (Corridor #14)** - I-310 from US 90 to I-l0 varies from four to five lanes with an ADT of 28,200.

- **I-55 (Corridor #15)** - I-55 between I-10 and I-12 has four lanes with an ADT of 14,900.

- **I-12 (Corridor #16)** - I-12 between I-55 and US 190 is four lanes with an ADT of 32,800.

- **I-12 (Corridor #17)** - I-12 between US 190 and I-10 is four lanes with an ADT of 34,400.

- **I-510 - Orleans Parish / St. Bernard Parish and LA 47, Paris Road (Corridor #18)** - I-510 between I-10 and US 90 has four lanes with an ADT ranging from 11,700 to 12,800. I-510 between US 90 and Almonaster has four lanes with an ADT of 24,500. LA 47 (Paris Road) has four lanes from Almonaster to Canal with an ADT of 26,500. LA 47 has five lanes from the Arpent Canal to LA 46 with an ADT of 21,100.

2.1.2 Existing Level of Service (LOS) and Speeds

Freeway traffic congestion can be estimated in different ways. Volume, speed, and freedom to maneuver (a function of density) have all been used to describe freeway operation. Although speed (and its derivative, travel time) is a major indication of service quality to drivers, it is not an adequate measure of service level for engineering purposes.

In practical terms, recent studies suggest that speed on freeways is insensitive to flow over a broad range of flows. Because modern freeway operating characteristics show that speed is nearly constant over a wide range of flow rates, speed alone is not an adequate measure of performance. Freedom to maneuver within the traffic stream and proximity to other vehicles have a major impact. These two qualities are related to the density of the traffic stream. Furthermore, density increases throughout the range of flows from zero to capacity, resulting in a measure of effectiveness that is sensitive to flow throughout the range of useful values.

Density is therefore the parameter of choice for defining the level of service (LOS) for a freeway section. The LOS ranges from A (free-flow operation) through D (traffic stream has little space to absorb disruptions) and E (the density at which capacity occurs for different free-flow speeds and different widths of freeway) to F (congestion, breakdown, queue formation).

Given a volume, it is possible to calculate the service flow rate (SFR) for that volume for a particular freeway segment, and compare it to the maximum flow rate. This ratio of volume to capacity (V/C) can be compared to thresholds based on the collective professional judgment of the members of the Highway Capacity and Quality of Service Committee, as found in the Highway Capacity Manual (HCM).

The thresholds for levels of service used in this database are derived from Table 3-l of the HCM, which takes into account the variation in capacity (C) as a function of number of lanes (2,200 vehicles per hour per lane for four lane freeways, and 2,300 vehicles per hour per lane for six and eight lane freeways). Additional factors affecting traffic flow such as percent of trucks, section restrictions for lane widths and lateral clearance, and free flow speed (urban vs. rural) are also used in the calculation per the HCM methodology.

Figures 2-3 and 2-4 show the existing **V/C** (volume/capacity) ratios on the study area links for 1995. The following is a summary by corridor of the levels of service (LOS) experienced on the study area roadway segments:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - In this corridor, all segments of I-10, US 11 and US 90 (Chef Menteur Highway) operate at LOS C or better.

- **I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard (Corridor** #2) - In this corridor, LOS E exists with peak period speeds less than 36 mph in the two mile section on I-10 from US 90 to Crowder. In the three mile section on l-10 between Crowder and Bullard, LOS D exists with peak period speeds of 49 mph or better. The four mile section on l-l 0 from Bullard to just east of l-510 operates at LOS C. US 90 (Chef Menteur Highway) in this corridor experiences peak period speeds from 20 to 37 mph, with a LOS F for five miles. Most of Hayne Boulevard operates at LOS B with the exception of the section between Downman Road and Elysian Fields which operates at a LOS of C.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor** #3) - In this corridor, the entire three mile section of I-10 from I-610 to US 90, and the entire three mile section of US 90, from I-10 to Franklin Avenue, operate at LOS F. Peak period speeds on the Industrial Canal Bridge are close to or below 30 mph in both directions. Peak periods speeds on US 90 are close to or below 25 mph in both directions.

- **I-610 Interstate (Corridor** #4) - Four of the five miles of I-610 operate at LOS E or F. The remaining one mile section between St. Bernard and Broad operates at LOS D. The lowest peak period speeds, below 30 mph, occur on l-61 0 near l-l 0 and Canal.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue (Corridor** #5) - I-10 between both connections with I-610 operates primarily at LOS E or F, with peak period speeds less than 30 mph. US 90 (Chef Menteur Highway) between Franklin and I-10 operates at LOS E or F, with peak period speeds less than 15 mph in the peak direction. Canal from City Park to I-10 operates at LOS C or better. From I-10 to the Convention Center, the LOS on Canal deteriorates to F. Traffic volume data and V/C ratios were not available for Poydras Avenue, however peak period speeds measured indicate it operates at LOS C between l-10 and South Rampart and LOS E for the remaining length. Elysian Fields Avenue between Leon C. Simon and N. Peters operates at LOS C or better, except for the one mile section between l-610 and l-10 which operates at LOS D.

- **I-10 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** l-10 from l-310 to Williams operates at LOS D with peak period speeds near or above 50 mph. The remaining eight miles of I-IO between Williams and l-610, operate at LOS F, with peak period speeds at or below 30 mph. The eight mile section of Veterans Boulevard from West End to Williams operates at LOS E or F. The remaining three mile section from Williams to the Jefferson / St. Charles Parish line operates at LOS C and D.

- **I-I0 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - I-10 between l-310 and US 51 operates at LOS C, with peak period speeds of 55 mph or greater. Information from the LDOTD Highway Needs Summary indicate LOS B for this section of Airline Highway (US 61) from l-310 to US 51.

- **Causeway Toll Bridge (Corridor** # 8) - The two mile section of the Causeway between W. Esplanade and I-10 operates at LOS E and F. The remaining 29 mile section between l-12 and W. Esplanade operates at LOS C.

- **US 9OB (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor** #9) -All of US 90B in this corridor, between l-10 and the Mississippi River, operates at LOS F except the half mile section between I-10 and Claiborne which operates at LOS D. Peak period speeds on US 9OB between Dryades and the Mississippi River are less than 15 mph. The Crescent City Connection crossing the Mississippi River operates at LOS F with peak period speeds of 25 to 30 mph. Poor operation continues on the West Bank Expressway which operates at LOS E with a speed of 30 mph from General DeGaulle to Stumpf. The West Bank Expressway from Stumpf to Avenue D operates at LOS D or better, with corresponding speeds of 40 mph or better. On the WB Expressway from Avenue D to Westwood the LOS is D, with peak period speeds between 25 and 35 mph. The lower speeds in this section are probably due to queues formed from the adjacent sections which are operating at LOS F. These sections, from Westwood to US 90, the WB Expressway, operate at LOS E or F with speeds less than 30 mph. The WB Expressway frontage roads operate at LOS C or better from Westwood to Barataria. The frontage roads between Barataria and Avenue A operate at LOS F. From Avenue A to Stumpf the West Bank Expressway frontage roads operate at LOS D or E. The remaining section of the frontage roads from Stumpf to Terry Parkway operate at LOS C. US 90 between the WB Expressway and Jefferson Highway, including the Huey P. Long Bridge, operate at LOS F with peak period speeds below 30 mph.

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor #10)** - The entire sections of LA 39 (North Claiborne Avenue) and LA 46 (St. Claude Avenue) in this corridor operate at LOS F with peak period speeds less than 20 mph.

- **US 61, Airline Highway and LA 3139, Earhart Expressway (Corridor #11)** - Airline Highway (US 61) between I-310 and I-10 operates at LOS F with peak period speeds less than 30 mph. LA 3139 between David and Causeway operates at LOS D or better with peak period speeds of 20 mph or greater. Between Causeway and Claiborne, LA 3139 operates at LOS E and F with peak period speeds less than 20 mph. The speeds are particularly low, less than 10 mph, in the two mile section of LA 3139 between Carrollton and Claiborne.

- **US 90, Jefferson Highway / Claiborne Avenue (Corridor #12) -** The entire eight mile section of US 90 in this corridor operates at LOS E or F with peak period speeds less than 20 mph.

- **US 90 West - St. Charles Parish (Corridor # 13)** - The eight mile section of US 90 from I-310 to the Jefferson / St. Charles Parish Line will operate at LOS E. The six mile section of US 90 from the Jefferson / St. Charles Parish Line to the West Bank Expressway operates at LOS F with speeds near 30 mph.

- **I-310 North - St. Charles Parish (Corridor** #14) - I-310 from US 90 to I-10 operates at LOS B.

- **I-55 (Corridor #15)** - I-55 between I-10 and I-12 operates at LOS B.

- **I-12 (Corridor #16)** - I-l2 between I-55 and US 190 operates at LOS B.

- **I-12 (Corridor #17) - I-12** between US **190 and** I-10 operates at LOS C.
- **I-510 - Orleans Parish / St. Bernard Parish and LA 47, Paris Road (Corridor** #18) - I-510 between I-10 and Almonaster operates at LOS B. LA 47 (Paris Road) operates at LOS B between Almonaster and the Orleans / St. Bernard Parish Line. LA 47 operates at LOS C from the Parish Line to LA 39 and between LA 39 and LA 46.

2.1.3 Accident Data

Accident data was gathered from several different sources for this project. In the Congestion Management Plan for the New Orleans Metropolitan Area performed by G.C.R & Associates, Inc., the table below summarizes the intersections with the highest accident rates for 1992 on the State and Federal highway system. Of the 59 locations cited, 75 percent are part of the study roadway network. The number of accidents ranges from 11 accidents per year to 88 accidents per year. The following is a list of the 10 highest accident frequency locations on State and Federal highways along study roads:

1992 High Accident Frequency Locations

Location	Accidents
I-10 & Louisa St.	88
us 90 & Hwy. 48	85
West Bank Exp. & Barataria Blvd.	80
West Bank Exp. & Manhattan Blvd.	51
Airline Highway & Causeway Blvd.	50
West Bank Exp. & Stumpf Blvd.	50
Judge Perez Dr. & Paris Rd	46
I-10 & West End Blvd. / Pontchartrain Blvd.	40
West Bank Exp. & Belle Chasse Hwy	39
Jefferson Hwy & Causeway Blvd.	39

A review of the accident data for 1994 indicated the following intersections as the 10 highest accident frequency locations along the study roadway network.

1994 High Accident Frequency Locations

Location	Accidents
Pontchartrain Exp. & South Claiborne Ave	130
Causeway Blvd. & Veterans Memorial Blvd.	121
Chef Menteur Hwy. & Downman Blvd.	100
Clearview Pkwy. & Veterans Memorial Blvd.	99
South Claiborne Ave & Melpomene Ave	99

I-10 & Louisa St.	57
I-10 & Chef Menteur Hwy.	59
I-10 & I-610	58
Causeway Blvd. & West Esplanade Ave	56
Severn Ave & Veterans Memorial Hwy.	56

There are some locations that appear in both surveys as high accident frequency locations, but were not in the top ten highest.

Along with these spot intersection accident data, the consultant has gathered accident data for mainline segments of the roads within the study network and summarized the data in a spreadsheet. This accident data, combined with the geometric data that is also part of the spreadsheet, was used to calculate the number of accidents per lane mile. This spreadsheet can be found in the Appendix A of this report.

2.1.4 Existing Recurring and Nonrecurring Congestion

Recurring congestion is associated with roadway segments that experience the same type of congestion at the same location, usually during the peak periods. The criteria to determine areas of recurring congestion was based upon the typical peak period percentage of the AADT and the resulting volume to capacity ratios that would occur for the particular roadway type. Recurring congestion occurs when the facility experiences Levels of Service E/F. The speed criteria chosen suggests that a problem is beginning to occur below 35 mph on a freeway and 25 mph for arterial roadways based upon the 1985 and 1994 versions of the Highway Capacity Manual.

Nonrecurring congestion is associated with accidents and is less predictable than recurring congestion. The criteria is based upon the average number of accidents that occur along a roadway segment. The usual "Accidents per Million Vehicle Miles Traveled" data is not a statistic that provides the frequency of accidents at a location. In order to determine the amount of delay associated with nonrecurring congestion, the frequency of accidents was used. The volume criteria was lowered to a Level of Service D, because accidents have an affect on traffic at Level of Service D as well as E/F.

RECURRING CONGESTION CRITERIA

FREEWAY / INTERSTATE	DIVIDED ARTERIAL	UNDIVIDED ARTERIAL
15,000 ADT/LANE	10,000 ADT/LANE	7,500 ADT/LANE
Less than 35 mph	Less than 25 mph	Less than 25 mph

NONRECURRING CONGESTION CRITERIA

FREEWAY / INTERSTATE	DIVIDED ARTERIAL	UNDIVIDED ARTERIAL
12,000 ADT/LANE	8,000 ADT/LANE	5,000 ADT/LANE
7-8 ACCIDENTS/LANE MILE	11-12 ACCIDENTS/LANE MILE	14-15 ACCIDENTS/LANE MILE

The following table summarizes the amount of roadway miles that experience recurring congestion and nonrecurring congestion and the percentage of the total study network.

Table 2-1. Existing Recurring and Nonrecurring Congestion

Characteristics	Existina	
	Miles	% of Study Area
Recurring Congestion	**97.72**	**27.2%**
ADT Exceeding 15,000	14.56	4.1%
Nonrecurring	**22.37**	**6.2%**

A combination of the number of accidents and the amount of traffic that passes that particular accident location is used to determine the areas of nonrecurring congestion. The number or frequency of accidents at a particular location is important in determining the amount of disruptions to the normal flow of traffic. It is also helpful to know the severity of the incidents and the amount of disruption that occurred. This information is used in determining the benefit of installing and operating the Intelligent Transportation System components for traffic and incident management.

Figures 2-5 and 2-6 show the study area links experiencing recurring and / or nonrecurring congestion in 1995.

The following is a summary by corridor of the roadway segments identified as experiencing either recurring and/or nonrecurring congestion based on the criteria described above:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - In this corridor, the roadway sections of I-IO and US 90 do not exhibit recurring or nonrecurring congestion problems. US 11 exhibits recurring congestion for the 12 mile section between l-12 and I-IO.

- **I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard (Corridor** #2) - In this corridor, recurring congestion occurs in the one mile section on I-10 from US 90 to Morrison. US 90 (Chef Menteur Highway) from US 11 to l-51 0 exhibits recurring congestion in this 5 mile section.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor** #3) - In this corridor, the entire three mile section of I-1 0 from l-61 0 to US 90, which includes the Industrial Canal Bridge, experiences recurring congestion. The 3 mile section of US 90 (Chef Menteur Highway) between I-10 and Franklin Avenue experiences recurring congestion.

- **I-610 Interstate (Corridor** #4) - The one mile section of I-610 between I-10 and Canal experiences recurring congestion.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue (Corridor** #5) - The entire eight mile section of I-10 between the two connections with I-610 experiences recurring congestion. The entire five mile section of US 90 (Chef Menteur Highway) in this corridor, between Franklin and I-10 experiences recurring congestion. The entire two mile section of Poydras Avenue from I-10 to the Convention Center experiences recurring congestion, as exhibited by the very low peak period speeds.

- **I-10 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** Nine of the 12 miles in this corridor on **I-10,** from Williams to I-610, experience both recurring and nonrecurring congestion. The nonrecurring congestion exists due to the high number of accidents recorded on I-10 between Loyola and I-610.

- **I-10 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - No recurring or nonrecurring congestion is experienced in this corridor.

- **Causeway Toll Bridge (Corridor** # 8) - The two mile section of the Causeway between W. Esplanade and I-10 experience nonrecurring congestion.

- **US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor #9) -** All of US 90B in this corridor between I-IO and the Mississippi River experience recurring congestion except the half mile section between I-IO and Claiborne. The Crescent City Connection crossing the Mississippi River experiences recurring congestion which continues on the West Bank (WB) Expressway to Stumpf. An additional three miles on the WB Expressway between Avenue D and Louisiana also experience recurring congestion. From Louisiana to US 90, nonrecurring congestion is experienced on the WB Expressway. The three mile section of US 90 between the WB Expressway and Jefferson Highway which includes the Huey P. Long Bridge, experiences both recurring and nonrecurring congestion

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor** #10) - The seven mile section of LA 39 (North Claiborne Avenue) from I-10 to Paris Road experiences recurring congestion. The six mile section of LA 46 (St. Claude Avenue) from Elysian Fields to Paris Road also experiences recurring congestion.

- **US 61, Airline Highway and LA 3139, Earhart Expressway (Corridor #11)** - The nine mile section of Airline Highway (US 61) between I-10 and Williams experiences recurring congestion. The entire 10 mile section of LA 3139 experiences recurring congestion.

- **US 90, Jefferson Highway / Claiborne Avenue (Corridor #12) -** The entire eight mile section of US 90 in this corridor experiences recurring congestion. In addition, the section between the Jefferson Highway and the Causeway experiences nonrecurring congestion.

- **US 90 West - St. Charles Parish (Corridor** # **13)** - The six mile section of US 90 from the Jefferson / St. Charles Parish Line to the West Bank Expressway experiences nonrecurring congestion due to the high number of accidents in this section.

- **I-310 North - St. Charles Parish (Corridor #14)** - No recurring or nonrecurring congestion experienced in this corridor.

- **I-55 (Corridor #15)** - No recurring or nonrecurring congestion is experienced on I-55 between I-10and I-l 2.

- **I-12 (Corridor #16) -** No recurring or nonrecurring congestion is experienced on I-l 2 between I-55 and US 190.

- **I-12 (Corridor #17)** - No recurring or nonrecurring congestion is experienced on I-l 2 between US 190 and I-10.

- **I-510 - Orleans Parish / St. Bernard Parish and LA 47, Paris Road (Corridor** #18) - In this corridor, I-510 does not experience recurring or nonrecurring congestion. LA 47 (Paris Road) experiences recurring congestion in a one mile section between the Arpent Canal and LA 39.

2.1.5 Public Transit

The City of New Orleans is one of the largest transit properties in the nation with approximately 500 buses and 35 light rail vehicles in the system. The Regional Transit Authority (RTA) operates a rail and busway system, carrying over 23,000 riders per day, within the Central Business District (CBD). In addition, the metropolitan area has three new park and ride facilities serving the East and West Bank of Jefferson and the City of Slidell.

Jefferson Parish Transit System is comprised of 13 fixed transit routes. Five of these routes are located on the Eastbank while eight are on the Westbank. One of the Eastbank routes is destined for the New Orleans CBD while four access the CBD on the Westbank. Service is provided to the Airport as well as to the Gretna Terminal and to connections to the RTA for extended service to the CBD. There are a total of four park and ride lots that connect to the Parish routes. The most recent counts indicate slightly over 16,000 riders per day.

Figures 11-7 and 11-8 show the routes of the RTA and Jefferson Parish Transit systems. On the seventeen corridors being evaluated for ITS service, Canal Street carries the most buses a day, averaging over 530 bus trips per day. I-10 between Carrollton and Downman is the next most heavily used with 480 bus trips per day. US 90 West, US 90 East and LA 46 are also high bus volume routes, each carrying between 320 and 360 bus trips per day. Several other roadways such as the Westbank Expressway, I-10 between Downman and Read, Hayne, US 61 and Veterans all carry significant bus volumes each day.

2.1.6 Existing ITS Initiatives

Transportation Systems Management

Several traffic signal improvements are programmed for completion in Jefferson and Orleans Parishes as part of the regional Transportation Improvement Program (TIP). These include upgrading 130 closed loop signal systems in Jefferson and adjoining parishes. One (1) project is under construction, three (3) are being designed and five (5) projects are in the planning phase under the direction of the DOTD District 02 office. These traffic signals are being upgraded to feature a traffic responsive mode as well as vehicle priority preemption for emergency and transit vehicles. The traffic operations center is located in the District 02 headquarters and will operate from 7:45 AM to 4: 15 PM, Monday through Friday and as needed. The cost is approximately $10,000 to $50,000 per intersection with annual operation and maintenance of approximately $2,000 to $3,000 per intersection. In order to facilitate a traffic responsive operation, there is also a system of detectors to collect traffic volumes and determine traffic density to identify congested locations in real time. This information will be used to adjust the timing plans for diverted traffic.

Also, signal controller upgrades, intersection interconnection and telephone line improvements, new signal installations and intersection redesigns in Jefferson Parish are anticipated over the next three to four years, as well as expansion of the closed loop signal systems in Jefferson Parish along major arterial routes.

Within the City of New Orleans, there are plans to design and implement a computerized signal system for 400 signalized intersections throughout the City of New Orleans. This project is under the direction of the City of New Orleans Department of Streets and phases I, II and III are currently in design. The project includes upgrading the traffic signal hardware, controllers, detection equipment, software, communications media and standards and specifications. The central computer will be located at 838 South Genois Street and will operate continuously. The Regional Planning Commission has allocated $2,000,000 per year for construction of this project. Maintenance will be contracted out to a third party at $480,000 per year. The operation will include $100,000 per year for an engineer and an engineering technician. Related to this project, thirty-eight (38) traffic signal upgrades are currently under construction,

Along LA 39, LA 47 and LA 46 in St. Bernard Parish, there are plans to improve eighteen (18) intersections with new traffic signal installations and geometric changes.

Incident Management

The following discussion of existing incident management in the New Orleans Metropolitan Area is excerpted from a presentation made at the New Orleans Regional Incident Management Conference, May 14, 1993. The conference was sponsored by the Regional Planning Commission and the Louisiana Department of Transportation and Development. The information is supplemented with data gathered from the user survey conducted for this study.

There are several major arterials in the metropolitan area that have various levels of incident management. The Lake Pontchartrain Causeway is a toll bridge with its own enforcement agency that provides constant patrols. During periods of low visibility on the bridge, traffic is convoyed by the patrol at a reduced speed and in single file. Variable message signs provide advance warning of incidents and call boxes are located every four-tenths of a mile for the length of the span. A call box system also exists on I-10 and I-610 throughout the study area.

The Crescent City Connection, parallel bridges linking the New Orleans CBD with the Westbank, is managed and operated by the Crescent City Connection Division of LADOTD. They provide Bridge Emergency Service Team (BEST) patrols to identify and remove stalled vehicles and respond to calls from the I-10 and I-610 call boxes located in Orleans Parish.

The Huey P. Long Bridge, connecting the Eastbank and Westbank of Jefferson Parish, is a 60 year old bridge with narrow lanes which carries very heavy traffic volumes, particularly during peak periods. The bridge is patrolled by a contingent of the Causeway Police. They are posted at each end of the bridge to monitor traffic and to expedite the removal of any incident.

The **I-10/I-610** systems within the City of New Orleans are under the jurisdiction of the New Orleans Police Department (NOPD). The NOPD responds to any incidents that occur and coordinates with necessary medical or towing support. The Louisiana State Police have jurisdiction over the Interstate system in Jefferson, St. Charles, St. John and St. Tammany Parishes.

When icing, flooding or a major incident requiring closure occurs, the responsible agencies contact the Louisiana Department of Transportation and Development (LADOTD) for support. The LADOTD provides support in effecting road closures and in supplying equipment or materials necessary for clean up or clearing of the incident. The LADOTD District 02 office has two portable programmable variable message signs that are used in effecting detours.

The Louisiana State Police provide special training to their troopers in the identification and handling of hazardous materials. The Mobil Oil Corporation makes its HAZ MAT Mobil Response Vehicle available upon request by local enforcement agencies to provide technical advice concerning the handling of hazardous leaks or spills.

Local media play an important role in providing information on current traffic conditions to motorists who are either planning their commute or who are en route to their destination. MetroScan Traffic Network provides traffic reports on local radio and television stations which use this service. Other major radio stations provide traffic reports from airborne observers and others operate cameras in the CBD and on bridges to monitor and report conditions. The Times-Picayune newspaper provides information on “Hot Spots”, reporting where there will be lane closures for construction, and elicits comments and suggestions from motorists for possible improvements.

The Regional Planning Commission (RPC) recently completed a separate incident management planning study. In addition a motorist assistance patrol funded by FHWA and directed by the Greater New Orleans Expressway Commission was recently instituted to provide assistance to motorist on I-IO in Orleans and Jefferson Parishes.

Intelligent Transportation Systems (ITS)

Crescent City Connection Toll System (AVCS). The Crescent City Connection Toll System has several lanes capable of accepting vehicles equipped with transponders. These vehicles are able to move through the toll gates without coming to a complete stop.

The RPC is working with local transit operators and traffic engineering departments to evaluate Bus Priority Control System technologies along selected arterial routes. One arterial segment is Veterans Boulevard between Bonnabel and the Orleans Parish line. Bus Priority Control technologies will be incorporated with the traffic signal upgrade projects.

The New Orleans Regional ITS Action Program includes measures to reduce incident duration, restore and maintain traffic capacity, and reduce demand and redirect traffic on the interstate and major arterial street system. Elements of this Program will be implemented through the Transportation Improvement Program on a phased, multi-year basis.

The Transportation Plan for Year 2015 (Financially Constrained) for the New Orleans Urbanized Area includes elements of the ITS Action Program, including development of a traffic management center in fiscal year 1998-99.

The Crescent City Connection HOV lane is operational. This exclusive HOV lane will provide priority access for commuters between the Westbank and the New Orleans Central Business District.

The Regional Transit Authority (RTA) is conducting an ITS Feasibility Planning Study with project components for AVL/AVI.

The Greater New Orleans Expressway Commission has toll lanes to accept vehicles equipped with transponders at the North and South Toll Plazas of the Causeway.

A number of ITS studies are underway to identify ways to move trucks and other commercial delivery vehicles with greater safety and efficiency within the New Orleans area. Specific study areas include a) Jourdan Road / US 90 Port access serving the east side of the Industrial Canal and the Almonaster-Michoud Industrial District, b) US 61 (Airline Highway) and I-IO access corridors to the New Orleans International Airport Industrial Park, c) US 190 / Gause Boulevard, and d) US 11 Bridge connecting Slidell with New Orleans East.

2.2 Future Conditions

Because deployment of ITS technology will take place over a long period of time, future conditions have a major role in determining the method of such deployment. Traffic volumes have to be estimated for twenty years into the future. Since it is beyond the scope of this study to predict traffic growth in detail, existing available estimated traffic volume information was utilized.

Future traffic volumes and V/C (Volume/Capacity) ratios were obtained primarily from the transportation network model maintained by the RPC. For those routes outside of the model limits, the Louisiana Department of Transportation (LDOTD) Highway Needs Summary was utilized.

2.2.1 Future Traffic Volumes

Future volume forecasts indicate that I-10 will experience some of the highest growth in the metropolitan area. An average growth rate of 4% per year is forecast on the segments of I-10 near US 90B and I-10 between US 90 and I-12. High growth of 5% per year is also forecast to occur on segments of US 90 East near US 11 and I-510, and on segments of I-55 near I-12. Sections of Earhart Expressway near Carrollton are forecast to grow at 4% per year. Growth of 2 to 3% per year is forecast on both Causeway and I-12. On US 90B growth of 2% per year is forecast near I-10. Forecasts for all of the remaining study area roadway segments indicate growth of 2% per year or less. Figures 2-9 and 2-10 show the future Average Daily Traffic (ADT) on the study area links for 2015. The following is a summary of volume growth by corridor:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - In this corridor, growth of over 100% of the 1995 ADT volumes is forecast to occur by the year 2015 on I-10. The segment of I-10 from east of I-510 to US 11 is projected to have an ADT of 105,300. From US 11 to Oak Harbor, the ADT is projected to be 101,700. From Oak Harbor to I-12, I-10 the ADT is projected to vary from 94,700 to 105,300.

- **I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard (Corridor** #2) - In this corridor, the ADT is forecast to grow by 100% on all segments of I-10, except the approximately one mile segment between US 90 and Morrison. The future ADT on this segment is projected to be 117,500. For the other sections of I-10 between Morrison and just east of I-510, the ADT is forecast to vary from 155,000 to 109,700. The future ADT forecast on US 90 (Chef Menteur Highway) from US 11 to I-510 is 18,100. Hayne Boulevard is forecast to grow 16% between Paris and Bullard with a future ADT of 2,200, while the section between Bullard and Read is forecast to decrease 18% with a future ADT of 2,200. The sections of Hayne Boulevard between Read and Elysian Fields are forecast to grow between 27 and 37%, to future ADT varying from 4,800 to 16,300.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor #3) -** In this corridor, negative growth of 3% is forecast on I-10 between I-610 and Louisa. The projected ADT in this section is 104,400. The Industrial Canal Bridge section of I-10 between Louisa Drive and Downman Road is forecast to grow 5% with a future ADT of 99,200. The remaining section of I-10 in this corridor, between Downman Road and US 90 is forecast to grow 7% with a future ADT of 76,800. US 90 (Chef Menteur Highway) between I-10 and Franklin Avenue is forecast to grow 4 to 5%, with future ADT ranging from 33,500 to 40,600.

- **I-610 Interstate (Corridor #4)** - I-610 is a forecast to grow by 6 to 8% between the eastern end near I-10, to the western end near I-10, with future ADT ranging from 55,600 to 86,200.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue (Corridor** #5) - In this Corridor, I-10 is forecast to experience growth varying from 3% to 162%. The highest growth is forecast to occur near US 90B with a future ADT of 76,000. US 90 (Chef Menteur Highway) between Franklin and St. Bernard is forecast to grow at 7%, with a future ADT of approximately 30,000. Between St. Bernard and I-10, decreasing growth of 0 to 5% is forecast on US 90. Canal is forecast to decrease by 8% between City Park and Jeff Davis with a future ADT ranging from 13,600 to 14,300. Between Jeff Davis and Broad, growth of 8% is forecast, with a future ADT of 10,500. Between Broad and I-10, a decrease of 36% is forecast on Canal, with a future ADT of 10,500. Elysian Fields Avenue is forecast to decrease by 3 to 10% between Leon C. Simon and N. Peters, with future ADT ranging from 5,200 to 17,700.

- **I-10 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** I-10 from I-610 to I-310 is forecast to grow from 1 to 22%, with future ADT ranging from 70,600 near I-310, to 138,600 near I-610. Future ADT on Veterans Boulevard is projected to decrease between the Jefferson / St. Charles Parish Line and I-10. Between I-10 and Clearview, growth of 4% is projected with a future ADT of 42,000. Decreasing ADT of 3% is forecast between Cleat-view and Causeway with a future ADT of 48,600. Between Causeway and West End, growth of 4% is projected on Veterans Boulevard, with a future ADT of 46,600.

- **I-10 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - In this corridor, 30% growth on I-10 between l-310 and US 51 is forecast to occur with future ADT ranging from 55,600 to 56,000. A 64% growth is estimated to occur on US 61 resulting in an ADT of **30,000 to 33,000.**

- **Causeway Toll Bridge (Corridor** # 8) - Future growth of 60 to 80% is forecast on the Causeway between Veterans and the Toll Plaza, with ADT ranging from 45,300 to 58,200.

- **US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor #9) -** US 90B between I-10 and Claiborne is forecast to grow 50% with a future ADT of 72,700. Between Claiborne and the Mississippi River, minimal growth is forecast. The Crescent City Connection crossing the Mississippi River is forecast to decrease 20% with a future ADT of 88,700. From the Connection, the West Bank (WB) Expressway continues with future growth forecasts of between 4 and 12% to Tanglewood, with future ADT ranging from 57,400 to 68,700. A small decrease is forecast between Tanglewood and Avenue H. Growth of 2 to 11% is forecast between Avenue H and Segnette, with future ADT ranging from 33,800 to 41,900. Between Segnette and US 90, a decrease of 19% is forecast on the WB Expressway, with a future ADT of 26,700. The WB Expressway frontage roads from Westwood to Terry Parkway are forecast to grow between 2 and 34% with future ADT ranging from 61,400 to 23,500. US 90 between the WB Expressway and LA 18 is forecast to grow 10% with a future ADT of 39,700. On US 90, the Huey P. Long Bridge between LA 18 and Jefferson Highway is forecast to grow 11% with a future ADT of **51,500.**

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor #10)** - LA 39 (North Claiborne Avenue) between I-10 to Industrial Canal is forecast to grow 5 to 8% with future ADT ranging from 34,400 to 36,000. Between Industrial Canal and the Orleans / St. Bernard Parish Line, a decrease of 7% is forecast with a future ADT of 35,700. Between the Parish line and Paris Road, a growth of 4% is forecast on LA 39 with a future ADT of 38,200. ADT on LA 46 (St. Claude Avenue) from Elysian Fields to Paris Road is forecast to decrease between 5 and 11% with future ADT ranging from 28,100 to 35,900.

- **US 61, Airline Highway and LA 3139, Eat-hart Expressway (Corridor #11)** - Airline Highway (US 61) between I-10 and Clearview is forecast to decrease from 3 to 14% with future ADT ranging from 48,300 to 38,900. Between Cleat-view and Williams, Airline Highway is forecast to grow from 3 to 9% with future ADT ranging from 40,300 to 28,100. The segment of Airline Highway between Williams and I-310 is forecast to decrease 40%, with a future ADT of 20,900. LA 3139 between David and Monticello is forecast to grow between 5 and 17% with future ADT varying from 37,700 to 49,800. The segment between Monticello and Carrollton is forecast to grow 107% with a future ADT of 52,300.

- **US 90, Jefferson Highway / Claiborne Avenue (Corridor #12) -** US 90 between Jefferson Highway and Carrollton is forecast to grow 2 to 7% with future ADT ranging from 35,300 to 50,200. Between Carrollton and Louisiana, US 90 is forecast to decrease by 5% with future ADT ranging from 20,100 to 24,300. US 90 between Louisiana and M. L. King Jr. is forecast to grow by 16% with a future ADT of 23,500. The section of US 90 between M. L. King Jr. and US 90B is forecast to decrease by 5% with a future ADT of 25,600.

- **US 90 West - St. Charles Parish (Corridor # 13)** - US 90 from I-310 to the Jefferson / St. Charles Parish Line is forecast to grow by 24% with a future ADT of 30,200. From the Parish Line to the West Bank Expressway, US 90 is forecast to grow 6% with a future ADT of **42,000.**

- **I-310 North - St. Charles Parish (Corridor #14)** - The future ADT forecast on I-310 between Airline Highway and I-10 is 25,500.

- **I-55 (Corridor #15)** - I-55 between I-10 and I-12 is forecast to grow from 34 to 177% with future ADT ranging from 20,000 to 40,500.

- **I-12 (Corridor #16)** - I-12 between I-55 and US 190 is forecast to grow 71% with a future ADT of 56,100.

- **I-12 (Corridor #17)** - I-12 between US 190 and I-I 0 is forecast to grow 96% with a future ADT of 67,600.

- **I-510 - Orleans Parish / St. Bernard Parish and LA 47, Paris Road (Corridor #18)** - I-510 between I-10 and Lake Forest is forecast to decrease 2% with a future ADT of 12,500. Between Lake Forest and US 90, I-510 is forecast to grow 15% with a future ADT of 13,500. I-510 between US 90 and Almonaster is forecast to grow 34% with a future ADT of 32,700. LA 47 (Paris Road) from Almonaster to the Parish Line is forecast to decrease 15% with a future ADT of 22,400.

Between LA 39 and LA 46, LA 47 is forecast to grow 9% with a future ADT of 22,900.

2.2.2 Future Level of Service (LOS)

The future level of service (LOS) on the study area roadways worsens on the roads with increased volumes since no capacity improvements are assumed. The roads with high growth forecast will experience a deterioration to LOS F. Some of the roads have low or negative growth forecast, but since the volume decreases are small, the corresponding improvement in LOS will be insignificant. Overall the main change in LOS will be deterioration from existing LOS D and E to LOS F due to the increased forecast volumes. Figures 2-l 1 and 2-12 show the future V/C (volume/capacity) ratios on the study area links for 2015. The following is a summary by corridor of the future levels of service (LOS) on the study area roadway segments:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - Due to the large volume increase forecast on I-10 in this corridor, LOS will deteriorate to D for 12 miles, and LOS F for 9 miles.

- **I-10 East New Orleans and I-IO East Service Roads US 90, Chef** Menteur **Highway / LA 47, Hayne Boulevard (Corridor #2) -** Due to the large volume forecast in this corridor operating conditions will deteriorate with the entire nine miles of I-10 in this corridor experiencing LOS F. US 90 (Chef Menteur Highway) in this corridor will continue to experience LOS F.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor** #3) - In this corridor, the entire three mile section of I-10 from I-61 0 to US 90, and the entire three mile section of US 90, from I-10 to Franklin Avenue, will continue to operate at LOS F.

- **I-610 Interstate (Corridor #4) -** All of the five miles of I-610 will operate at LOS E or F.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue (Corridor** #5) - I-10 between both connections with I-610 will continue to operate at LOS E or F. US 90 (Chef Menteur Highway) between Franklin and I-10 will also continue to operate at LOS E or F. Canal from City Park to I-10 will continue to operate at LOS C or better. From I-10 to the Convention Center, the LOS F will continue. All sections of Elysian Fields Avenue between Leon C. Simon and N. Peters will operate at LOS C or better, due to decreasing volume forecasts.

- **I-10 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** The operation on I-10 from I-310 to Williams will deteriorate to LOS D and E. The remaining eight miles of I-10 between Williams and I-610, will continue to operate at LOS F. The eight mile section of Veterans Boulevard from West End to Williams will continue to operate at LOS E or F. The remaining three mile section from Williams to the Jefferson / St. Charles Parish line will continue to operate at LOS C and D.

- **I-10 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - I-10 between I-310 and US 51 will continue to operate at LOS C.

- **Causeway Toll Bridge (Corridor** # 8) - The LOS on the Causeway between the Toll Plaza and Veterans will deteriorate to LOS F.

- **US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor** #9) -All of US 90B in this corridor, between I-10 and the Mississippi River, will operate at LOS F. The Crescent City Connection crossing the Mississippi River will operate at LOS F. Poor operation will continue on the West Bank (WB) Expressway which will operate at LOS F mph from General DeGaulle to Stumpf. The WB Expressway from Stumpf to Westwood will operate at LOS D. The sections on the WB Expressway from Westwood to US 90, will all operate at LOS F. The WB Expressway frontage roads will operate at LOS C or better from Westwood to Barataria. The frontage roads between Barataria and Avenue A will operate at LOS F. From Avenue A to Lafayette the WB Expressway frontage roads will operate at LOS D or E. The section from Lafayette to Stumpf will now operate at LOS F. The remaining section of the frontage roads from Stumpf to Terry Parkway will operate at LOS D. US 90 between the WB Expressway and Jefferson Highway, including the Huey P. Long Bridge, will continue to operate at LOS F.

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor #10)** - The entire sections of LA 39 (North Claiborne Avenue) and LA 46 (St. Claude Avenue) in this corridor will continue to operate at LOS F.

- **US 61, Airline Highway and LA 3139, Earhart Expressway (Corridor #11)** - Airline Highway (US 61) between I-10 and I-310 will continue to operate at LOS F. LA 3139 between David and Cleat-view will operate at LOS D. Between Clearview and Claiborne, LA 3139 will operate at LOS E and F.

- **US 90, Jefferson Highway / Claiborne Avenue (Corridor #12) -** The entire eight mile section of US 90 in this corridor will continue to operate at LOS E or F.

- **US 90 West - St. Charles Parish (Corridor** # 13) - The LOS will deteriorate to F for the entire fourteen mile section of US 90 in this corridor, from I-31 0 to the West Bank (WB) Expressway.

- **I-310 North - St. Charles Parish (Corridor #14) - I-310** can be expected to operate at LOS C or better.

- **I-55 (Corridor #1 5)** - I-55 between I-10 and I-12 will operate at LOS C or better.

- **I-12 (Corridor #16)** - The operation of I-12 between I-55 and US 190 will deteriorate slightly, with a future LOS of D.

- **I-12 (Corridor #17) -** The operation on this 21 mile section of I-12 between US 190 and I-10 will deteriorate to LOS E operation.

- **I-510 - Orleans Parish / St. Bernard Parish and LA 47, Paris Road (Corridor #18)** - I-510 between I-10 and Almonaster will continue to operate at LOS B.

2.2.3 Future Recurring and Nonrecurring Congestion

An analysis was performed to estimate the roadway segments that will experience recurring and/or nonrecurring congestion based on the future ADT. The roadway segments were evaluated based on the criteria stated in Chapter 2, section 2.1.4.

To evaluate the ADT criteria, the year 2015 ADT per lane volumes were used. To evaluate the speed criteria, estimates of future speed were made by adjusting the existing speed down or up, based on the corresponding growth or decrease forecast for the future ADT. To evaluate the accident criteria, existing accident data was used.

As shown in Table 2-2, the increased future volumes and corresponding decreased speeds create approximately 42 additional miles of recurring congestion over the existing condition. This indicates that in the year 2015, approximately 38.9% of the study area roads will be experiencing recurring congestion. In the year 2015, approximately 2 additional miles of nonrecurring congestion over the existing condition will exist, indicating that approximately 6.7% of the study area roads will be experiencing nonrecurring congestion. The estimate of nonrecurring congestion in the future does not increase significantly since the primary determinant is number of accidents.

Table 2-2. Existing and Future Recurring and Non Recurring Congestion

Characteristics	Existing		Future	
	Miles	% of Study Area	Miles	% of Study Area
Recurring Congestion	97.72	27.2%	139.97	38.9%
ADT Exceeding 15,000 veh/lane	14.56	4.1%	64.12	17.8%
Nonrecurring Congestion	22.37	6.2%	24.15	6.7%

Figures 2-13 and 2-14 show the study area links that will experience recurring and/or nonrecurring congestion in 2015. The following is a summary by corridor of the roadway segments predicted to experience recurring and/or nonrecurring congestion based on the future volumes and identified criteria:

- **I-10 East Twin Spans and US 11 / US 90, Chef Menteur Highway (Corridor #1)** - Due to the large increase in volume forecast on I-10, recurring congestion will occur in the 19 mile section of I-10 from east of I-51 0 to I-12. Recurring congestion will continue to exist on US 11 for the 12 mile section between I-12 and I-10.

- **I-10 East New Orleans and I-10 East Service Roads US 90, Chef Menteur Highway / LA 47, Hayne Boulevard (Corridor #2) -** Due to the large increases in volume forecast on **I-10,** recurring congestion will exist over the entire 9 miles of I-10 in this corridor. Recurring congestion will continue to exist on the 5 mile section of US 90 (Chef Menteur Highway) between US 11 and I-510.

- **I-10 High Rise (Industrial Canal Bridge) and US 90, Chef Menteur Highway (Corridor #3) -** The section of I-10 between I-610 and Louisa is forecast to decrease, but will still experience recurring congestion. The other sections of I-10 between Louisa and US 90 will continue to experience recurring congestion. The 3 mile section of US 90 (Chef Menteur Highway) between I-10 and Franklin Avenue will continue to experience recurring congestion.

- **I-61 0 Interstate (Corridor #4)** - The one mile section of I-610 between I-10 and Canal will continue to experience recurring congestion.

- **I-10 Interstate and US 90 East and Canal Boulevard / Poydras Avenue / Elysian Fields Avenue (Corridor** #5) - The entire eight mile section of I-10 in this corridor will continue to experience recurring congestion, due to increased volumes, especially in the vicinity of US 9OB. The entire five mile section of US 90 (Chef Menteur Highway) in this corridor, between Franklin and I-10 will continue to experience recurring congestion, even though the growth forecast is less than 7% in all sections. The entire two mile section of Poydras Avenue from I-10 to the Convention Center will continue to experience recurring congestion.

- **I-10 West, Jefferson Parish, and Veterans Boulevard (Corridor #6)** Recurring congestion will continue on nine of the 12 miles in this corridor on I-10 from Williams to I-610. Nonrecurring congestion will also exist on the two mile section of I-10 from Loyola to Williams, due to the forecast ADT and number of accidents.

- **I-10 West, St. Charles Parish and US 61, Airline Highway (Corridor** # 7) - No recurring or nonrecurring congestion will be experienced in this corridor.

- **Causeway Toll Bridge (Corridor** # 8) - The two mile section of the Causeway between W. Esplanade and I-10 will continue to experience nonrecurring congestion.

- **US 90B (GNO Bridge) and US 90 (Huey P. Long Bridge) Approaches and West Bank Expressway (Corridor #9) -** All of US 90B in this corridor between I-10 and the Mississippi River will experience recurring congestion. The Crescent City Connection crossing the Mississippi River will experience recurring congestion which will continue on the West Bank (WB) Expressway to Stumpf. An additional three miles on the WB Expressway between Avenue D and Louisiana will also experience recurring congestion. In addition, from Westwood to US 90, nonrecurring congestion will be experienced on the WB Expressway The three mile section of US 90 between the WB Expressway and Jefferson Highway which includes the Huey P. Long Bridge, will experience both recurring and nonrecurring congestion.

- **LA 39, North Claiborne Avenue and LA 46, St. Claude Avenue (Corridor #10)** - The seven mile section of LA 39 (North Claiborne Avenue) from I-10 to Paris Road will continue to experience recurring congestion. The six mile section of LA 46 (St. Claude Avenue) from Elysian Fields to Paris Road will also continue to experience recurring congestion.

- **US 61, Airline Highway and LA 3139, Earhart Expressway (Corridor #11)** - The nine mile section of Airline Highway (US 61) between I-10 and Williams will continue to experience recurring congestion. The entire 10 mile section of LA 3139 will continue experience recurring congestion.

- **US 90, Jefferson Highway / Claiborne Avenue (Corridor #12) -** The entire eight mile section of US 90 in this corridor will continue to experience recurring congestion. In addition, the section between the Jefferson Highway and the Causeway will continue to experience nonrecurring congestion.

- **US 90 West - St. Charles Parish (Corridor** # **13)** - The six mile section of US 90 from the Jefferson / St. Charles Parish Line to the West Bank Expressway will experience recurring and nonrecurring congestion.

- **I-310 North - St. Charles Parish (Corridor** #14) - No recurring or nonrecurring congestion will be experienced in this corridor.

- **I-55 (Corridor** #15) - No recurring or nonrecurring congestion will be is experienced on I-55 between I-10 and I-12.

- **I-12 (Corridor #16)** - No recurring or nonrecurring congestion will be experienced on I-12 between I-55 and US 190.

- **I-12 (Corridor #17)** - Recurring congestion will be experienced on this 20 mile section of I-12 between US 190 and I-10.

- **I-510 - Orleans Parish I St. Bernard Parish and LA 47, Paris Road (Corridor #18)** - In this corridor, I-510 will not experience recurring or nonrecurring congestion. LA 47 (Paris Road) will experience recurring congestion in a one mile section between Canal and LA 39.

Chapter 3
Institutional Framework

3.1 Background

This chapter presents an assessment of the "institutional" (also known as "non-technical") issues associated with an ITS plan. In addition, this discussion aims to define possible solutions to the issues that will inevitably accompany new, non-traditional approaches to solving the area's transportation problems, assisting the City of New Orleans, Jefferson Parish and the Louisiana Department of Transportation and Development in becoming an efficient and informed operator/manager of vital transportation facilities.

Some issues relevant to this new approach that have been identified in ITS literature include:

- Political barriers to public/private arrangements.
- Access to State, Parish and City highway rights-of-way.
- Revenue generation and its allocation.
- Participation of other governments, agencies, or firms in regionally coordinated efforts.
- Anti-trust legislation.
- Intellectual property and proprietary technology.
- Invasion of individuals' privacy.
- Information discrimination.
- Potential liability.

Each of these issues is examined in this chapter with the following items being specifically addressed.

1. Existing transportation system funding and implementation procedures

2. Procedures for future adoption of the ITS Deployment Plan

3. Procedures for future ITS project identification, prioritization and implementation.

    - Prioritization process
    - Funding options
    - Operation options
    - Maintenance options

A review was made of the data from governmental documents, codes, laws, seminars, articles, and reports. Information from other states was also incorporated. To gain additional insight for the New Orleans ITS Strategic Plan, questionnaires were mailed out to various public agencies to obtain information from area agencies involved in transportation and inventory of the current regional ITS activities. Through the questionnaire, an understanding was gained of the various agencies' perspectives, roles and priorities related to the implementation of ITS in the study area. The questionnaire was mailed directly to the following agencies:

State Police Troop B
Jefferson Parish Dept. of Public Works
Metro Scan Traffic
Regional Planning Commission
Regional Transit Authority
New Orleans Police Department
St. Bernard Parish
City of New Orleans Dept. of Streets
American Automobile Association
St. Tammany Parish
Jefferson Parish Transit
Louisiana Dept. of Transportation & Development (District 02)
Greater New Orleans Expressway Commission
Louisiana Motor Transport Association
Louisiana Dept. of Transportation & Development, Planning Division
Crescent City Connection
Highway Safety Commission

In addition, questionnaires were made available to the Program Steering Committee which provided direction and input throughout the course of the study. A copy of the questionnaire and responses organized in tabular form is shown in Appendix B of this report.

3.2 Discussion of Institutional Issues

The field of ITS is growing rapidly in response to the public's increased demand and need for improved transportation efficiency. Many of the changes that the deployment of ITS technology will generate have political implications. Accordingly, some of these issues could have widespread impact on governmental agencies at all levels, on private companies, and ultimately, on the traveling public.

The deployment of an ITS system requires improved cooperation and coordination among all the agencies providing transportation services. This includes not only the public sector at the state and local level, but also private agencies.

3.2.1 Coordination and Cooperation

Chapter 2 of the "Non-technical Constraints and Barriers to Implementation of Intelligent Vehicle-Highway Systems" report to Congress by the US Department of Transportation points out that state and local agencies will have to cooperate better if they are going to take advantage of **ITS** technologies. The responsibility for managing traffic in most metropolitan areas has evolved over time in response to public needs, resources, and prevailing institutional and political arrangements. Within each political jurisdiction these managerial responsibilities are often dispersed among separate public agencies. If cooperation is lacking, this fragmentation will inhibit chances for the successful implementation of certain elements of the national ITS program.

A US DOT sponsored report ("Institutional Impediments to Metro Traffic Management Coordination," September, 1993) concluded that public transportation agencies and political jurisdictions generally worked together effectively to introduce and operate traffic management systems. Many of the transportation officials interviewed for this report believe that cooperation and coordination can be achieved among agencies and political jurisdictions without far-reaching changes to established laws, regulations, or policies, Local transportation managers expressed the need for cost-benefit analyses that would allow them to generate the level of public and political support necessary to make large investments in these advanced technologies and to pay for these investments with taxes and user fees,

3.2.2 Relationship with Emergency Response Agencies

The local perception of freeway operations in the New Orleans area is one of a practical mixture of various authorities and operating agencies. Most police, fire and highway agencies will readily cooperate with one another when the need arises.

For ITS to succeed in the New Orleans Metropolitan area, there must be consensus that this new technology fills a genuine need. Experience in other regions has shown benefits, and the local emergency response agencies need to understand how advanced surveillance and communication can help them carry out their responsibilities more efficiently.

The key to a successful "buy-in" of local emergency response agencies will be to foster regional cooperation without violating their sense of autonomy. In order to maintain a conflict free working relationship among the various participants, it should be stressed that each agency maintains autonomy over their own traffic management operations, while benefiting from the flow of information from a variety of sources.

3.2.3 Political and Legal Concerns

All of the issues discussed in this chapter have political and legal consequences or implications at some point in their resolution. The following discussion, however, focuses on those issues with particularly sensitive or prominent political considerations or obvious legal issues.

Political barriers to public/private partnership arrangements

Forming partnerships between public and private agencies will require the resolution of legal, regulatory, technical, and user application issues. If such partnerships involve private agencies in fields where there is strong competition, such as telecommunication networks, then the executive and legislative branches of state government are likely to come under lobbying pressures. This will be especially true if large sums of money, whether capital and/or operating, are involved, as is likely to be the case.

In public/private relations, there are many varying opinions on the types of partnerships that should be formed. There are frequently culture clashes, since private companies are mostly market driven, while the public sector is driven by a multitude of Federal, State and local jurisdictions' specifications and regulations.

By examining how other states handle public/private partnerships, the City, Parish and LDOTD will be better able to determine the best course for their own policies and procedures.

In North Carolina, three telephone companies (Southern Bell, GTE South, and Carolina Telephone Company) will build their own network, the North Carolina Information Highway. The state will then become their biggest customer, utilizing the network for interagency communication.

The Oklahoma State Regents for Higher Education Telecommunications Network provides voice, data, and video communications within and outside of the state. The Office of State Finance has secured an agreement with US Sprint to lease the partial use of a fiber optic cable. This system amounts to a small private telephone or communications company that is owned and operated by the State of Oklahoma. It is not subject to many of the restrictions and tariffs that govern public utilities and private carriers.

The Massachusetts Executive Office of Transportation and Construction is interested in leasing telephone lines. This agency is also working with private companies to jointly fund a motorist assistance program and to provide Advanced Traveler Information, which is managed by a private company and evaluated by consultants.

The New York Department of Transportation is on a number of public/private teams, but only one (NYNEX) requires public funding. It has partnered with the private sector for data services and offered its expressways as a test site for infrared technology. It also volunteered a rest area to be a test site for electronic highway projects.

The Virginia DOT is working with private partnerships for safety service. For example, People's Drug Store operates the service vehicles, and VDOT underwrites the State Police for safety service.

The Minnesota Department of Transportation is involved with several private partnerships for such projects as transit and traveler information projects. The Department has a range of partnerships from simple agreements and traditional traffic engineering projects to partnerships with detailed, sophisticated contracts. In addition, Minnesota DOT is installing its own fiber optic cable, and is considering allowing private telephone companies to invest in or lease its fiber. An unsatisfactory experience with one cable company has compelled the Department to proceed with caution. The Minnesota DOT has also encountered the issue of revenue and royalties, which could become an issue. The project produces royalties from a product. Superficially, the extra revenue appears invaluable; however, royalties can create a bias for public agencies to issue contracts based on how much money it can net. Ideally, public agencies should not be biased by such financial enticements.

Access to highway rights-of-way

The legality of granting access to others for the use of state, Parish and local highway rights-of-way is still open. Application of existing laws to this issue is subject to differing interpretation.

Several other state DOT's that have granted access to highway rights-of-way have experienced some negative results. Therefore, the Department, Parish and City should proceed with caution to minimize the risks, and develop well-defined contracts to grant access to their rights-of-way in accordance with the laws of supply and demand.

Revenue generation and its allocation

In addition to the question of whether the State, Parish or City can charge other public agencies and/or private agencies for the use of its rights-of-way, there will be substantial issues and potential political implications regarding how such revenue would be allocated and to whom.

Operating and maintaining ITS facilities will require a continuous stream of revenue. It is therefore necessary to accept new annual operating costs that did not exist previously, or to find a way to fund these operations. One option worth exploring is the concept of in-kind services instead of lease payments for right-of-way access. Cellular telephones or maintenance services could be provided in lieu of lease payments.

Participation of other governments, agencies, or firms in regionally coordinated efforts

Efforts along these lines are just now getting under way, and the establishment of linkages with local and other state agencies and the private sector for deployment of ITS initiatives is still being developed.

Anti-trust legislation

There is still disagreement as to whether anti-trust concern is a real obstacle or just a perceived one. Some resolution is forthcoming through such channels as the National Cooperative Research Act, which provides protection for collaborations in the name of research.

There is concern in the business community that particular cooperative agreements between actual or potential competitors in the field of ITS may lead to violations of anti-trust laws (e.g., in joint ventures, mergers, and acquisitions). For ITS, the most relevant anti-trust statutes are the Sherman Act of 1890, which prohibits monopolization and contracts in restraint of trade; and the National Cooperative Research and Production Act of 1993 (NCRPA), which allows certain joint ventures engaged in research and production to limit their potential anti-trust liability. NCRPA "encourages" parties to engage in joint ventures in the ITS field. According to the US Department of Justice and the US DOT, it is too early to recommend any changes to the anti-trust laws at this time.

The risk of creating a monopoly has to be balanced against the resources that will be available to address the issue. Smaller companies may not be able to compete with the resources and funding of national conglomerates. Any government agency must be cautious of setting up a potentially inequitable arrangement that could hurt not only corporate competitors, but ultimately the taxpaying public by locking agencies into sole-source arrangements.

Intellectual property and proprietary technology

Proprietary technology and its associated intellectual property rights serve as motivation for private investment. It will require careful planning and negotiation for both sides to foster a successful implementation.

The Bayh-Dole Act is generally applicable to federally funded grants, contracts, cooperative agreements and experimental work. Under this act, the Federal Government retains certain rights to inventions made under Federal funding. It has "march-in" and unlimited rights to data produced under Federal procurement contracts. Private parties may face a problem in offsetting research and development costs through sales if public sector agencies demand a greater share of intellectual property rights to an ITS technology or service. The private sector is concerned that retention of intellectual property rights by a public agency will result in their release into the public domain.

A private party may avoid losing rights to pre-existing or independently developed work by registering copyrights before participating in a federally funded project. For example, new inventions and services can be protected via legal counsel and the creation of programs for in-house documentation of conception and development of inventions.

Invasion of individuals' privacy

This is another category where opinion is divided regarding the perception of this issue as a real concern or something that will resolve itself over time. Current consensus seems to be leaning toward the latter interpretation. However, since ITS technology will collect information on individual's travel, some applications could affect national and/or state right to privacy provisions.

Successful ITS applications require political support. Political support is very sensitive to public opinion. If the public perceives that ITS technology invades their privacy, there could then be a backlash against ITS. This poses a dilemma, because certain ITS deployments will create data bases identifying individuals' travel patterns and account balances. For example, ATM cards can register information on the time and place of the transaction, as well as the amount. Therefore, it is important to deploy the types of ITS services and technologies for which there is a genuine need. However, it must be realized that these needs will change over time, and allow for these changing needs to be accommodated.

Information discrimination

Related to privacy issues is the matter of information discrimination. Information needs to be disseminated fairly among all interested users. Depending on the pricing structure and accessibility, travel information may not be equitably available. This potential for inequity comes in many forms: social, economic, regional, or demographic. For example, if private companies become involved in distributing travel information, they can create inequities by charging fees or providing location specific information.

As public agencies get into the information business, a need to establish checks and balances arises. The need for verification of information accuracy is necessary not only for customer satisfaction, but also for the agency's credibility and liability.

Potential liability

The dissemination of travel information entails possible liabilities related to the accuracy and timeliness of that information. Traffic diversion by the suggestion of alternate routes is another area with potential liability aspects. Other technical advances, such as automated highways, could also introduce significant exposure. Liabilities arising out of defective manufacture, incorrect information, reliance on systems that fail to avoid accidents and defective design liability claims are important issues. If public agencies assume responsibility for operations and maintenance of ITS technologies, then the status quo persists. Since private firms may also operate and maintain these technologies under contracts, apportionment of responsibilities should be negotiated and incorporated in the contract.

3.2.4 Public Involvement

The key to integration and coordination is communication, not only among the agencies carrying out the work, but with the customers as well. In this case, the customers can be broadly defined as anyone who uses the public highways. Thus, communication will include direct and indirect links to the public.

The process of reaching out to the traveling public should start immediately, to inform them of the benefits that can be realized from ITS. All forms of media should be used to gain the public's support. When the public better understands the issues, they will be better prepared to provide feedback. For ITS to succeed in the New Orleans region, it must have support from a broad range of stakeholders: the traveling public, all levels of local government, and various private agencies. All must be informed of the issues and need to participate in brainstorming and decision making whenever feasible. Public and legislative input should be solicited and the responses incorporated into the action plan.

Once ITS is a reality in the region, traffic and construction information should be provided to the media, or to the public directly. Weekly construction advisories should be sent to regional trucking firms. Travel information could be faxed to selected businesses during major incidents (like inclement weather or emergency maintenance/construction).

Accurate and timely information will serve to reinforce public support for ITS and will help encourage participation by a variety of private agencies as they realize the benefits of advanced surveillance and communication technology applied to surface transportation.

3.2.5 Funding

Unlike previous large-scale transportation undertakings such as the Interstate Highway Program, the ITS program is not envisioned to be funded primarily by the federal government. In fact, 80 to 90 percent of ITS deployment costs over the next twenty years are expected to be borne by the private sector and individuals. The federal ITS program is directed more toward nurturing the emergence of an American ITS industry, instead of using public funds to rebuild the highway infrastructure into an information age transportation system.

At the same time, transportation decision making is shifting from the federal level to state and local governments. Local leaders will make decisions that will affect transportation services in their own regions. Recent changes in the political climate have created competing priorities and budget pressures. There is intense competition for limited transportation funds. Consensus building across jurisdictional boundaries is difficult, but the ultimate success of ITS may lie not in the technology itself, but in the people who put it together and operate it on a daily basis. Solutions to area-wide transportation problems will only be found through cooperation.

Funding for implementing the final New Orleans Metropolitan ITS Deployment Plan will most likely come from several sources. Three generic funding sources are available:

- Public funds
- Private funds
- User fees

Since the deployment will take place over an extended period, the balance will shift over time between public, private, and user financing.

In the public sector, funds from Federal, State, and local sources can be tapped. Private funds can be used to develop infrastructure and services, with the expectation that this investment will be recovered in the form of user fees for the services provided by private ventures. User fees collected by public agencies can also be put to direct use in expanding the infrastructure.

Aid in the form of redistributed federal gasoline tax revenues has provided the bulk of the funds for construction of projects, with matching funds required from the local agencies, usually at an 80:20 ratio. Recent legislation has also allowed some of these funds to be used for operation expenses of, for example, Traffic Control Centers. Efforts are being made to extend the time limits on these allocations. Special Federal grants may also be available for demonstration projects. These funds can serve as early “start-up” money for establishing the necessary public infrastructure, leading to private investment.

One early deployment element that will be evaluated in the “Technology Assessment and Recommendations” Working Paper is the use of automatic vehicle location (AVL) technology to improve performance. A further extension of this technology can be used to provide feedback to the transit user, furnishing accurate information about the arrival of the next bus or train.

With limited federal funding, the major portion of future ITS hardware costs, once the initial investment of public funds stimulates the process, will probably come from private sources: from service providers, and from users who will pay for equipment and for the service itself. Parallels in the cable television industry come to mind.

The initial infusion of capital for the New Orleans ITS deployment will most likely be from Federal and/or State funds. Assuming such is the case, Figure 3-l presents a flow chart of the steps required to bring the project from the drawing board to the field.

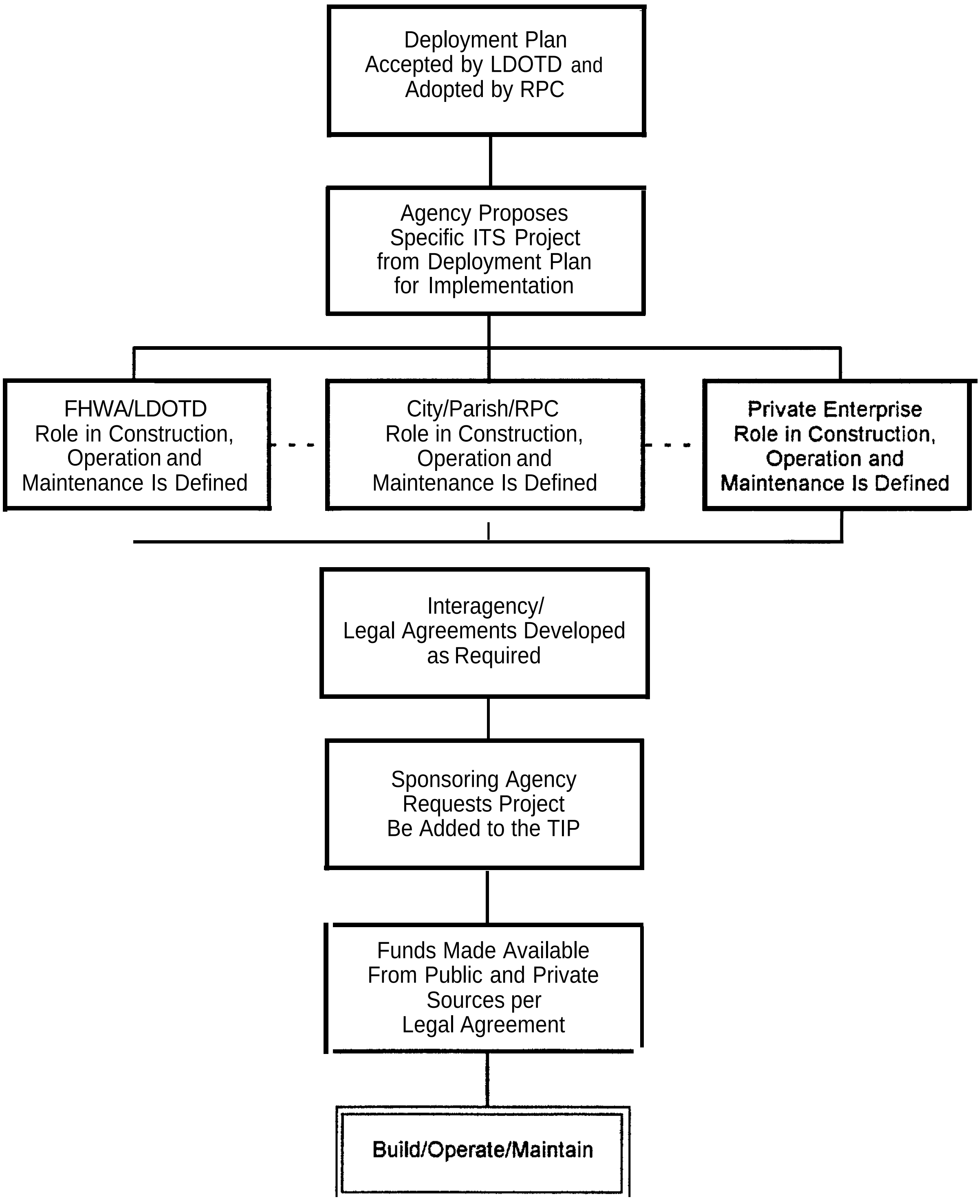
3.2.6 Public Funding Impediments

Primarily because of Federal incentives, a significant amount of capital funds is designated for ITS type projects. Although these funds may be limited in duration and narrowly specified, they nonetheless constitute a major source. These funds can be accessed, but several issues need resolution: inexperience with high technology procurements, contracting regulations, and organizational conflict of interest limitations.

Inexperience with High Technology Procurements

Public agencies traditionally rely on “arms-length” negotiations to ensure that all parties are treated fairly. These procedures, however, make it difficult to achieve the close interaction needed between public agencies and the private sector to develop new technologies. Under current requirements, before a

Figure 3-l. Project Funding Assuming Use of Federal or State Funds



public agency can enter into a contractual relationship with a firm to obtain a high technology product, it must prepare a proposal that specifies, in detail, product specifications and performance requirements. These specifications and requirements must be developed without unduly favoring a particular vendor or technical solution.

Under most circumstances, government contracts must be explicit and conform to established procedures and regulations. Product requirements are fixed. If a public agency seeks to revise product requirements before the terms of the existing contract are met, the result is often additional cost and delay. Furthermore, the agency preparing the procurement may not have the staff expertise to understand all the relevant aspects of the technology or product it wants to acquire. Faced with such a situation, the agency may be forced to turn to specialized contractors and consultants, who will help prepare the procurement and evaluate the bids -- a process that also increases cost and produces delay.

Contractors have come to expect that winning work for government agencies is more likely to be based on the competitiveness of their bids than on whether they have established an understanding of the intent of the procurement and have developed a close working relationship with the public agency. Such a relationship is particularly valuable when the agency is unsure as to the final solution.

Ideally, the agency can go to the potential vendors and discuss its needs without having to pre-specify all relevant details and enter into a formal agreement. As its needs clarify, the agency can work with a vendor to develop or modify the product or technology. Currently, such cooperative working arrangements with private firms are unusual for public agencies.

Contracting Regulations

Private firms are not usually interested in their supplier's operations and management practices. The terms of contract between private parties are generally confidential. By contrast, public agencies often promote social goals through their business relationships with private firms, paying close attention to their suppliers' operations, expenditures, and employment practices. Often, small firms are overwhelmed by the number of laws and regulations that apply to government contracts. Complying with these regulations may require a commitment of resources that may not be realistic for many small firms.

Compliance can become even more burdensome as the ITS program moves toward deployment, since the contractor may then have to conform to a multitude of accounting and procurement regulations. The vast majority of initial ITS technology purchases will be made by state and local governments. if these purchases are to be financed with Federal funds, as most are expected to be, they will be subject to certain Federal regulations. However, state and local government are generally allowed to use their own procurement procedures.

The flexibility that gives state and local governments the ability to meet local needs can also present difficulties for firms that have to comply with different procurement regulations in different political jurisdictions. While this situation is not unique to ITS procurement, special problems may arise due to the complicated nature of acquiring high-technology products and services.

Organizational Conflict of Interest Limitations

It is common for private firms to work closely with their suppliers. For public sector procurements, however, it is not considered good public policy for the same company to be both the designer and builder of a system. When seeking the design of a system, a public agency does not want to create a situation where the developer enjoys an unfair competitive advantage if the system is subsequently built.

Some ITS vendors have stated that the Organizational Conflict of Interest (OCI) rules may exclude them from certain procurements. They further contend that the OCI rules do not necessarily guarantee that the private contractor will provide objective advice. These OCI rules may also have adverse public policy consequences, since the firms that have developed advanced transportation systems and have the expertise to build them are proscribed from doing so because of the rules. Government agencies need to find the correct balance between the need for unbiased information and the need to involve firms in all aspects (design, construction, operation) of new ITS technologies. Another alternative is to adopt a “turn-key” approach, which would allow a single entity to design, build and deploy the system.

3.2.7 Procedures for Private Participation

Properly structured, partnerships between public agencies and private enterprises can blend the best features of both, and provide something for everyone. The public sector taps new sources of capital without raising taxes, and the private sector gains investment opportunities and the work activity it needs to stay in business. The public at large gains as well, from new jobs and needed infrastructure.

The term “partnership” has not yet been fully defined. No established procedural model exists for the purpose of carrying out such arrangements. All existing institutional arrangements fail to address some feature of the partnership concept. Federal and State laws currently ensure transactions are conducted at arm’s length. This principle is antithetical to a true partnership arrangement. There is also the possibility that some firms can exploit the concept to avoid engaging in open competition. Small firms can be excluded, since they may lack the financial resources to participate in cost sharing or project financing.

Viable partnerships are not easy to create, nor to keep together as projects move from the drawing boards into the field. Numerous obstacles stand in the way: restrictive state laws, political opposition, misunderstanding of public/private partnerships, and lack of experience in evaluating and structuring non-traditional financing.

Six building blocks to successful partnerships have been identified (Steven George, “Joining Forces,” Intelligent Highway Systems, ENR, April, 1994):

A strong project team
A proper legal framework
A strong Franchise agreement
Political support
A viable financial plan
Private sector incentives and innovation

Team Making

There must be a strong project team with comprehensive multidisciplinary skills and experience in development, finance, law, engineering, construction, operations, traffic/revenue projections and marketing. The team must have significant financial resources available for development expenses, permanent equity requirements and unforeseen events.

Prior experience in public/private partnerships and creatively financed infrastructure projects is a tremendous benefit. Few in the United States are experts, but clearly many are beginning to try it. This means that the collective base of professionals in the area will probably grow in the future.

Proper Legal Framework

While well written enabling legislation for public/private partnerships exists at the federal level, the extent and quality of state legislation varies widely. ISTEA makes it possible for states to use some federal highway funds to provide capital (in the form of a grant or a loan) for a portion of a privately developed project (up to 50% of the cost of a road and even higher percentages for the cost of a bridge or tunnel) with the remaining capital supplied by the private sector. A key feature of the law is that it specifically allows states to utilize private developers to form public/private partnerships and collect tolls to repay private investors.

California, Washington, Minnesota, Texas, Virginia, and Florida are among the states that have enacted legislation permitting public/private infrastructure projects. But the language and content of these laws differ significantly. In California, state agency officials are granted the authority and flexibility to negotiate, finalize and implement franchise agreements. This appears to make the California law more attractive for public/private partnership, and may explain why many other states are patterning their legislation after California's.

To be successful, a state needs to set up broad guidelines to protect the public interest, but the law must then allow state officials the freedom and flexibility to solicit proposals, award franchises and negotiate contract terms to attract the right partners and investors.

Major problems can develop if state laws appear too restrictive or if legislation is too narrowly worded. In some cases, laws may prohibit the mixing of public and private funds, or impose other problematic conditions such as requiring specific legislative approval to finalize project funding.

In Florida, for example, after a franchise is negotiated by state transportation officials and private partners, it must go before the Florida Legislature for final review. This creates uncertainty among investors and can allow projects to become overly politicized.

Strong Franchise Agreement

A strong franchise agreement must fairly reflect the interests of both the public and the private sectors. This includes protection for the public's interests, such as requiring that a project meet current design and safety standards, requiring that completion guarantees be included, allowing officials to limit the rate of return the private partners can expect, and mandating that the project be properly maintained.

To protect the private sector's investment, the state, through the franchise agreement, must ensure that it won't introduce any unanticipated facilities. For example, few private groups would wish to invest in a toll bridge based on expected traffic volumes, only to learn later that a competing bridge will be built nearby, altering all financial projections. It is important for the private sector that the franchise agreement offer protection against harmful changes in the law, that regulation is not excessive, and that intellectual property is secure.

Another critical factor contributing to a strong franchise agreement is that incentives be provided to the project's private investors. This can include a build-operate-transfer, or build-transfer-operate concession.

Political Support

Political support is crucial to the success of any public/private partnership: without the backing of the governor and a majority of state legislators, true public/private partnership is virtually impossible. Equally important is generating support and understanding from state and local transportation officials and the general public. Finally, both the public and legislators must accept the concept of user fees for public/private projects.

Viable Financial Plan

A successful public/private partnership must have a viable financial plan based on realistic economic and revenue assumptions. For instance, traffic volume and user demand must be sufficient to pay for the project and provide a reasonable profit for private investors. The plan must also provide reasonable toll rates, as well as forecasts projecting usage vs. alternative transportation choices. These demand projections should be supported by verified research data from a respected traffic and revenue consultant,

Another important component of the plan is that it include all appropriate costs for construction, development, financing and operations. A fixed-price, date-certain construction contract from a highly capable firm should be the heart of cost assumptions. Additionally, a sound financial plan should assume realistic capital structure, appropriate for the specific project. For example, the plan should detail how much of the project’s capital the private and public sectors will contribute, and whether the project financing will be purely private, or more publicly oriented.

The financing plan should also include contingency funds and insurance, or other mitigating measures to prevent major delays and overruns. In addition, interest rates and maturity must accurately reflect current levels in capital markets targeted to provide project funding, as well as realistic offering size.

Private Sector Incentives and Innovation

Finally, the private sector must be given incentives to spur partnership and innovation. Most experts agree that projects can be completed significantly faster if alternatives to traditionally sequential design and construction phasing methods are used.

Fast-track techniques have designers and engineers working together, or in an overlapping manner, while design-build employs a single firm responsible for project design and construction. By bringing projects on-line more quickly, developers can lower costs and make the projects more attractive to investors.

3.2.8 Procedures for User Fees

Most people are used to being charged for water or sewer services, but often resist paying user fees for roads. Currently, only about 4,700 total miles of roads, bridges and tunnels in the US charge tolls. While total annual revenue amounts to about $2.5 billion, some experts argue that this is not enough to pay for needed improvements and operation and maintenance. Economist Winston Clifford of the Brookings Institute has designed a series of infrastructure user fees that could raise as much as $60 billion a year. The fees would promote efficiency by discouraging unnecessary travel, pay for maintenance, and provide revenue for other essential public works.

Infrastructure projects can also be viewed in the context of the impact they have on the economy. Money spent on infrastructure projects would create jobs, raise the output of businesses, and improve the nation's productivity. Transportation improvement projects that alleviate congestion will reduce the environmental impact of stop-and-go traffic, improve safety, and increase productivity.

User fees can be collected several ways. Public agencies can sell travel information collected by publicly funded infrastructure to private service providers, who resell it to end users after refining the data to satisfy their customers' needs. The public agencies can then reinvest the proceeds in operation and maintenance, and programmed expansion.

Alternatively, public agencies could give away travel information collected by publicly funded infrastructure to private service providers who would be obligated to distribute some of it over their own infrastructure at no charge to users (basic service), and can sell some of it after adding value to it to other, properly equipped users (premium service). The private agency would collect and keep the user fees, and the benefit to the public agency would be the widespread dissemination of travel information, enabling the general public to make more efficient use of the transportation network.

3.3 Summary of Local Institutional Issues and Needs

This section indicates the questions posed, summarizes the responses to the questionnaire and highlights some of the institutional issues that were considered during this study. It also discusses what the area's agencies and potential users of a regional system see ITS providing.

What do you or your agency see as the transportation problems in the region today and in the future? All of the responders agreed that there is a significant existing congestion problem due to inadequate capacity and that this problem will become worse in the future. The responses stated that time, finances and limited right of way to expand the existing freeway system will all contribute to the inability to meet future traffic demands. It was stated that there are too few freeways and acceptable alternate routes. It was also stated that there are problems with just funding the preservation and maintenance of the existing transportation system.

Who do you view as the transportation users (customers) that you are serving? In the responses to this question, the agencies included the area residents, commuters from outlying areas, commercial vehicle operators, tourists, transit operators, emergency vehicles, and users of alternative transportation modes such as pedestrians and bicyclists. **In** addition a couple of responses stated that it includes everyone since all consumers are impacted by the transportation network.

Please rank the ITS user services that are important to the region. Agencies were asked to rank in order of importance, twenty-two user services which have been identified and defined by the Federal Highway Administration. A composite of all the individual agency rankings indicated that incident management and traffic control were identified as the most important user services for the region. The group of services which rank next in importance to the region included en-route driver information, route guidance, hazardous material incident response, and emergency management.

What are the planned or on-going ITS activities in the region? There is presently an incident management study underway for the New Orleans Metropolitan area. The purpose of this study is to develop a coordinated Incident Management Program for minimizing the impacts of incidents which disrupt or impede the flow of traffic in the region. It will identify specific techniques for incident detection, site response, site management and site clearance. The study is under the direction of LDOTD and is being coordinated by the RPC. A Study Task Force was established to obtain information and input from area agencies. The RPC is also involved in a study of an AVL/AVI system for the Regional Transit Authority. Other proposed projects include signal upgrades for the City of New Orleans and areas of Jefferson Parish. Automatic Toll Collection facilities presently exist at both the Crescent City Connection and the Lake Pontchatrain Causeway and traffic information is being provided via radio broadcast from information obtained by the private firm of Metro Scan. This firm provides information from closed circuit TV cameras and airplane surveillance.

Do any of your activities involve other agency coordination? If yes, describe the procedures. The Regional Planning Commission as the MPO coordinates with the LDOTD, the Parishes, Municipalities and transit operators on all planning studies throughout the region. The LDOTD District 02 office coordinates with other jurisdictions in order to provide coordinated signal timing plans for state highways in the region. Traffic signals on the State system within the City of New Orleans are maintained by the City under contract to the state.

What is your agency's role in providing transportation services? The roles of the agencies which responded included the planning, engineering construction and maintenance of transportation facilities in the area. These facilities include highways, bridges, tunnels, ferries, toll facilities, transit facilities and programs.

Do you see your present role being expanded? The RTA, Greater New Orleans Expressway Commission, LDOTD Planning Division, and the Crescent City Connection did not see their roles expanding. All other agencies did see their roles expanding. The New Orleans Department of Streets questioned how their role could be expanded when faced with the budgetary constraints that exist. Their 1996 budget was 85% of the 1995.

What issues do you foresee that have the potential to derail or slow down the development of a future regionally coordinated transportation management and information system? The list of responses to this question included funding, communication, political boundaries, cooperation, coordination, inadequate staffing, maintenance, differing goals, and public acceptance. The most frequent response received was related to perceived funding problems for implementation, training, staffing and maintenance of any system.

Do you see a need to change the current organizational structure in your agency or in the region to support ITS initiatives? Most agencies saw no change in their organizational structure. It was suggested that reorganization on a technical basis should occur to allow for closer cooperation between agencies. Other suggestions included the consolidation of similar personnel assignments across jurisdictional lines. Consolidation was also suggested for within an individual agency.

Do you see a role for the private sector? If yes, what? how? where? If no, why? A majority of the responders answered yes to this question. The suggested roles of the private sector included providing the research and development of technology for systems, construction and maintenance, and filling staffing shortages. Specifically, one response included towing services and providing motorist information services.

Do you feel your staff is capable of managing, operating and maintaining a high tech approach to transportation management? All of the responders answered yes to this question. There is a feeling throughout each agency that the staff is very capable of handling any high tech system. It is noted that the commitment must be made to education and training.

What goals do you have for ITS? The responses included both general and specific goals for the region. The general goals included providing a more efficient system, a regional approach to improve transportation, increase capacity of existing facilities, reduce congestion, safe and efficient movement of people and goods, and improved information gathering. Specific goals included an incident management program; improve transit movement, security, monitoring, and information; user information for travel options; special event transportation; video enforcement system in conjunction with ETTM; access control for exclusive HOV/Transit lanes.

3.4 ITS Policy Decisions

ITS projects differ from more traditional engineering projects in process, content, and participants. Louisiana, like most other states, has not yet standardized the development process for ITS projects. Because deployment of ITS technology will take place over a long period of time, future conditions have a major role in determining the method of such deployment. Therefore, major elements of this plan will have to be in place before funding sources are identified. Consequently, the plan will need to be iterative as these sources are identified and refined.

The proposed New Orleans Metropolitan Area ITS Deployment Plan will require capital funds, as well as operation and maintenance funds. There are temporary provisions in the ISTEA legislation that allow funds to be used for operation expenses for a period of two years. Beyond that time, other sources of revenue will have to take over.

3.4.1 Policy Adoption Requirements

The feedback provided from the questionnaires distributed to public agencies within the study area primarily focused on the lack of funding, followed by concerns that local agencies need to cooperate and coordinate their efforts more closely. Of the two, the more critical issue in making the deployment of ITS technology in the New Orleans study area successful is interagency coordination and cooperation, since this process needs to start as soon as possible, while funding sources can be developed at a different rate.

Even in the presence of adequate funding, lack of cooperation and coordination can hinder the deployment of ITS technology. With the reality of limited funding, interagency cooperation and coordination is vital to successful deployment, since competing for limited funds would be counterproductive. It is therefore important to define a methodology for funding allocation and project prioritization that is acceptable to all interested parties, so that deployment can proceed efficiently.

The initial deployment will most likely take place on the most heavily traveled roadways first, expanding over time to other parts of the transportation network as resources become available. It is therefore of paramount importance to gain region wide support, both public and private, up front, before actual deployment begins. It is necessary to get commitments in advance, because once deployment starts, inevitably some areas and agencies will realize benefits earlier in the process than others. If all parties agree in advance that ITS technology can contribute to system-wide improvements (even if not immediately in their particular area of interest), future improvements will build upon past successes and accelerate the deployment as more people realize the advantages provided by up-to-the-minute travel information, and demand access to these services.

Therefore, a policy-setting body that determines funding allocation and project priority cannot be a single agency, such as the Regional Transit Authority or the State Department of Transportation. Their decisions would always be viewed as autocratic or self-serving. Instead, the authority for setting **ITS** policy should rest with a group that has the consensus of all interested parties to act for the interests of the entire region.

3.4.2 Recommendations

This report cannot recommend an optimal ITS operating environment. The industry's collective experience and knowledge of existing and planned technology are not yet sufficient to specify the optimal set of institutional and organizational arrangements that would guarantee the successful deployment of ITS products and services, whether in the New Orleans study area, or anywhere else. Advanced transportation technologies are currently being operated under a multitude of different institutional arrangements and operating environments. What works in one area may not necessarily work in another.

There are two approaches to solving this conundrum: starting from the ground up, or modifying an existing structure. Starting fresh provides the opportunity to avoid past mistakes, but also poses the risk of committing new ones. Modifying an existing structure takes advantage of its good aspects while providing the opportunity to improve the parts that do not work well. However, it poses the risk of harming the working relationships established over the years.

A completely new organization could be set up that would be charged with coordinating local ITS interests. An example of such an entity is the TRANSOM (Transportation Operations Coordinating Committee) organization in New York/New Jersey, a consortium of public and private entities all contributing staffing, funding, and equipment to facilitate transportation in the area.

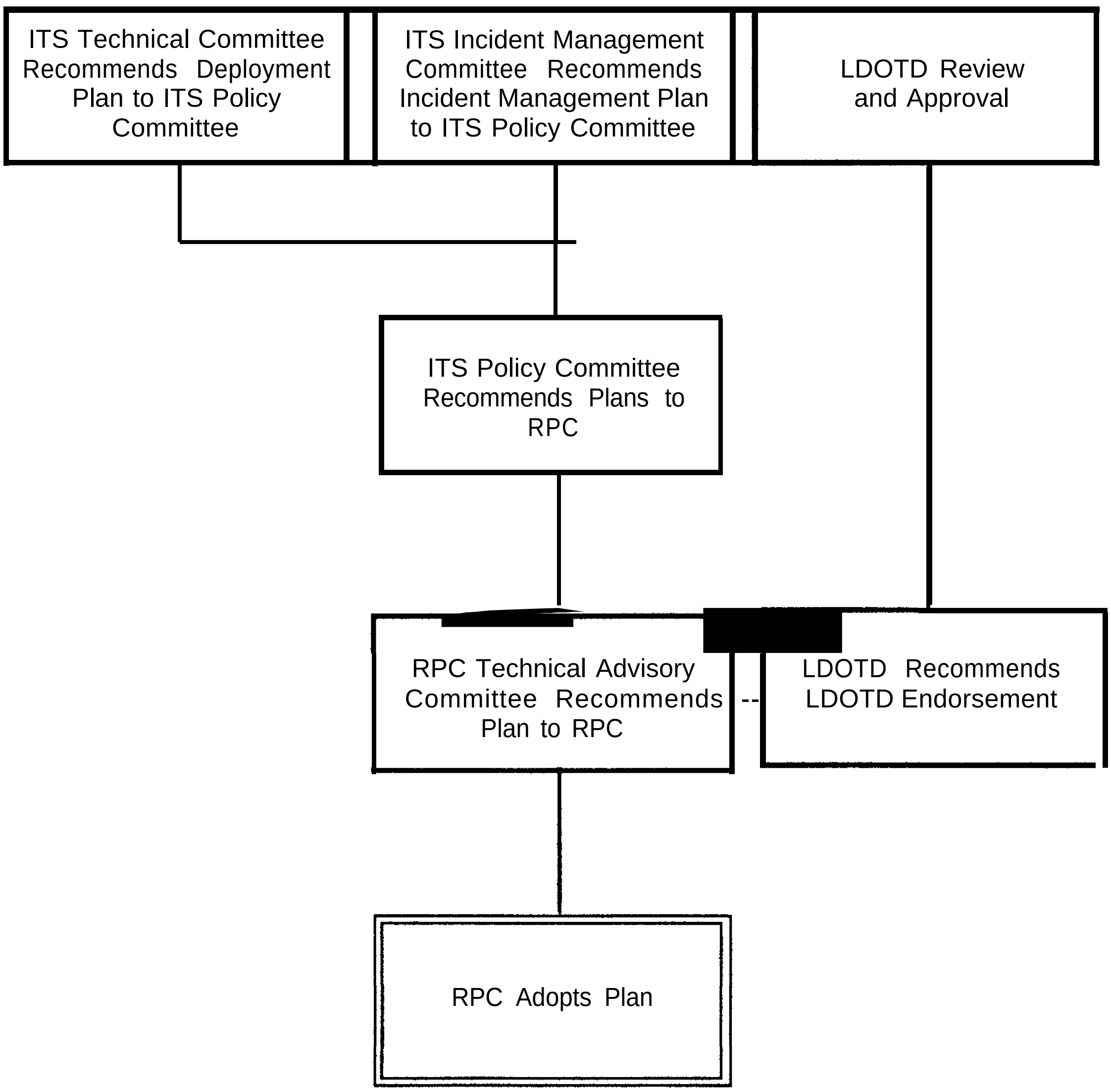
Another option would be to use the existing metropolitan planning organization (RPC) and enhance its structure, forming a subcommittee of the Transportation Policy Committee, with the Louisiana Department of Transportation and

Development as the lead agency with full voting rights. This approach also takes advantage of existing cooperative networks, and builds upon them. In addition, RPC has been making acceptable policy decisions regarding transportation projects, which would be conducive to the process of making acceptable policy decisions in ITS matters.

An operating agreement could also be signed combining the LDOTD Traffic Operations Section, City/Parish of New Orleans Traffic Engineering Division and Jefferson Parish Traffic Engineering Division into a three party cooperating agency responsible for Metropolitan ITS facilities.

However, given the diversification of authority within the study area, and taking advantage of the existing working relationships, the best approach would be to use the bodies set up for this project (the Technical, Incident Management, and Policy Committees), and, with LDOTD review and approval, approach the MPO (RPC) for formal adoption of the Deployment Plan as is current practice for regular transportation improvement projects. The following flow chart, Figure 3-2 outlines the process.

Figure 3-2. Deployment Plan Adoption Process



Chapter 4
ITS USER SERVICE PLAN AND PERFORMANCE CRITERIA

4.1 Transportation System Characteristics

4.1.1 Agency Involvement

New Orleans operates under a home-rule charter, meaning the State must get the consent from the city/parish for anything the state wants within the boundaries of the incorporated area. The reverse also applies. The local jurisdiction must get the State's consent for anything it wants. The principal agencies involved in transportation issues for the Metropolitan area include Louisiana Department of Transportation and Development (LDOTD) Districts 02 and 62, New Orleans Department of Public Works and Jefferson parish Traffic Engineering Department.

The Parishes within the study area contained in District 02 include Orleans, Jefferson, St. Bernard, and St. Charles. The Parishes within District 62 which are included in the study area are Tangipahoa, St. Tammany and St. John The Baptist. The LDOTD is the lead agency on all state routes within the metropolitan area. Traffic engineering services within the study area are performed by the City of New Orleans, Jefferson Parish and the LDOTD District offices. Traffic signals along the State system within the City of New Orleans are maintained by the City under contract with the State.

The Regional Planning Commission is the metropolitan planning organization (MPO) for the region. This agency represents the Parishes of Jefferson, Orleans, St. Bernard, Plaquemines and St. Tammany and coordinates all highway planning activities for the region.

Public transportation in the study area is provided by the Regional Transit Authority and Jefferson Parish Transit. The Regional Transit Authority operates both busses and light rail serving the Central Business District and Eastern New Orleans. The Jefferson Parish Transit serves Jefferson Parish providing service on both the east and west banks of the Mississippi River.

4.1.2 Transportation System Operating Characteristics

Overall, there were nearly 360 miles of roadway evaluated in the freeway network. The following table summarizes the amount of roadway miles that experience recurring congestion and nonrecurring congestion and the percentage of the total study network.

Table 4-1. Recurring/Nonrecurring Congestion Summaries

Characteristics	Existing		Future	
	Miles	% of Study Area	Miles	% of Study Area
Recurring Congestion	97.72	27.2%	139.97	38.9%
ADT Exceeding 15,000 Veh/lane	14.56	4.1%	64.12	17.8%
Nonrecurring Congestion	22.37	6.2%	24.15	6.7%

Over 27% of the network experiences recurring congestion while over 6% would be significantly impacted by an incident resulting in nonrecurring congestion. In the future, the situation is expected to deteriorate as shown in Table 4-l.

4.1.3 Regional Goals and Objectives

The national ITS program has defined a series of strategic goals that include:

- Improve Safety
- Increase Efficiency
- Reduce Energy and Environmental Impacts
- Enhance Productivity
- Enhance Mobility

From the local perspective the surveys of regional agencies that were recently conducted showed that, locally, agencies are looking for ITS to:

- Improve travel times
- Increase service through efficient use of resources
- Reduce capital investment in construction
- Promote smooth traffic flow
- Provide a safe and efficient transportation system
- Improve communications to users
- Reduce traffic congestion on a cost-effective basis
- Provide dependable information to the traveling public
- Respond quickly and professionally to emergencies and incidents
- Decrease delay due to incidents
- Promote more efficient modal utilization
- Increase efficiency in providing transit service
- Provide priorities to HOVs.

It is obvious that a common base is indicated by the agencies' suggestions. The project goals should thus be defined as:

- Reduce both recurring and nonrecurring traffic congestion by improving the efficiency of the existing transportation system.
- Improve the overall safety of the transportation network.
- Improve communications to the general public and between transportation providers.
- Improve the response time and clearance of emergencies and incidents on the transportation's network.
- Promote more efficient modal utilization.

4.1.4 Measures of Effectiveness

In order to evaluate the potential success of any future plans and recommendations, measures of effectiveness (MOE's) can be used to define the success or failure of a strategy or system component. These MOE's must be related to the goals and objectives of the project. For the New Orleans project it is suggested that the following MOE's be used in the evaluation process:

- Average vehicle speeds
- Vehicle hours of delay
- Response and clearance times for incidents
- Number of accidents
- Modal volumes

With the deployment of ITS components within the last few years, benefits such as accident reductions, time savings, roadway capacity improvements, emission reductions and reduced fuel consumption have been documented. It has been reported after a study of freeway management systems throughout the country that the benefits included travel time reductions of 20 to 48 percent, travel speed increases of 16 to 62 percent, and an accident rate decrease between 15 to 50 percent. Similarly, with the installation of computerized coordinated signal systems, travel times can be decreased between 8 and 15 percent while travel speed will increase 14 to 22 percent. Analysis of incident management programs have indicated clearance time reductions of between 5 to 8 minutes, and decreases in travel times within the range of 10 to 42 percent. Traveler information systems which provide real time traffic data to the highway and transit user can provided as much as a 20 percent decrease in travel time under incident conditions.

The measures of effectiveness information is utilized to develop a user service plan which meets the goals established above, and to aid in the analysis of the benefit to cost ratios of the elements of the Strategic Deployment Plan.

4.2 User Services Plan

4.2.1 Description of User Services

The national ITS program has defined twenty-nine interrelated user services. These user services are defined by their ability to meet the transportation-related needs of the users in a given metropolitan area. They are not necessarily related along lines of common technology. The users include the entire spectrum of transportation providers, operators and travelers as well as other fringe groups involved in these transportation services or who may benefit from improved transportation services. Figure 4-l shows the cross section of all potential users in a metropolitan area and how the national program defines their interrelationships.

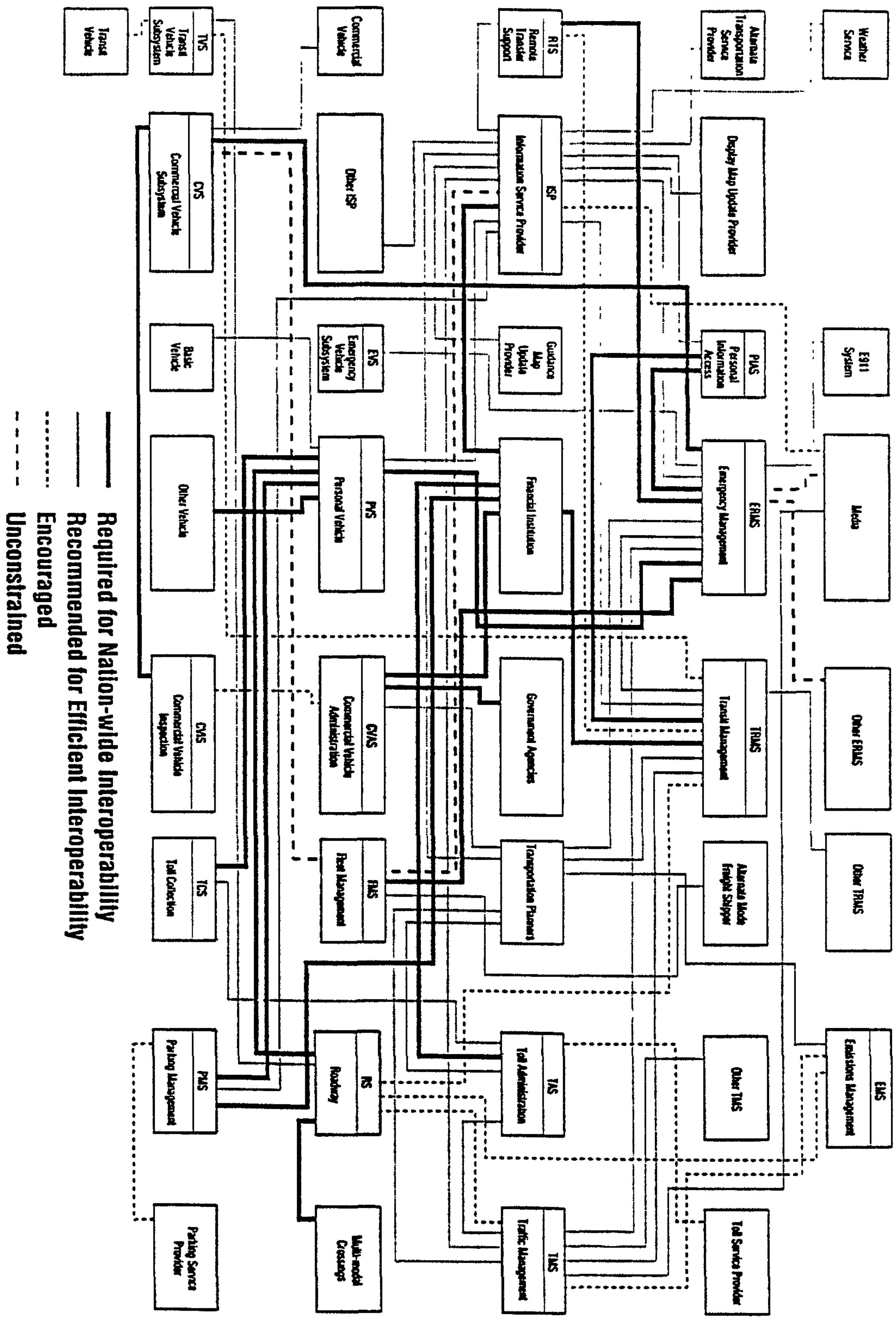
The actual user services are comprised of multiple technological elements and functions. They serve as building blocks that can be combined in many ways for deployment in the New Orleans area. The combination of user services should be selected to meet local priorities, needs, institutional frameworks and regional market forces. The user services should be combined in deployable systems and services that will meet the goals for the region. The user services have been grouped into bundles based on those services that are likely to be deployed in a region or corridor scenario. The bundles also typically take into account the commonality of the technological functions for the services. Table 4-2 lists the bundles and services and a brief description of each of these services and bundles follows below.

Travel and Transportation Management

The Travel and Transportation Management bundle includes six user services that are designed to use advanced systems and technologies to improve the safety and efficiency of the transportation system, and to provide motorists with current information about traffic and roadway conditions, as well as traveler services.

- **En-Route Drive Information:** Provides driver advisories and in-vehicle signing for convenience and safety.
- **Route Guidance:** provides travelers with simple instructions on how to best reach their destinations,
- **Travel Services Information:** Provides a business directory, or "yellow pages," of service information.
- **Traffic Control:** Manages the movement of traffic on streets and highways.

Figure 4-1. National User Services Relationships



- **Incident Management:** Helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic.
- **Emissions Testing and Mitigation:** Provides information for monitoring air quality and developing air quality improvement strategies.

Table 4-2. National User Services

Bundle	User Services
1. Travel and Transportation Management	1. En-Route Driver Information 2. Route Guidance 3. Traveler Services Information 4. Traffic Control 5. Incident Management 6. Emissions Testing and Mitigation
2. Travel Demand Management	1. Pre-Trip Travel Information 2. Ride Matching and Reservation 3. Demand Management and Operations
3. Public Transportation Operations	1. Public Transportation Management 2. En-Route Transit Information 3. Personalized Public Transit 4. Public Travel Security
4. Electronic Payment	1. Electronic Payment Services
5. Commercial Vehicle Operations	1. Commercial Vehicle Electronic Clearance 2. Automated Roadside Safety Inspection 3. On-Board Safety Monitoring 4. Commercial Vehicle Administrative Processes 5. Hazardous Material Incident Response 6. Commercial Fleet Management
6. Emergency Management	1. Emergency Notification and Personal Security 2. Emergency Vehicle Management
7. Advanced Vehicle Control and Safety Systems	1. Longitudinal Collision Avoidance 2. Lateral Collision Avoidance 3. Intersection Collision Avoidance 4. Vision Enhancement for Crash Avoidance 5. Safety Readiness 6. Pre-Crash Restraint Deployment 7. Automated Highway Systems

Travel Demand Management

The Travel Demand Management (TDM) bundle includes three user services that are designed to reduce congestion on the transportation infrastructure by encouraging commuters to use modes other than the single occupant vehicle (SOV), to alter the time and or location of their trip, or to eliminate a trip. In response to congestion and air quality concerns, many cities have already initiated travel demand management activities, and other will be required to do so in response to the mandates of the 1990 Clean Air Amendment.

- **Pre-Trip Travel Information:** Provides information for selecting the best transportation mode, departure time, and route.
- **Ride Matching and Reservation:** Makes ride sharing easier and more convenient.
- **Demand Management and Operations:** Supports policies and regulations designated to mitigate the environmental and social impacts of traffic congestion.

Public Transportation Management

The Public Transportation Management bundle includes four user services that are designed to utilize advanced vehicle electronic systems to provide data which is then used to improve transit service to the public.

- **Public Transportation Management:** Automates operations, planning, and management functions of public transit systems.
- **En-Route Transit Information:** Provides information to travelers using public transportation after they begin their trips.
- **Personalized Public Transit:** Provides flexibly-route transit vehicles to offer more convenient customer service.
- **Public Travel Security:** Creates a more secure environmental for public transit patrons and operators.

Electronic Payment

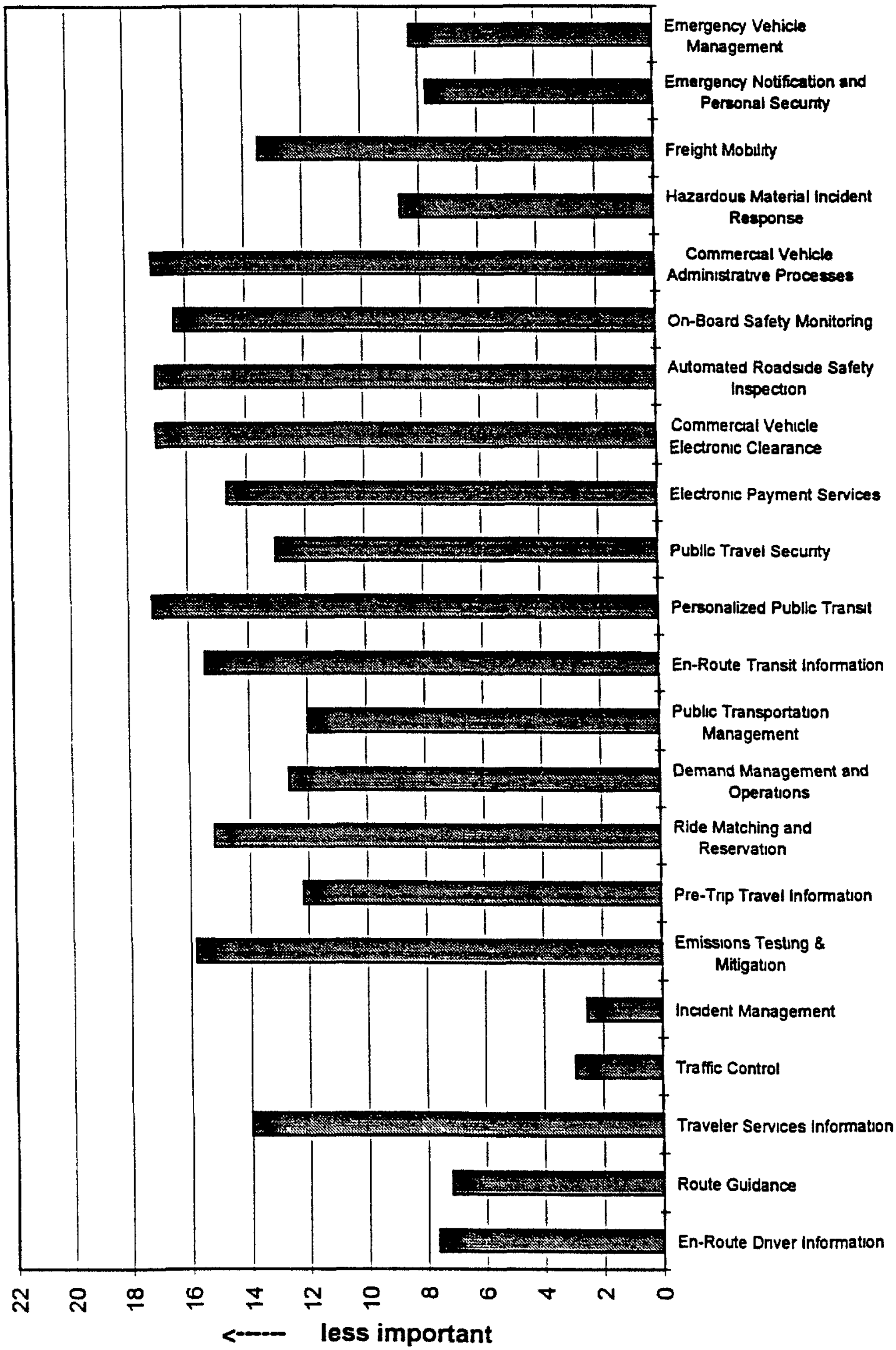
The Electronic Payment bundle includes one user service, electronic payment services.

- **Electronic Payment Services:** Allow travelers to pay for transportation services electronically.

Commercial Vehicle Operations

The Commercial Vehicle Operations bundle includes six user services that are concerned primarily with freight movement and focus in two specific areas, one

Figure 4-2. User Services Composite Ranking



- *Public Transportation Operations Bundle*
  - Public Transportation Management
  - Public Travel Security

- *Emergency Management Bundle*
  - Emergency Notification and Personal Security
  - Emergency Vehicle Management

Below is a summary of how each of the services is expected to be used in the New Orleans area.

Incident Management

The Incident Management user service will develop the capabilities for detecting incidents and taking the appropriate actions in response to them. Both unpredictable incidents and predictable incidents such as construction or planned lane closures would be included. Incidents such as accidents, construction and maintenance activities, adverse weather conditions, parades, sporting events, tourist attractions, or other events can cause congestion by temporarily increasing demand or reducing the capacity of the transportation network. “Rubbernecking” by those not directly affected by the incident can also lead to congestion and delays. Even minor incidents, such as a disabled or abandoned vehicle on the shoulder, will create a potential safety hazard and potentially cause rubbernecking delays.

In the New Orleans area the Incident Management user service will be developed to use advanced sensors, data processing, and communications to improve the detection and response capabilities of transportation and public agencies. The service will help to quickly and accurately identify a variety of incidents, and to implement a set of actions to minimize the effects of these incidents on the movement of traffic. The service can also help to identify or forecast hazardous weather, traffic, and facility conditions so that agencies can take action in advance to prevent incidents or minimize their impacts.

A major focus of the Incident Management user service will be to improve the response to unpredictable incidents, such as accidents, vehicle breakdowns, and loss of cargo situations. There is generally little or no advanced warning for these types of events so that the speed of detecting the incident and implementing the proper response is critical. Detection systems will likely use advanced sensor technology, data generated by numerous other sources, such as freeway service patrol and cellular telephones and sophisticated software to quickly verify the location, characteristics, and potential impacts of an incident. Advanced computer-based decision support systems can also be developed to help all appropriate agencies to cooperatively decide on the best set of actions to minimize the effects of an incident and determine who is responsible for implementing each action. These actions may involve dispatching emergency or service vehicles to the incident scene, providing information and routing instructions to travelers, and/or altering existing traffic control. The user service will also provide the capability to coordinate the scheduling of many predictable incidents, to minimize their traffic flow impacts.

With "Home Rule" in Louisiana, an effective response to any incident will require extensive communication and institutional coordination. Due to the dynamic nature of incidents and their impacts, contact among all agencies must be maintained throughout the life of an incident. This will require the use of advanced data management and communications technologies to help ensure that the best possible information on the nature of an incident, and the associated response effort, is available at all times. A determination will have to be made of the best way to respond to all verified incidents, including which organizations, resources, and procedures to use. This response plan must be developed as part of the development of this user service. Response plans for both unpredictable and predictable incidents should be developed in advance.

Traffic Control

The Traffic Control user service should be used to manage the movement of traffic on streets and highways. It could include surface street controls such as adaptive signal systems and freeway control techniques such as ramp metering and lane controls. Since the focus of this study is the freeway network the emphasis of the user service will be on control aspects of the freeway network as well as future integration needs to allow the surface streets and freeways to work together. Traffic Control will help to improve the efficient movement of all users of the surface transportation system.

Traffic Control can also improve the people moving capacity of the roadway system through preferential treatment for mass transit and other types of high occupancy vehicles (HOVs). One of the long range goals of the Traffic Control user service in the New Orleans area will be the integration of the control of freeways and the regional network signal systems to promote areawide optimization of traffic movement. Many areas such as Los Angeles and Boston have already investigated this option. Obviously new institutional arrangements and increased interjurisdictional cooperation would be necessary to allow for this type of unified operation of systems owned and operated by multiple jurisdictions.

The appropriate type of traffic control will be implemented by devices such as traffic signals, information signs, freeway ramp meters, and devices for the dynamic control of the transportation infrastructure such as reversible lanes, rush hour turn restrictions, and HOV signals. The Traffic Control user service will manage these control mechanisms so that control can be provided on an area-wide basis, thereby avoiding fragmented or conflicting control strategies. For example, in the New Orleans area, metered ramps implemented will not allow traffic queues to overflow the ramp and disrupt the operation of adjacent intersections. The implementation of Traffic Control will require the use of many supporting technologies. These technologies will generally fall into the functional areas of traffic surveillance, data and voice communications, data processing and automation, and human interface.

Route Guidance

The Route Guidance user service provides motorists with a suggested route to reach their destination, along with instructions for upcoming turns or other maneuvers. Ultimately, a route guidance system would provide travelers utilizing all modes with directions to their destinations based on real-time information about the transportation system, including lane closures, traffic conditions and transit information.

Route guidance could be hindered by the lack of feasible alternative routes around an incident. Information from police officers can be time consuming and takes away from the officer’s traffic control duties. It is important to develop an automatic system for providing directions to diverted motorists. Trailblazer signs directing traffic along the most feasible route back to the freeway as expeditiously as possible is a key step toward a proper route guidance system. Highway advisory radio transmissions can cover large areas with constant directions to return to the freeway. Variable or changeable message signs can be utilized to keep large amounts of traffic from arterial streets from feeding traffic onto a closed section of freeway.

En-Route Driver Information

The En-Route Driver Information user service will provide travel-related information to drivers after their trips have begun. This user service includes the provision of real-time information on traffic, transit and roadway conditions. En-Route Driver Information is composed of two sub-services: driver advisory and in-vehicle signing. For the New Orleans Metropolitan area the plan will focus on the driver advisory aspects. Smoother traffic flow should result from reduced congestion by improved route selection, and trips shifted to public transportation systems.

Driver advisory will require some electronic equipment for each vehicle, perhaps something as simple as a radio. It could consist of a variety of electronic devices which might also be capable of receiving information at home, at the office, and at convenient public locations through a variety of technological means and media. These devices will require advanced communications and microprocessor techniques to accommodate a variety of driver and traffic network requirements. FM subcarrier communications techniques that use the existing communications infrastructure, spread spectrum two-way radio, microwave and infrared beacon, cellular radio, variations of Highway Advisory Radio, and transponder-based vehicle-to-roadside systems are some of the technologies. Information dissemination techniques, such as variable message signs, roadside displays, video monitors, as well as audio/visual presentation methods may also be included.

Emergency Notification and Personal Security

This user service is closely related to the previous one as it sends immediate notification of an incident to response personnel. The users of this service are drivers who will benefit from more timely responses in emergency situations. Primary service providers include telecommunications carriers, emergency response centers, police departments, highway patrols, fire and rescue units, emergency medical service providers and those providing towing and other motorist assistance services. This service directly addresses the goal of improving safety by improving EMS/roadway services responses, reducing the number of pedestrian and vehicle collisions secondary to an incident, and reducing the number of fatalities and the severity of injuries resulting from a collision. Driving stress is reduced by providing a means of summoning assistance in the event of an emergency.

The user service can provide manually initiated notification of emergency and non-emergency incidents such as mechanical breakdowns, fire, non-injury accidents, or injury accidents where a person on the scene is able to manually initiate the notification. Request for assistance can be directed to emergency and non-emergency response personnel including emergency medical, fire, law enforcement, as well as towing or repair assistance to deal with a disabled vehicle. Systems would include the capability to automatically transmit the vehicle’s location with notification message. Initially this service will provide for manually initiated notifications through service patrols, cellular 911 or call boxes. Primary service providers include telecommunications carriers,

The responding agency would received the incident notification and location coordinates and manage the response. Information would be sent to a centralized dispatch center. Ideally, a focal point, such as an existing dispatch center, would be used as the primary unit to receive calls, determine response requirements and route distress calls to predesignated responding agencies.

A network of these points has been established throughout most states to deal with emergency 9-l-l calls. These communications centers operate as an agency of a government entity such as the parishes or the City of New Orleans. They are responsible for answering 9-l-l calls. These centers either dispatch a response or transfer the call to another center for dispatch. Agencies and response services typically involved include: state and/or local transportation officials, police department, highway patrol, fire and rescue, emergency medical service providers, and towing and other "courtesy" services. The Bridge Emergency Service Team (BEST) at the Crescent City Connection Bridge could be notified directly.

Emergency Vehicle Management

The Emergency Vehicle Management User Service is oriented towards reducing the time from the receipt of notification of an incident to the arrival of the emergency vehicles on the scene. The most common of this service is the ability to access, process, and exchange real-time information on the location and nature, of incidents on roadways, enabling appropriate responses to be promptly programmed and implemented at all potential response sites. This service has three primary users: law enforcement services, emergency medical services (EMS), and fire services. These primary users may need assistance by rescue services, hazardous materials clean up services, and other secondary responders. In many areas of the country this effort is being coordinated through existing 911 operations.

ITS technologies will allow emergency responders receiving notification of response requirements, to immediately identify the appropriate, closest, available responder or mix of responders, and to transfer complete, accurate information regarding the nature and location of the response need. A working model for this ITS function already exists in the Enhanced E-9-l-l (E-9-l-l) function know as selective routing. Selective routing automatically routes a 9-1 1 call to the agency responsible for public safety in the region where the call originated.

Several technologies will need to be integrated to allow this user service to be fully achieved. Most important will be real-time reliable transportation information that is essential to responding to traffic incidents. It requires use of current traffic information, locations of the incident and navigational alternatives to arrive at the proper location.

Hazardous Materials Incident Response

The Hazardous Materials Incident Response user service will provide emergency management response personnel with information on the type and quantity of material at the scene of a spill. When a spill occurs, the emergency response personnel will have all the information about the vehicle and the type of material and will know the proper way to dispose of the spilled material in an expeditious way.

The National Academy of Sciences determined that is not cost effective to track all hazardous material shipments. For certain types and amounts of hazardous materials it may only be important to locate these trucks when they are involved in a serious incident and then provide specific cargo information to the appropriate emergency responders.

Public Transportation Management

The Public Transportation Management user service will apply advanced vehicle electronic systems to public transportation modes by using the data generated by these modes to improve service to the public. For the New Orleans ITS plan this user service will focus on the operational aspects of public transportation. Real-time data from individual vehicles can be communicated via a data link and compared with schedule information and other predetermined parameters. A computer can identify deviations, can display them to the dispatcher and determine the optimum scenario for returning the vehicle to its schedule. Corrective instructions can be transmitted to the driver to adjust. Integrating this service with the Traffic Control user service can maintain transportation schedules and minimize varied impacts on traffic congestion.

In addition, using a vehicle location system, a computer will calculate the arrival times of two buses at a transfer point. The bus that arrives first will be instructed to remain at the transfer point and wait for the second arriving bus. This will permit transferring passengers to make their connections. In addition, accurate arrival and travel times can be given to the customer.

Public Transportation Management will depend upon the vehicle's communication system. The communication system will provide voice communication and data transfer among the various devices installed on the vehicle, including location equipment and other sensors, and components. On-board sensors can automatically monitor such elements as vehicle location, vehicle passenger loading, fare collection, and vehicle operating conditions. These data must be transferred between the vehicle and the control center.

In addition, smart card use under a distance based fare scheme can be used for automatic passenger counters. Many cities are now using inputs from on board electronic sensors such as an Automated Vehicle Location (AVL) systems, electronic fareboxes, passenger counters, electronic destination signs and automated bus stop announcement equipment.

Pre-Trip Travel Information

The Pre-Trip Travel Information user service will provide travelers with information prior to their departure and before a mode choice decision is made. The Pre-Trip Travel Information service integrates information from various transportation modes and presents it to the user through electronic communications or public information centers. Users of the service will include all travelers, as well as agencies who will develop pre-trip information services. The Pre-Trip Travel Information user service will eventually allow travelers to access a complete range of multimodal transportation information at home, work, and other major sites where trips originate.

These systems will provide timely information on traffic and highway conditions; transit routes, schedules, transfers, and fares; intermodal connections to rail services; real-time information on incidents, accidents, road construction, alternate routes, traffic regulations and tolls; predicted congestion and traffic speeds along specific routes; parking conditions and fees; availability of park-and-ride facilities; tolls; special event information; and weather information. To provide travelers with a common information medium for all transportation modes, integration of intermodal information should occur. Traffic control systems generating data on highway conditions should be integrated with public transportation systems providing transit location and route information. Paratransit services and access to ridematching services could also be included.

Real-time public transportation data should include information gathered by an automated vehicle location (AVL) system, while route and schedule data can come from the transit operators. Highway condition information will eventually be collected through the Traffic Control and Incident Management user service using closed-circuit television, roadway sensors, and image processing. Additional highway condition information can also be made available through Electronic Toll and Traffic Management (ETTM) systems, and equipped vehicles acting as traffic probes.

In the initial systems, information will be presented on a standard or cellular telephone, which will ask the listener to push the number corresponding to the desired service, and then provides continually updated information. The Pre-Trip Travel Information User Service can also be presented through personal computers with modems, cable television, and Personal Communications Devices (PCDs).

The ultimate system will include elaborate interactive map presentations requiring larger amounts of computer memory, and will be provided at major generators and public locations in kiosks.

Demand Management and Operations

The Demand Management and Operations user service is intended to reduce roadway vehicle demand by developing and encouraging modes other than single occupant vehicles, and to decrease congestion by altering the timing or locations of trips, or eliminating vehicle trips altogether. The Travel Demand

Management user service uses ITS technologies and systems to facilitate the implementation and operation of TDM strategies.

The user service will generally operate and function through interactive computer operations and communications centers that implement the TDM management and control strategies, by:

- Receiving information and data from transportation operators and/or users, on the current status, need, and level of activity and;

- Sending or disseminating operational information and commands to operators and/or users on how to control or manage activity so as to conform and comply with a program, policy, or regulation.

For the New Orleans area this user service might include:

HOV Facility management and control: HOV Lanes can be operated and enforced to responded to current conditions and situations. Occupancy requirements could be adjusted by time of day or to reflect current demand and congestion levels and incidents. Another example of this operational concept is for traffic management systems to give priority to the movement of Carpools, Vanpools, and buses at ramp-meters and signalized intersections.

Parking Management and Control: The allocation, price, and availability of parking spaces could be managed and controlled to effect a mode change to HOVs. Working from a traffic operations center, variable message signs, and detection equipment could be used to respond to events by implementing strategies by time of day or in a dynamic manner.

Mode Change Support: This would involve the coordination between buses and trains and passenger cars at park and ride lots, train and bus stations.

4.2.4 Core Infrastructure

The **ITS** “core infrastructure” will be the focal point for implementing and deploying the user services in the New Orleans Metropolitan area. FHWA has defined seven elements that contribute to the deployment of Intelligent Transportation Systems (ITS) and establish a foundation for the deployment of future ITS user service. This core infrastructure focuses on metropolitan Advanced Traffic Management Systems (ATMS) and Advanced Traveler Information Systems (ATIS), and does not directly address the user services in the Commercial Vehicle bundle and the Advance Vehicle Safety Systems bundle. The seven elements included in the core infrastructure are:

- Regional *Multimodal Travel Information Center (RMTIC).* The RMTIC complies and maintains current roadway and transit information, and is the link between the general public and the transportation system managers.
- *Traffic Signal Control System(s):* Signal control systems increase transportation efficiency by adjusting green times to maximize vehicle and person throughput and minimize delay.
- *Freeway Management System(s):* Freeway management systems monitor freeway traffic conditions, identify recurring and nonrecurring congestion, and allow implementation of control and management strategies such as route diversion and traveler information via variable message signs and highway advisory radio.
- *Transit Management System(s):* Transit management systems include fleet management systems, and advanced computer and communications equipment on vehicles. These systems increase the efficiency of operations and maintenance.
- *Incident Management Program:* Incident management programs facilitate the rapid identification and removal of incidents on freeways and arterial roadways, reducing delay and driver frustration.
- *Electronic Fare Payment:* Electronic fare payment for transit eliminates the need for transit patrons to provide exact change, and facilitates the coordination of fares among multiple transit providers.
- Electronic *Toll Collection:* Electronic toll collection allows drivers to pay tolls without stopping, decreasing delays and enhancing transportation efficiency.

The identification of the core infrastructure elements should guide metropolitan areas like New Orleans in near-term deployment decisions, and at the same time facilitate opportunities in the future for the implementation of the full range ITS user services. The implementation of as many of the core elements as possible in the New Orleans area is expected to provide a foundation for future successful implementation of a full range of ITS user services.

A number of principles were considered by FHWA in the defining these core infrastructure elements and suggesting that they become the focus of initial deployment, including:

- Deployment of elements will enable implementation of ATMS/ATIS user services, and facilitate implementation of other ITS user services.
- Each element can be deployed independently, although concurrent implementation would provide economies of scale.
- Elements can be deployed in the near term using state-of-the-art concepts and technologies.
- Elements can be deployed using varying technologies, from low-tech to high-tech.

- Elements are appropriate for implementation in a variety of environments (considering institutional arrangements, geographic/spatial development patterns, etc.), and elements will evolve to provide increased benefits and/or lower costs.

As the New Orleans plan evolves key considerations for the deployment of the core infrastructure elements must recognize the fact that multiple elements utilize common hardware and software components, and face similar institutional issues. The key considerations for deployment will include:

- Capability to distribute multimodal traveler information to the general public.
- Capability for surveillance and detection, resulting in current, complete and accurate traffic and transit information.
- Communications systems linking field equipment with central systems for database management.
- Communications among jurisdictions, agencies and organizations, without any implied change in control and/or responsibility.
- Proactive management of resources, both roadway and transit, to achieve the transportation objectives.
- Continuing support for system operations and maintenance needs.

4.2.5 Implementation Time Frame

A time frame for implementation needs to be identified for each of the ITS user service. The time frame associated with each user service is based on a number of things, including input from local agencies, agency rankings of priority, the state of the technology that is needed to implement various aspects of the user service, and whether or not the user service contributes to the core infrastructure. In general, the specified implementation time frame corresponds to the priority indicated by the local agencies unless there are other limiting factors, such as available technology. User services identified as highest priority are considered appropriate for application in the short term unless technology limitations would constrain implementation in this time frame. User services are identified for implementation in the short term, medium term, or long term. In general, short term is considered within five years, medium term is considered within ten years, and long term is considered more than 10 years.

It is important to note that a single user service could encompass any number of projects, some of which require minimal technology and thus could be implemented in the short term, and other which require very sophisticated technology that is currently in the research, or even theoretical, stage. For example, consider the Emergency Notification and Personal Security user service. A “low tech” project geared toward the objectives of this user service would be to indicate milepost markers on the freeway, as well as identify the roadway on bridge overpasses, so that people calling in to report an incident could more accurately communicate their exact location. On the other hand, a “high tech” project geared toward the objectives of this user service would be automatic collision notification, which might be an in-vehicle device that would be activated upon impact (much like an airbag) and would automatically send out a distress signal that would be received at the traffic control center or by emergency dispatch. It is also important to note that any plan that incorporates “advanced technologies” as a component must necessarily be dynamic, changing to reflect and utilize new technologies and applications. Many technologies are rapidly evolving, and this evolution cannot always be anticipated. This plan must be modified to reflect not only changing circumstances, but also changing technologies.

It is also important to re-iterate that there is often overlap between the various user services. A single project might fulfill the objectives of two or more of the user services. For example, a changeable message sign could be used to provide En-Route Driver Information; moreover, the information provided could be regarding a detour or alternate route around an incident, thus providing Route Guidance, and enhancing Incident Management.

In summary, the priority and implementation time frame noted for each user service should be considered a general, rather than an absolute, guideline. Actual implementation time frames would also be affected not only by priority and the availability of proven technology, but also by opportunity and available funding. Road widening projects and other activities may present the opportunity to implement advanced technologies at a much lower cost, making implementation of these user services appropriate, even though they might not otherwise be.

Table 4-4. User Services Implementation Time Frame

USER SERVICE	IMPLEMENTATION TIME FRAME I		
	Short (O-5 yrs)	Medium (5-1 0 yrs)	Long (>IO yrs)
Incident Management	X		
Traffic Control	X		
Route Guidance		X	X
En-Route Driver Information	X	X	
Emergency Notification and Personal Security	X	X	X
Emergency Vehicle Management	X		
Hazardous Material Incident Response		X	
Public Transportation Management	X	X	
‘Pre-Trip Travel Information	X		

Table 4-4. User Services Implementation Time Frame (Cont.)

Demand Management and Operations	X	X	
Public Travel Security			X
Freight Mobility			X
Traveler Services Information	X	X	
Electronic Payment Services		X	
Ride Matching and Reservation		X	
En-Route Transit Information	X	X	
Emissions Testing & Mitigation			X
On-Board Safety Monitoring			X
Commercial Vehicle Electronic Clearance			X
Automated Roadside Safety Inspection			X
Commercial Vehicle Administrative Processes			X
Personalized Public Transit	X	X	

Chapter 5
FUNCTIONAL REQUIREMENTS AND TECHNOLOGY ASSESSMENT

5.1 Functional Requirements

5.1 .1 Introduction

The Federal ITS Program has defined seven technical functional areas: surveillance, communications, traveler interface, control strategies, navigation/guidance, data processing, and in-vehicle sensors. ITS technologies have each been classified into one of these seven functional areas. While some technologies may be applicable in more than one functional area, each technology is categorized in the functional area in which it is most relevant. Table 5-I provides information regarding the technical functional areas that are utilized by the highest priority ITS user services previously in the User Service Plan.

5.1.2 Functional Areas

The following sections describe the various functional areas pertinent to the successful application of the required User Services in an area. Note that all of the user services are provided through technologies from more than one functional area. User services shown in Table 5-I include all of the user services previously identified as appropriate for implementation in the short and medium time frame in the Metropolitan New Orleans area.

Surveillance

Surveillance is the mechanism that permits the collection of a range of transportation data including speed, volume, density, travel time, queue length, and, in some cases, vehicle positions for buses and transit. Control strategies that may need to be implemented, incident management plans, responses and procedures, and motorist information are selected on the basis of this collected information. The data are used for making transportation management decisions and stored to provide a historical record of transportation conditions. Surveillance can also be used to obtain information on vehicle classification, length, speed, acceleration characteristics, and cargo (hazardous materials). Specific technologies in the surveillance technical functional area are shown in Table 5-2.

Table 5-l. Technical Functional Areas For Selected User Services

User Service	Surveillance	Communi-cations	Traveler Interface	Control Strategies	Navigation / Guidance	Data Processing	In-Vehicle Sensors
Traffic Control	**X**	**X**		**X**		**X**	
Incident Management	**X**	**X**	X	**X**	**X**	**X**	X
En-Route Driver Information	**X**	**X**	X		**X**	**X**	X
Travel Information Services	**X**	**X**	X		**X**	**X**	**X**
Pre-Trip Travel Information	**X**	**X**	**X**		**X**	**X**	
Demand Management and Operations	**X**	**X**	**X**		**X**	**X**	**X**
Public Transportation Management	**X**	**X**		X	**X**	**X**	X
Hazardous Materials Incident Response		**X**				**X**	X
Emergency Vehicle Management	**X**	**X**			X	**X**	
Emergency Notification and Personal Security		**X**					**X**

Table 5-2. Surveillance Technologies

Technology	Explanation, Examples or Characteristics
Vehicle probes	Examples includes vehicles with an on-board computer, two-way communications link, or AVI transponder.
Loop detectors	Detect vehicle through a change in the magnetic field (embedded in the pavement).
Infrared sensors	Detect vehicles when infrared beam is broken (located above the pavement).
Microwave and radar sensors	Detect vehicle motion through Doppler phase shift (located above the pavement).
Acoustical sensors	Detect vehicle presence by identifying characteristic sounds.
Machine vision	Examples include video cameras, which may or may not include a microprocessor for image interpretation.
Aerial surveillance	Uses helicopter or light airplanes to monitor traffic flow, detect incidents, and identify alternate routes.
Automatic vehicle identification (AVI)	Uses vehicles-based and readers at fixed locations
Weigh-in-motion	Uses road-mounted sensors and processors to determine vehicle weight.
Automatic vehicle classification	Uses vehicle sensors, detectors (which receive information from sensors), data processing, and a recorder (to store data).
Automatic vehicle location (AVL)	Uses transmitters, dead-reckoning, global positioning systems (GPS), or LORAN, and map matching to identify vehicle location.
Police/emergency medical/other traveler information	Information based on human observation and transmitted via two-way information link.
Weather and other environmental information	Includes information based on weather monitors (roadway monitors, National Weather Service Monitoring, etc.), as well as pollution and emissions monitors.

User Services That Utilize Surveillance Technologies

Surveillance is one of the most important technical functional areas, because it provides the data necessary for many of the user services to work properly and to be integrated together. Without surveillance capabilities, however primitive or sophisticated, there is no knowledge of the current operating conditions, there is no information for operational decisions, and ultimately there is no information to provide to the users.

In the proposed plan all of the user services except the Emergency Notification and Personal Security user service would be expected to utilize technologies in the surveillance technical functional area. The Emergency Notification and Personal Security user service provides direct notification to the traffic management center (TMC) or emergency responder, and thus does not require surveillance.

Many of the user services would utilize surveillance technologies that provide general information about traffic flow, such as detectors, vehicle probes, and video surveillance. This information may be augmented by information provided by Automated Vehicle Identification (AVI) and Automated Vehicle Location (AVL) systems that work with buses, commercial vehicles and emergency response vehicles. This information would be utilized for routing purposes for Emergency Vehicle Management, Public Transportation Management, En-Route Driver Information, and as general information to be provided to the public and operating agencies. The user services focusing on transit, namely Public Transportation Management, would also utilize surveillance technologies that provide more specific information, such as an AVL system for transit vehicles, and audio or video surveillance of transit vehicles and facilities.

Communications

Communications include all transmissions (including voice, video, and data transmissions) between the elements of the transportation system, both the vehicles and the infrastructure. Communications technologies provide the TMC with information about traffic and roadway conditions; transit vehicle locations and schedule adherence and allow system users to be better informed about network conditions which in turn allows for more efficient utilization of the system. Communications services include:

- Communications between traffic management infrastructure and vehicles;
- Communications between elements of the infrastructure and supporting organizations and agencies; and
- Communications between vehicles.

Specific technologies in the communications technical functional area are shown in Table 5-3 and Table 5-4.

User Services That Utilize Communications Technologies

Communications is one of the most important technical functional areas, because it is necessary to transmit data for surveillance, and to transmit information to operating agencies and transportation consumers. Without communications capabilities, there is no mechanism to transmit roadway data to the TMC, and no mechanism to communicate conditions to either incident responders or roadway users. The importance of communications is exemplified by the fact that all of the user services shown in Table 5-l would be expected to utilize technologies from the communications technical functional area.

Table 5-3. Technologies For Communications Between Vehicle and Infrastructure

Technology	Explanation, Examples or Characteristics
Local-area broadcasts	Examples include highway advisory radio (HAR) and automatic HAR (AHAR), which will automatically tune to the AHAR frequency for the duration of the message.
FM subcarrier (one-way)	Utilities spare bandwidth in the guard bands of conventional FM radio stations (vehicles must be equipped to receive and decode the data).
Infrared and microwave beacons (two-way)	Transfer data at high rates, but coverage range is limited (less than 100 feet).
Wide-area radio system (two-way)	Transmits common information to all vehicles, to be stored by a device in the vehicle.
Cellular radio services (two-way)	Can selectively access vehicles within specific cells of the system (message could vary depending on driver location).
Satellite communications (two-way)	Provide nationwide coverage of voice or data transmission.

Table 5-4. Technologies For Communications Between Elements of the Traffic Management System

Technology	Explanation, Examples or Characteristics
Landlines	Examples include twisted pair wire (for data from detectors), and coaxial or fiber optic cable (for unprocessed video). Lines needed depend on transmission rates required.
Microwave	Transmits images and data from roadside video cameras, or controls variable message signs; used where landlines are not cost effective (such as in rural and mountainous areas).

Table 5-4. Technologies For Communications Between Elements of the Traffic Management System (Cont.)

Technology	Explanation, Examples or Characteristics
Wide-area radio	Connects variable message signs to the TMC where land lines are not cost effective.
Satellite communications (two-way)	Used where land lines are not appropriate due to cost or other factors.

Traveler Interface

The traveler interface allows the traveler to interact with the ITS system to obtain traffic management center updates or information from the database. The traveler may interact with the system:

- At home or work via telephone, computer, television, or radio;
- At bus stops or transit kiosks; and
- In-vehicle through a computer, car radio, cellular telephone, or roadside variable message sign.

This functional area includes all the technologies with which the traveler interfaces. Traveler interface technologies must be easy to understand, without ambiguity, and designed to provide a level of detail appropriate to the needs of the user and the task at hand. Specific technologies in the traveler interface technical functional area are shown in Table 5-5.

User Services That Utilize Traveler Interface Technologies

Technologies in the traveler interface technical functional area are utilized by five of the user services shown in Table 5-1. With applications for the Incident Management, En-Route Driver Information, Traveler Information Services, Pre-Trip Travel Information and Demand Management and Operations user services, traveler interface technologies are needed for communication with transportation consumers. In general, the traveler interface technologies vary from the communications technologies in that they can allow interaction with the user. For example, traveler interface technologies allow motorists to query about conditions on specific routes, and provide preference information for input into route selection algorithms.

Note that other user services, such as Public Transportation Management and Emergency Vehicle Management, might utilize some of the technologies included in the traveler interface technical functional area (such as a keyboard). However, the use of the traveler interface technologies in these cases would not be for "traveler interface," or communications with transportation consumers, and thus they are not indicated in Table 5-l.

The kind of technology used for traveler interface varies, depending on the user service. While a kiosk at a transit station might utilize a touch screen to provide En-Route Transit Information, a variable message sign might be used to provide information regarding alternate routes for Incident Management.

Table 5-5. Traveler Interface Technologies

Technology	Explanation, Examples or Characteristics
Touch Screen	When user points **to** an item on the display screen, an infrared light grid overlaying the display screen is broken.
Key pad or key board	Used to input destination or reference data, or request traveler services information (when vehicle is not in motion).
Variable message sign	Displays information regarding current traffic or roadway conditions, or alternate routes.
Voice recognition	Allows user to give voice commands to on-board computer without looking away from the roadway.
Voice output	Computerized voice may provide audio warning and advisory information (including route guidance) to augment graphic information
Visual display	Displays route guidance information (via simplified street diagrams and turn arrows), traveler services information, and safety and incident advisories. More detailed graphics are displayed when vehicle is stopped.
Heads up display	Projects route guidance visual display information onto a two-dimensional laser holograph that the motorist can view without looking away from the roadway.

Control Strategies

Control strategies include those strategies that the TMC can implement to help control demand on the infrastructure, smooth traffic flow, or help to improve traveler safety. Control strategies may focus on either the freeway or the surface streets, or they may manage traffic on the entire system.

The control function involves the operation of traffic control measures such as signals, freeway ramp meters and HOV lane restrictions. Control strategies allow the TMC to respond to incidents and other special events by changing signal control to accommodate additional traffic loads on specific links of facilities. Control strategies attempt to increase the efficiency in the roadway network, and generally involve demand reduction techniques. Specific technologies in the control strategies technical functional area are shown in Table 5-6.

User Services That Utilize Control Strategies Technologies

As shown in Table 5-1, technologies in the control strategies technical functional area may be utilized in conjunction with the Traffic Control, Incident Management and Public Transportation Management user services. Signal control and ramp metering technologies may be used to directly influence vehicle volumes on certain links, which may be important for the Incident Management and the Traffic Control user services. Signal pre-emption may be provided for transit vehicles, contributing to the Public Transportation Management user services.

Table 5-6. Control Strategies Technologies

Technology	Explanation, Examples or Characteristics
Ramp metering	Traffic signals at freeway entrance ramps help maintain an acceptable level of service (LOS) on the freeway. Traffic flow improves because vehicles merge onto freeway one at a time rather than in platoons.
HOV restrictions	Limit use of a lane to certain kinds of vehicles (such as buses and/or registered Vanpools) or vehicles that meet the minimum occupancy requirement (such as two or three person carpools).
Signal control	Allows for orderly and efficient movement of vehicles on arterials and through networks. May improve traffic flow and reduce vehicle delay and incidents.
Parking restrictions	Include limits on on-street parking (especially near intersections). May increase capacity.
Ramp/lane closures	Closure of the freeway entrance ramp or freeway lane segment prior to entrance point may help maintain LOS on the freeway.
Road use pricing	Also called congestion pricing, this demand management technique allows variable pricing for peak and off-peak periods.
Reversible lanes	Lane capacity is assigned based on directional distribution of traffic. Examples include reversible HOV lanes.
Lane control	Lanes can be closed off during incidents through the use of overhead signals in advance of the scene, reducing the impact of temporary loss of capacity.

Navigation/Guidance

On-board navigation systems assist the traveler in route planning and route following. Information may be provided via a video display terminal in the vehicle, a heads-up display, voice output, or dashboard signals. While this functional area does not necessarily include information on real-time conditions, more advanced systems will integrate this information. Specific technologies in the navigation/guidance technical functional area are shown in Table 5-7.

User Services That Utilize Navigation/Guidance Technologies

Technologies in the Navigation/Guidance technical functional area may be used in conjunction with the provision of the Incident Management Emergency Vehicle Management, Public Transportation Management, En-Route Driver Information, Pre-Trip Travel Information, and Demand Management user services. For the Pre-Trip Travel Information and Incident Management user services, the navigation/guidance technologies provide information about the local transportation infrastructure, including a map and possible routes. In all other cases, the technologies in the Navigation/Guidance technical functional area would also provide information regarding current vehicle location, and its relationship to the final destination. For the transit user services, this information would not only be of interest to the patrons on-board (as well as the drivers and managers), but it would also be of interest to patrons waiting for the next bus.

Table 5-7. Navigation/Guidance Technologies

Technology	Explanation, Examples or Characteristics
Position disolav	Indicates current vehicle oosition on road network.
Guidance display	Simplified street diagrams and turn arrows guide vehicle while it is in motion. Include information on lane changes, turns, freeway exits, etc.
Map database	Includes road network, and parking facilities; may include speed limits and traffic control information (such as turn restrictions that vary depending on the time of day).
Dead reckoning	Determines vehicle location and orientation based on distance and direction traveled.
LORAN (long range radio navigation system)	Identified vehicle location using multiple transmitters. System initially developed for maritime use, thus most transmitters are located along the coast.
Global positioning system (GPS)	Provides vehicle location based on satellite-based radio triangulation system.
Map matching	Provides vehicle location using dead reckoning and map database, requires extensive database for high accuracy.

Data Processing

Data processing includes the management and quality control of all data pertaining to ITS. The data processing function includes all in-vehicle, roadside, and central computer processing. This functional area also includes the algorithms that are used for navigation and for making traffic management decisions. Specific technologies in the data processing technical functional are shown in Table 5-8.

User Services That Utilize Data Processing Technologies

Many of the technologies in the data processing technical functional area provide the "intelligence" in the ITS systems. These technologies are often algorithms that sort through extensive data regarding current and historical conditions, and identify not only the current operation characteristics (and identify them as typical or unusual), but also may provide an optimal management strategy, if action needs to be taken. The recommended action might be a suggested route for a specific emergency vehicle, or a traffic management plan for implementation of all but one of the user services shown in Table 5-l. Data processing becomes increasingly critical as the volume of data (provided by the surveillance technologies) increases.

Table 5-8. Data Processing Technologies

Technology	Explanation, Examples or Characteristics
Coupled route selection and traffic control	Algorithms that adjust route guidance recommendations and signal settings based on demand levels.
Database -- static	Contains historical time of day and day of week traffic data. Useful for predicting traffic conditions and identifying unusual conditions.
Database -- dynamic	Contains real-time data describing current traffic conditions. Useful for traffic management decisions.
Route selection algorithms	Estimates optimal routing for individual vehicles based on destinations and route preferences.
Driver, vehicle, and cargo scheduling	Matches available drivers and vehicles to cargo delivery needs, facilitates just-in-time delivery.
Real-time traffic prediction	Calculates current traffic flows, queue lengths, and delays based on volume and speed information indicated by detectors.
Traffic assignment algorithms	Predict traffic loads and link travel times on network based on current traffic data. Estimate routes that individual vehicles will take based on trip and network characteristics.

Table 5-8. Data Processing Technologies (Cont.)

Route guidance algorithms	Translate route information into simple directions displayed in the vehicle.
Data fusion techniques	Integrate historical and current data from a variety of sources to provide estimates of traffic characteristics.
Optimal control strategies	Uses algorithms to optimize settings of traffic control devices at central or subarea TMCs.
Incident detection algorithms	Uses algorithms (such as pattern recognition and time series) to detect anomalies or disruptions in traffic flow due to an incident.

In-Vehicle Sensors

In-Vehicle sensors include all in-vehicle devices that monitor the individual vehicle and driver. In-vehicle sensors also include sensors that monitor elements of the driving environment that pertain to individual vehicle operation. Specific technologies in the in-vehicle sensors technical functional area are shown in Table 5-9.

User Services That Utilize In-Vehicle Sensor Technologies

Technologies in the in-vehicle sensors technical functional area may address a variety of user services, including Emergency Notification and Personal Security, En-Route Driver Information, Public Transportation Management, Traveler Information Services and Demand Management and Operation. For the Emergency Notification and Personal Security user service, in-vehicle sensors would check the status of vehicle operating systems, and provided notification of malfunction, collision, or other dangerous situations. For the En-Route Driver Information, Demand Management and Public Transportation user services, in-vehicle sensors would be used for identification of vehicle location.

Table 5-9. In-Vehicle Sensor Technologies

Technology	Explanation, Examples or Characteristics
Equipment status sensors	In-vehicle systems programmed to store and/or display engine diagnostics; may also record operating information (speed, acceleration, fuel consumption, etc.).
Vehicle headway sensors	Monitor front and rear headway, as well as side distances and lane position indicators (may use gap radar or other technology).
Odometers	Electronic odometers used in navigation can measure distance traveled in increments of less than one inch.

Table 5-9. In-Vehicle Sensor Technologies (Cont.)

Technology	Explanation, Examples or Characteristics
Electronic compasses	Superimposition of the earth's magnetic field produces a phase shift in the induced voltages of the electronic compass when orientation of compass changes due to a change in vehicle orientation.
Driver fatigue and performance monitoring	Sensors monitor driver conditions, which may include drowsiness, and slow or excessive reactions (sensors mav also include breathalvzer. etc.)

5.1.3 Technical Functional Area Priorities

The technical functional areas that appear most important in the short and medium term for the Metropolitan New Orleans area are:

- Surveillance, which is needed to monitor traffic flow and detect incidents;
- Communications, which are needed to convey traffic information to the appropriate operating agencies as well as to the public;
- Control Strategies, which are needed to optimize the efficiency of freeways and arterials, during typical conditions and in response to incidents;
- Traveler Interface, which is need to communicate with the public; and
- Data Processing, which becomes increasingly important as the amount of data to be processed increases.

The technical functional areas that appear less important in the short and medium term are:

- Navigation/Guidance
- In-Vehicles Sensors.

The technologies in both of these technical functional areas depend heavily on in-vehicle devices and thus may be more appropriate for implementation by vehicle manufacturers, rather than local transportation providers.

5.2 Functional Assessment Of Technologies

There are three main technology components of an Intelligent Transportation System; Surveillance, Traveler Interface and System Communications. Control Strategies and Data Processing deal more with the system and software aspects. The section on Surveillance that follows, discusses the pavement intrusive and non-intrusive technologies that are used to determine the conditions of traffic flow, as well as the use of closed-circuit television (CCTV) cameras to confirm the exact location and level of an incident. The issues related to camera location, image transmission and image display are discussed in this section. Traveler Interface involves the use of variable message signs, highway advisory radio, highway advisory telephone, kiosks and electronic bulletin boards to provide outlets for travelers to access information on travel conditions. The System Communications section describes the media currently available for transmission of data, voice and video for Intelligent Transportation Systems.

5.2.1 Surveillance

Advanced Traffic Management Systems (ATMS) typically provide two different sub-systems for roadway surveillance: vehicle/traffic flow detectors, and closed circuit television (CCTV) cameras. These two subsystems provide different functions, and operate together to provide the traffic operations center (TOC) with real-time status of traffic conditions. The vehicle detection sub-system electronically monitors the flow of traffic on the roadways, and transmits this information in “real-time” to the TOC for analysis and status displays. The operators utilize the results of the analysis and the status information to make decisions regarding management of the traffic. The CCTV sub-system provides the operators with visual means for verification of the conditions reported by the vehicle detection sub-system. The CCTV images also provide the operator with an independent evaluation of traffic conditions.

Each of these two sub-systems can be deployed and utilized jointly as well as separately. However, the complementary interaction of the two sub-systems improves the overall system operation in a manner that neither system can provide alone. The vehicle detection system, since it is automated and can function with minimal human intervention, provides continuous surveillance and up-to-the-minute data. The CCTV system allows the human observer to view and interpret an incident, or other traffic conditions, and determine an appropriate response. As more progress is made in the technologies of image processing, artificial intelligence and expert systems, it is inevitable that computer systems will augment the capabilities of the human observer.

Vehicle/Traffic Flow Detection

Vehicle detection technologies form the foundation of the surveillance sub-system used for automated incident detection and traffic management. Surveillance information provided by vehicle detection enables collection of a range of traffic data including speed, volume, density, travel time, and in some cases, vehicle position. Control strategies, incident management procedures, and motorist information displays are selected based upon the data collected by the vehicle detection system. The collected data is used in real-time for making traffic management decisions and stored to provide a historical database of traffic conditions. Surveillance can also be used to obtain information on vehicle classification, length, speed, acceleration characteristics and hazardous materials.

Operational environment and maintenance requirements are two of the most critical factors in determining the types of detectors for the system. Systems that involve cutting existing road surfaces and pavement (such as induction loops) can create installation and maintenance problems or compromise the structural integrity of the roadway, especially on bridges and other structures. Technologies that do not require these modifications are termed non-intrusive installations, and minimize the traffic diversion and control problems.

The choice of detectors for an automated system is dependent on the data requirements. To meet the needs of the recommended system, real-time data to ascertain vehicle speed, counts, lane occupancy, classification and changes in motion and position, will be required for automated incident detection. This real-time data should be stored for historical as well as planning use.

There are two separate approaches to vehicle detection; those that are passive and involve no electronics in the vehicle, and those that cooperatively utilize electronics in the vehicle and alongside the roadway. As with all areas of electronic technologies, changes occur regularly providing new solutions to existing problems, but conversely requiring that systems be flexible enough to accommodate change on a regular basis.

Various technologies applicable to this project are discussed below. There are numerous other technologies that have been experimented with and tested by various DOTS and the FHWA. In particular, the current "Detection Technology for IVHS" project sponsored by FHWA is evaluating a wide range of equipment under laboratory and field conditions. Although many of these technologies show promise, they have not progressed to reliable field operation. In order to limit system complexity, and resultant operations and maintenance costs, minimizing the number of different technologies is preferred.

Passive Vehicle Detection

Technologies that do not require any devices in the vehicle are the basis for most current vehicle detection systems. Passive approaches allow all vehicles in the vicinity of the sensor to be detected and monitored, but provide less information than will ultimately be available in the future.

Intrusive Technologies

Induction Loops: The most commonly used vehicle detection technology is the induction loop. This technique is extensively used for arterial controls and has a long history of successful field deployment. The advantages of induction loops are their well-known performance characteristics, maturity, application flexibility, and multiple vendor availability. Over the years the manufacturers have enhanced and refined their equipment, providing numerous options and alternatives to meet a wide range of application needs. Pairs of loops can be used to measure speed and vehicle length for classification purposes. Some vendors have announced products that measure speed with a single loop, but field experience is limited. Some disadvantages of induction loops are the result of the need to embed the loops in the pavement surface, and the problems associated with pavement deterioration and freeze-thaw damage. Further difficulties include damaging the loop conductors during resurfacing operations or construction, and the reduced effectiveness of loops when in close proximity to reinforcing steel.

Recent improvements have been made in inductive loop technology. Loop detectors have been primarily utilized to provide a digital output that is representative of vehicle presence above the induction loop in the pavement. In this regard, a sophisticated computer system is unable to gain access to any information contained in the magnetic or inductive signal collected by the detector amplifier. New products are available with on-board microprocessors that are able to monitor the “signature” of the detected field. Use of this data allows accurate speed measurement and provides some capability for classification. Serial data ports with RS-232 communication, allow systems to access a detector amplifier internal database, to perform remote sensitivity adjustments and compensate for weather conditions.

Another development is the manufacture of pre-formed loops, which are available from a number of suppliers. This type of loop is pre-assembled, with the wires encased in a filled conduit. This assembly is embedded in the pavement, typically several inches below the surface, during the construction of the roadway. This technique offers improved reliability and life expectancy.

A similar approach, that of embedding the loop in the pavement, is being utilized in some areas as part of roadway reconstruction projects. After the milling operation that is used to remove old pavement, the induction loop is saw-cut into the milled surface. After the new pavement is applied, the loop is buried several inches below the road surface, where it is less subject to damage from traffic, construction or weather.

While induction loop detectors are often maligned because of the problems noted previously, they are currently the primary source of vehicle detection in most systems around the country. Studies in Los Angeles were performed by video taping the traffic stream, time-stamping and manually counting the vehicles on the video tape. Results show that the accuracy of induction loop data with respect to vehicle counts is +0.6%.

Magnetometer: Magnetometers, and the related micro-loop technology, are often suggested for deployment on bridges and other areas where loop installation in the existing pavement area could affect structural integrity. Magnetometers have had spotty operational success, and other technologies have often been considered for these particular needs. However, the use of new digital processing technology has the potential to significantly improve the performance of magnetic detectors. A re-evaluation of their role will be appropriate after sufficient field experience is gathered. Preliminary results from the IVHS Detection Technology project show that magnetometers have an accuracy in the ±5% range.

Axle Counters: The FHWA requirement for 13 bin vehicle classification on certain roadways generates the need to count axles. The most commonly used technology uses a bending beam piezoelectric strip embedded in the roadway surface. These devices, working in conjunction with inductive loops, measure the vehicle length and speed, and count the axles. The vehicle length, combined with axle count, are used to classify the vehicle.

Non-Intrusive Technologies

Radar; Radar detectors operate by emitting a signal in the microwave portion of the electromagnetic spectrum, and analyze the returned signal. These detectors are in limited use in incident detection and freeway management projects. Continuous wave (CW) radar detection operates on the Doppler effect (measuring frequency shifts between the transmitted and received beam caused by vehicle motion), and thus directly measures vehicle speed. Vehicle counts can be determined by accumulating each vehicle detected, but this approach cannot readily obtain lane occupancy and vehicle lengths. Similarly, detection of stopped vehicles, or very slowly moving vehicles, is difficult.
Another type of CW radar detector transmits a signal that is swept over a range of frequencies. This technique allows measurement of range from antenna to vehicle, and is thus able to function as a presence detector. The sweep frequency; however, functions much as sample rate to quantify presence.

Pulsed radar operates by transmitting a burst of microwave energy, and interpreting the “echoes” reflected from vehicles in its “field of view”. Because of the complications involved in processing multiple reflection, pulsed radar units utilized for traffic detection limit their field of view to a portion of the lane, such that a single vehicle is present in their detection zone. This technique permits the determination of the distance to the nearest reflection, and by monitoring this reflection over time, the position and resultant speed of the vehicle can be determined. This type of radar can be used to sense stopped vehicles, but has the limitation of a sample rate that must be frequent enough to provide accurate presence calculations to determine other traffic parameters.

Continuous wave radar detectors of the Doppler and sweep frequency types require one antenna per lane, mounted on a structure or a sign bridge over the lane. The same limitation applies to pulsed radar units. The IVHS Detection Technology project early results show that these radar detectors have accuracy's that range from ±0.5% to ±6%.

Microwave detectors have recently become available. When mounted at the side of the roadway, this device is able scan up to twelve lanes. Since side mounting facilities are often available, or can be readily installed, the device is more cost effective. The device can also detect vehicle presence, and is thus able to determine occupancy and existence of stopped vehicles. However, it does not measure speed directly, relying upon "single loop" speed estimation techniques based upon average vehicle length. The accuracy of this device, as stated in the early results from the Detection Technology project, is in the ±5% range for volumes. Test results indicate missed and duplicated counts across multiple roadway lanes upon the passage of large vehicles.

The advantages of radar and microwave devices include the ease of use, requiring no cutting of pavement and disruption of traffic flow for installation or maintenance (if mounted on a structure or sign bridge where overhead access is possible). For the Doppler units, direct speed measurement is a significant benefit. If traffic lanes are shifted, radar antennas can be easily re-aimed. The disadvantages of radar are: the overhead mounting requirement, limited field operational experience for many of the new units, a small number of vendors in the market and difficulties of accurately sensing lane occupancy and slow moving or stopped vehicles with Doppler units.

Radar detectors can be configured with two types of interfaces: RS-232 serial data and two pulse-type contacts. The serial output provides data (volume, speed, etc.) in an ASCII text string. Modifications to this format to incorporate an error checking communications in a standardized protocol would allow a multi-lane unit to be installed without a local field microcomputer. The dual pulse-type contact closures provide for emulation of a loop-pair speed trap. The first contact closure occurs when the vehicle enters the detection zone, and the second contact closure is timed relative to the first closure by the detector to provide the correct travel time based upon a calibrated "loop spacing".

Infrared: Infrared detectors monitor electromagnetic energy in the band above the visible spectrum. Both active and passive devices are marketed that utilize infrared detection.

Active infrared devices illuminate the detection zone with infrared energy supplied by either light emitting diodes (LEDs), or lasers. Lasers can provide a higher level of output energy. A portion of the energy reflected back from the vehicle is detected and processed. The detector consists of optical elements to focus the returned signal onto a matrix of infrared sensors. The two-way travel time of the infrared pulse from the source to the sensors is used to measure the distance to the vehicle. This strategy is similar to that used in a pulsed radar detector. Processing of the data provides vehicle counts, occupancy, presence, speed and classification information. Because infrared energy is attenuated and scattered by rain, snow, fog and mist in the air, active infrared detectors are vulnerable to these atmospheric conditions. In addition, other obscurants in the air, such as smoke and dust, can reduce the effectiveness of the detector.

Passive infrared devices do not emit any energy themselves, but utilize the characteristic that all objects emit heat (infrared radiation) as a function of their surface temperature. The amount of infrared energy is also a function of the emissivity of the object itself. By detecting difference between the temperature/emissivity of vehicles and the roadway surface, a passive infrared detector can determine the presence and passage of vehicles. The infrared energy is focused through an optical system onto the infrared sensors. The resultant signal is processed to provide presence, vehicle counts and occupancy. As noted above, infrared energy is obscured by atmospheric effects. Because passive infrared detectors are dependent upon the sun and other infrared sources for their input energy, diurnal changes, cloud cover, glint from bright objects reflecting sunlight, etc. can create confusing and unwanted signals.

By increasing the number of sensors in a passive infrared detector, an “image” of the scene of interest can be generated. This increase in detail allows additional information from the scene to discerned and analyzed. As the number of individual sensors becomes large enough, the boundary between an infrared detector and an infrared sensitive CCTV camera becomes blurred. For practical applications, an infrared imaging system has essentially all the same characteristics of Video Image Detection systems discussed below.

Sonic: There are several techniques that have been explored utilizing sound. Some devices operate as sonar devices, sending out sound waves and analyzing the returned echoes from the vehicles - much like the radar systems. The early results from the ultra-sonic unit included in the IVHS Detector Technology test show an accuracy in the ±2% range. Other sonic detectors passively “listen” to the noise generated by the vehicles, and analyze this noise energy to detect individual vehicles and resultant location and speeds. These devices have not yet been extensively used, and thus field experience is limited. However, the technology has been applied for submarine noise signature detection by the military and could become a valid tool for classification of vehicles.

Video Image Detection: Video Image Detection (VID) systems (sometimes referred to as machine vision systems) are comprised of fixed orientation CCTV cameras strategically located to provide views of specific areas or long sections of roadway, coupled with a computer that analyzes the video image in real time (30 times per second). This technology has been developed for various industrial, manufacturing, military and aerospace applications. It has been applied to traffic management in recent years, with growing success. Early systems were troubled by harsh environments, adverse and changeable lighting conditions, shadows, differing vehicle shapes and sometimes difficult operating conditions. These difficulties, for the most part, have been solved by extensive field testing, actual deployment, more powerful computers and increasingly sophisticated software.

Two fundamentally different strategies are used to analyze the video images: fixed analysis zones that detect vehicles moving through them, and vehicle identification and subsequent tracking. A third strategy, involving reading license plates "on-the-fly" may be appropriate for toll violations and related applications, but is not directly applicable to incident management systems. The technique utilizing fixed analysis zones, analogous to a "loop" in the video image, is the most stable and best tested approach. Equipment based on this approach can provide vehicle counts, lane occupancy, speeds, and lengths. Software in the VID processor collects the standard parametric information (volume, occupancy, and speed) and can also provide some analysis and processing of this data, including statistics accumulation, data smoothing and level of service calculations.

A key benefit of a VID system is its ability to monitor large areas of roadway from a single equipment location. Because the CCTV camera can be oriented to monitor a section of roadway (up to I/4 mile in length), and the entire image can be analyzed, significantly more roadway and numbers of vehicles can be monitored. The most promising usage of a VID system is detection of stopped or stalled vehicles (either in a travel lane, or on the shoulder), providing direct detection of an incident. The monitoring of wide areas of roadway, coupled with individual vehicle detection, will provide significantly more information than existing point source (such as induction loop or radar) technologies.

While the promise of VID systems is significant, it is still a young technology that will evolve and grow for many years. There are operational problems under adverse lighting, transitions between daylight and darkness and storm conditions that will require more refinement Camera placement must be carefully considered, as shadows from objects outside the detection area may affect performance. The early results from the Detector Technology project report show an accuracy ranging from ±0.3% to ±2.3% with accuracy decreasing under dark or adverse weather conditions.

Passive Vehicle Detector Cost Comparisons

Two different categories of passive vehicle detectors are discussed above: those that are embedded in the road surface, such as induction loops, and those that are mounted overhead, such as a radar detector or a video image detector.

As discussed, embedding detectors in the roadway requires that the road surface be cut or drilled, and subjects the detector to failure due to pavement deterioration, etc. This can create ongoing maintenance problems, or poor detector reliability. As noted, newer construction techniques which embed the detector several inches below the pavement surface are being used to solve some of these problems.

Detectors that are mounted above each lane, such as most radar detectors and ultrasonic detectors, require some form of support structure. A claimed advantage of this installation location is minimal traffic disruption during installation and maintenance. Mounting on an existing over the road structure is an option, but can create aesthetic concerns and often results in limited accessibility requiring that a traffic lane be closed to service the unit. The use of signal head mast arms is another possibility, but has the drawback of motion under high wind loading and the need to block traffic for installation and servicing. Sign bridges are a third possibility, and where they already exist are excellent choices, especially if they include a cat-walk so that the units can be installed and serviced without shutting down traffic. However, the installation of new sign bridges for the mounting of detectors is an expensive alternative.

In general terms, many of the overhead detectors cost between $750 and $1,000 per unit that monitors a single lane. Poles and mast arms cost about $200 per foot (with foundation and installation), resulting in a cost of roughly $2,400 for a 12 foot lane installation, This is about 2.5 times the cost of the detector. Sign bridges roughly cost $500 per foot (with foundation and installation), or $6,000 for a 12 foot lane. This is about 6 times the cost of the detector. This needs to be compared to the installed cost of induction loops of about $1,000 per lane.

Thus, overhead mounted detectors that must be positioned over each lane can be significantly more expensive than induction loops, when the cost of a mast arm and pole, or sign bridge must be included. Under those situations where an existing structure or sign bridge is available, they can be cost effective, but may still require traffic disruptions for installation and servicing.

Another category of overhead devices - side fired radar and video image detectors (VIDs) - can be mounted off the side of the road or on a pole in the median. This reduces the cost of mounting to roughly $5,000 and does not require stopping traffic for access to the unit. These devices also have the advantage of being able to monitor several lanes from a single unit, thus spreading the cost of the unit and the mounting pole across several lanes. A disadvantage of side mounting or an oblique camera view is the blockage of line of sight by larger vehicles (trucks) of smaller cars. This results in missed counts. With VIDs, the ability to discriminate between two closely following vehicles is a function of mounting height and angle of view. Increased height improves the discrimination ability, but results in a more costly pole and foundation. Another problem noted with VlDs is motion of the mounting pole under wind loading, or twisting of the pole due to differential solar heating. These conditions result in the camera field of view changing and “moving” the fixed analysis zones to another portion of the image.

For comparison purposes, a six lane cross section of freeway has been utilized as shown on Table 5-10. Five different equipment configurations have been evaluated:

- Induction Loops, with lead in wires saw-cut into pavement surface and processor cabinet on one shoulder;
- Side Fired Radar, with unit mounted on a pole located on one shoulder adjacent to the processor cabinet;
- Video Image Detector, with two cameras mounted on a pole in the median and the processor cabinet on one shoulder;
- Overhead Mounted Sensors on Mast Arm with the pole in the median and the processor cabinet on one shoulder; and
- Overhead Mounted Sensors on Sign Bridge with processor cabinet on one shoulder.

For all configurations, it is assumed that power and communications conduits are available at the location of the processor cabinet. With the exception of the video image detector, a Model 170 processor and cabinet is included. Conduit, cable, installation and testing costs are included for all cases. For the two configurations with median located poles (VID and Overhead Sensors on Mast Arm), costs for jacking conduit under three lanes are included.

Table 5-10 Passive Vehicle Detector Cost Comparison

CONFIGURATION	PER LANE	SIX LANES
Induction Loops	$3,400	$20,300
Side Fired Radar	$3,725	$22,350
Video Image Detector	$ 10,100	$60,600
Overhead Mounted Sensors on Mast Arm	$6,250	$37,500
Overhead Mounted on Sign Bridge	$13,250	$79,500

Maintenance costs are usually calculated as 10% per year of the equipment costs. induction loops may be higher if local experience shows that typical loop life is short.

Active Vehicle Detection

Technologies that place electronics in the vehicle that interacts with the roadside infrastructure, and other vehicles in the immediate vicinity, is the direction of progress for automated guidance and highway systems. It will be at least two decades before these technologies become widespread, but devices in this category are being used for specific applications around the country.

Aufomafic Vehicle Identification: The recent conversion of many toll facilities to electronic toll tags for electronic toll collection (ETC), also referred to as automatic vehicle identification (AVI), creates a potential for vehicle detection and monitoring. By monitoring the movement of individual vehicles past various AVI antennas, the vehicles become active probes and link travel times can be determined. This technology is successful in areas where AVI tags are in use for toll roads, but is of limited applicability elsewhere.

Another use of AVI technology is its use on transit vehicles to determine their location. The use of induction loops as the reading antenna has been successfully deployed in some areas. This usage of AVI has found a receptive audience as a method for more accurate tracking of bus fleets for control and dispatch.

Global Positioning Systems (GPS): GPS equipment is being used by various emergency (police, etc.) and fleet (trucking) organizations to permit continuous tracking of vehicle locations. The costs per vehicle are still too high for widespread usage by the general public, but the technique is very beneficial for those cases where it can be justified Accuracy's range from a few hundred feet, to a few feet, depending upon the capabilities of the GPS receiver. The more accurate units are proportionally more expensive. GPS receivers as accessories for PCs are now available at prices of less than $1000. As sales volumes increase, prices will continue to come down and additional hardware and software features will be added.

GPS receivers are an important component of vehicle navigation systems currently being tested. It is included as a component of the in-vehicle navigation systems and vehicle emergency notification (Mayday) systems being considered as part of the National IVHS Architecture being developed by the USDOT. Vehicle location using this technology, coupled with a data channel linking a public service vehicle (police, fire, transit, etc.) to the TOC is being evaluated as a component of incident response systems elsewhere in the US. The ability to locate emergency response vehicles in real time on a status map, is a very useful tool in managing and coordinating incident response over a wide area.

After some initial operational experience is gained from systems currently in development, the effectiveness and costs can be evaluated for possible use.

Automatic Vehicle Location: A variation on the GPS strategy is the use of fixed location beacons that can be monitored by a vehicle, such as a bus. Through the use of an on-board computer, monitoring of the vehicle's movement with an electronic odometer, and known information about a route **to** be followed, the location of the vehicle can be estimated. The location beacon allows the strategy to be refined by providing "check-points" that permit the on-board computer to update and correct its estimates of location.

The periodic transmission of vehicle location to a central computer allows a central dispatcher to track the vehicle. This tracking can be matched to a bus schedule, for example, and alert the driver and the dispatcher if the bus is ahead of or behind schedule. This automated vehicle monitoring can be input to the traffic management system. It would provide active probes in the vehicle stream, similar to the AVI system discussed above. The use of buses as probes must take into account the start/stop nature of transit vehicles when estimating the flow of traffic. The integration of this tracking with voice communications to the bus driver is a very useful tool in locating incidents, and determining their nature and severity.

Detector Comparison Matrix

Table 2 illustrates the major features of the most common types of vehicle detectors. The matrix is a tabulation of the major classifications of detector types. It includes the primary parameter that is most directly measured by the detector and the preferred mounting.

Table 5-11. Detector Comparisons

DETECTOR TYPE	PRIMARY DATA	MOUNTING LOCATION	COMMENTS
LOOP	PRESENCE	ROADWAY PER LANE	Roadway cut installation life approx. 3 years
PIEZOELECTRIC	AXLE COUNT WEIGHT	ROADWAY PER LANE	Installation involves roadwav cut.
RADAR (CW)	SPEED	OVERHEAD PER LANE	Poor results at low speeds.
RADAR (MULTI-ZONE)	PRESENCE	OVERHEAD, SIDE MULTILANE	Some tests show difficult calibration.
PASSIVE IR (NON-IMAGE)	PRESENCE	OVERHEAD PER LANE	Few installations.

Table 5-1 1. Detector Comparisons (Cont.)

DETECTOR TYPE	PRIMARY DATA	MOUNTING LOCATION	COMMENTS
PASSIVE IR (IMAGE)	PRESENCE	OVERHEAD, SIDE MULTILANE	Few installations.
ACTIVE IR (NON-IMAGE)	PRESENCE	OVERHEAD PER LANE	Few installations.
ACOUSTIC (PASSIVE)	PRESENCE	OVERHEAD PER LANE	Some tests show reliable operation. Few installations.
ULTRASONIC (PULSED)	PRESENCE	OVERHEAD PER LANE	Poor sample rate for high soeed flow statistics.
ULTRASONIC (CW)	PRESENCE	OVERHEAD PER LANE	Poor results at low speeds.
MAGNETOMETER OR MICRO-LOOP	PRESENCE	ROADWAY PER LANE	Manufacturer claims good results on bridae decks.
VIDEO IMAGE	TRACKING	OVERHEAD, SIDE	40 ft mounting height suggested.
AVI	TRAVEL TIME LOCATION	OVERHEAD, SIDE LIMITED RANGE	As electronic toll use increases, population of users should grow.

Closed-Circuit Television

Closed circuit television (CCTV) provides the eyes for the operator at the traffic operations center, and has proven to be one of the most valuable elements of an ATMS. Operational experience shows that constant monitoring of CCTV images by operators is not effective, as the operator soon becomes “numbed” by the constant repetition of vehicles moving across the screen. The primary role of CCTV is to verify a reported incident or other traffic condition, to evaluate its severity, and determine the appropriate response vehicles and personnel to dispatch to the incident scene.

In addition to its primary role in incident verification and response coordination, CCTV can also be used for other purposes including:

- Monitoring the operation of critical signalized intersections that are in the vicinity of the CCTV camera. This allows evaluation of signal timing and the related functions of the controller. One agency has reported the installation of a spare optical fiber to each intersection so that they can install a CCTV camera on an as-needed basis during trouble shooting and problem isolation This saves them many trips to the site when they are trying to correct intermittent failures.

- Utilizing the CCTV camera to monitor adjacent parallel streets to a freeway to determine current operating conditions. This allows verification that the arterial streets have adequate vehicle capacity to handle added traffic prior to implementing a freeway diversion plan. Monitoring of the operation of the streets during the diversion to insure successful operation is also available.

- Monitoring motorist response and traffic movements on the mainline, entrance and exit ramps, and HOV lanes. This is utilized to verify compliance with ramp metering or HOV restrictions, or observance and response to messages posted on a VMS or transmitted on an HAR.

CCTV cameras, lenses and typical mounting heights (typically 40 foot poles) allow monitoring of roughly one-half to one mile in each direction from the camera location, This is of course restricted by topography, roadway geometry and vegetation. Some installations have mounted CCTV cameras on high-mast poles or towers more than 100 feet above the road. This added height provides larger areas of coverage, if topography and vegetation are favorable.

Specific selection of camera locations is controlled by the desire to monitor high-incident locations and other areas of interest. Ability to view parallel surface streets and ramps should also be considered in site determination. The constraints imposed by access, available locations for cabinets and pole foundations, and communications often limit the optimum selections. Each prospective site must be investigated to establish the camera range and field-of-view for the mounting height and lens combination selected.

The biggest problem to overcome with CCTV is the transmission of the image from the camera location to the control center. Direct video requires a communications channel that is equivalent to more than 1500 voice grade audio channels. Thus, most efforts in optimizing CCTV systems are directed toward reducing the bandwidth of the CCTV communications channel. These efforts range from not updating the image in real-time (every I/30 sec), to digitally compressing the image, through analyzing the image and transmitting only the moving elements of the image.

The standard for CCTV pictures is a “broadcast” quality, full-motion, real-time image. At present, this is usually implemented by use of a fiber optic communications system, with a separate full bandwidth fiber allocated for each CCTV camera. With tremendous bandwidth available on a fiber optic system, this direct approach is often the least costly and provides the best performance. When this direct approach is not cost effective, alternative solutions must be utilized.

Color versus Black and White

Color images provide the greatest amount of visual information, and are the preferred choice of most traffic operations centers. However, color CCTV cameras rapidly lose their sensitivity under nighttime, or other dim, lighting conditions. Black-and-white cameras, on the other hand, are available that will produce usable images even when it is too dark for a person to see. A black-and-white camera is able to produce a usable image with 1/10 or less the light level required for a color camera. Some vendors have solved this dilemma by packaging both a color camera and a black-and-white camera in the same housing. This of course increases the price of the assembly, but the added cost may be acceptable in some locations. Actual field testing should be performed, or verification of performance of cameras at existing traffic operations centers, before committing to a specific equipment selection. The typical cost of a color camera, with field controller and cabinet, pan/tilt unit, housing and mount, with installation and testing is roughly $20,000

Pan/Tilt/Zoom/Focus Control

The CCTV camera in the field must be moveable (left and right, and up and down) in order to permit it to monitor the greatest possible area. Similarly, a zoom lens to allow viewing of vehicles at varying distances and associated focus control, is required. These functions must be controllable by all operators who have access to the CCTV images. This functionality is implemented by placing a microcomputer at each CCTV location that receives commands from the traffic operator and turns on and off the appropriate motor in the pan/tilt unit or the motorized lens.

Each CCTV system vendor has its own proprietary system for this type of control. As systems grow and expand over time, control compatibility must be maintained so that the operator is not faced with several different camera control systems. The needs for the control system, both initial and long-term must be addressed during the system architecture design, considering the growth requirements and future needs.

Digital versus Analog Transmission

The technology currently used for most long haul, “broadcast quality” CCTV systems has been analog transmission. Within the past five years, significant progress has been made in the development of cost-effective digital transmission equipment. Once video is converted to the appropriate digital format, it can be transmitted long distances over a fiber optic link using a digital protocol such as a Synchronous Optical Network (SONET) communications system with no further conversion and without degradation of image quality. Additionally, digital video switches are smaller, and lower priced than analog switches.

Another benefit to digital video is the ability to compress the video image, and thus utilize lower bandwidth on a less expensive data communications channel, which may be used to transport the video to another facility. Typical compression ratios are 4O:l. The cost of compression/ decompression (codec) equipment is currently about $20,000 per unit, but new products are being discussed which may bring the price down into the $5,000 range. Given normal price/performance curves in the digital electronics industry, this price drop will probably require about 3 years. However, if the price/performance ratio of digital systems does not progress as rapidly as desired, an analog system will provide fully satisfactory results.

Fiber versus Coaxial Transmission

The use of fiber optics for transmission of video has almost completely replaced the use of coaxial cable, except for very short runs of less than 500 feet. Disadvantages of coaxial cable include requirements for amplification of the transmitted signal every few thousand feet to compensate for signal attenuation, and the susceptibility of the cable to induced noise. Fiber optic transceivers are now available with ranges up to five miles for multi-mode fiber, and over 20 miles for single-mode fiber. These transceivers range from less than $300 for short range units to over $2,000 for long range devices.

Geographicallv Distributed Control

An effective and needed strategy in modern incident/traffic management systems is distributing video images to the multiple locations and agencies that can utilize them. This provides for joint, coordinated response to an incident. In addition to the video images, camera selection and pan/tilt/zoom control must also be distributed. Geographic distribution of these control functions must be considered in the basic design of the CCTV system, since adding these capabilities to a simpler system is often difficult and costly.

Video Switch

A key component of the CCTV system is the video switch that allows any CCTV camera to be viewed on any monitor, at any location that has access to the CCTV system. A variety of switch architectures are available, from fully centralized to fully distributed. Each has its own advantages and disadvantages, and associated costs. Most CCTV systems have more cameras than monitors, with typical ratios being in the to 10:1 range.

The cost of analog video switches is a function of the number of switching points, which is the product of the number of camera inputs and monitor outputs. Thus, prices can increase exponentially as the size of the switch grows. For a relatively small switch (30 camera inputs and 10 monitor outputs) the installed cost is about $20,000. Doubling the size of the switch to 60 camera inputs and 20 monitor outputs results in the cost increasing to about $75,000.

Newer digital techniques, similar in concept to a LAN, are being utilized to transmit and switch video images. With these techniques, the video image is digitized and divided into small segments. These segments (or packets) are then distributed on a very high speed transmission system, and those users who need to view a particular image copy the packets for that image and reassemble the image for viewing. This strategy is commonly used in the telephone industry for switching voice conversations. Since switches of this nature do not increase exponentially in size, they have the potential for being less costly than analog switches. However, because of the high bandwidth and transmission speeds required, these devices are still more expensive than moderate sized analog switches. With the typical decline in costs for all digital based systems, digital switching of video images will rapidly become a cost effective alternative.

In all cases, cost of video monitors, interconnection to the video transmission system and monitors, operator controls and system integration is in addition to the cost of the basic switch.

Larse Screen Video

A large video screen (Often 3' x 4', or larger) is frequently included in traffic operations centers. The ability to project either an enlarged video image, or an enlarged computer generated graphic can be useful for decision support during incident response or for public relations during tours or demonstrations. Operators in TOCs with large screens report that they seldom use these enlarged images during normal operations.

Two fundamental technologies are available: video projection, and video wall. Video projection utilizes either a CRT or an LCD system to optically enlarge the image and display it on a screen (using either front or rear projection). Care must. be exercised with the room lighting as the projected image is easily washed out by available light. A video wall provides a large display area that overcomes this problem. The video watt combines a number of moderate sized (21 inch typical) video monitors into an array. This array is often four monitors high and four monitors across. Electronic circuitry divides the original image into smaller parts (say sixteen for a 4 x 4 array) and displays each sub-image on a separate CRT. Current cost for large screen projectors is in the $35,000 range, while video walls are often above $50,000.

Electronic Toll And Traffic Management

Electronic Toll and Traffic Management (ETTM) systems encompass Automatic Vehicle Identification (AVI) and Electronic Toll Collection (ETC) with communication between vehicle and roadside. Transponders carried by

vehicles participating in the program can be used to track travel times of vehicles on the roadway. The information obtained in this manner can be used to improve detection of incidents that create significant impacts on the level of service provided by the roadway system.
Electronic tags, slightly larger than credit cards are placed on the inside of a vehicle windshield. The tags communicate on high frequency radio links with equipment at a toll plaza as the vehicle passes through the toll lanes. Violators using the lanes without a valid tag cause an image of the vehicle license plate to be processed by an agency that will send a bill or summons to the registered owner.

Vehicle Probes

ETC provides the opportunity for vehicle tracking that was formerly not possible. Each toll tag has a uniquely identified electronic serial number and can be read at highway speeds. The use of equipment to read the tags at opposite ends of a highway link allows the system track the passage of individual vehicles and thus provide a direct measurement of link travel time. Each equipped vehicle provides the system with an origin location and time and a destination location and time for each equipped link and hence becomes a probe vehicle without disturbing the traffic flow.

Installation of the antenna to communicate with the in-vehicle transponder must usually be done so that the communications range can be kept below a distance of about 30 feet. An overhead antenna may be able to cover three or four lanes simultaneously. The question of interference from multiple tags responding simultaneously has been considered by the various manufacturers. A solution proposed by MARK IV uses an overhead antenna array to communicate across the multiple lanes. In this configuration, one reader is connected to the multiplexed array of radio frequency transceivers which are in turn connected to separate antennas for each lane. For the purpose of collecting travel time data, a lower cost “compact reader” interfaced to only one antenna could be used to scan multiple lanes. Some vehicles will be missed when in the shadow of another vehicle or simultaneous responses cause the return data to be garbled, and some vehicles will be missed if they are in a position that is beyond the range of the equipment. Data collected from a few such stations should, however, provide enough successful matches of transponder reads to calculate a good estimate of travel time without performing a complete census of the toll tag users on the roadway.

Alternative Probe Technologies

Investigations are being performed that utilize cellular telephone serial number tracking with direction finding capability at some cell towers to determine average vehicle speeds.

Legislation concerned with privacy may have an effect on this type of device, but products that do not monitor conversations and do not use actual telephone number identification are still in development. A demonstration project is currently in construction (with funds from the FHWA) for the Virginia Department of Transportation (VDOT). This project employs a system that will compute vehicle speed vectors from a combination of direction finding and map matching.

Freeway Service Patrols

Freeway Service Patrols are important in areas where timely incident detection and response is particularly critical or where other electronic detection equipment is not available. Many minor accidents and incidents can be cleared with the patrol vehicle, eliminating the cost and delayed response of tow trucks. The supplies carried by service patrols are sufficient to clear many incidents related **to** vehicle breakdown. In addition, push bumpers mounted on the service vehicle allow for quick clearance of small accidents. Also, once the patrol stops at an incident scene, its detection capability on the rest of the primary routes is eliminated. Several private companies have successful organized service patrols. They train the personnel, equip the vehicles, and operate the service. Other freeway service patrols are operated in a similar manner by transportation agencies.

Cellular Call-In System

Cellular Call-In Sysfem is similar to a “911” system, but uses a different phone number. In many cases these systems can be monitored by existing dispatch staff, requiring no special training. Motorists usually provide timely information about a particular incident. However, the use of the system is limited to cellular telephone owners, the workload of the dispatcher is increased dramatically, and roadside signs are required to inform motorists of the system. Capital, operating and maintenance costs are relatively low and the benefits are generally high. To increase these benefits, cellular telephones could be distributed to State DOT personnel who frequently use the freeways during commuting hours in return for calls at regular intervals to track travel speeds and report incidents. This technique has been successful in the Boston area.

5.2.2 Traveler Interface

Variable Message Signs

Variable Message Signs (VMS), both fixed and portable, are widely used to provide motorist information during an incident. The ability to quickly alert motorists of a problem ahead, and provide for diversion to an alternate route, **is** a successful strategy for minimizing the impact of an incident.

A VMS consists of a matrix of dots, each of which can be individually controlled. The minimum group of dots for a single character is five dots horizontally and seven dots vertically. Larger "character cells" are often implemented for improved character resolution, the use of lower case letters, and "double stroke" characters. Since individual characters on a VMS are composed of discrete dots, the "sharpness" of a character is controlled by the number of dots per character. The tradeoff is cost, with cost of the sign being proportional to the number of dots on its surface. The human eye fuses together the adjacent dots in the character pattern, and recognizes the character as a whole. In general, the legibility of 5 inch by 7 inch character cell VMSs is very acceptable, especially if only upper case letters are used, which is typical for roadway applications. When lower case is required, or other effects are needed, larger character cells, and proportionally more expensive signs, are necessary.

If the VMS is intended for text messages only, adjacent "character cells" can be separated by a blank space to minimize the cost of the sign. An alternative approach is the "continuous matrix" sign, in which the separating blank space is deleted, resulting in all locations on the surface of the sign being controllable. This permits moving text, "exploding" and "collapsing" images, roller blind, horizontal shutter, and other types of special effects to be implemented. These special effects are more commonly used in commercial displays than in roadway applications. Use of a proportional font for improved readability or graphics is a common use of continuous matrix signs on a roadway.

Various display philosophies are in use by different agencies. Some feel that a VMS should only be used when necessary to display instructions or information about roadway conditions, feeling that if routine messages are displayed, the driver's awareness of the sign becomes numbed. Other agencies display a routine or safety message on the signs to confirm operability, while some agencies use their signs to advertise events. Because a VMS can display a wide variety of characters in each character cell, dynamic messages can be created by manipulating the timing of the display of individual characters, or groups of characters. Simple effects that are quite effective for roadways include blinking text, moving arrows, and the cyclic display of a sequence of messages with delays between them. An example of the latter is displaying a repeating series of safety messages, such as "BUCKLE UP", "DRIVE 55 FOR SAFETY", and "USE YOUR SEAT BELT". Message complexity, information acceptance rate, and driver attention span all must be considered when utilizing these features on high speed roads.

<u>Types of Variable Message Signs</u>

Two fundamental technologies, light reflectance and light emission, are used to form the individual dots that create the letters of the message.

Light Reflective Signs: Light reflecting VMSs consist typically of a matrix of mechanically changed dots. The individual dot can be a flat disk that is black on one side, and colored on the other, or a ball or cube that has color on one half, or a split flap that exposes a colored surface when opened. Other implementations consist of a multi-part flap that some vendors have utilized to implement a "white" character for daytime usage, and a "fluorescent color" character for improved visibility at night. This technique has been extended by one vendor to allow display of six different colors for each pixel. A variety of techniques have been used to improve the visibility of these signs, including internal illumination and retro-reflective surfaces. Because the dots are mechanically moved, a finite amount of time is required to change the message displayed on the sign. Different vendor's implementations result in a range of timing characteristics. On the slow end of the spectrum, rates of 30 characters per second are typical. At this speed, a sign with three rows of twenty-two characters per row will require over two seconds to change its message. Faster character write rates are available, some capable of changing the entire message in parallel, but tradeoffs of power consumption, dot inertia, overshoot, and flutter all enter into the dynamics of the implementation.

To provide stability during periods of power outage so that dots do not randomly change position and display "garbage" on the sign face, and to reduce power consumption, some method of latching the dots into a fixed position is normally used. A common technique is magnetic, where a small fixed magnet is attached to the shaft on which the dot rotates. The dot is changed from its "dark" state to its "bright" state with a pulse of an electromagnet, thereafter remaining stable with no power input required. This has the advantage that a message that was displayed prior to a power failure will remain on the sign face.

These signs have a proven field track record, with a generally high reliability rate. Individual dots are rated in the range of 100 million operations. However, it is not uncommon to find individual dots stuck, either "dark" or "bright", as a sign ages. The signs are fabricated for easy repair, with each character cell being quickly replaceable, and individual dots being repairable. The technology is easily scaleable, with character sizes ranging from 2" to 18" in height. A wide range of colors can be used on the "bright" side of the dot, with white or yellow being most common, but green, red, orange, gold, and others are becoming available. Because of the mechanical nature of this technology, a weatherproof enclosure is required. Cost of these signs is in the medium to expensive range, depending upon size, mounting, enclosures, and various options. For many agencies, these signs have been the "mainstay" of their VMS implementations.

By mechanically rotating the disk, ball, or flap with different colors on the surfaces, the dots on the surface of the sign form letters. The key advantage of this type of sign is the maturity of technology, and the long experience of their usage. Another advantage is the continued operation of the sign during a power outage, since the dots are bi-stable -- requiring power to change their state, but not to maintain them in a particular state. The disadvantages include limited visibility under some lighting conditions, fading of color contrast over time, and mechanical failures resulting in a “stuck dot”.

Costs of these signs is a direct function of the number of characters on the sign face, and the attention to detail and quality by the manufacturer. Since this type of sign is electro-mechanical, operational experience and product refinement based on many years of development have an impact on long term reliability. Large signs (3 rows by 20 characters/row) range in cost from $50,000 to $90,000, including installation and commissioning. Small signs (3 rows by 8 characters/row) cost $25,000 to $50,000. Cost of the support structure (sign bridge, attachment to overpass, or roadside poles) is in addition to the basic sign cost.

A related type of sign is the changeable seven segment numerical display. This technology is useful for the display of variable speed limits. A sign may be fabricated in the form prescribed by MUTCD for a speed limit signal with the numerical digits formed by remotely controlled displays. This technique produces an easily recognized, variable speed limit that is less costly than a full VMS.

Another related sign is the rotating drum sign, where several faces of a rotating drum (or several drums) can be used to display one of several messages. These signs can be configured with the same size, shape, and letter fonts as traditional static signs. Further advantages are their lower cost when compared to a “dot matrix” sign, and mechanical simplicity resulting in higher reliability. Their prime disadvantage is the limited number of messages that can be displayed on a single sign. The drum sign has applications where a fixed message (such as LANE OPEN/LANE CLOSED) has to be displayed for portions of a day. Their use for incident response is limited.

Light Emitting Signs: The use of an active light source at each dot (or pixel) of a VMS produces a light emitting sign. The original light emitting sign is the incandescent bulb matrix. This type of sign provides good visibility, and is currently used in commercial applications. However, it has fallen into disfavor for roadway applications due to the low reliability and high maintenance costs from bulbs burning out. Another major problem is heat as a result of the high bulb wattage, and the resultant power consumption. Some agencies in warm climates have found that they have to limit the number of bulbs that are on simultaneously due to heat rise in the sign enclosure. In general, these signs are not favored because of these limitations.

Current technology developments utilizing “solid state” lamps over the past several years have produced signs with high brightness, simple control, and long life. The light source in these signs is the light emitting diode (LED). Until recently, the brightness of the LED has not been fully adequate for bright daylight conditions. In particular, the “amber” LED, which is preferred for roadway usage, has been difficult to manufacture with the desired characteristics. Early LEDs suffered from variability in light output between “identical” LEDs, and aging effects which reduced brightness (often non-uniformly) over time. However, about three years ago these problems appear to have been solved, and the LED sign is finding acceptance in the field with many major manufacturers fabricating these signs.

A typical implementation utilizes a group of LEDs (on the order of 15) to form each individual pixel. This increases the brightness of each pixel, and averages any small differences between adjacent LEDs. These signs have a very fast turn on and turn off time, removing the problems noted above with the rotating disk type signs. Because of the physics of the semiconductor junction and wavelength of emitted photons, LEDs have a limited range of colors. Red is the most common color, but yellow is preferred for most roadway signage applications. Green is also commonly available. Combinations of different colored LEDs are being used to implement “colored” signs. The small size of the LED, coupled with computer type integrated circuits, can produce displays with large numbers of individually controllable dots for special effect applications. The long life of the LED, combined with the inherent simplicity of the design concept, should result in very good reliability. Actual field experience, as these signs are deployed in large numbers, will have to be gathered to verify this expectation. Cost of these signs is moderately expensive, but that should change as their usage increases.

Enhanced visibility is the key advantage of light emitting signs. The ability to mix various color light sources to produce differently colored messages is also useful. The biggest disadvantage of these signs is their requirement for continuous power, making them non-operable during power failures. If power failures are common, and the sign is critical to continued operations, some sort of back-up power is required.

LEDs have had some problems due to loss of light output intensity due to the aging of the light emitting active elements. Intensity reductions on the order of 50% have been observed after 30,000 hours of operation. A side-effect of this problem has been brightness differentials as a result of differing power-on times. This results in variations between different dots on the sign. Newer generations of LEDs appear to have solved these problems, with preliminary reports indicating either no intensity loss, or even a slight gain. This is based on initial testing, with long term field results not yet available. Another benefit of these newer LEDs is their increased intensity, allowing a sign to be fabricated with fewer LEDs per pixel (resulting in a lower fabrication cost), or a brighter sign with the same number of LEDs, or the ability to operate the LEDs at lower power (prolonging their life and reducing the aging effects).

Costs of LED signs is controlled by the size of the sign (number of characters on the sign face), the quality and reliability focus of the manufacturer, and the type of LED used. The newer, high-output amber LEDs are more expensive than older devices because of limited manufacturing yield and the need for the supplier to recover development costs. As with all semiconductor devices, component prices will decline fairly rapidly - especially as sales volumes increase. Large signs (3 rows by 20 characters/row) range in cost from $60,000 to $130,000, including installation and commissioning. Small signs (3 rows by 8 characters/row) cost $40,000 to $60,000. Cost of the support structure (sign bridge attachment to overpass, or roadside poles) is in addition to the basic sign cost.

Hybrid Technology Signs: The combination of a rotating disk or shutter in front of a light source produces a hybrid of mechanical motion and light emission. If the rotating disk is colored on one side, the light source “enhances” the message on the sign, providing additional visibility and “punch” for longer distance viewing. Some vendors consider this an enhancement of the basic rotating disk/shutter sign, while others explain their product as a totally different technology.

The LED is often used as the light source, with the LED being mounted behind the disk, and the disk serving as a shutter to permit the LED to be seen when the disk in the “bright” position, and masking the LED when the disk is in the “dark” position. One implementation mounts the LED off center, with a hole through the disk. When the “bright” side of the disk is visible, the hole is positioned over the LED. When the disk is rotated so that the “dark” side is exposed, the hole and the LED no longer coincide, and the LED is masked. Different vendors implement this same basic idea with a range of schemes, all effectively performing the same task.

A variation of this approach utilizes digital control technology that is connected to the circuit that controls the disk, and turns off the LED at each pixel when the “dark” side of the disk is exposed. This technique requires a location within each pixel that is constantly visible, and works well with circular dots where the LEDs can be located in a “corner” of the pixel. However, with split flap pixels that are square or rectangular in shape, the locations for mounting the LEDs are limited.

The approach of combining a light source with a light reflecting sign is an effective manner for increasing the visibility of the basic VMS, producing a good combination of daytime and nighttime usage. The prime reliability concerns are those of the basic sign. Cost is greater than that of the basic sign, and the performance enhancement must be considered within the constraints of the project.

A matrix of shuttered pixels, with each pixel containing a fiber optic bundle that is illuminated by a high intensity light source is another combination used by some vendors. The concept utilized with this design is that of a light source for several characters (on the order of three or more), and bundles of optical fibers to “pipe” the light to each individual dot on the sign face. One configuration utilizes a rotating disk as the shutter. In another configuration, the shutter is assembled with its rotational shaft perpendicular to the sign face. This shutter functions in a manner similar to that of a camera, alternately blocking or uncovering the light source. The mechanical orientation of the shutter, and its motion, seem to result in enhanced reliability.

The light source is a high intensity light bulb, similar to that used in a slide projector. The brightness of each individual dot is several times brighter than that obtainable with the hybrid LED sign. A useful design “trick” is to utilize two separate bulbs for each fiber bundle, with an automatic switch over circuit when a bulb fails. Monitoring the current flow of the small number of bulbs involved in this design is convenient, resulting in the ability to report a bulb failure to the central control station. The second bulb can also be used to produce an “overbright” condition for poor visibility conditions, such as fog. Another convenient feature utilizes a motor driven colored filter between the bulb and the fiber optic bundle to produce different colored characters on the sign face.

This type of sign has carried a higher price tag, making it the “Cadillac” of VMS applications. The prime selling feature of these signs has been their brightness and resulting high visibility. Some vendors emphasize the reliability of their signs, which may be more a result of high quality manufacturing and engineering, than the fundamental technology. Competition, other market forces, manufacturing efficiencies, and related factors may eventually push the price down to being more competitive with other technologies. As more of these signs are installed and field experience gained, their relative merits will be more sharply focused.

The combination of devices (light source and mechanical shutters) used to create a hybrid sign increases the cost about 20% over either light reflective, or a light emitting sign. However, the increased visibility is a key benefit that is often required.

The cost of hybrid signs is also dependent upon the size of the sign (number of characters on the sign face), and the approach taken by the manufacturer. The “flip-disk” signs, to which LEDs or fiber-optic light sources are added as an enhancement cost 15% to 20% more than the basic sign. Thus, for a large sign (3 rows by 20 characters), the cost will be in the $60,000 to $105,000 range. A small sign (3 rows by 8 characters) will cost $30,000 to $60,000. The fiber optic sign that utilizes shuttered pixels is primarily available in a 3 row by 18 character configuration, and costs about $135,000, including installation and commissioning. Cost of the support structure (sign bridge, attachment to overpass or roadside poles) is in addition to the basic sign cost.

VMS Control Systems

As the number of individually controllable elements on the sign face increases, the complexity of the control requirements increases. For all but the simplest rotating drum signs with just a few messages, some sort of computer based control is required. The manufacturers have selected a variety of microcomputers to meet this need. A few manufacturers have selected the Model 170 intersection controller as the microcomputer, which has the advantage of utilizing a standard item of hardware that is familiar to highway agencies. In other cases, the vendor has developed a special purpose microcomputer for controlling the specific sign they manufacture. In all cases though, a unique software package has been developed for each implementation.
Similarly, the command set used for communication between these signs and a control location is unique to each vendor's system. This command set is called the "communications protocol".

For an agency getting started with VMSs, a fully packaged system from a single supplier is simpler because the vendor can be assigned total responsibility for the system. But the "proprietary" nature of each vendor's implementation (because standards have not yet been defined) creates difficulties when trying to integrate equipment from several vendors into an overall system. An agency can easily get "locked into" a single supplier, when there are superior or more cost-effective products available. Or the agency can suffer from poor support, or a product being "orphaned" when a newer model is introduced or a company is bought out.

In any application of VMSs where more than a "few" different messages are to be displayed, some form of central control and operator interface is required. The "central" control computer supplied by the vendor for remote access to and monitoring of the signs is usually a PC, but often with vendor specific hardware enhancements such as unique serial communications boards. The software that runs on the PC is unique to each manufacturer's implementation, and ranges from "convenient" to "obtuse" in its user interface. Prices for the central system range from little more than the cost of the PC itself, to many times that, depending upon the features, the total system size, and the vendor's perception of the value of the central control system. The complexity of this software must not be underestimated. There are a great many features, interdependencies, database management issues, and operating subtleties to be handled, all of which contribute to the implementation difficulty and resultant cost.

The challenges associated with the control system can be addressed by carefully understanding the operational needs of the system, considering the growth requirements and future needs. In all cases, the vendor must be required to supply full documentation of all system components. The details of the communications protocol are especially important, so that existing signs can be integrated into a larger system when the agency's needs evolve. Another option that will be available in the near future **is** the specification of the National Transportation Controller/lVHS Protocol (NTCIP). This protocol is currently under development by NEMA/FHWA for NEMA/l70 controllers, and will be extended to VMSs after the initial traffic controller work is completed. Selection of a VMS on the basis of ease of integration into a future larger system will usually **be** beneficial as the overall scope of this type of traffic information system increases.

VMS Communications

The connection between a VMS and the central processor can be provided by a standard serial data communications link. Data requirements for signs are usually small. VMS systems are often implemented with a precanned library of messages. An operator usually needs only to select a pre-composed message, resulting in a very small communication load. If a completely new message is typed in by an operator, the communication load is only slightly higher. A complex message with graphics will require a larger amount of data to communicate the display to the sign. The communication link to a VMS will not generally need to operate above 1200 bps. This data rate will allow roughly 120 characters per second to be transmitted.

When a secure "closed" communications system is required to prevent unauthorized access to VMS control capability, an owned or leased communication link is necessary. Although the public switched telephone network is an "open" system, security measures can be added. Security measures could include the use of encryption devices and/or call-back security. Encryption involves the transmission of messages in a code that cannot be easily reproduced with a personal computer. Call-back security involves the placement of a call to the VMS and entry of an identification code. The VMS then places a call back to the control point before allowing access to changes in the sign message.

Highway Advisory Radio

Highway advisory radio (HAR) is widely used to provide motorist information to travelers in a limited geographic area. Non-commercial information services include construction and traffic congestion information, possible alternate routes, traveler advisories, parking information at major destinations safety information, availability of lodging, rest stops and local points of interest. AM broadcast-band, low power level equipment has been used to provide this information on two frequencies, 530 KHz and 1610 KHz. Presently, the standard broadcast frequencies between 530 KHz and 1700 KHz are available, in IO KHz increments, provided there is no interference with existing stations. The transmitters signal must also be low pass filtered in the audio range, to about 4 KHz resulting in a voice quality much like telephone transmission (between 3

KHz and 20 KHz the filter must attenuate at 60 log (f/3)dB where f is the audio frequency in KHz). The HAR transmitter consists of a device to record and playback messages, a radio transmitter, and an antenna. There are three different configurations used for HAR, vertical antenna, “leaky cable”, and micro-transmitter. Regulations governing the operation of HAR systems are defined by the FCC rules in Part 90.242.

Types of Hiahwav Advisorv Radio Transmitters

Vertical Antenna: Probably the most commonly used HAR system utilizes a vertical antenna. This type of HAR is termed a Traveler Information System (TIS) and must be appropriately licensed. A single vertical antenna produces an omni-directional (circular) radiation pattern that diminishes uniformly as the square of the distance from the antenna, provided there are no geographical obstructions.

FCC regulations for vertical antenna HAR/TlS stations include the following requirements:

- A separation of at least 15 kilometers from the 0.5 millivolts/meter daytime contour of any AM broadcast station operating on the same frequency.
- A separation of at least 130 km from the 0.5 millivolts/meter daytime contour of any AM broadcast station operating on the same frequency.
- The height of the antenna must not exceed 15 meters above ground level.
- The RF output of the transmitter must not exceed IO watts.
- A minimum distance of 15 kilometers must be maintained from any other Vertical Antenna HAR/TlS station.
- A minimum distance of 7.5 kilometers from a “leaky cable” antenna HAR/TIS at the same frequency.
- A frequency stability of ±20 Hz must be maintained.
- Signal field strength of antenna emission at the operating frequency must not exceed 2.0 millivolts/meter at a distance of 1.5 kilometers from the HAR antenna.

“Leaky Cable” *Antenna:* A specially designed lightly shielded coaxial cable is used to provide the antenna for this type of HAR/TIS transmitter. The signal transmitted from this arrangement is strong near the antenna, but dissipates rapidly when the distance from the antenna increases. Compared to a vertical antenna system, much more control of the emission field strength is available.

There is less chance of interference with other radio services. Multiple HAR/TIS systems could be operated along a roadway with different messages for traffic in each direction.

FCC regulations for a “leaky cable” antenna HAR/TIS stations include the following requirements:

- A separation of at least 15 kilometers from the 0.5 millivolts/meter daytime contour of any AM broadcast station operating on an adjacent frequency.
- A separation of at least 130 kilometers from the 0.5 millivolts/meter daytime contour of any AM broadcast station operating on the same frequency.
- The maximum length of the cable antenna must not exceed 3 kilometers.
- The RF output of the transmitter must not exceed 50 watts.
- A minimum distance of 0 5 kilometers must be maintained from any other HAR/TIS “leaky cable” station.
- A minimum distance of 7.5 kilometers from a vertical antenna HAR/TIS at the same frequency .
- A frequency stability of 20 Hz must be maintained.
- Signal field strength of cable antenna emission at the operating frequency must not exceed 2.0 millivolts/meter at a distance of 60 meters from any part of the station.

Micro-Transmitter: Very low power HAR transmission is permitted by Part 15 of the FCC regulations without requirements for a license. The area covered by a micro-transmitter is usually defined by a radius of 0.15 to 0.4 kilometers although some manufacturers claim twice as much. Part 15 of the FCC code includes the following requirements:

- The lead length of antenna and ground may not exceed IO feet.
- Any standard AM frequency between 530 KHz and 1705 KHz may be used.
- The RF output of the transmitter must not exceed 100 milliwatts.

Message Record/Playback

TIS messages to be broadcast on a HAR are usually recorded on an audio tape recorder and more recently in digital memory. Digital memory is preferred since it uses no moving parts, and thus does not require periodic cleaning or maintenance. Some devices offer features that include:

- Message capacity of nearly half an hour.
- Ability to retain messages during power failures.
- Provide concatenation of various stored message sequences in any order to form the broadcast message.
- Double buffer to allow playing one message while recording another.

Digital memory is available in several varieties:

- EEPROM (Electrically Erasable Programmable Read Only Memory)
- DRAM (Dynamic Random Access Memory) low cost but inefficient and sensitive to power fluctuations.
- SRAM (Static Random Access Memory) low power consumption can be battery backed-up with on-board lithium battery. Recent price drops make SRAM a good candidate for digital memory.

Transmitter

The function of the transmitter is to convert the audio signal from the message record/playback subsystem into a modulated AM radio signal to be transmitted from the antenna. Various classifications of transmitters are available. The power amplification stage of the transmitter is characterized by an alphabetic letter A through D to describe the linearity and efficiency of operation. Class A is the most linear and least efficient, while Class D is essentially switched on and off for various parts of the output signal and hence is the most efficient. Class D transmitters have a typical efficiency of 75%. Greater efficiency results in less heat losses and hence better operation. Efficient transmitters can be kept in sealed enclosures to protect them from dirt and moisture, thereby extending their useful life. Highly efficient transmitters will be more conservative in use of battery power during power outages.

Vertical Antenna Systems: It is desirable to place a HAR antenna in an area that has few obstructions to radio signals. Large buildings, geographic obstructions, trees, metal towers and overhead power lines should be avoided. An ideal site is a flat open field that is several hundred feet across. Good soil conductivity is another important factor. A radio ground plane can be improved with radials composed of heavy gauge copper wire buried about 12 inches below the surface and extending about one hundred feet in all directions from the base of the antenna. Ground rods are usually attached at the ends of the radials as well.

Special chemical systems are available to provide a ground plane where available space may be as small as IO feet in diameter.

The antenna must be tuned to the operating frequency. Both electrical and mechanical means are usually used to adjust the antenna and lead in cable to the transmitter output, to this provides maximum radiation from the antenna.

"Leaky *Cable" Antenna Systems:* Cable antenna systems are usually run in conduits and either suspended near the roadway or directly buried. A cable antenna is generally considered to be more expensive to install than a vertical antenna. If buried, the antenna is easily damaged by roadway construction, roadside guiderail, sign and delineator installations as well as attack from rodents.

HAR Control Systems

Most systems allow remote control that can be provided either from a touch-tone telephone or a personal computer. Telephone control is accomplished by interpretation of dual tone multi-frequency (DTMF) tones as commands, from a touch-tone phone. Some systems utilize voice prompts to instruct the operator to utilize the remote control features of the recorder and provide status messages. Under computer control, all functions and diagnostics can be controlled from a PC. The control software could incorporate a graphical user interface (GUI) to make system operation clear and intuitive.
Some systems allow the message to be composed and digitized at the PC before transmission to the HAR. The use of such a digital transmission reduces noise that might be introduced by this transmission. The resultant broadcast is clearer and more easily understood.

The communications link between the HAR site and the control point could be standard telephone, cellular telephone, owned cable, radio or fiber optics. Multiple HAR micro-transmitters could be utilized on the same frequency, transmitting the same message, provided that they are carefully synchronized, A fiber optic interconnect could be utilized to provide this means of synchronization.

Most HAR systems are able to operate in a mode that provides live message broadcast should the need arise.

Notification Signs

Signs advising drivers to tune their radios to the frequency required to receive an HAR broadcast should be placed near the edge of the reception area. Signs with flashing attention lights that are activated when an important message is being broadcast may prove useful to motorists.

Kiosks

Another medium for traveler information is the use of kiosks. Kiosks, in this instance, are video screens that display maps and/or text information regarding traffic, incident and transit information, Placed strategically at shopping malls, schools or large places of business; kiosks can provide pre-trip information. This pre-trip information can be used by motorists to plan alternate routes around congested areas or around incidents. Transit users can plan alternate routes with information provided on the status of transit vehicles. Communications from the Traffic Operations Center and the Transit Dispatch Center to the kiosks is vital to the success of a kiosk system.

Dial-In Systems

A useful pre-trip informational tool is the Dial-In System. A telephone number is established for the public to call for current traffic conditions for the ATMS. Usually, the messages are prerecorded with the time and date so the caller knows the age of the traffic information. This system could be set up as a toll free number or as a toll call. Once the call is placed, choices could be given to enter the highway route number or in the case of transit the bus line number. The recording would provide details as to traffic conditions at various interchange locations.

Information from the Traffic Operations Center and Transit Dispatch Center must be fed to the Dial-In System operator to update the recordings.
In New Jersey, both the Garden State Parkway and the New Jersey Turnpike have Dial-In Systems. The Turnpike provides a toll free number (I-800-33NJTPK) and provides choices for north, central and southern sections of the Turnpike. The Parkway's number is a toll call (I-908-PARKWAY), but also provides choices for north central and south sections of the Parkway. The New York State Thruway provides one toll free number (I-800-847-8929) for traffic conditions on the entire NYS Thruway between New York City and Albany, west to Pennsylvania, the New England Section, Cross Westchester Expressway, I-84, Berkshire Section and Niagara Section. In Chicago, the Illinois DOT provide information on the expressways in and around the city to the general public by dialing either 708-DOT-INFO in the suburbs or 312-DOT-INFO in the city.

Internet Access

The World Wide Web (WWW) portion of the Internet computer network has become the latest medium that some agencies are using to provide real-time traffic information to the public. By utilizing links between an agency's traffic computer and an Internet feature known as a "home-page", users are typically able to view a regional map that is color-coded to reflect various levels of congestion that may exist at the present time (usually updated every minute), may view a list of estimated travel times from various origins to various destinations within an area under traffic surveillance, may obtain construction delay information, and/or may allow users to directly link to other related WWW sites, including those for transit, weather, and/or tourist information. For example, visitors to the Illinois Department of Transportation's home-page for the Chicagoland area may obtain a color-coded map of freeway congestion, may obtain travel-times to and from the downtown Chicago "loop" and various major freeway interchanges or traffic generators (i.e. O'Hare International Airport), and may obtain the actual traffic speeds at specific locations on any of the region's freeways that have been instrumented with an appropriate number of traffic "detectors". Real-time traffic information for the following cities is currently available at the following Internet addresses on the World Wide Web:

- Chicago: http://www.ai.eecs.uic.edu/GCM
- Houston: http://herman.tamu.edu/houston-real.html
- Seattle: http://www.wsdot.wa.gov/regions/northwest/NWFLOW/
- Southern California: http://www.scubed.com/caltrans/

5.2.3 System Communications

Commercial circuits and agency-owned circuits are the two primary alternatives available for system communications. Typical ITS use both of these alternatives, with the chosen mix of types being driven by cost constraints and other technical- and system-specific requirements. However, irrespective of the choices to use private- or publicly-owned systems, it is of utmost importance that the communications system architecture be designed around common and commercially supported standards so that it has sufficient flexibility to respond to the rapid changes in communications technology. This will enable agencies to utilize emerging lower-cost, faster, and higher capacity circuits, in addition to many of the new wireless communications options that are being spurred by growth in both portable computers and personal communications.

The following sections summarize selected communication options, Additional detail and extensive discussions are provided in much of the published literature. Especially valuable is a 1993 FHWA publication, "Communications Handbook for Traffic Control Systems".

Commercially-Owned Facilities

The local telephone company, cable television provider, cellular carriers, and other communications service suppliers provide a variety of circuits operating at a wide range of speeds. They are typically priced with both a one time installation charge and a recurring monthly charge, and can be obtained on either a month-to-month basis or on various contractual terms that range from one year to ten years. Month-to-month service provides the most flexibility since service can be terminated when required. However, this flexibility also makes it the most expensive option. Multi-year contracts provide lower monthly costs, but do include penalties for cancellation prior to the end of a contract period.

Commercial communications circuits are available as either switched (dial-up) or dedicated (private line) facilities. In addition, each of these basic types can be configured as point-to-point circuits (2 parties) or multi-point circuits (three or more parties). On dial-up facilities, a multi-point circuit is usually referred to as a "conference call"; whereas, on dedicated facilities, a multi-point circuit is usually refereed to as a "multi-drop" circuit. A further distinction is in the transmission technique used (i.e. analog or digital). It should be known that the original telephone network was designed as an analog system for transmitting voice. However, the availability of low-cost, high-performance computer circuits has allowed the telephone system to convert much of its transmission and switching equipment to digital technologies that are resulting in better quality and performance.

Since initial installation costs and short-term monthly costs for low speed data circuits are relatively low, they are advantageous for vehicle detection and variable message sign circuits. In addition, since maintenance and repair is provided by the commercial service provider, many agency requirements for special training or equipment are eliminated. This advantage, however, can also be a potential drawback due to the "finger pointing" that often occurs when multiple parties are involved in maintenance disputes; especially, those involving repairs at locations where the commercial infrastructure ties into agency equipment. A second disadvantage of leasing commercial circuits are the expense of high-speed circuits, when necessary, and the reality of long-term costs (i.e. recurring monthly billings) that an agency must pay. This is because monthly costs are considered operational expenses, and therefore must be budgeted from annual operations budgets -- dollars that are often more difficult to obtain than initial capital funds.

Dial-Up Analog Service

This is the basic, universally accessible, dial-up voice-grade business and residential telephone service that is used extensively with widely available/inexpensive modems (about $250) and personal computers for data and fax transmissions at transfer speeds of up to 28.8 Kbps. Dial-up telephone service is a useful alternative for occasional and relatively short-term data transmission only. This is because the dialing and connect time is of such length (approximately fifteen to thirty seconds) that it does not realistically permit data collection or control of devices more frequently than every five minutes. In addition, since the dial-up telephone network was designed and configured for human calling patterns and call holding periods in order to allow the service provider to share their expensive central office equipment among many subscribers, use of dial-up circuits for frequent data calls of long holding times throughout many hours of the day can result in the local telephone company complaining about inappropriate usage due to the tie up effects this has on their central-office equipment.

Disadvantages, as with any dial-up configuration, are primarily security related. The ability of “hackers” to break into computer systems has been widely reported, and documented cases have included the display of inappropriate or unsafe messages on variable message signs. Additional system security via the use of dial-up/dial-back verification, data encryption, lengthy security passwords, and/or other safeguards reduces the risk for these cases, but at the expense of increased system complexity and additional “hassle” for the authorized personnel who must support and maintain the system.

Dedicated Voice-Grade Analog Circuits

Even though these circuits were designed for voice transmissions and therefore not optimized for data transmissions, they have been the backbone of many traffic management and arterial control systems over the past twenty years due to their wide-spread availability and low cost for low speed applications. They can be configured as either point-to-point or multi-point circuits, and can support data-transfer speeds of up to 9600 bps. Furthermore, modems to utilize these circuits are included in the designs of both NEMA and 170-Type controllers, in addition to the availability of other wide ranging interface equipment. It should be noted, though, that there are reports of telephone companies changing their tariff and pricing policies in order to discourage the long-term use of these analog circuits in an attempt to move customers to digital circuits.

Digital Carrier Circuits

In the mid-1960s, the telephone companies began converting their long-haul trunk circuits from analog technology to digital technology. Called either DS-1 (Digital Service 1) or T-l circuits, they operate at 1.544 Mbps and are configured to support 24 voice-grade channels with each channel having 64 Kbps of digital bandwidth. The primary interest in T-l for traffic/incident management systems is in its capability to digitally transmitting video signals; especially, since within the past few years, T-l service has become more readily available to end-users -- driven by the demand for higher speed communications channels to link computers and local area networks together. It is possible that T-l may provide a reasonable option to agency-owned fiber-optic cable for a few circuits used over a limited period of time; however, if large numbers of circuits are involved, T-l can quickly become quite expensive.

It should be noted that there is a hierarchy of faster digital circuits, each built upon various combinations of T-l circuits. For example, a typical combination known as DS-3 (T-3) operates at 43.232 Mbps, which is equivalent to 672 voice-grade channels. The emerging Synchronous Optical Network (SONET) standard further builds upon DS-3 and is defined in various combinations of up to OC-48 (Optical Carrier 48), which operates at 2,488 Mbps -- the equivalent of 32,256 voice-grade channels.

Dataphone Digital Service (DDS)

The telephone companies offer an additional category of digital circuits, often referred to as DDS (DATAPHONE Digital Service) circuits, that range in data transmission rates from 2.4 Kbps to 64 Kbps. Primarily available as dedicated circuits, but occasionally available in a switched configuration, since they were specifically deigned for data transmission, they have very good reliability and operational characteristics. However, a difficulty with these circuits is that they often require adapters at each end of them because they are usually configured as "synchronous" data channels; whereas, most communications for incident/traffic management systems are configured for "asynchronous" data transmissions. Finally, since the telephone companies have a limited availability of the Data/Channel Service Units (DSUICSU) that are needed to connect to these DDS circuits, DDS may not be a viable option in all areas for incident/traffic management system communications.

Integrated Services Digital Network (ISDN)

The technology for Integrated Services Digital Network (ISDN) was specifically developed by the telephone industry during the early 1980s as a digital service with appropriate operational parameters and error characteristics to yield excellent performance. However, up until the last few years, its implementation has been very slow. Since then, ISDN has experienced significant market penetration increases in many areas due to its key claimed benefit of allowing 144 Kbps of switched digital data to be transmitted over two-pairs of wires that are configured as two 64 Kbps data channels and one 16 Kbps control channel. Another benefit is its reduced switching/interconnect time, thus making it feasible to support additional field-devices on dial-up connections. ISDN interface boards (their equivalent to modems) for certain types of computers are currently priced in the $1,000 to $2,000 price range, with costs expected to decrease as equipment availability continues to increase.

ISDN is currently offered in two user configurations: the Basic Rate Interface (BRI), and the Primary Rate Interface (PRI). Basic rate ISDN is the digital equivalent of dial-up analog service; whereas, primary rate ISDN is the equivalent of T-l service -- providing the user with 23 channels of 64 Kbps data and one control channel also operating at 64 Kbps. The bandwidth available on a single BRI circuit is probably not enough for most applications to show traffic motion; however, some manufacturers are providing inverse multiplexing capabilities in their equipment such that they can obtain the required bandwidth from the inclusion of additional BRI data channels. Since it has been reported that video devices are coming on the market with ISDN-compliant interfaces that may be able to feasibly utilize this technology to access remote cameras for transmitting video images to a TOC, the next generation of traffic equipment may well be able to take advantage of some aspects of ISDN.

Still, though, utilization of ISDN circuits for the current generation of traffic/incident management system projects is probably not feasible due to the lack of appropriate interface boards for the field equipment, and the limited number of ISDN circuits that are available for use, even if enough of the appropriate equipment existed. Furthermore, since ISDN is basically a “dial-up” service, its use for full time channels, as typically used for traffic-monitoring applications, may not be effective.

Packet Radio

Packet radio is a wireless technique that was designed specifically for transmitting data. When operated by commercial suppliers, radio base stations are utilized to communicate with multiple field transceivers via time-synchronized data bursts known as “packets”. Since many field transceivers share the same frequency pair for transmitting and receiving data, a “cooperation strategy” known as a communications protocol is utilized to coordinate this sharing. Because of this sharing, however, there can be several second delays whenever data-packets are delivered.

Since the basic architecture of packet radio yields a pricing structure that is based upon the amount of data that is transmitted (measured in either bytes or “packets”), packet radio is most effective when transmitting short messages rather than large quantities of data. For example, at typical prices of $0.03 per 100 bytes transmitted, real-time communications with a traffic-monitoring processor would cost about $5.00 per hour. This cost is probably prohibitive for continuous communications ($120 per day), but may be attractive for occasional use to communicate with a remote VMS and/or isolated weather-station controller that may have previously been reached by another method such as cellular telephone. It should be mentioned, however, that considerable development may be required to convert currently configured remote devices and central processors in such ways that they would be able to communicate in a packet network protocol environment.

Cellular Service

The use of cellular telephones by field personnel has simplified many maintenance and incident response procedures by eliminating the need to connect to a telephone company service point. In addition, convenience and declining prices have rapidly expanded the market-penetration of cellular telephones over the past five years such that the cellular network now covers an area that can serve over 93 percent of the United States population. This has introduced a high degree of flexibility and enables equipment to be located anywhere within the coverage area -- especially valuable for temporary installations of portable or mobile equipment where the capability of establishing circuits on an as needed basis may prove cost effective for infrequent communications. However, for many incident/traffic management systems' more lengthy data transmission needs, the primary disadvantages of cellular service -- cost and its current limitations for the transmission of data -- become readily apparent.

Each cellular "telephone" incurs a monthly service charge ranging from $15 to $45 per month, and a per-minute "airtime,, charge ranging from $0.10 to $0.50 per minute. Increased competition and the economies of scale from increased call volumes made by greater numbers of cellular users are decreasing prices via unit-cost reductions and "innovative" cellular service plans; however, even if costs got as low as ten cents per minute, airtime would still cost $144 dollars per day -- prohibitively expensive for full-time cellular communications. In addition, since a cellular system's operating efficiency is based on the principle of dynamically reallocating each cell's limited frequency resources among all users, even if a traffic control system wanted to use a cellular system for continuous communication between field master controllers and intersection controllers, there could be no dynamic reallocation of the channels to other subscribers -- thereby, eliminating cellular telephone as a viable alternative.

Additional cellular service limitations can also be found in the context of relatively short-length data transmissions. Even though off-the-shelf cellular modems permit data to be transmitted over a cellular network, because cellular modems utilize different techniques for error correction and circuit initialization, they are often not compatible with landline modems. Furthermore, since the existing cellular network utilizes analog transmission, it is somewhat noisy; thus, limiting data transmission speeds. It should be noted, though, that cellular networks may be moving toward digital transmissions that would increase data transmission speeds. The first steps in the development of this system can be seen in the offering by some systems of a service called Cellular Digital Packet Data (CDPD). The National ITS System Architecture program is currently investigating this possibility; however, only time will tell if this eventually becomes a viable alternative.

<u>Satellite Communications</u>

Even though satellite communications services have been available for many years and have proven cost effective for both long distance point-to-point circuits and wide area broadcast applications, their use in "local" applications such as traffic management systems are not considered cost effective because of the prohibitive costs of ground-station and satellite transponder rentals, and the reality that costs are essentially distance independent. For example, a 56 Kbps satellite-based communications circuit will typically cost $10,000 per month, irrespective of whether or not the circuit is to be used for either a 200-mile or a 2,000-mile transmission.

The one case, however, where satellite communications may prove useful for traffic-management purposes is for incident response in rural areas. The ability to deploy an incident-response vehicle with capabilities to communicate live voice, data, and limited-motion video to a central control facility has proven effective in field trials; nevertheless, the long-term costs vs. overall benefits to be derived from this approach's flexibility must still be weighed against other communications channel options.

Microwave

Point-to-point microwave is an attractive alternative for the initial stages of ITS implementation, or for periodic transmission of video images from CCTV cameras; especially, in those cases where it is neither technically feasible nor cost effective to install conduit and fiber-optic cable. Depending on performance, prices for a video transmission microwave system can range from $20,000 to $40,000, including transmitter, receiver, and reverse direction control channel. If a fiber-optic system is eventually installed, the microwave equipment can then be re-used to extend CCTV coverage beyond the end of the fiber-optic network. A key limitation, though, is that microwave requires a line-of-sight transmission, and signal quality does degrade under adverse weather conditions. Finally, all microwave installations must receive a site-specific Federal Communications Commission (FCC) license.

Wireless Video: A recent video transmission development is wireless video. This equipment transmits full-motion video over a radio circuit in a manner similar to that used by microwave, but without the stringent installation requirements that microwave has (i.e. it does not require an FCC license because the equipment is class licensed by the manufacturer). A potential disadvantage, however, is that wireless video requires a line-of-sight transmission. Its antennas, though, are much less sensitive to alignment errors.

Agency-Owned Facilities

In an effort to reduce monthly operating costs and to provide the communications bandwidth necessary to support large numbers of video cameras, many agencies install their own communications facilities.

Cable-Based Techniques

Various cable-based land line systems are available and summarized in the following sections. For these systems, the costs for cable, installation, splicing, and electronics termination equipment are relatively moderate, ranging from $5 to $15 per foot, depending upon the installation specifics. However, the costs for trenching, installing conduits and ducts, backfilling, and patching are significant. Depending upon the construction conditions, these conduit installation costs alone can range from $20 to $40 per foot -- translating into capital costs of over $100,000 to $200,000 per mile, or even higher if structures need to be crossed or roads need to be bored-under, etc.

To minimize these ITS-charged installation expenses and to provide for future needs, some agencies have found it reasonable to install conduit during all major roadway reconstruction activities since it can be placed at reduced costs during these times -- provided that a means of record keeping can be utilized to locate this conduit when it is needed. To further save in trenching costs, conduit may also be stacked on top of each other or buried side by side. For example, the New Jersey DOT stacks two 4-inch rigid non-metallic conduit on top of each other in a six-inch wide trench. Similarly, the Washington State DOT has installed two conduits buried side-by-side in a I-foot-7-inch wide trench, and has even installed four conduits in a similar sized trench by placing them simultaneously side-by-side and stacked. Finally, several agencies add a type of innerduct to their conduit in order to provide extra non-obtrusive space for additional cable to be pulled through at a later time. This is accomplished by either using fiberglass conduit that already has four chambers molded right into the conduit, or by pulling “innerduct” material through standard rigid metallic or non-metallic conduit in order to provide separate raceways for the cables.

Twisted-Pair Cable: Twisted-pair cable, usually installed in combination with a fiber-optic long-haul system for interconnecting field equipment to a communications hub, provides a simple, straightforward, and low-cost method to handle the short-haul circuits that provide connections between the termination of high capacity backbone circuits, and individual vehicle detector cabinets or variable message signs. As such, twisted-pair cable has been referred to for decades as the backbone of “the last mile” of communications systems. It works well for data transmissions of several miles at speeds up to 28,800 bits per second (bps). However, if the system connects numerous nodes, a slower/ “practical” baud rate limitation of approximately 12,000 bps is often utilized in order to achieve faster data synchronization.

Coaxial Cable: Coaxial cable has been used in the past for the transmission of video images from CCTV cameras into a control center. However, due to the need for active amplification every 1/2 mile, image degradation over long cables, and maintenance problems, coaxial cable is no longer recommended for ITS applications.

Fiber-Optic Cable: Fiber-optic cables utilize pulses of light instead of electrical signals to transmit information. They are either being proposed or installed in virtually all new communications systems for incident/traffic management because it provides very high data rates (up to 2.5 Gbps) over long distances (over 25 miles) without amplification. In addition, these fibers are small (a 0.5-inch cable can contain 72 fibers), have high immunity to electrical interference, and can avoid the ground loop and lightening strike problems that are often encountered with metallic conducting cables such as copper wire.

Fiber-optic cable is commonly manufactured with two internal structures: those fibers that support single-mode transmissions, and those that support multi-mode transmissions. Single-mode fibers are used for long-haul circuits (longer than five-miles) and require more expensive transmission and receiving equipment to utilize their higher performance characteristics. Multi-mode fibers, on the other hand, can utilize lower-cost transmission and receiving equipment because they are typically used for short-distance transmissions (i.e. video images from a CCTV camera to a communications hub), which are then combined (or multiplexed) onto a long-haul single-mode fiber for transmission to a control center.

It should be noted that since many telephone and cable television companies are upgrading their systems to fiber-optic cable, opportunities do exist for public/private partnerships that could reduce each organizations' fiber-optic installation and maintenance costs.

<u>Network Configurations</u>

Star, Bus, and Ring are the three basic network configurations, or topologies, that are used to design fiber-optic systems. Since all topologies assign unique addresses to each communications node in order that data retrieval and control information can be sent/received to/from the proper field-devices, the major differences between any network configurations are usually related to system coverage and degree of redundancy. It should be noted that additional configurations are available via hybrids of these topologies. For example, Star-Ring is a frequently used hybrid that maximizes the advantages of both the Star- and the Ring-type configurations such that a system can have high-speed trunkline communications and a significant number of alternate data-routings in the case of any breaks in the fiber.

Star-Type: In a star configuration, separate fiber-optic trunks are used to connect the central facility to each communications hub. Additional connections are then made from each communications hub to the field devices via a local distribution network that can consist of various media types such as additional fiber-optic cable, twisted-pair cable, or radio-based communications, etc. Finally, all data to and from the central facility is multiplexed and de-multiplexed at the communications hub.

Even though this is a proven configuration that has been successfully used in many traffic management systems, a star topology has disadvantages in that separate "home-run" links are required from each hub to the central facility, and that star topologies are typically not configured with redundant, automatic switch over fibers or equipment.

Bus-Type: In a bus configuration, each communications unit (i.e. any device that is located at a node or communications hub, or any field device such as a 170 controller, etc.) is assigned a channel and an address, and is connected to either a fiber-optic link or series of fibers that carry data in two directions (i.e. full-duplex). Devices are then accessed by polling them on their assigned channel, using their specified address.

This configuration is commonly used in local area networks (LANs) to link together personal computers, and is advantageous in that it uses a single communications facility to reach from the central location to each field device. However, since bus configurations have not been utilized in operational traffic management systems, there is very limited experience with them in this environment. Additional disadvantages are that low-cost fiber-optic modems that are directly compatible with 170 controllers, variable message signs, and other traffic related equipment are not yet readily available.

Ring-Type: In a ring configuration, each communications unit is connected in series ("daisy-chained") to the communications units that are located immediately upstream and downstream of this first unit in order to create a single ring closed-loop. If significantly increased system reliability is desired, a second set of transmitters and receivers can be added to each communication unit such that a double-ring closed-loop is created. In fact, most ring configurations that are being installed today utilize this redundant double-ring concept in order to implement a concept known as automatic reconfiguration that takes advantage of this configuration's "self-healing" capabilities to re-route data transmissions in the event of a break in the fiber.

Dual ring configurations can be disadvantageous because of the requirements for additional fibers between communications nodes and equipment redundancy at each communications node; however, the operational advantages of self-healing rings are clear. Especially, when compared to the life cycle costs of system failures, the incremental costs of both redundant equipment and additional fibers within the same cable are very small (approximately $150 per fiber per kilometer, plus equipment costs). In addition, because this configuration is being widely implemented and utilized, a full-range of equipment is readily available at competitive prices, Data-Transfer Standards -- SONET

Fiber-optic communications systems were initially developed in the 1960s by the telephone companies for long-haul transmission of voice and data. Early implementations replicated the existing systems that were based on twisted-pair cable, coaxial cable, and microwave channels such that these digital carrier systems were only being implemented at DS-I (1.544 Mbps) and DS-3 (43.232 Mbps) transmission rates, Within the past ten years, however, successive refinement of fiber-optic technology has resulted in a new communications standard termed Synchronous Optical Network (SONET). Based upon multiples of 51.84 Mbps, which is known as an Optical Carrier I (OC-I) channel that is capable of carrying a DS-3 data stream plus additional control/status information, SONET systems are typically installed with either OC-3 (155.52 Mbps) or OC-12 (622.08 Mbps) capacity. Some systems are even implementing data transfer rates as high as OC-48 (2488.32 Mbps), with still even faster data-streams currently being planned.

SONET systems are implemented to utilize four single-mode optical fibers operating at a wavelength of either 1310 nm or 1550 nm for transmissions on each link, preferably with two separate routings. Devices known as multiplexors/de-multiplexors are then utilized to interconnect the low-speed data streams (1200 bps to 9600 bps) from field devices (i.e. 170 controllers, variable message signs, etc.) to a "communications hub", which is then able to connect to the much higher data rates of the SONET backbone. This also makes best use of a SONET system's capacity by allowing data originating at several field-devices to be combined together in a "time-slice" format for transmission to the central facility. Similarly, in the reverse direction, data coming from the central facility is extracted, or de-multiplexed, from a combined data stream for routing to individual field-devices. An equivalent set of multiplexors/de-multiplexors also exists at the central facility to perform these same functions of combining and separating the data.

Another of SONET's key design concepts is known as "self-healing", and refers to the redundancy that is achieved by using dual counter-rotating ring circuits that provide for automatic re-routing of data traffic onto a secondary ring in the event of failure in the primary ring. Since a SONET's secondary ring transmits data in the opposite direction from the primary ring, a cable break at one location does not result in a total system failure. Furthermore, except for a momentary loss of real-time voice or video traffic information, this switch over from the primary ring to the secondary ring occurs rapidly enough such that most data communications can recover without any loss of data. In the event of a cable break, however, restoration of full system functionality occurs as soon as the broken cables are field repaired. Equipment failures are also contained by the inclusion of redundant components at all key locations.

SONET's advantage of supporting a very wide bandwidth is also its greatest drawback since this communications capacity results in higher costs when compared to lower-bandwidth solutions. In addition, wide bandwidth systems have the potential to be more affected by system failures since these failures would impact a greater number of field-devices and communications channels than would probably be affected if they were served by lower bandwidth systems. In spite of this, SONET's self-healing capability and designed-in redundancy typically results in a more reliable overall system than could otherwise be obtained.

While alternate configurations may be considered, it should be remembered that SONET has been the preferred choice of all new communications systems; especially, since it can also be used for voice communications when voice is represented in digital format. In fact, some agencies often utilize this voice capability to implement PBX-to-PBX links between their various locations in order to bypass the telephone companies and reduce their long distance charges. Furthermore, SONET's digital-voice ability has resulted in its extensive use by local telephone companies and long distance carriers, which has been a major driving force behind much of the competition to develop additional digital carrier and SONET technologies. As such, a wide range of manufacturers and equipment vendors have developed highly cost effective, very reliable, and feature rich SONET systems Overall, other alternatives do not have SONET's range of options and features, and are typically more expensive when compared to SONET on a functionality basis.

Wireless Techniques

Spread Spectrum Radio: Spread spectrum radio was developed nearly fifty years ago by the military as a secure communications technology, and was commercialized in 1985 when the FCC assigned it to the 902-928 MHz frequency bands. It operates by having a transmitter unit spread a message's signal bandwidth over a wide range of frequencies such that when this transmission is recovered by a receiver unit that knows the coding technique utilized, the original message can be reconstructed.

The technique of spreading a signal over multiple frequencies results in high noise immunity. In addition, since each communications circuit within a given band utilizes a different coding technique, multiple and simultaneous circuits can co-exist. This introduces significant potential for traffic management applications. Further advantages related to increased equipment availability and decreased price could also be realized if the many efforts currently underway to evaluate spread spectrum radio for the next generation of digital cellular telephones results in that industry's wide application of the spread spectrum radio technology. This could, though, result in increased personnel training requirements and specialization, and technological complications

Potential disadvantages are that spread spectrum radio generally requires line-of-sight transmissions, which limits its range to about six miles, and that its signal is attenuated by vegetation, so a site survey is recommended before committing to this technology. In addition, even though there are no FCC facilities license requirements, spread spectrum equipment operating in the 902-928 MHz band cannot interfere with licensed equipment, and must accept interference from licensed services. Finally, as with any new sophisticated equipment, its implementation will increased agency personnel training and specialization -- especially related to maintenance issues.

5.2.4 Miscellaneous

Weigh In Motion Systems

Many weigh-in-motion (WIM) scale systems utilize both magnetic loops and axle sensors connected to a microprocessor located in a roadside cabinet. Classification parameters such as length, axle spacing and dynamic axle weights as well as statistical parameters such as vehicle speeds and counts are collected and processed by the equipment at the WIM station. Of course, the various manufacturers of WIM systems have differing capabilities which should be evaluated before a system is considered for implementation.

<u>Data applications</u>

The data automatically collected by WIM has many applications. WIM data can be applied to:

- Facility planning and programming, collecting more than vehicle counts, WIM can be used to provide highway data on individual vehicles.

- Pavement design and rehabilitation, pavement structural damage, associated with load equivalency factors (LEFs) and related to the Equivalent Single Axle Load (ESAL) which corresponds to 18,000 pounds on a single axle with dual tires.

- Weight regulation compliance. WIM scales can be used to identify trends and major deviations.

- Truck dimension compliance and regulatory policy development.

- Safety Analysis. Truck exposure and vehicle behavior can be analyzed from WIM data.

- Vehicle speed distribution for cars and trucks. Headway distributions.
- Traffic operation and control.
- Bridge load level analysis.

Accuracy of systems

WIM systems are often difficult to calibrate as one station may register a two axle truck several percent high while a three axle truck at the same station may register as several percent low. It appears that both roadway dynamics and calibration have an effect on the measurements. A methodology is suggested in the literature for calibrating weigh-in-motion systems and for monitoring that calibration over time. The proposed methodology can be used to determine when the calibration of a WIM system has changed by a significant amount (4% is proposed as significant).

Demonstration project

Weigh-in-Motion systems have been developed and refined over the past forty years. The systems are still rapidly changing with the technology. The Crescent Demonstration Project, part of the Heavy Vehicle Electronic License Plate (HELP) program is being conducted along parts of Interstate 5 and Interstate IO from British Columbia to Texas. The project includes an evaluation of WIM and other technologies used in automatic toll collection. The system which is being implemented will allow a truck to drive through the length of the project without having to stop at any weigh station or port of entry. The project should be able to provide a comparative evaluation of WIM systems when sufficient data has been collected.

Sensor technology

The literature contains an evaluation of data quality, performance, ease of use, and output format utility that was performed for systems with sensors from three technologies; capacitive weigh mat, bridge weighing, and piezoelectric cable. The evaluation is largely subjective. Findings show data quality roughly equivalent, with less favor of the quality from the piezoelectric system. The capacitive weigh mat and bridge systems were considered more portable than the permanently installed piezoelectric cable. Software considerations were found to provide the major differences between systems.
A capacitive weighmat is generally used in a transportable system. The mat is often used to screen overweight vehicles in a slow moving truck stream before a static weight check.

Bending plate technology provides a roadway sensor that is roughly six inches wide. A strain gauge is attached to the bending plate to measure deflection of the plate that is proportional to the vehicle weight.

A hydraulic load cell usually utilizes a heavy steel platform where the vehicle load is transferred by torsion arms to an oil filled load cell where a transducer allows the load to be measured. Both static and dynamic modes of operation can be utilized at this type of installation.

Piezoelectric sensors are usually composed of a powder filled coaxial cable that produces a voltage proportional to the applied pressure. The sensor cable is sealed inside an aluminum trough (about an inch wide) which is sealed into a roadway slot with a flexible epoxy compound.

Multisensor piezo WIM devices are suggested to more accurately estimate vehicle static weights than single sensor devices. Results show that increasing the number of sensors beyond five does not offer significant statistical improvement.

Svstem Implementation

Systems are available that obtain power from the AC line, solar cells and rechargeable batteries. Temperature compensation should be used with all sensor technologies, as the measurements from any sensor are affected by the sensor temperature. Thermistors, located near the sensors, supply temperature correction information to the system processor to provide the automatic adjustment.

The local processor is usually located at a highway or pole mounted cabinet. A connection to the central system is generally provided by modem and telephone line. Communications is usually at 1200 to 9600 baud. Any standard means of serial data communication, including fiber optics, cellular telephone and packet radio should be capable of providing the connection. Data communication may be used to convey either continuous information updates, or blocks of data consisting of the last 24 hour period When WIM systems are coupled with induction loops, vehicle classification can be automatically performed.

System Accuracy

Dynamic pavement loading is considered in the literature. It is suggested that various agencies feel that WIM is not sufficiently accurate because it fails to duplicate the static weight, moreover a device rarely records the same weight when tests are repeated. The Problem is in the interpretation of dynamic WIM data. Other factors including vehicle suspension, roadway roughness tire type, and tire pressure are all factors influencing the dynamic forces between vehicle and roadway.

Sensor Type	Technology Description (Typical Temperature Range)
Bending Plate	Strain gauge bonded to steel plate. Strain is measured from applied load. (-40 to 80°C)
Hydraulic Load Cell	Load from heavy steel platform is transferred by torsion arms to oil filled load cell. (-45 to +60°C)
Capacitive Weight Mat	Sensor consists of an approximately 80 lb. rubber mat with steel sheets attached as part of a tuned circuit in an oscillator. The frequency change of the oscillator is measured to calculate dynamic weight. (0 to 80°C)
Piezoelectric	A sensor consisting of a section of coaxial cable filled with a powder, that produces a voltage when under pressure, is installed in a specially constructed slot in the roadway. Thin film piezo devices are also now available. (-40 to +60°C)

Roadway/Weather Monitors

Roadway/Runway Weather Information Systems (RWIS) are finding increasing use in locations where localized temperature or precipitation conditions can disrupt traffic, or require roadway maintenance activities. The most common use is for monitoring visibility and road surface freezing conditions for traveler information, or for dispatch and management of snow and ice removal crews. The responsibility of the National Weather Service is for general and severe weather forecasting. This role often does not provide detailed, up-to-the minute data needed to optimize the management of roadways due to local conditions. Additional value added services which provide site specific forecasts based on RWIS data have proven effective in snow and ice control.

Currently available technology can monitor pavement surface conditions, especially temperature which can be as much as 7°C warmer than the air temperature at the start of a storm, and can lag several hours behind the temperature of the air as it cools. An inverse situation is surface radiation cooling on a clear night, resulting in a roadway surface that is below freezing and icing from water vapor in the air.

The first situation, when managed based upon roadway surface conditions can result in several hours of delay before ice control chemicals are required. This delay reduces labor costs and materials costs for effective ice management. By extrapolating the data, the freeze point can be predicted so that chemicals can be applied on a pro-active basis, rather than reacting to conditions. Manpower and materials can be saved when knowledge of roadway conditions is available in advance. An ice/pavement bond can be prevented with far less chemical application than would be required to remove ice that has formed on the pavement surface.

The second situation, where unexpected icing conditions develop can be detected and alarmed by a weather monitoring system. This alarming can be used to dispatch sanding and salting crews in a timely manner to reduce the hazard and the resulting accidents.

Roadway weather information is also useful to monitor subsurface conditions that may be cause to restrict the travel of heavy vehicles. Major damage to roadway surfaces can occur during thaw cycles when the sub-surface can take on a plastic consistency. Application of pavement treatments can also be performed during seasons when conditions are variable, provided that roadway surface temperatures can be expected to remain within acceptable range.

Weather monitoring systems can provide a variety of data inputs including roadway surface temperature, surface condition (dry, wet, ice, dew, frost), chemical concentration on roadway surface, sub-surface temperature, air temperature, relative humidity and dew point, wind speed and direction, precipitation rate and type, and visibility. This data, when monitored locally and tracked over time, provides additional information for effective management and decision making. Specialized analysis of the data, when combined with wider area weather information, can be provided by a service organization staffed by professional meteorologists. This additional analysis provides forecasts and interpretations of conditions that can enhance the management of the area roadways. Nearby states that have installed roadway weather monitoring systems include: Pennsylvania, Ohio, Virginia, Indiana, Illinois, Tennessee, and the District of Columbia. Many agencies on the East Coast and northern mid-west have reported beneficial operation from use of weather monitoring systems.

Communications

Communications between the remote sensor station, called a remote processing unit (RPU), and central processor unit (CPU), should be reasonably frequent during critical periods. The RPU should be programmed to call the CPU upon detection of various types of threshold parameters, as well as periodic updates to confirm proper RPU operation. As many as fifteen to twenty calls per day should be anticipated when weather is critical. The method of communication to be used should be selected on the basis of availability, reliability, and cost. The obvious choices include: leased line, standard telephone, cellular telephone, packet radio, and owned communications infrastructure that includes existing radio and cable facilities. Data transfer requirements are only a few hundred bytes per inquiry, so standard communication rates and low cost modems can be utilized.

Remote Systems

An RWIS field site consists of surface sensors, atmospheric sensors and a field microprocessor (RPU). Each field site costs about $25,000 to $30,000. A central computer, together with communication ports and modems, collects the data from each field site on a regular basis, A software package in the central computer stores and analyzes the data, and presents it in graphical and tabular form. The central hardware/software package costs about $30,000.

Preliminary Communications Recommendations

A good candidate for communications of RWIS data is cellular packet radio. Packet radio was developed for the transmission of data. This communication technology is not likely to be in heavy use during severe weather emergencies. Cellular telephone systems, on the other hand, could be overloaded when they are needed the most. At present, each application to be used on packet radio requires certification by the carrier. This could involve some costly software modifications to adapt to the packet protocol. The use of packet radio should provide a rapidly implemented reliable and cost effective means of data communication to areas where wire lines may be difficult to install.

5.3 Selection Of Individual Functional Elements

The importance of the elements of the technical functional areas vary, depending on the objectives and extent of the ITS system. However, preliminary examination of the technical function areas and specific technologies does result in expectations regarding the most important technical functional areas and technologies.

Based on local priorities and examination of the technologies that have been successfully implemented in other cities, the specific technologies that appear most important in the short and medium term are:

- Surveillance
    - Loop detectors and/or sensors (infrared, microwave, sonar, video and/or radar)
    - Closed circuit television cameras
    - Information provided by police, freeway service patrols and cellular call-in
    - Weather monitors

- Communications
    - Local area broadcast (HAR)
    - Commercial radio

- Landlines (fiber optics)
- Cellular/wireless services
- Microwave communications

- Control Strategies
  - Signal control

- Traveler Interface
  - Highway Advisory Radio
  - Kiosks
  - Variable message signs

- Data Processing (data processing capabilities become increasingly important as the amount of data to be processed increases)
  - Incident detection and route guidance algorithms
  - Static and dynamic databases
  - Optimal control strategies
  - Coupled route selection and traffic control

It is more difficult to identify the technologies that may be appropriate in the long term, due to the fact that technology advancements are expected to have a significant effect on the capabilities and relative costs of the options available.

Chapter 6
SYSTEM ARCHITECTURE AND VISION STATEMENT

6.1 Introduction

This chapter examines the options for the basic architecture that will lead to the early deployment of Intelligent Transportation Systems (ITS) technologies and processes in the Metropolitan New Orleans Area. This architecture will provide the framework for an incremental and logical evolution of ITS in the area since it is evident that funding is not currently available for a comprehensive implementation of the entire region to the utmost degree. Also, not all elements of the architecture are clearly defined yet nor available for implementation at this time.

The Federal Highway Administration's (FHWA) National Architecture Program is now yielding documents that can be used to engineer an architecture for the Metropolitan Area. In preparing this analysis, FHWA's June 1995 ITS Architecture, Physical Architecture document has been referenced extensively. This is important because adhering to the National Architecture when developing an Early Deployment Plan provides a level of confidence that the future incremental growth of user services, including the geographic enlargement of metropolitan areas, can be accomplished efficiently, effectively and in a manner that is compatible with the National efforts and other regional efforts.

6.2 National Architecture Overview

The emergence of an ITS National Architecture now provides a definitive roadmap for geographically diverse areas to implement ITS designs and deployment strategies in a consistent manner. While the National Architecture is not totally defined, it is sufficiently developed to provide general direction and guidance in formulating solutions to transportation issues and the provision of the core user services. The Physical Architecture (ITS Architecture, Physical Architecture, U.S. Department of Transportation, Federal Highway Administration, June, 1995) forms the basis for the architecture definitions presented herein.

There are four basic elements of the architecture:

- Users: The class of people who interface with architecture implementation as travelers or operators. The capabilities and services of ITS would be utilized for improved travel, enhanced service, streamlined operations, and increased profits.

- External Systems: The computer systems outside of ITS that interface with the architecture.

- System Environment: The physical world of roadway, air, obstacles, etc.

- Internal Subsystems: The key elements of the Architecture that interact to provide ITS services and functionality.

These four basic elements provide a top level architecture for the nineteen (19) subsystems that are defined in the National Architecture.

Remote Access:
1. Personal Information Access
2. Remote Traveler Support

Centers:
3. Information Service Provider
4. Traffic Management
5. Emissions Management
6. Emergency Management
7. Transit Management
8. Toll Administration
9. Fleet and Freight Management
10. Commercial Vehicle Administration
11. Planning

Vehicles:
12. Emergency Vehicle
13. Personal Vehicle
14. Transit Vehicle
15. Commercial Vehicle

Roadside:
16. Commercial Vehicle Inspection
17. Toll Collection
18. Parking Management
19. Roadway

This document will focus on developing the appropriate subsystems necessary and sufficient to meet the user services and priorities established in previous tasks of this project. It should be emphasized, though, that adhering to this model should provide for the reintroduction of additional detail sufficient to accommodate growth as conditions change and it becomes necessary to implement new/evolving user requirements within the project area.

6.3 New Orleans Architecture

6.3.1 User Services Requirements

From discussions with the Regional Planning Commission (RPC) evaluation of existing and future conditions and results of the user services surveys, the following User Services have been defined in terms of priority and implementation time frame. This will allow the scope of this Early Deployment Study to focus on "early winners" that can provide for near term pay-backs to the area. Table 6-l summarizes the User Services that the Regional Architecture must address.

Table 6-l. User Services Priority and Time Frame

USER SERVICE	PRIORITY	TIME FRAME
Incident Management	High	Short
Traffic Control	High	Short
Route Guidance	High	Short
En-Route Driver Information	High	Short
Emergency Notification and Personal Security	Medium-High	Short
Emergency Vehicle Management	Medium-High	Medium
Hazardous Material Incident Response	Medium-High	Medium
Public Transportation Management	Medium-High	Medium
Pre-Trip Travel Information	Medium	Medium
Demand Management and Operations	Medium	Medium
Public Travel Security	Medium	Medium
Freight Mobility	Medium	Medium
Travel Services Information	Medium	Medium
Electronic Payment Services	Medium	Medium

Analysis of these User Services in terms of the Architecture's subsystems allows the **ITS** National Architecture to be shaped to the specific priorities of Metropolitan New Orleans. Figure 6-l shows the subsystems, interfaces and information flows necessary to address these services. It must be emphasized, however, that the Architecture shows what the system does, (i.e. the allocation of responsibilities), but not necessarily the "how" of implementation. The selection of technologies to enable the "how" was the topic of Chapter 5. In this chapter, the "how" will be addressed in terms of potential designs. This approach facilitates an implementation strategy that coincides with local priorities, technological evolution and funding availability.

The Logical Architecture presents a functional view of the ITS user services. This perspective is divorced from likely implementations and physical interface requirements. It presents only the functions (process specifications) that are necessary to perform ITS services and the data flows that need to be exchanged between these functions. The functional decomposition process begins by defining those elements that are inside the architecture, and those which are not. For example, travelers are external to the architecture but the equipment that they use to obtain or provide information is inside. A financial institution is outside of the architecture but the ITS components that detect vehicles, and keep track of tolls are inside. The existing broadcasting media are outside of the architecture but the elements that provide ITS information to the media are inside.

The ITS functions are represented as data flow diagrams. A simplified top level diagram is presented below (see the Logical Architecture for a complete top level diagram). Circles represent functions that are broken down into finer detail on subsequent diagrams. The lowest level of decomposition is a Process Specification. (An example of a process specification is Detect Roadside Pollution Levels. The function detects pollution levels present in the environment and passes the pollution measurement data on to another process, Process Pollution Data where it is combined with other such detected data.) Lines represent data flows that are also further subdivided on subsequent diagrams and are described in a data dictionary. Rectangles represent external entities.

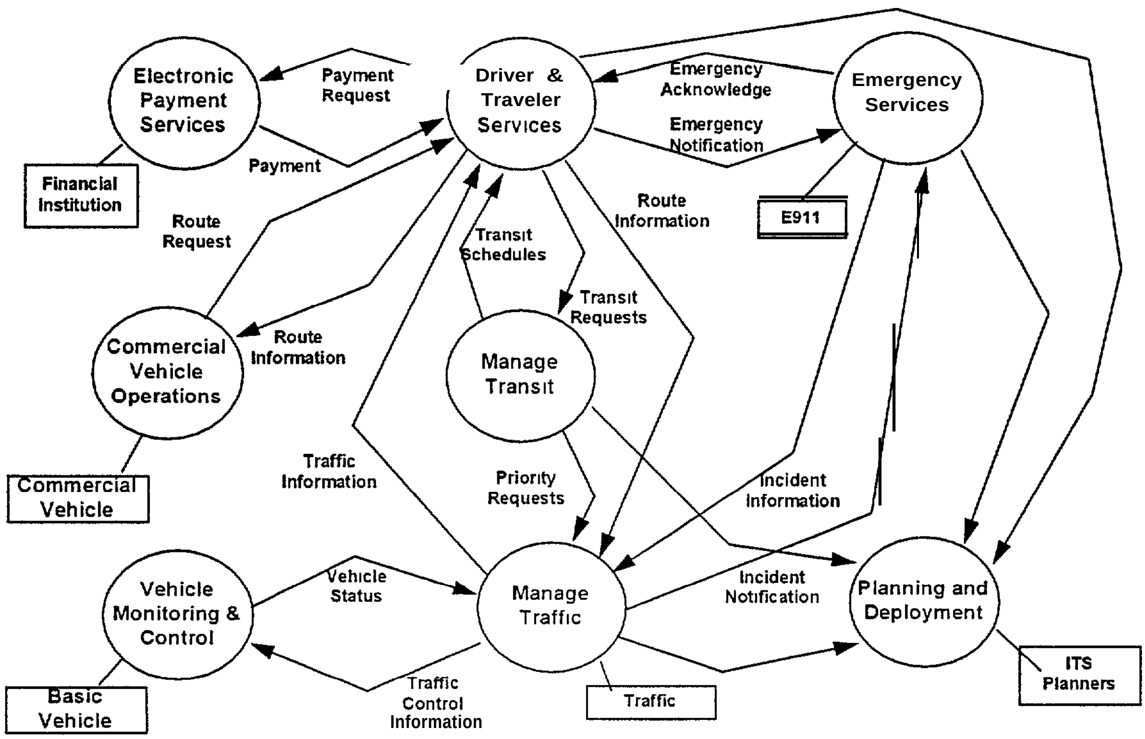


Figure 6-l Logical Architecture

6.3.2 ITS Subsystem Definitions

ITS subsystems are categorized into four functional perspectives known as "classes". These include:

- "Centers", which collect, process and store information
- "Roadsides", which encompasses elements deployed along the "roadway" regardless of the type of "road" (e.g. rail, air, sea)
- "Vehicles", which travel the "roadways"
- "Remote Access", which represents ITS users with transportation needs.

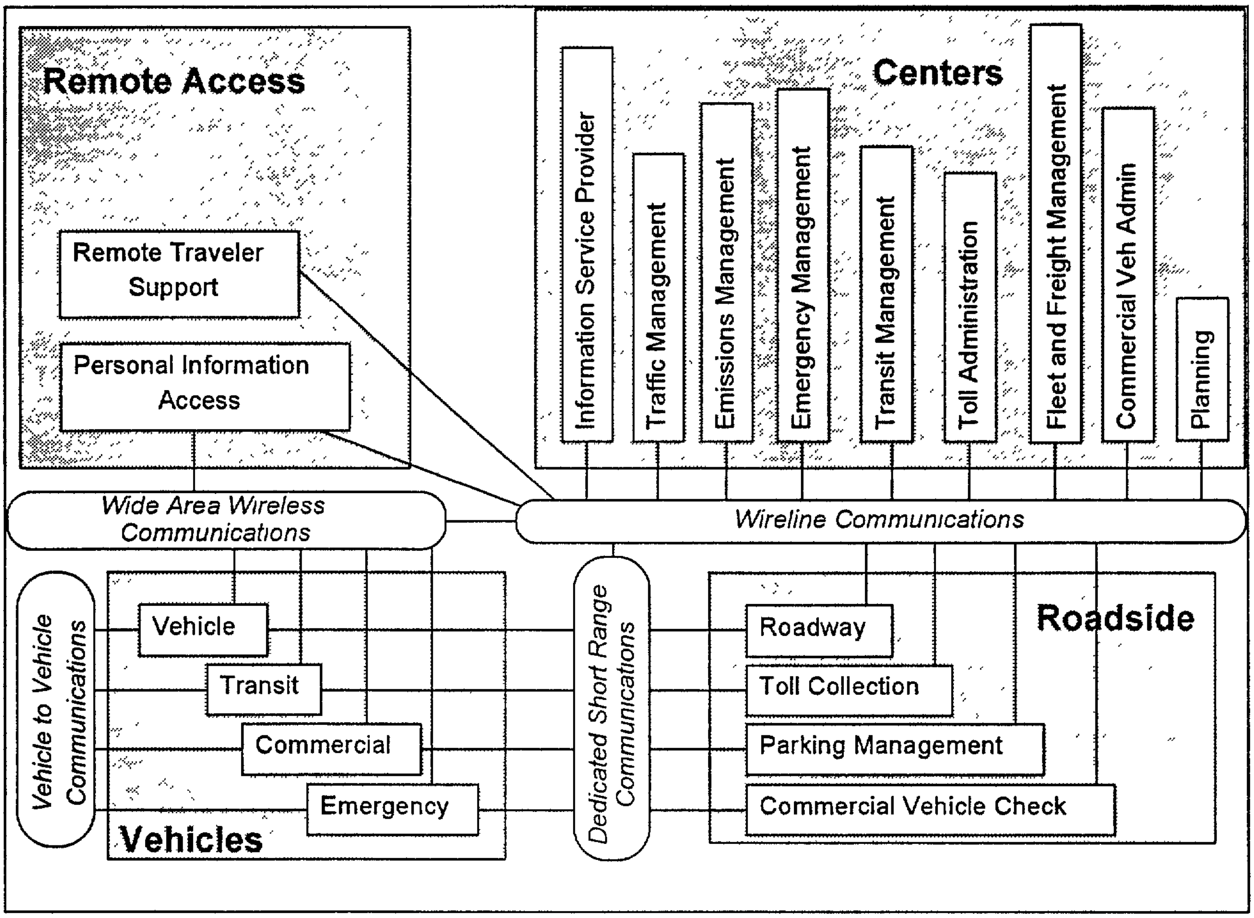


Figure 6-2 Physical Architecture

A diagram of these "classes" and subsystems is shown in Figure 6-2. The following briefly defines these system classes and their appropriate Architecture subsystems as necessitated by the above User Services requirements. ITS National Architecture information has been derived from the ITS Architecture, Physical Architecture and Building the ITI: Putting the National Architecture into Action documents (referenced previously in Section B).

Center-Class Subsystems

The "Center"-Class Subsystems provide management, administration and support functions for the transportation system. By communicating to other center-subsystems any relevant information gathered from center-controlled roadside- and vehicle-subsystems, they enable regional coordination across jurisdictional boundaries and between transport modes.

Traffic Management Subsystem

The Traffic Management Subsystem, usually operating within a traffic management center or other fixed location, monitors and manages traffic flow via communications with the Roadway Subsystem and other Traveler Subsystems. It can coordinate traffic information and control strategies in neighboring jurisdictions, monitor and manage maintenance activities, disseminate maintenance work schedules and road closures, manage reversible lane facilities and process probe vehicle information. This subsystem also supports high occupancy vehicle (HOV) lane management and coordination, road pricing and other demand management policies that can alleviate congestion and influence mode selection. When incidents are detected and verified, appropriate incident information is provided to the Emergency Management Subsystem, to travelers (through Roadway Subsystem Highway Advisory Radio and Variable Message Signs), and to third party providers. Finally, the Traffic Management Subsystem provides capabilities necessary to exercise control over those devices utilized for automated highway system (AHS) traffic and vehicle control.

Emergency Management Subsystem

The Emergency Management Subsystem, operating in various emergency centers that support public safety (including police and fire departments, search and rescue special detachments, and HAZMAT response teams), interfaces with other Emergency Management Subsystems to support coordinated emergency response involving multiple agencies. The subsystem creates, stores and utilizes emergency response plans to facilitate coordinated response, and tracks and manages emergency vehicle fleets using automated vehicle location (AVL) technology and two-way communications with the vehicle fleets. Interfaces with the Traffic Management Subsystem allow strategic coordination in tailoring traffic control to support en-route emergency vehicles. Also, interfaces with the Transit Management Subsystem allow coordinated use of transit vehicles to facilitate response to major emergencies. In addition, real-time traffic information received from the other “center” subsystems is used to further aid the emergency dispatcher in selecting the appropriate emergency vehicle(s) and routes that will provide the most timely response.

Information Service Provider Subsystem

This subsystem provides the capabilities to collect, process, store and disseminate traveler information such as basic advisories, real time traffic conditions, transit schedule information, yellow pages information, ride matching information and parking information to subscribers and the public at large. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In advanced implementations, reservation services are also provided. This subsystem provides the capability for an informational infrastructure to connect providers and consumers, and gather needed market information to assist in service improvement planning and operations and maintenance. Available communications links, such as basic one-way (broadcast) and personalized two-way links, provide information to the traveler via the Personal Information Access Subsystem, the Remote Traveler Support Subsystem and various Vehicle Subsystems.

<u>Transit Management Subsystem</u>

The Transit Management Subsystem provides the capability for determining accurate ridership levels, implementing corresponding fare structures, supporting travelers using a fare medium applicable for all surface transportation services, providing for optimized vehicle and driver assignments, and providing for vehicle routing for fixed-route and flexible-route transit services. An interface with traffic control can allow for integration with traffic signal prioritization for transit schedule adjustments, and the transit vehicle maintenance management can be automated with schedule tracking. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations; and can provide the capabilities to furnish travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options and transit routes and fares. In addition, the capability to monitor key transit locations with both video systems, audio systems and traveler activated alarms, can be provided such that system operators and police are automatically alerted regarding any potential incidents.

Roadside-Class Subsystems

These infrastructure subsystems, governed by and connected to one or more of the center subsystems, provide interfaces to support operations and other functions that require data distribution to the roadside for direct surveillance, information provision, and control plan execution. Direct user interfaces to drivers and transit users, and short range interfaces to the vehicle subsystems are also generally included.

<u>Roadway Subsystem</u>

This subsystem includes traffic control and monitoring equipment that are distributed along roadways, such as highway advisory radios, variable message signs, motorist assistance call boxes, vehicle loop detectors, traffic and railroad signals, freeway ramp metering systems and closed circuit television (CCTV) cameras and video image processing systems for incident detection and verification. Also provided are capabilities for emissions and environmental condition monitoring, and HOV and reversible lane management functions. In advanced implementations, this subsystem supports the monitoring and communications functions of automated vehicle safety systems that control access and egress to and from an Automated Highway System. This includes systems such as intersection collision avoidance that determine the probability of a collision in the intersection and then send appropriate warnings and/or control actions to the approaching AHS-equipped vehicles.

Vehicle-Class Subsystems

These vehicle-based subsystems communicate with the roadside subsystems and center subsystems to provide general driver information, vehicle navigation and advanced safety system functionalities. It should be noted that general traveler information and vehicle safety functions, as detailed in the Personal Vehicle Subsystem section below, are also applicable to the three fleet vehicle subsystems (Commercial Vehicle Subsystem, Emergency Vehicle Subsystem and Transit Vehicle Subsystem). The fleet vehicle subsystems also include vehicle location and two-way communications functions that support efficient fleet operations, in addition to various special functionalities that support their specific service areas.

Personal Vehicle Subsystem

Residing in a personal automobile and providing the sensory, processing, storage, and communications functions necessary to support efficient, safe and convenient travel by personal automobile, the Personal Vehicle Subsystem uses both one-way communications options (i.e. low-cost broadcast facilities) and two-way communications options (i.e. advanced subscriber personalized information systems) to support a spectrum of information services that provide drivers with current travel conditions and the availability of services along a given route and at a particular destination. Route guidance capabilities assist in formulating both an optimal travel route and step by step guidance along that route. Advanced sensors, processors, enhanced driver interfaces and actuators complement the driver information services so that in addition to making informed mode and route selections, the driver travels these routes in a safer and more consistent manner. Furthermore, initial collision avoidance functions can provide “vigilant co-pilot” driver warning capabilities. When unavoidable collisions do occur, precrash safety systems can be deployed and emergency notification messages can be issued. In the future, more advanced functions may assume limited control of the vehicle to maintain safe headway. Ultimately, this subsystem supports completely automated vehicle operation through advanced communications with other vehicles in the vicinity and in coordination with the supporting Automated Highway System infrastructure subsystems.

Emergency Vehicle Subsystem

Residing in an emergency vehicle and providing the sensory, processing, storage and communications functions necessary to support safe and efficient emergency response, the Emergency Vehicle Subsystem interacts with the Emergency Management Subsystem to support coordinated responses to emergencies. Using two-way communications and automated vehicle location equipment, appropriately equipped emergency vehicles are able to be monitored by vehicle tracking and fleet management functions in the Emergency Management Subsystem so that the proper emergency response vehicle can be dispatched. In addition, route guidance and traffic signal preemption capabilities can be added to further enable safe and efficient routing to an emergency via communications with the roadside subsystem.

Transit Vehicle Subsystem

Residing in a transit vehicle and providing the sensory, processing, storage and communications functions necessary to support the safe and efficient movement of passengers, the Transit Vehicle Subsystem interacts with the Transit Management Subsystem to collect accurate ridership levels, support electronic fare collection, relay transit vehicle maintenance data and integrate automated vehicle location functions that enable more efficient operations. The Transit Vehicle Subsystem also furnishes travelers with real-time travel information, continuously updated transit schedules, transfer options, routes and fares. In addition, an optional traffic signal prioritization function can communicate with the roadside subsystem to improve transit on-schedule performance.

Remote Access-Class Subsystems

The remote access subsystems include general purpose equipment that is typically owned and operated by the traveler, such as personal computers, telephones, personal digital assistants (PDAs), televisions and any other communications-capable consumer products that can be used for gaining access to information that can be supplied to a traveler within the scope of the ITS architecture. These subsystems interface to the information provider, usually one of the center subsystems (most commonly the Information Service Provider Subsystem), in order to access the traveler information. A range of service options and levels of equipment sophistication are considered and supported.

Personal Information Access Subsystem

This subsystem provides the capabilities for travelers to receive formatted traffic advisories from the infrastructure at fixed locations such as homes, workplaces and other major trip generation sites; and via multiple types of electronic media at mobile locations such as mobile information centers or within individual vehicles. Included is basic route-planning information that allows users to select those transportation modes that avoid congestion, and in more advanced systems, travel information that allows users to specify those transportation parameters that are unique to their individual needs. Also provided are capabilities to initiate a distress signal, and to cancel a prior issued manual request for help.

Remote Traveler Support Subsystem

This subsystem uses kiosks and other informational displays that support varied levels of interaction and information access to provide traveler information at transit stations, transit stops, other fixed sites along travel routes and at major trip generation locations such as special event centers, hotels, office complexes, amusement parks and theaters. For example, at transit -stops, simple displays providing schedule information and imminent arrival signals can be provided. This basic information may be extended to include yellow pages information, and multi-modal information regarding traffic conditions and transit schedules to support mode and route selection at major trip generation sites -- including personalized route planning and route guidance information based on criteria supplied by the traveler. In addition, this subsystem supports fare card maintenance, public safety monitoring using CCTV cameras or other surveillance equipment for emergency notification within these public areas, and other features to enhance traveler convenience that may be provided at the discretion of the deploying agency.

6.4 Design Alternatives

6.4.1 Introduction

With the National Architecture defining what information is processed and where the information flows, it is now possible to evaluate various designs that are bounded by the architecture The three design alternatives provided in this document are based on operational scenarios that are viable for the Metropolitan New Orleans area. The basic premise of the all three designs is that sensor information (volume, speed, occupancy, video, device status, etc.) from the roadway will be gathered and analyzed either manually or via computer algorithms in order to assess current roadway status and/or determine if there is an incident. In addition to just being of value to the traffic management function, this information is also valuable to emergency management, transit management, commercial vehicle operations and the traveling public. Looking at the “how” of information flows and processing are the focus of these design alternatives.

6.4.2 Characteristics

The design alternatives; Centralized, Distributed and Hybrid; are best described by looking at distinguishing characteristics, since all three provide the same basic functionality. These characteristics are detailed in the following text, and summarized in Table 6-2, below.

Levels of Coordination

Levels of Coordination are characterized by the inherent synergy of the three key management functions: traffic, emergency and transit.

- Alternative A consolidates all three under a single common umbrella or Intelligent Transportation System Center (ITSC).
- Alternative B provides a very high degree of independence among the three functions, assuming they are geographically dispersed. The other management functions are linked to the ITSC for voice, data and video communications.
- Alternative C includes LDOTD in the ITSC with Jefferson Parish. Communications links would be established with the other area Parishes, the City of New Orleans, as well as any other traffic, transit and emergency agencies.

Table 6-2. Design Alternatives

DESIGN CHARACTERISTIC	ALTERNATE-A: CENTRALIZED	ALTERNATE-B: DISTRIBUTED	ALTERNATE-C: HYBRID
Level of Coordination:	Tightly Coupled; Traffic, Emergency, & Transit Management	Uncoupled; Independent Traffic, Emergency, & Transit Management	Tightly Coupled Traffic; Independent Transit and Emergency Management
Control Logic:	Centralized	Distributed	Distributed
Number of ITS Centers	1	Center for each function	1 Main Center and several others
Data Processing:	Centralized; Tightly coupled computer system	Distributed; Very loosely coupled computer systems	Distributed; Tightly coupled for Majority of Processing and Data; Loosely coupled with Transit
Operations Impact:	Common staff to handle multiple functions	Independent staffs specialized for specific functions	Traffic functions shared but Emergency and Transit staff separate
Arterial Signal Control:	Centralized	Distributed to each Jurisdiction	Centralized for Key Corridors

Table 6-2. Design Alternatives (Cont.)

DESIGN CHARACTERISTIC	ALTERNATE-A: CENTRALIZED	ALTERNATE-B: DISTRIBUTED	ALTERNATE-C: HYBRID
Communications Network Complexity:	Simplified: Data flows to a Central Point for All	Complex: Data delivered to multiple locations; Information shared to multiple locations	Medium Complexity: Key Incident and roadway status centralized; Information shared with Emergency and Transit -

Control Logic

Control Logic focuses on where the responsibility and capability to control the functions exist. The alternatives considered include centralized control logic (Alternative A), in which all of the data processing for the entire metropolitan area is conducted through a single server, or a system with two servers, with a central information server to exchange information between the two servers and to provide information to outside sources, such as the media and traffic reporting agencies (Alternatives B and C).

- Alternative A centralizes the control of traffic, emergency and transit resources.
- Alternative B maintains the independence of each function to control its own assets.
- Alternative C is basically a single point of control, and maintains a sharing of information with emergency and transit, while it continues to control its own.

Number of ITS Centers

The options considered with respect to the number of ITS Centers include either a single ITSC for the entire Metropolitan New Orleans Area (Alternative A), or separate ITS Centers (Alternative B) for each agency. One advantage of the latter option is that it would allow the LDOTD to move forward independently, as funding permits. An advantage of a single ITS Center is that it would facilitate coordination of the activities by the State, the Parishes and the City of New Orleans and it also might present some economies of scale. Alternative C specifies one server housed in the main ITS Center and a few smaller ITS Centers for emergency and transit with information servers to receive and transmit information, which would allow autonomy for each agency while facilitating coordination between agencies.

Data Processing

Options considered include centralized data processing, where most of the data is processed at the central server in the ITS Center, or distributed data processing, where much data is processed in the field, some control decisions are automatically made in the field based on the results of field-processed data, and mostly processed data is returned to the ITS Center.

Advantages of decentralized data processing are that it reduces the amount of data required to be communicated to the functional centers, and decreases the processing loads on the central server(s). Distributed processing may also imply increased reliability, because the system is less dependent on the central server. Disadvantages of distributed data processing are that any increases in reliability due to increased redundancy with respect to data processing, communications and control capabilities usually result in an associated cost increase. Furthermore, there may be increased maintenance requirements due to the equipment not being located in a single location.

Operations Impact

Centralizing transit, traffic and emergency operations have impacts on the facilities required and the integration of existing operations. As described in Alternative A, all agencies must be in agreement in funding initial startup and continued operating costs. Economies should be realized in the staffing and operations personnel required to run the system. Alternative B maintains the existing "stovepipe" operations and does not derive any economies from overlapping tasks and responsibilities. Alternative C provides some level of synergy between traffic agencies for incident detection, verification, response and management. A close working relationship should expedite the response to incidents and effect control measures to minimize the impacts of the incident by notifying travelers via highway advisory radio or changeable message signs. Emergency and transit agencies would be provided with information on incidents and dispatchers would evaluate contingency plans if routes are affected.

Arterial Signal Control

Signal system management is of particular importance on arterial roadways that might be used as alternative routes during an incident on the freeway. New Orleans does have a number of freeways that may serve as primary alternate routes, but arterial roadways are normally impacted by any significant incident requiring re-routing of traffic. Since the scope of the Metropolitan New Orleans Area freeway system consists of routes crossing multiple jurisdictions with a variety of arterial signal control systems, it presents a significant problem in providing control or control information (e.g. expected demand) and having the timing plans updated if at all possible. There are several ways to control the signal system operations during diversions due to incidents. First, the individual agency would maintain control of the signal system and the LDOTD would request that the timing plans be changed to accommodate the increased diverted traffic. Second, LDOTD could develop a set of timing plans based upon a diversion of traffic during an incident and submit these timing plans to the owning agency. When the diversion is to occur the LDOTD would again request that the particular timing plans be utilized. Third, and probably the most effective, the LDOTD would have some level of control of the set of signals along the diversion route. When the diversion is to occur, the LDOTD would simply change the operations of the signal system to reflect the traffic volume changes. The latter would be the most efficient way to operate.

Communications Network Complexity

While the three designs are independent of the communications transmission system, there are levels of complexity associated with each.

- In Alternative A, all data and information flows into a centralized system and the sharing of information is collapsed into this single location.
- Alternative B is more complex since each function requires and maintains its own communications network to its assets, and an additional network is required to support the sharing of information.
- In Alternative C, several traffic entities share a common network with limited amounts of information (incident information) being shared with transit and emergency services. This minimizes the complexity and capacity aspects of the communications network.

A fiber optic communications medium was previously recommended in the Technology Assessment Technical Memorandum because it provides adequate capacity for all ITS applications, and has been proven in applications in other urban areas. While it does represent a major initial investment, it provides needed infrastructure into the foreseeable future for roadside subsystems such as detection and surveillance. Also, since most municipalities are located along the freeway system, any communication network would be a candidate for providing high-speed, high-capacity connections to them.

A star/ring communications configuration is preferable because the topology of the Metropolitan New Orleans freeway system most represents a hub and spokes with I-12, I-I0, I-55 and I-610 in and around the city. Branches from the ring would emanate as I-310, US 90, Lake Pontchartrain Causeway, I-59 and US 61. The ring configuration provides a physical security in facilitating alternate routing in case of a communications failure. Rings could be created on the branches by routing cable on both sides of the road or burying two conduit at different depths. This philosophy, while increasing communications reliability, does double the cost of material and increase the cost of installation. What is normally done is running a “collapsed” ring within a single cable bundle. This is usually acceptable since there are no “life support” functions within the system and the areas are usually on the outer fringes of the system.

6.5 Alternatives Evaluation

Each of the three design alternatives presented in Section 6.4 will accommodate the implementation of all User Services that have been identified by representatives of the agencies participating in this study for priority implementation in the Metropolitan New Orleans area (see Chapter 4). The top twelve (12) ranked User Services include: Incident Management, Traffic Control, Route Guidance, En-Route Driver Information, Emergency Notification and Personal Security, Emergency Vehicle Management, Hazardous Material Incident Response, Public Transportation Management, Pre-Trip Travel Information, Demand Management and Operations, Public Travel Security and Freight Mobility. In addition, because each design incorporates features compatible with the National ITS Architecture (see Section 6.2) all alternatives will be able to accommodate the implementation of any combination of the other ten (10) lower ranked User Services when, and if, they are ever deemed appropriate for implementation in the Metropolitan New Orleans area.

Even though each of the three design alternatives are equivalent from the perspective of satisfying User Service requirements, it is still necessary to determine which one of them implements the User Service requirements most efficiently, and most effectively. To do this, the design alternatives were evaluated from several perspectives including cost, system availability, flexibility, expandability, potential for staged deployment, potential for arterial diversion and institutional considerations. Table 6-3 summarizes the list of sixteen evaluation areas.

Table 6-3. Evaluation Assessment

EVALUATION CATEGORY	SPECIFIC DETAILS
cost:	Initial cost for equipment, installation, and software
	Maintenance cost
	Operating cost
System Availability:	Reliability of field equipment
	Reliability of communications network
	Reliability of data processing equipment
	Reliabilitv of operations center software/hardware
	Capability to monitor and control operations in the event of a break in communications capability

Table 6-3. Evaluation Assessment (Cont.)

EVALUATION CATEGORY	SPECIFIC DETAILS
	Extent of loss in capability due to a single break in communications capability
Flexibility:	Capability for equipment to operate independently or be controlled by the operations center
	Capability of one agency/jurisdiction to proceed independently of another
Expandability:	Extent to which system can be modified to provide additional capabilities at a later time (e.g. equipment)
	Ease with which the system can be expanded to encompass additional geographic areas
Potential for Staged Deployment:	Ease of incremental implementation with respect to technology, functions, or funding
Potential for Arterial Diversion:	Ease with which an arterial diversion scheme could be implemented, for example, the number of agencies and Intelligent Transportation Systems Centers that would need to be involved to change signal timing along an alternate route
Institutional Considerations:	Whether design is compatible with existing institutional framework, or whether new institutional agreements would be necessary

6.5.1 Cost

Included were consideration of capital costs, including the initial equipment and software costs; the cost for later enhancements to a system; and ongoing costs, namely system maintenance and operating costs.

6.5.2 System Availability

Included were consideration of the reliability of the field equipment, the communications equipment, and the data processing equipment (i.e. expected failure rates); the impacts that result from equipment failures; and the capability of a system to accommodate equipment failures based on the level of redundancy of the system.

6.5.3 Flexibility

Included were consideration of both the capability of system functions to be operated independently of the center, and for one agency/jurisdiction to proceed independently of another agency/jurisdiction.

6.5.4 Expandability

Included were consideration of technological expandability for the inclusion of still-to-be-developed components in the future, as well as geographic expandability to encompass additional corridors or extensions **of** existing corridors.

6.5.5 Potential for Staged Deployment

Included were the ease with which a proposed design could be implemented in discrete but operable segments over a period of time, including the ability to add additional ITS functions (i.e. automatic vehicle location and automatic vehicle identification, etc.) at a later date. For example, a project may be segmented with respect to either geography, with certain corridors operational prior to others; or with respect to technology, with more advanced equipment being implemented as justified by changes in operating conditions, or as additional funding becomes available.

6.5.6 Potential for Arterial Diversion

Included here is the ability of the system to facilitate the implementation of an arterial diversion scheme, the ease with which an arterial diversion scheme could be implemented, and the effectiveness of such an arterial diversion response. For example, capabilities for arterial diversion will usually depend on the operating agreements with local jurisdictions, as well as the sophistication of the signal control equipment on the affected arterial roadways.

6.5.7 Institutional Considerations

Included was the feasibility of a system to be implemented with respect to non-technical/jurisdictional considerations. For example, a system that is technically satisfactory will be of no benefit if it cannot be implemented due to institutional obstacles.

6.5.8 Recommended Architecture

The architecture recommended for implementation in the Metropolitan New Orleans Area is Alternative C. This alternative includes one main central server with a central information server to transmit and receive information between the other ITS Centers. This control logic will provide autonomy for the LDOTD, yet will facilitate coordination and provide redundancy. Coordination will also be enhanced by specification of a single Intelligent Transportation System Center (ITSC). With respect to data processing, the recommended alternative utilizes centralized data processing, which is the standard and proven system used in most applications across the country. The communications network is a fiber optics backbone in a star/ring configuration, which will have adequate capacity for all anticipated components. Emergency management coordination will be based on the existing 911 dispatch system. ITSC operators will contact emergency responders directly using the 911 system. Follow up coordination may be via either telephone or radio. The recommended architecture takes a hybrid approach to arterial signal control. Some arterial signal systems will be controlled from the ITSC, while others will be controlled outside the ITSC by the Parishes or the City of New Orleans. The ITSC should work closely with cities that will maintain signal control, pre-planning appropriate timing plans, and notifying city personnel in the event of an incident. The final characteristic identified by the architecture is coordination with public transit. Public transit functions will be maintained outside the ITSC, although this does not preclude coordination of activities, particularly for the dissemination of information.

This architecture includes some of the best features of both the completely centralized and decentralized systems. This architecture is compatible with the large number of local agencies, because it takes a hybrid approach to characteristics such as signal control. At the same time, specification of a single ITSC will facilitate coordination and communication between the state, the Parishes and the City of New Orleans resulting in a seamless system for the entire metropolitan area.

6.6 A LONG-TERM VISION STATEMENT

Once an architecture has been selected for the area, it is then necessary to picture how it would function in the Metropolitan New Orleans area. Therefore, a Vision Statement for the area has been created.

6.6.1 What is a Vision?

- A vision is the ability to see the potential in, or necessity of, opportunities right in front of you.
- A vision is not a forecast of the future -- it is creating the future by taking action in the present.

6.6.2 Basic Elements of the Vision

The Advanced Transportation Management System (ATMS) for Metropolitan New Orleans should provide an integrated system for the movement of people and goods on the freeway and arterial highways and transit system. The system should create a seamless link among agencies including Louisiana Department of Transportation and Development (LDOTD), Jefferson, Orleans, St. Bernard and St. Tammany Parishes, Emergency Medical Services (EMS), law enforcement agencies, Regional Transit Authority (RTA) Jefferson Parish Transit, the City of New Orleans, Crescent City Connection, Greater New

Orleans Expressway Commission and private interests. Through current and advanced techniques in surveillance and communication, data on real time traffic flow and weather information will be available to users. Through partnering among agencies use of existing resources can be maximized to improve regional transportation operations and responses to incident conditions.

6.6.3 **Goals for the** ATMS **System in the Metropolitan New Orleans Area**

GOAL **1:**

Implement an Advanced Transportation Management System (ATMS) for the New Orleans region that strikes a cost-effective balance. In the balance, consider:

- comprehensive geographic coverage
- wide range of technologies
- expressways and arterial roadways
- multi-modal perspective
- eventual 24 hour span of coverage

as well as:

- regional benefits
- costs
- funding availability for capital and operational needs.

GOAL 2:

Establish an Advanced Traveler Information System (ATIS). It should:

- widely disseminate real-time information
- provide alternate route information during emergencies
- develop a Roadway/Weather Information System (RWIS) and use it to provide information to key users and general public

GOAL 3:

Continually improve emergency response on the transportation network. In doing this:

- provide delineation system on the roadway for use by highway users
- create an Intelligent Transportation Systems Center that manages traffic flow
- provide a resource for the Incident Commander as part of the Incident Command System
- provide links to the office of emergency preparedness and Civil Defense
- consider traffic signal pre-emption
- promote regional cooperation among agencies with overlapping responsibilities

GOAL 4:

Promote private/public partnership opportunities, such as:

- Emergency service patrols

- Industry
- Education facilities
- Parking facilities
- CB users
- Equipment suppliers
- Communications
- Closed circuit television cameras
- and others

GOAL 5:
Promote feedback and ongoing evaluation of the performance of all ATMS/ATIS components.

6.6.4 Highlights of the Vision

LDOTD should build, maintain and operate an ATMS on the entire freeway network in the Metropolitan New Orleans Area.

- The ATMS should be implemented incrementally, justifying and building public support continually.
- LDOTD, City of New Orleans and the area Parishes should develop and/or upgrade and/or expand any existing traffic control systems and integrate them with the ATMS.
- Communications and operations links should be developed between the ATMS and other relevant agencies in the area.
- Private sector participation in the ATMS should be encouraged.
- Partnering activities should be encouraged between participating agencies.
- Incident management activities, including rapid response to incidents, should be implemented.
- The Regional Transit Authority (RTA) should upgrade its monitoring activities to include automatic vehicle location (AVL).
- The Jefferson Parish Transit should upgrade its monitoring activities to include automatic vehicle location (AVL).
- RTA should upgrade, collect and distribute real time information on transit services.
- The Jefferson Parish Transit should upgrade, collect and distribute real time information on transit services.
- ATMS information should be used for transportation and transportation-related enforcement activities.
- Training programs for ATMS should be prepared to educate staff of participating agencies.

6.6.5 Detailing the Vision

A vision statement includes a set of indicators of where policy should be developed to further the agreed-upon goals. For the Metropolitan New Orleans

Area ATMS, the following categories have been explored by the participating agencies:

- Needs of the Relevant Agencies
- Customers and the Benefits Received
- Roles and Responsibilities of the Relevant Agencies
- Other Issues

6.6.6 Needs of the Relevant Agencies

Agencies which have a direct interest in the establishment of the ATMS have been identified and encouraged to participate in the establishment of the ATMS. These agencies should ultimately include the following:

- Louisiana Department of Transportation and Development
- Louisiana State Police Troop B
- Jefferson Parish Department of Public Works
- Orleans, St. Bernard and St. Tammany Parishes
- Public Safety Departments
- Emergency Preparedness Offices
- Sheriffs Offices
- Regional Transit Authority
- Jefferson Parish Transit
- Regional Planning Commission
- City of New Orleans Police Department
- City of New Orleans Department of Streets

The needs of these agencies were derived from a survey conducted in 1995, along with discussions since that time. The survey revealed these crucial information needs: real-time traffic conditions, incident status, weather status, tracking transit vehicles, variable message signs (VMS) for motorists, and transit rider information. The technical needs of the agencies include: signal system upgrade, fiber optic communications links and training. There was an expressed need for one traffic management/information system to: provide strategic and long range direction, foster coordination, avoid duplication and foster a common language. The interviews revealed an outline of what the system needs: comprehensiveness in geography, technologies and modes, 24 hour access, coverage of all expressways and arterial roadways, incident management that includes all police and links to offices of emergency preparedness system/Parish alerting system. Open issues cited in the interviews include: the role of the private sector, funding sources and implementation. The 1995 surveys were used to form a basic structure for discussion among the agencies. The agencies have met repeatedly to outline an integrated information and data system. For the New Orleans ATMS, the following needs and goals have been identified:

Information Needs

- Real-time traffic conditions (traffic volumes, classifications, weigh-in-motion, speeds, densities)
- Incident status
- Weather status/roadway conditions
- Tracking transit vehicles
- Variable message signs (VMS) for motorists
- Transit rider information
- Events management
- Park & ride locations and availability
- Downtown parking management

Technical Needs

- Signal system development and/or upgrade and/or expansion
- RoadwayWeather Information System (RWIS)
- Fiber optic communications links
- Training

Integration of Traffic Management and Other information Systems Needs

- Foster common language
- Provide strategic, long range direction
- Foster coordination
- Avoid duplication -- allow piggybacking

6.6.7 Customers and the Benefits Received

As the New Orleans ATMS is implemented, real benefits will accrue to three distinct sets of customers:(l) End User Customers -- Automobile users, commercial vehicle operators (CVOs) and transit riders; (2) Interim Customers -- Public agencies charged with preserving safety and mobility on the roads; and (3) Regional Residents and Businesses. The manner in which these customers **receive** benefits **is** outlined below:

End User Customers -- Automobile Users, CVOs and Transit Operators and Riders

- Improved traveler information; re: location guidance, incidents, delays, alternative routes and weather problems.

- Greater variety of means of receiving real-time, relevant and useful information.
- Improved travel times and travel time reliability on the roads, due to better incident management and better travel advisories.
- Safer conditions on the road, due to better incident management, delay reduction and better traffic advisories.
- improved route guidance for transit riders and reassurance of arrival and departure status.

Interim Customers -- Public Agencies Charged with Preserving Safety and Mobility on the Roads

- Improved quality and timeliness of information so that it directly enhances their ability to perform their work.
- More efficient use and management of personnel, physical resources and funding.
- Improved credibility of agencies -- better able to meet the needs of their customers, and better able to communicate directly with customers.
- Improved, continually evolving traffic information data base for participating agencies.
- Improved timeliness of service, including on-time transit performance.
- Improved interagency coordination.

Regional Residents and Businesses

- The economic competitiveness of the region is improved because of improved flow of goods and services.
- Travelers experience a transportation system that is closer to being “seamless” -- among various highway network links, and between highway and transit modes, which makes fare or toll collection easier for users.
- The quality of life for area residents will be maintained or improved, due to a reduced strain on driving conditions; people feeling that they have more control over their lives as a result of having better information; and added safety to their daily lives.
- Improved sense of community identity
- Benefits to commercial vehicle operators and industries may be measurable in terms of reduction in delivery times and increased efficiency of just-in-time deliveries.
- In-vehicle information, both aural and visual, aids individual decision making before and during travel.

6.6.8 Roles and Responsibilities of the Relevant Agencies

The following is a description of the future roles and responsibilities of the agencies participating in establishing an ATMS for the Metropolitan New Orleans Area:

Louisiana Department of Transportation and Development

LDOTD will build maintain and operate an Advanced Transportation Management System (ATMS)/Advanced Traveler Information System (ATIS) on the entire freeway network in the Metropolitan New Orleans area that should consist of the following:

- The LDOTD's Roadway/Weather Information System (RWIS) should be advanced and incorporated into the ATMS.
- Control of all field equipment on the expressways is with the LDOTD traffic operations group.
- Equipment, primarily covering the freeway/expressway network, that includes a variable message sign (VMS) system, a traffic detection system, a closed circuit television (CCTV) surveillance system, and a highway advisory radio system. Additionally, provisions should be made to incorporate a traveler information kiosk system in key generators in the area and to offer a highway advisory telephone (HAT), and an electronic bulletin board system **to** the citizens and businesses in the area.
- Other systems, not presently justified by the existing or future traffic conditions, may include a freeway/expressway ramp metering system and a high occupancy vehicle (HOV) network. These should be continually evaluated over time.
- Any moveable bridges should be included as part of the ATMS to monitor the status of the bridges. This information will be useful in determining diversionary routes for traffic during incidents.
- The status of any at-grade railroad crossings should be incorporated as part of the ATMS. This information will also be useful when choosing alternate routes during times of incidents.
- The Toll Authorities should advance the use of electronic toll collection equipment. An electronic toll and traffic management (ETTM) system should utilize transponders for electronic toll collection (ETC). With transponder-equipped vehicles used as probes, individual vehicle travel times can be measured between instrumented reader stations. With sufficient market penetration, this direct measurement may be a better indication of congestion along expressways, freeways and major arterial roadways, than presently available methods of detection.
- Additional traffic signals, not already on a traffic control system, should **be** accommodated so the signal systems can monitor traffic and be made part of the overall ATMS.

- Freeway service patrols should be incorporated/expanded into the overall traffic and incident management system to help in the removal of disabled vehicles associated with minor incidents.
- **These** ATMS/ATIS systems, described above, should be operated and maintained by the appropriate agency, either directly through increased staffing and training or contracted to an outside company or agency.
- The traffic operations staff should be a totally dedicated single function unit coming under the Traffic and Safety Section-of the LDOTD supported by maintenance staff.
- LDOTD should have sole control of the operations of the freeway/expressway systems.
- The LDOTD, City of New Orleans and the area Parishes traffic signal systems should be compatible to allow for the option of "joint control" should there be a need for joint operations of the traffic control system in the future.

City of New Orleans and Jefferson, Orleans, St. Bernard and St. Tammany Parishes

The City of New Orleans and the area Parishes should upgrade any existing traffic control systems to a system that can be totally traffic responsive and would have integration capabilities with a large regional system on a PC based multi-tasking platform with a geographic information system (GIS) based computerized graphical map display (compatible with other agencies).

The upgraded traffic control systems should be interfaced with the freeway/expressway system and with the State's traffic control system using a common database and reactive to the same conditions. The system must be capable of including traffic signals at the ramp termini with end of queue detectors on the ramps for ramp metering.

- The remainder of the Parishes and City of New Orleans signals, not yet included in a system, should be incorporated into the upgraded PC based systems.
- The area Parishes should have primary control of operations of the signal system outside of the City limits.
- The freeway management system and traffic signal system of the LDOTD and the signal systems of the area Parishes and the City of New Orleans should operate under a networked, distributed operating system; ultimately housed in the same center.
- The area Parishes, City of New Orleans and LDOTD should each have control of any CCTV cameras on the arterial network, while LDOTD should retain primary control of those cameras on the expressways. Communications should be established for multiple agencies to view any CCTV camera image at any time.
- The area Parishes, City of New Orleans and LDOTD should implement signal pre-emption for emergency and transit vehicles on the arterial system.

Louisiana State Police Troop B

The State Police should be located in the Intelligent Transportation Systems Center (ITSC) with LDOTD, City of New Orleans and any of the area Parishes interested in being physically located in the ITSC. An officer, with the authority to make decisions with regard to traffic control and safety, should be located at a traffic operations console for command and control of police operations.

- State Police should have no direct control of the operations of the freeway/expressway or traffic signal equipment.
- The police desk should be able to view the CCTV camera images and should be able to request selection and movement of the CCTV cameras.
- The police desk should be able to view the freeway and arterial status displays.

Greater New Orleans Expressway Commission, Crescent City Connection

- The Greater New Orleans Expressway Commission, Crescent City Connection should at least have dial-up remote access to the ATMS information and status display.
- The Greater New Orleans Expressway Commission, Crescent City Connection should have no control of the equipment off of their jurisdiction.
- The ETTM system should be implemented in the Metropolitan New Orleans Area and use of the ETTM system as a means of detection of incidents in the appropriate areas of the network should be pursued.

Regional Transit Authority/Jefferson Parish Transit

A communications link should be established between the ITSC and the transit dispatch center(s) for direct access to the recurring and nonrecurring traffic information. The transit agencies should consider locating one operations person in the Intelligent Transportation Systems Center for two purposes; 1) to be the contact at the ITSC for RTA's automatic vehicle location (AVL) system information, and 2) to contact the RTA and Jefferson Parish Transit dispatch center with traffic flow information from the ATMS.

- The transit representative(s) should have no control of the operations system equipment, but should be able to request information.
- The AVL system displays would be included in the ATMS PC based multi-tasking environment and be used as a primary or secondary source of traffic flow information.

911 Center/Office of Emergency Preparedness

- The 911 Center should have a two-way communications link with the ITSC.

- The 911 Center can serve as a primary detection source from cellular 911 calls. These calls can provide direction as to which CCTV cameras to view or in general where an incident has occurred.
- The Emergency Operations Center (EOC) should have a two-way communications link with the ITSC.

City of New Orleans Department of Public Works

- A two-way communications link from the ATMS to the City of New Orleans and any Parish not located in the ITSC should be established. This could include such agencies as Engineering, Department of Environmental Services, Municipal Parking, Police and others.
- Information on the freeway network should be available to the appropriate agencies at the City of New Orleans and the participating Parishes, especially during special events. Ultimately, control of all field equipment is with the LDOTD ITS Division.
- Information on the arterial roadway system should be available to the LDOTD, with control of the field devices resting with the City of New Orleans.

6.6.9 Issues in Implementation

Maintenance Issues

Agencies participating in the ATMS should develop clear guidelines on the maintenance of the elements of the system. The following are beginning elements of assigning responsibilities for maintenance:

- A flexible agreement between LDOTD, City of New Orleans and the area Parishes should be expanded for the maintenance of the signals. The agreement needs to be flexible to account for any changes that might occur in the jurisdiction of certain traffic signal systems.
- New traffic signals added to the area Parish systems should be maintained as part of an agreement between LDOTD, City of New Orleans and the particular Parish.
- Maintenance agreements should be formalized and written, whether the work is done in-house by public agencies or by contract with private firms.
- Maintenance of other ATMS equipment should be formalized and written, whether the work is done in-house by public agencies or by contract with private firms.
- Space at the ITSC should be reserved for maintaining, testing and troubleshooting; either on-site or off-site storage should be provided.
- Consideration should be given to establishing central dispatching for all traffic signals to simplify complaint reporting by the public.

Operations Issues

Agencies participating in the ATMS should also develop clear guidelines on the operations of the ATMS system. These responsibilities should grow from the following initial principles of operation including:

- LDOTD, City of New Orleans and the area Parishes should determine which traffic signal systems will be within which jurisdiction. This could be determined on a case-by-case basis. Certain systems could become part of the state system, others could remain within the Parish system, and some individual intersections could change jurisdictions.
- Any new ramp metering signals on the freeways should be LDOTD's responsibility.
- LDOTD, City of New Orleans and the area Parishes traffic signal systems should be as compatible as possible, should joint operations of the traffic control system be necessary and/or desirable in the future.

Open Issues

There are several issues that will continue to be explored and which will be continually updated as new information becomes available:

- Funding sources: agencies, balance, availability
- Full implementation
- Policy on CCTV use -- Traffic purposes or commercial viability
- "Open architecture" for in-vehicle navigation systems
- Modify to incorporate new technologies

Private Sector Issues

- Wherever possible, the private sector should be involved in developing and expanding the ATMS.
- Private sector should include, but not be limited to, universities/colleges, manufacturing and service companies, the broadcast and print media, communications and entertainment companies, etc.
- The areas where the private sector should participate include freeway service patrols, information kiosks, new products testing, area wide communications network development, etc.

6.7 Intelligent Transportation Systems Center

6.7.1 Background

The Intelligent Transportation Systems Center (ITSC) will serve as the centerpiece of the New Orleans ATMS. Most ATMS functions will be performed at the ITSC. Both technically and visually, the ITSC will play a major role in defining the success and public image of the New Orleans ATMS.

The internal functions of the ITSC will include items such as incident management, traveler information systems operations, freeway and arterial monitoring, congestion management and other ITS activities. Important to the success of the internal operations of the ITSC is the facilities (i.e. building, grounds, utilities, etc.) and location. Adequate floor space, highway access, communication linkage, site security, building construction and alternate route access all contribute to a successful ITSC.

6.72 ITS Center Evaluation

There are eight categories which describe the various site attributes for an ITSC. The following is a listing and description of these categories.

Ownership - States whether the property is owned or leased.

Space Availability - Lists amount of space available for the ITSC. This is given in square feet for existing structures, and acreage for vacant lots.

Highway Access - Indicates distance to the nearest access to the highway system.

Emergency/ Alternate Access - Lists alternate routes from the site to the highway system. These routes are in addition to those listed in the highway access category.

Costs Reflects approximate site preparation costs. That is, the cost of all items necessary to prepare the site for the installation of the ITSC. Included within this would be items such as building construction or renovation, utility connections/installations, communication linkage, property acquisition, etc.

Communication Link Potential — This category reflects proximity to fiber optic networks, microwave towers, and telephone lines, types of telephone lines, cellular phone usage, short range microwave capabilities, etc.

Site Utilities - Includes existence or availability of utilities such as electricity, sewer, HVAC, gas and water.

Site Security - Includes items such as fences, barriers and adjacent types of development.

The result of this criteria a list of target requirements for a potential site which represents the minimum criteria for the ITSC. These represent those attributes a site should have to successfully develop the ITSC.

The following is a list of the general criteria.

a) Site Area - 2 acre (87,120 ± sq. ft.)

b) Available Parking - 45 to 60 available parking spaces

c) Building Area - 12,000 to 20,000 sq. ft.

d) Building Volume - Ability to have 12’ - 0” clearance (min.) within control center (approx. 1,000 to 1,500 SF area), 8’-0” elsewhere

e) Construction Type - Non-combustible/fire protected steel framing or masonry construction

f) Exterior Windows - Acceptable for office use, minimize for operation center

g) Floor Loading - 50 PSF (if existing structure to be used)

h) Elevator (if existing multi-floor building to be used)

i) Proximity to major highway corridors - Site should have direct access or be in close proximity to the primary freeway system.

j) Availability to alternate route access and emergency routes

k) Communication linkage - existing or potential telephone line

l) Utilities - existing or potential for gas, water, electricity, sewer, and storm

6.7.3 Suggested Location

Although other sites were mentioned during the course of the study, the preferred location for the ITS Center is the site at the intersection of Veterans Memorial Boulevard and Pontchartrain Boulevard.

Chapter 7
STRATEGIC DEPLOYMENT AND OPERATIONS PLAN

7.1 Introduction

7.1.1 Guide to Deployment of Intelligent Transportation System Equipment:

General

This is intended to be a guide for locating Intelligent Transportation System equipment along roadways in the Metropolitan New Orleans area. The database of traffic and accident information should be used as a basis for locating nonrecurring and recurring congestion. This database should be used to define which routes and the limits of the routes where ITS is deployed. The criteria for locating recurring and nonrecurring congestion is shown below.

RECURRING CONGESTION CRITERIA

FREEWAY/INTERSTATE	DIVIDED ARTERIAL	UNDIVIDED ARTERIAL
15,000 AADT/Lane	10,000 AADT/Lane	7,500 AADT/Lane
LOS E/F	LOS E/F	LOS E/F

NONRECURRING CONGESTION CRITERIA

FREEWAY/INTERSTATE	DIVIDED ARTERIAL	UNDIVIDED ARTERIAL
12,000 AADT/ Lane	8,000 AADT/Lane	5,000 AADT/Lane
7-8 Accidents/Lane/ Mile/Year	1 l-l 2 Accidents/Lane/ Mile/Year	14-l 5 Accidents/Lane/ Mile/Year
LOS D, E/F	LOS D, E/F	**LOS** D, E/F

Currently available and acceptable, state-of-the-art technology for ITS system components should be employed whenever possible. However, life cycle cost comparisons should be used to determine the most cost effective equipment to be used. The cost of training, maintenance and operation are important criteria.

Benefit:Cost ratios should be developed to determine the order in which systems and system components should be deployed and the intensity of equipment and systems. The choices for traffic diversion routes should be prioritized as follows:

First:	Limited Access Highway to Limited Access Highway
Second:	Major Arterial Roadway to Limited Access Highway
Third:	Limited Access Highway to Major Arterial Roadway
Fourth:	Major Arterial Roadway to Major Arterial Roadway
When and where appropriate:	Diversion to Mass Transportation

The key to mitigating the impact of diverted traffic on any one roadway is to provide the information as wide spread as possible to the motorists. This allows the motorist to choose the diversion route well in advance of the incident. Providing information to the motorist about the extent of the queue developed by the incident may help motorists to stay on their route to reach their destination.

Diversion Routes

If the alternate Interstate or Limited Access Highway has not been instrumented, then manual means of monitoring the alternate route should be deployed until the alternate route has been instrumented. This can be accomplished through roaming service patrols and cellular call-in by motorists to the Parish 911 center(s) or to the ITS Center.

An analysis of the capacity of the available adjacent alternative roadways should be performed. A list of criteria which would eliminate a roadway from being an alternative route is as follows:

- Substandard roadway alignment or geometrics
- Lack of shoulders
- Residential areas
- Schools
- Hospitals
- Heavy pedestrian traffic
- Active railroad crossings
- Substantial change in speed limits
- Circuitous routes
- Roads which require resurfacing and/or reconstruction
- No traffic signals to control or use to artificially increase capacity for diverted traffic.

Variable Message Signs (VMSs):

On lnfersfafe and other Limited Access Highways:
VMSs should be placed prior to interchanges with Interstate and other Limited Access Highways for alternate route diversion. VMSs should be placed approximately 3/4 of a mile prior to the alternative route decision point; keeping

in mind the sight distance necessary to read a message of three panels of three lines each at the prevailing speed of the roadway. Special attention should be given to vertical and horizontal curves.

On Major Arterial Roadways; *at least two (2) lanes per direction:*
VMSs should be placed prior to interchanges with Interstate and other Limited Access Highways as well as Major Arterial Roadways. VMSs should be placed approximately one 1/2 mile prior to the decision point; keeping in mind the sight distance necessary to read a three-panel message at the prevailing speed of the facility. Special attention should be given to vertical and horizontal curves.

On Minor Arterial Roadways; one (1) lane per direction:
The option of smaller, less sophisticated and less expensive changeable message signs (CMSs) should be considered (i.e. rotating drum signs, blank-out signs, or electro-mechanical flip panel signs). These CMSs should be used due to their relative cost as compared to the number of motorists that will use the information on the CMS. The use of these CMSs would be less obtrusive and would provide information to the motorist as to the conditions of the adjacent facility (i.e. either normal conditions ahead with no message; or roadway closed ahead using the appropriate message).VMSs should avoid being located prior to interchanges with roadways that have little or no capacity to accept the diverted traffic.

Closed Circuit Television Cameras (CCTV):

CCTV cameras should be deployed along roadways that meet the criteria for high accident locations. CCTV cameras should be placed at such intervals as to cover the entire segment of roadway that meets this criteria.

For all other roadway segments, CCTV cameras should be considered at interchanges with other Interstate and Limited Access Highways, and interchanges with Major Arterial Roadways. More than one CCTV camera may be needed depending upon the site conditions. These CCTV cameras would be used to verify the conditions of interchanges to diversion routes before, during and after a diversion plan. In many cases the capacity of the interchange is unable to accept the additional traffic volume, especially at peak traffic times. The CCTV images could be used to determine whether diversions should be used and/or continued or be discontinued.

Traffic Volume, Travel Speed and Traffic Density Detection Systems

Detection systems provide information on speed, traffic volume and remaining capacity on the diversion routes. Detection equipment should be deployed along roadways that meet the criteria for high incident roadways. It also must be considered that detection equipment be deployed along segments of roadways that act as links between alternative routes. These detection systems could provide valuable information with regard to travel speeds and traffic volumes to determine the usefulness of a link for diversion purposes.

Detection Systems should be deployed on roadways that meet the high accident criteria and should be placed at intervals along the roadway that provide the most cost-effective use of such systems (i.e. 1/2 mile spacing or between interchanges). Whenever possible, detection equipment should be employed that is non-intrusive to the flow of traffic. This provides detection equipment that can be installed, operated and maintained with minimal disruption to traffic flow.

Coordinated Arterial Traffic Signal Systems

The coordination of traffic signal control should be deployed along those signalized arterial roads that experience recurring congestion and are important as alternate routes. In some special cases, control of an isolated traffic signal would be necessary when that signalized intersection provides access between alternate routes.

Management of coordinated traffic signal systems should follow the criteria for high accident locations along arterial roadways. In such cases the deployment of CCTV should follow the "Closed Circuit Television ***Cameras (CCTV)"*** section of this guide. The deployment of VMSs should follow the criteria for ***"Variable Message Signs (VMSs)"*** in this guide. The deployment of detection equipment should follow the section on ***"Traffic Volume, Travel Speed and Traffic Density Detection Systems".***

Highway Advisory Radio transmission (HAR)

It is recommended that a system of individual HAR transmitters be deployed to cover the entire area. The transmission ranges should be set and the transmitters should be located such that they do not overlap or interfere with one another. An area wide initiative should be deployed. This initiative should coordinate with the HAR of the airport and the toll authorities. Some degree of cooperation, coordination and shared use of the messages on HAR between the airport, the toll authorities and the State in the area should be developed based upon location, severity and impact of an incident on the adjacent agencies roadway.

Communications

There are several issues that need to be explored when deciding on communications for an Intelligent Transportation System. Two major options exist; agency owned system and public telephone communications The agency owned communication requires a long lead time for implementation, possibly up to five years. Developing plans, specifications and estimates for such a project can be time consuming and costly. While the telephone company communications system would require a shorter lead time, possibly less than 6 weeks to develop agreements and establish fees.

Maintenance **is** also an issue with which to be concerned. An agency owned communications system of cable and electronics needs a full time maintenance crew dedicated to this aspect. When there is a problem with the system, the crew must be able to react in a moments notice. When the system is down, valuable information is not being transmitted from the field to the ITS Center, The telephone company maintains their communications infrastructure. The maintenance costs of an agency owned fiber optic communications system could be an average of 5 to 7 percent of the installed cost. This is an annual cost. There are trade-offs to choosing one form of communications over another. In many cases, a hybrid situation is warranted based upon the density of the equipment along a segment of roadway.

7.1.2 Area of Coverage

The expressway system within the Metropolitan New Orleans area has been the primary consideration in developing the Strategic Deployment Plan for an area wide Advanced Transportation Management System (ATMS). There are approximately 200 miles of expressway in the study area. The arterial network would provide the alternate routes for incident management and would thus need to be integrated into the total transportation plan. Approximately 150 miles of arterial routes have been analyzed within the study area. The study area and suggested implementation phasing is shown in Figure 7-1. The Jefferson Parish traffic signal system control has been considered for co-location within the Louisiana Department of Transportation and Development (LADOTD) Intelligent Transportation System Center (ITS Center).

7.1.3 Agency Involvement

The Steering Committee formed during the process of this study is comprised of representatives of the LADOTD as well as various transportation, emergency management and private sector agencies within the Metropolitan New Orleans area. The participating agencies are listed below.

- Regional Planning Commission
- LADOTD
- FHWA
- FTA
- Highway Safety Commission
- LA State Police
- Jefferson Parish

- Regional Transit Authority
- Jefferson Parish Transit System
- City of New Orleans
- St. Charles Parish
- St. Tammany Parish
- St. Bernard Parish
- St. John Parish
- Plaquemines Parish

This committee should continue to meet on a periodic basis to discuss the outcome of major incidents, to plan construction and maintenance activities, as well as to guide the planning and design process of the Advanced Transportation Management System, to deploy early action ATMS strategies set forth in this plan and to promote improved communications between emergency response and management agencies. In addition to the agencies involved with the Steering Committee, The Greater New Orleans Expressway Commission and the Crescent City Connection have been contacted for coordination with the ATMS agencies which will be necessary when equipment is deployed in the vicinity of their facilities. Figures 7-2A and 7-2B illustrate the locations of the agencies that have a potential need to be linked to the **ITS** Center. Figures 7-2A and 7-2B also show the communications infrastructure proposed for the ATMS and the City of New Orleans proposed communications network. These figures are used to illustrate the communication linkages that are necessary to keep all agencies informed with regard to traffic and transportation information.

7.1.4 Deployment Schedule

Figure 7-l shows the segmentation or phasing of the ITS implementation described below. The segmentation is based upon logically manageable routes with the segments to eventually become one cohesive and comprehensive system to be managed.

Near-Term (Early Action Items) - Initial projects and/or actions which can be implemented within two years from the decision to proceed.

Short-Term (First Phase) - Projects and/or actions planned to be implemented in a time frame of two to five years from the decision to proceed.

Medium-Term (Second Phase) - Projects and/or actions to be implemented in a five to ten year time frame from the decision to proceed.

Long-Term (Third Phase and *Fourth Phase)* - Projects and/or actions to be implemented more than ten years into the future.

Figures 7-2A, 7-2B, 7-3A, 7-3B, 7-4A, 7-4B, 7-5, 7-6, 7-7 and 7-8 have been prepared to illustrate essential equipment locations of VMS, CCTV, communications infrastructure, traffic signal systems and HAR. Discussion of individual recommendations are presented below:

7.2 Implementation Plan Recommendations:

The Parish 911 Center(s) will be the relay point(s) of communications for incident command, control and dispatch within the Metropolitan Area. The ITS Center will facilitate detection and surveillance capabilities to decrease the amount of time it takes to detect and verify an incident on the area wide roadway network. The ITS Center will provide the necessary information to the 911 Center. The ITS Center will manage the transportation network through traffic signal control, VMSs and HAR broadcasts in coordination with the 911 Center. The 911 Center(s) will provide information to the ITS Center on locations of incidents called in by cellular phone users.

7.2.1 Near-Term Implementation Plan, within 2 years:

The following recommendations are designed to deliver the maximum benefit for the least amount of initial investment and to build a sound foundation for a future regional Advanced Transportation Management System.

It is necessary to implement such devices as the milepost/kilometerpost markers, landmark signs and route/direction designation signs and “Accidents/Incidents - Call 911” signs prior to developing the electronic deployment. The static signing provides the location designation for the existing operations of incident management. These static signs provide information to the motorist for locating incidents as well as providing information to the traffic incident responders, Training is essential to familiarize the incident response personnel with the more automated methods of detecting, locating and verifying incidents. Cellular phone users must be educated in the use of the milepost/kilometerpost markers when reporting incidents to the 911 operators.

Incident Repotting and Response (All routes within the study area)

- Deploy milepost/kilometerpost markers, landmark signs, and route/direction designation signs for freeways only (arterial roadways have cross streets and other reference markers).
- Deploy “Accidents/Incidents - Call 911” signs for low-tech, low-cost incident detection system fro freeways and arterials within the study area.
- Educate cellular phone users on what information is necessary to report an incident; i.e. develop insert for cellular phone bills with the roadside markers and **how** to read them.

- Existing Cellular 911 Center(s) continue(s) to take calls for expressway incidents, but in an increased capacity, due to the implementation of the "Call 911" program along the area freeways and arterial roadways.

- Appropriate police agency dispatched via Cellular 911 Center(s) to verify/assess incidents, establish command post; field command will continue in the same manner with the 911 Center as the point of contact for dispatching additional equipment and personnel to the scene.

- Collect and disseminate construction and maintenance information on a weekly basis to the participating agencies and to the public via print media.

Incident and Traffic Management

- Develop training program for field commanders to understand the ITS Center functions and management capabilities; establish clear signing plans and response protocols for incident management.

- Set up the temporary ITS Center which will be responsible for the coordination of construction and maintenance between the Parishes, City, State and Toll Authority agencies, coordination of traffic for special events management by utilizing portable, cellular-controlled variable message signs (VMSs) and permanent highway advisory radio (HAR) transmitters. This step must be implemented in order to further the development of the traffic and incident management process.

- Begin to establish closed-circuit television camera locations in high accident locations for verification of cellular phone calls to 911, via low speed equipment over the public telephone network or over wireless transmissions. Choose CCTV camera locations from the following list of high accident locations in the first phase of implementation:

Location	Phase
I-10 and Louisa Street	I
US 90 and Highway 48	II
West Bank Expressway and Barataria Boulevard	II
West Bank Expressway and Manhattan Boulevard	II
Airline Highway and Causeway Boulevard	II
West Bank Expressway and Stumpf Boulevard	II
Judge Perez Drive and Paris Road	II
I-10 and West End Boulevard / Pontchartrain Boulevard	I
West Bank Expressway and Belle Chasse Highway	II
Jefferson Highway and Causeway Boulevard	II
Pontchartrain Expressway and South Claiborne Avenue	I
Causeway Boulevard and Veterans Memorial Boulevard	I
Chef Menteur Highway and Downman Boulevard	I
Clearview Pkwy. and Veterans Memorial Boulevard	I

Location	Phase
South Claiborne Avenue and Melpomene Avenue	II
I-10 and Chef Menteur Highway	I
I-10 and I-610	I
Causeway Boulevard and West Esplanade Avenue	I
Severn Avenue and Veterans Memorial Highway	I

- Develop early action initial Incident and Traffic Management system consisting of portable and fixed VMS, wireless CCTV cameras, Roadway/Weather Information System (RWIS), HAR system and roadway markers.

- Develop and prepare design packages for the ATMS for the route segments with the highest benefit:cost ratios amounting to a 47 mile system. The following is the First Phase of implementation for the ATMS:

Route	From	To
I-10	I-610	Chef Menteur Highway
US 90 East	I-10	Franklin Avenue
Gentilly Boulevard	us 90	N Broad Street
I-610	I-10	I-10
I-10	I-610	I-610
US 90 East	I-610	I-10
Elysian Fields Avenue	Leon C Simon Drive	N. Peters Street
Canal Street	City Park	Convention Center
Poydras Street	I-10	Convention Center
I-10	Veterans Memorial Highway	I-610
Veterans Memorial Highway	I-10	Pontchartrain Blvd.

Traveler Information

- Implement portable, cellular-controlled VMSs to manage pre-planned incidents; i.e. roadway construction, special events, maintenance activities, etc.

- Utilize a network of permanent HAR transmitters to cover the Metropolitan New Orleans area to aid in the management of traffic during pre-planned incidents; i.e. construction, maintenance, special events, weather related incidents and major incidents involving lane closures or entire roadway closures of long duration or that allow sufficient time to set up portable VMSs and record HAR broadcast messages.

- Begin to advance to real-time management of traffic incidents with portable, cellular-controlled VMSs and permanent HAR transmitters.

Miscellaneous

- Implement Roadway/Weather Information System (RWIS) sensors in recurring fog areas; partner with the telecommunications companies and/or cable television companies for communications back to a central location and also download the information to the various local jurisdiction maintenance and traffic control dispatchers.

Location	Description
Interstate 10	I-55 to I-310
Interstate 10	US 11 toLA433
Lake Pontchartrain Causeway	

- Develop standards for construction projects to include ITS elements; i.e. fiber optic conduit and pull boxes while the roadway/shoulders are excavated. This is a critical step for reducing the expense of developing a fiber optic network and a communications plant to support the ITS equipment.

- Develop partnerships with the private sector and other public sector agencies in communications infrastructure, technology testing, traveler information systems, freeway service patrols, CCTV cameras, etc.

- Coordinate with any other communications infrastructure, planned or implemented within the study

Intelligent Transportation System Center (ITS Center)

- Finalize site selection for the permanent ITS Center and possible joint Traffic Control Center with the Jefferson Parish traffic signal systems and begin design of the facility.

- If the ITS Center and the Jefferson Parish traffic signal system controls are not located in the same facility; develop direct communication links between the **ITS** Center and the Parish. This is critical for developing a “seamless” system of traffic and incident management for the Metropolitan New Orleans area.

Traffic Signal Control

- Develop strategies for upgrading and expanding the Jefferson Parish and City of New Orleans traffic signal systems.
- Begin design of system upgrade to allow for future integration with the Jefferson Parish and City of New Orleans traffic signal systems.
- Develop interim incident traffic signal timing plans for alternate route implementation.
- Develop remote access capabilities for off-hour monitoring of the traffic signal systems.
- Design and implement emergency vehicle traffic signal preemption system for routes between responding fire stations and expressway entrance ramps.

7.2.2 Short-Term, 2 to 5 years:

Incident Reporting and Response

- Complete the implementation of closed-circuit television cameras remaining on the initial list.

Incident and Traffic Management

- Construct and implement the ATMS for the route segments within the urban area amounting to a 47 mile system:

Route	From	To
I-10	I-610	Chef Menteur Highway
US 90 East	I-10	Franklin Avenue
Gentilly Boulevard	us 90	N Broad Street
I-610	I-10	I-10
I-10	I-610	I-610
US 90 East	I-610	I-10
Elysian Fields Avenue	Leon C Simon Drive	N. Peters Street
Canal Street	City Park	Convention Center
Poydras Street	I-10	Convention Center
I-10	Veterans Memorial Highway	I-610
Veterans Memorial Highway	I-10	Pontchartrain Blvd.

Traveler Information

- Develop fixed locations for variable message signs along each route and at major decision points.
- Move the portable, cellular-controlled VMSs to the next set of roadways. Upgrade the wireless CCTV to hard-wired communications.
- Begin implementation of traveler information kiosks at major traffic generators and major employment centers.

Miscellaneous

- Test the option of wireless transmission of video images to the ITS Center.
- Begin to develop the regional fiber optic communications network and transition communications and control connections **of** field equipment from public telephone network and wireless media onto the fiber optic line.

Intelligent Transportation System Center

- Develop the permanent ITS Center.
- Incorporate or establish the links between the transit agency dispatch center(s) and the ITS Center and the Jefferson Parish Traffic Control Centers.

The total capital cost for the First Phase Implementation is $18.6 million, which includes nearly $5.7 million in capital cost for the 28 mile fiber optic communication system.

7.2.3 Medium-Term, 5 to 10 years:

Increase the intensity and the coverage of the Advanced Transportation Management System (ATMS):

Incident and Traffic Management

- Begin design and construction of the ATMS for those routes just outside of the urban area totaling an additional 141 miles:

Route	From	To
I-10	Chef Menteur Highway	Michoud Boulevard
US 90 East	us 11	I-10
I-10 Frontage Roads	Mayo Road	Paris Road

Route	From	To
Hayne/Leon C. Simon Boulevard	Paris Road	Elysian Fields Avenue
I-10	I-310	Veterans Memorial Highway
Veterans Memorial Highway	St. Charles/Jefferson Parish Line	I-10
Causeway	I-10	I-12
US Bus. 90	I-10	Mississippi River
West Bank Expressway	Mississippi River	us 90
US 90 West	us 90	Jefferson Highway
West Bank Frontage Road	Westwood Drive	Terry Parkway
LA 39	I-10	Paris Road
LA 46	Elysian Fields Avenue	Paris Road
US 61	I-310	I-10
Earhart Expressway	David Drive	Claibome Avenue
US 90 West	Jefferson Highway	US Bus. 90

Intelligent Transportation System Center

- Begin to develop plans for the ITS Center expansion and increase the staffing to accommodate the increased expressway coverage.

The total capital cost for the Second Phase Implementation is $15.1 million, which includes $4.7 million for the 23 mile fiber optic communication system.

7.2.4 Long-Term, 10 + years:

Incident and Traffic Management

- Develop the ATMS expansion plans for the remaining 180 miles of roadway segments in the Metropolitan New Orleans Area.

Intelligent Transportation System Center

- Continue to expand the Coordinated/Managed Traffic signal system coverage for additional signals within the coverage area of the ATMS.

The total cost for the Third Phase and the Final Phase of implementation is $5.1 million and includes the following routes:

Route	From	To
US 90 West	I-310	West Bank Expressway
I-310	US 90	I-10
I-510	US 90	Almonaster Avenue
LA47	Almonaster Avenue	LA 46
I-1 0	US 51	I-310
US 61	US 51	I-310
I-1 0	Michoud Boulevard	I-12
US 11	I-12	US 90
US 90 East	US 190	US 11
I-55	**I-10**	I-12
I-12	I-55	Causeway
I-12	Causeway	I-10

7.3 Benefit:Cost Calculations

Average annual daily traffic (AADT) volumes and the two year average (1991 and 1992) accident frequency data were provided by the Louisiana Department of Transportation and Development, These data were summarized by roadway segment into tables for the primary expressway routes and the secondary arterial routes. A typical roadway segment on the expressways is between interchanges and between intersections on the arterial routes. The peak hour traffic volumes were calculated by multiplying the AADT by a factor of 14 percent. The two year average accident frequency data were multiplied by a factor of six (6) to arrive at the number of incidents The number of incidents was then multiplied by a factor of 10 percent to arrive at the number of peak hour incidents, These factors are nationally accepted statistics; for the ratio of incidents to accidents and for the percentage of incidents during the peak hour. To calculate the benefits of implementing the advanced transportation management system (ATMS), an amount of time saved per vehicle per incident was determined. In order to calculate the reduction of vehicle-hours of delay for an incident, five (5) minutes of time saved was utilized. This is a total of the time saved in detecting an incident, responding to the incident and clearing the incident. This is a nationally accepted statistic for reduction in delay with transportation management equipment installed. The amount of traffic that passes the total number of accidents during the peak hour multiplied by the five (5) minutes of savings is the total amount of vehicle hours of delay saved on that segment of roadway.

Peak Hour Benefit	**=**	**Peak Hour Traffic Volume**	**x**	**Peak Hour Accident Frequency**	**x**	**Delay Saved Per Vehicle Per Accident**	**x**	**Dollar Value of Time Per Vehicle**	**x**	**Number of Peak Hours Per Day**

To calculate the cost of the segments, the equipment (CCTV cameras, VMS units and HAR transmitters) was placed on the map of the area (see Figures 7-3A, 7-3B, 7-4A, 7-4B and 7-5). The total capital costs were summarized for each segment. The annualized capital cost of the equipment was calculated using a factor of 0.1295 which is based upon a 5 percent annual rate of interest over a 10 year period. Ten years is the expected life of much of this equipment. The total annualized capital cost was divided into the total annualized benefit for each segment. This is the annual benefit:cost ratio for each segment of roadway.

Spreadsheets were developed which indicate annual benefit:cost ratios, total capital costs and the annualized costs for the expressways and arterial routes in the Metropolitan New Orleans Area. These spreadsheets are included as Tables C-l, C-2 and C-3 in Appendix C of this report. Phases of the implementation were based on the relative benefit:cost ratios as well as continuity of phasing for roadway segments.

The First Phase includes variable message signs and closed circuit cameras, as well as roadway reference markers, “911 Call-In” signs and allocation for related equipment and software development for the initial ITS Center. The Short-Term Implementation Plan of the Strategic Deployment Plan describes the development of the roadways segments in the central urban area. The approximate total capital expenditure for the equipment for the First Phase is summarized in Table 7-l and is approximately $18.6 million. The Second Phase of the plan is to complete the next set of roadway segments just outside of the urban area. The total capital cost for the equipment for the Second Phase shown in Table 7-l is approximately $15.1 million. The remaining expressway segments in the study area could be completed at a later date at a total Capital cost of $5.1 million.

In Table 7-1, the annual benefit/cost ratio for the First Phase includes the costs associated with a fully instrumented system for the initial roadways. First Phase of the implementation includes the cost of the highway advisory radio system, communications, roadway markers and ITS Center costs that are associated with the beginning of the fully instrumented ATMS. In addition to these costs, the costs associated with the Roadway/Weather Information System equipment, are also included in the First Phase. The benefit/cost ratios for the RWIS can be calculated separately on the basis of an area wide system. The benefit/cost ratio for the First Phase is calculated to be 10.30. The First Phase includes over $5.7 million for fiber optic communications along 28 miles of roadway. Also included in the First Phase is $5 million for the ITS Center development and associated hardware and software.

Table 7-1. Benefit:Cost by Implementation Phase

	<----- BENEFIT : COST					----->	
	Fully Instrumented Annual Benefit Cost	Less Than Fully Instru Annual Benefit Cost	Fully Instrumented Annual Benefit (B)	Less Than Fully Instru Annual Benefit (B)	Length(mi)	Fully Instrumented Annual Benefit/Mile	Less Than Fully Instru Annual Benefit/Mile
First Implementation Phase	7 93	15 01	$18,192,320	$9,096,160	47 16	$3,196,258	$1,598,129
Second Implementation Phase	14 89	20 79	$29,182,926	$14,591,463	140 83	$3,643,791	$1,821,896
Third Implementation Phase	6 70	6 33	$2,411,681	$1,205,841	56 43	$295,383	$147,692
Final Implementation Phase	18 16	9 59	$5,515,987	$2,757,993	124 70	$275,825	$137,912
Overall Total Deployment	11 24	15 48	$55,302,913	$27,651,457	369 12	$149,824	$74,912

** - Detection Systems, CCTV and Fiber Optic Communications NOT Included in the 'Less Than Fully Instrumente

"Less Than Fully Instrumented" Benefit equals 50% of "Fully Instrumented" benefits

Annualization Factor for 10 yrs 0.1295 (5% Interest)

Delay saved/incident assumed 5 minutes

Table 7-2. Total Capital Costs by Implementation Phase

<------------- T O T A L   C A P I T A L   C O S T S ----------->

	Fully Instrumented CapitalCosts	Less Than Fully Instru CapitalCosts	Roadway Markers	HAR Transmitter	VMS fixed	Weather Detection	Traffic ** Detection	CCTV**	Fiber Optic ** Communication
First Implementation Phase	$18,643,800	$4,680,000	$922,800	$300,000	$4,200,000	$180,000	$1,590,000	$775,000	$5,676,000
Second Implementation Phase	$15,133,000	$5,420,000	$0	$0	$5,100,000	$320,000	$4,140,000	$925,000	$4,648,000
Third Implementation Phase	$2,780,000	$1,470,000	$0	$0	$1,350,000	$120,000	$1,110,000	$200,000	$0
Final Implementation Phase	$2,345,000	$2,220,000	$0	$0	$2,100,000	$120,000	$0	$125,000	$0
Overall Total Deployment	$38,901,800	$13,790,000	$922,800	$300,000	$12,750,000	$740,000	$6,840,000	$2,025,000	$10,324,000

** - Detection Systems, CCTV and Fiber Optic Communications NOT Included in the 'Less Than Fully Instrumented'

First Implementation Phase Includes $5,000,000 for the ITS Center and Operating Software

"Less Than Fully Instrumented" Benefits equal 50% of "Fully Instrumented" Benefits

Annualization Factor for 10 yrs 0 1295 (5% Interest)

Delay saved / incident assumed 5 minutes

Table 7-3. Annualized Capital Costs by Implementation Phase

	<-------------- ANNUALIZED CAPITAL COSTS ----------->								
	** Fully Instrumented Annual Costs (C)	Less Than Fully Instrum Annual Costs (C)	Roadway Markers	HAR Transmitter	VMS fixed	Weather Detection	Traffic ** Detection	CCTV **	Fiber Optic ** Communication
First Implementation Phase	$2,294,870	$606,060	$119,503	$38,850	$543,900	$23,310	$205,905	$100,363	$735,042
Second Implementation Phase	$1,959,724	$701,890	$0	$0	$660,450	$41,440	$536,130	$119,788	$601,916
Third Implementation Phase	$360,010	$190,365	$0	$0	$174,825	$15,540	$143,745	$25,900	$0
Final Implementation Phase	$303,678	$287,490	$0	$0	$271,950	$15,540	$0	$16,188	$0
Overall Total Deployment	$4,918,281	$1,785,805	$119,503	$38,850	$1,651,125	$95,830	$885,780	$262,238	$1,336,958

** - Detection Systems, CCTV *and Fiber Optic* Communications NOT Included in the 'Less Than Fully Instrumented'

"Less Than Fully Instrumented" Benefits equal 50% of "Fully Instrumented" Benefits

Annualization Factor for 10 yrs	0 1295	*(5% Interest)*
Delay saved/incident assumed	5	minutes

The total capital cost table for the primary roadways (Table C-2), lists the equipment that is proposed to be implemented along each roadway segment. Table 7-2 is a summary of this information by phase. The Advanced Transportation Management System (ATMS) equipment **is** tabulated along with their total capital cost. The annualized costs shown in Table C-3 are used to calculate the annual benefit:cost ratios. A summary of annualized costs by Phase is shown in Table 7-3.

7.4 Operations Plan

7.4.1 Introduction

The key to success of the Metropolitan New Orleans ATMS will be an effective program of operations and maintenance. This will require personnel located at the Intelligent Transportation Systems Center (ITSC), individuals responsible for field maintenance, and a management structure to coordinate and administer the overall operation. Training of staff, both initially and on a continuing basis as new equipment and functions are added, is critical to ensure that the staff can provide maximum effectiveness. Complete and thorough system documentation is also necessary for effective operation. This section presents a review of actions and issues related to the operations and implementation of the future system. Procurement methods, staffing, ITSC sizing, system start-up plan requirements and operations plan requirements are addressed.

7.42 Agreements and Memorandums of Understanding

In order to be effective, the proposed incident management system must be conceived and operated in a cooperative effort by multiple state and municipal agencies. Generally, its purpose is to be responsive to traffic and incident conditions without regard to jurisdictional boundaries. The system will be designed as a unit, but it must operate in the context of decentralized functions and responsibilities. Since it will support and enhance current functions, the cooperative relationships established for its operation will extend beyond its functions of incident detection, incident response and motorist information. The system will serve as an effective catalyst to communication among agencies involved in incident response.

A series of agreements and memorandums of understanding will be necessary to establish and support the Advanced Transportation Management System. This will need to be developed over a period of time as an ordinary part of system design and development. Multiple agreements or memorandums are advisable in lieu of a single document to provide flexibility for responding to future needs.

Potential needs for cooperative agreements or memorandums of understanding would likely include four categories:

- Agency Support
- System Construction, Operations and Maintenance
- Emergency Response
- Specialized Control Plans

Agency Support

One of the first documents to be executed should be a joint statement of support for improved incident management systems and operations within the Metropolitan New Orleans area. This should be a statement of policy, with specific roles and responsibilities to be identified in follow-up documents. This agreement should provide a statement of goals and objectives in support of a cooperative policy. The agency support statement should be signed by the State, Parish and City authorities. This document will serve to inform the public of intent and commitment to the system, and will provide general guidance (through goals, objectives, and policies) for further system development.

To **best** serve its intended purpose, execution of the agency support agreement should be well publicized. This could include format signing ceremonies by Parish, City and State officials and perhaps include media coverage. In addition to indicating support and cooperation of involved jurisdictions, this will provide an early opportunity for public education regarding the character and intent of the system.

System Design, Construction, Maintenance and Operations

Agreements will be necessary among participating jurisdictions and agencies to establish and operate the system. These will be within the categories of: funding, system operation and maintenance, and functional roles and responsibilities. Among the topics which may need to be addressed are the following:

- Funding

  - engineering
  - construction
  - start-up
  - operations

- System Operation and Maintenance

  - control center

- field equipment
- administration and management
- staffing

- Functional Roles and Responsibilities

  - communication responsibilities of ITS Center
  - **on** site coordination (incident manager, call for tow trucks, etc.)
  - role and limitations of service patrols
  - identification and management of diversion route systems
  - operation of variable message signs and motorist information systems
  - data links (CCTV, traffic counts, operating speeds, etc.)

Emergency Response

Agreements, legislation, and cooperative understandings are already in place for the coordination of incident response as part of the existing all center operations. Changes may occur as emergency response personnel interact within the incident management committee and as the system design evolves but the system will not supplant or modify most established relationships. Some potential new emergency response policies may require enabling legislation, including:

- Vehicle removal policies
- Lane closure policies
- Tow truck notification policies

Specialized Control Plans

In addition to agreements and/or memorandums of understanding for day-to-day system operations and emergency response, it may be useful to establish roles, responsibilities, and relationships for special conditions. These include the following, as a minimum:

- Recurring special events
- Unique special events
- Maintenance of traffic during construction
- Special incidents, such as HAZMAT spills

7.4.3 ITS Center

The primary site for the potential ITS Center for the Metropolitan New Orleans Intelligent Transportation System is located at the interchange with Veterans Memorial Highway and Pontchartrain Boulevard within state right-of-way, adjacent to the Office of Motor Vehicles Headquarters property. This site was chosen because of its central location and access to Interstate 10 and Interstate 610.

Purpose

The purpose of an ITS Center is to coordinate and operate the intelligent transportation systems in the Metropolitan New Orleans area. An ITS Center is the hub of all information and control of traffic management. An ITS Center houses the control and data manipulation hardware and software for the management of traffic and incidents as well as the personnel to operate the controls of the traveler information and surveillance equipment. An **ITS** Center is necessary for the development of the Metropolitan New Orleans Advanced Transportation Management System and as a point of contact and control for traffic and transportation management. An ITS Center can be a very “hi-tech” center with automated computing equipment and communications equipment or it can operate in a “low-tech” mode with manual operations and surveillance of the area transportation facilities.

Schematic Diagrams

Schematic drawings have been developed to illustrate two (2) potential floor plans for an ITS Center. Scheme 1 (Figures 7-9, 7-l 0, 7-l IA and 7-l 1 B) shows three phases or stages to developing an ITS Center. The first phase is an interim floor plan layout that could accommodate the ITS for the first stages of implementation. This first phase would compliment the Phase 3 expansion. If Phase 1 of Scheme 1 would be chosen, then the expansion would be to Phase 3, skipping Phase 2. Phase 2 is intended to be a first and final phase of the ITS Center. Scheme 2 (7-12A and 7-12B) is depicted for the final Phase 3. This could also be developed into Phases 1 and 2 as well. These schematics are intended to be preliminary floor plan layouts to show the functions and space allocation for the ITS Center.

Functions of the Intelligent Transportation System Center

The ITS Center serves as the main facility from which ITS activities, such as incident management, are operated and coordinated. The ITS Center should house the following functions:

Administration

- Personnel management
- Facility operations
- Office space
- Record Storage
- Telephone Equipment
- Reception area
- Agency coordination - State Police, Fire and Emergency Management

METROPOLITAN NEW ORLEANS ITS STUDY ITS CENTER SCHEMATICS DIAGRAMS

Incident Management

- Operator workplace(s) (workstation with monitor, modem, report and graphic printers, scanner, laptop)
- Storage for computer service needs (toner, ribbons, boxes of paper)
- Communications server
- Tape backup unit
- Telephone equipment
- Radio equipment

Systems Operations, System Engineering, Command and Control, Interagency Coordination

- Engineers workplace(s) (workstation with monitor, modem, report and graphic printers, scanner, laptop)
- Offices with conference island tables
- Storage for computer service needs (toner, ribbons, boxes of paper)
- Communications server
- Tape backup unit
- Large Video Monitor wall
- VMS operating console
- Roadway/Weather Information System work station
- Future expansion
- Conference room for interagency coordination meetings

Communications and Dispatch, Data Collection and Dissemination, Electrical/ Communications Access

- Communication transmitter room
- Communications hardware room
- Satellite antenna
- HAR taping room
- Maintenance dispatch/communications
- Media room/podium/sound system

Maintenance, Field Support

- Maintenance workplace(s)
- Mechanical and electrical supply and equipment rooms
- Garages for vehicles
- Power room
- HVAC
- Expressway service patrol program/vehicles

Public Relations

- Conference room
- Speaker system
- Podium

Security

General

Kitchen
Lunchroom/Lounge
Showers
Lockers
Rest rooms
Parking

Hours of Operation

Experience from other freeway management systems show that the ITS Center needs to **be** staffed from the beginning of the morning rush hour to the end of the evening rush hour, typically from 6 AM to 7 PM. For ease of initial operations it is suggested that 15 hours be used (generally 5:30 AM to 8:30 PM) with a one hour shift overlap. Weekend staffing may not occur initially but eventually it should go from 9 AM to 5 PM, especially during special events or adverse weather. Taking into account vacations, sick leave, training time, and other activities, this translates into 3 full-time equivalents for the operations staff to provide one operator at the system console during these hours. This would be overseen by at least one systems manager and a control room operations supervisor.

Two different strategies for providing staff have been utilized by different agencies: utilizing agency personnel (either existing or **new** hires), and contracting to a private organization to provide the personnel. (This is the case for the INFORM System on Long Island.) In either case, the budgetary impact is essentially identical, although the specific budgetary categories may be different. As such, there is no distinction as to which approach is used.

During mid-day hours, when traffic is lighter, the operational staff can utilize some of their time to perform other activities that can be handled from within the control room. But the operator is still required to be immediately available to monitor and coordinate response to an incident which might occur. During the hours when the control room is not staffed, i.e., at night and on weekends, the system design and architecture must allow an auxiliary console to be located at a 24 hours per day facility, such as the EMS or police dispatch center.

ITS Center Operators

The specific functions that the operator needs to perform include:

- Utilizing the computer displays and CCTV screens to monitor and verify the traffic conditions and incidents on the freeways;

- Operating the computer systems, through a keyboard or mouse or joystick, to select different displays and to control field devices, such as Variable Message Signs and CCTV cameras;
- Responding to status and alarm messages from the computer systems, again with a keyboard and mouse, that are generated when incidents are detected or a equipment malfunctions are detected;
- Utilizing telephone and radio equipment to communicate with police, incident response personnel, fire personnel, etc. who are responding to an incident;
- Utilizing telephone or facsimile equipment to communicate with media and the public regarding the status of an incident or current traffic conditions;
- Operating recording equipment, such as a VCR, that would be utilized to capture the specifics of a particular incident;
- Troubleshoot and perform simple replacements for malfunctioning equipment in the ITS Center;
- Maintaining logs and other required records of activities.

Several different strategies have been utilized by other ITS Centers for hiring operators. These include college students working part-time, disabled individuals on either a part-time or full-time basis, or full-time agency technical or support staff.

Equipment Maintenance

The maintenance and repair of all equipment must be accomplished in a timely fashion in order to achieve effective system operation. The typical goal for these systems is a four hour response from the time a failure is reported until the equipment is returned to service. This requires a maintenance technician with adequate spares, appropriate tools and equipment, and up-to-date training.

For the scope of the initial ATMS project, one maintenance technician will be adequate. While it is possible to share this individual with other maintenance and support activities, it is important that the technician's first priority be the support of the field equipment, and not arterial signals or equipment of another organization. This individual should be available prior to the start of any construction for the project so that familiarity with the system design can be obtained. The technician's input to the design process, to insure that maintainability is built into the system, will yield long-term benefits. The technician should serve as the field inspector during all construction work so that details are retained by an agency employee. Also, since the technician will have to live with or correct any problems created by the construction, there will be a strong incentive to get the system built correctly.

Another important role of the maintenance technician is to coordinate with other roadway maintenance or construction activities to minimize the disruption of field equipment. Because contractors and other organizations do not recognize the importance of the field equipment and the associated **power** and communications circuits, their actions can create problems. The maintenance technician, by being available or on-site during these potential disruptions, can minimize or eliminate equipment down-time.

The maintenance technician needs to be well experienced in a wide range of skills, including electronics, communications, power distribution, cable installation and repair, portable generators, and general small scale mechanical repairs. Since the maintenance technician will be faced with a diversity of equipment and failure conditions, a broad set of general repair capabilities is required. Effective troubleshooting and problem isolation techniques, supported by a systematic and logical approach, is needed to quickly identify and correct problems. Preventive maintenance, locating and repairing small problems before they become major, and conscientious record keeping and documentation are also regular components of the equipment maintenance program.

Operations and Maintenance Costs

Adequate performance of the equipment tasks for routine, daily operations will generally require personnel in administrative, operations, and maintenance classifications. Of paramount importance in considering overall staff requirements, is the ability to create a certain level of redundancy in personnel in the operations and maintenance classifications to insure that the random occurrence of simultaneous, multiple events and/or incidents will not adversely affect overall system performance and personnel response.

The staff requirements and costs to achieve this goal are presented as a general basis of defining overall space needs. Daily weekday operations consisting of approximately 15 to 16 hours per day. Approximate hours of operation are anticipated to be 5:30 AM to 8:30 PM to provide adequate coverage for both AM and PM peaks, with allowances for “late clearing” of PM congestion and some overlap of shifts.

Staff Assignments and schedules are shown in Table 7-4.

Table 7-4. ITS Center Staffing and Schedule

Staff	Number		Schedule
	Short/Medium -Term	Long-Term	
Operations			
Systems Manager	1	1	8:OOAM - 5:OOPM
Asst. Systems Manager /Shift Supervisor	1	1	6:OOAM - 3:OOPM
Control Room Supervisor	0	1	11:30AM-8:30PM
Control Room Operators	1	2	5:00AM - 2:OOPM
Control Room Operators	1	2	12:OOPM - 9:OOPM
Maintenance			
Maintenance Supervisor	1	1	8:OOAM - 5:OOPM
Asst. Maintenance Supervisor	0	1	9:00AM - 6:OOPM
Electronics Tech.	2	4	6:30AM - 3:30PM / 9:30AM - 6:30PM

Table 7-5 summarizes the subtotal annual operations and maintenance costs in 1997 dollars for the implementation of each phase.

The annual operations, maintenance and equipment parts/physical plant in the following table represents the total annual costs at the end of each of the phases. For example, the costs of Operations Staff at the Second Phase also includes the cost of Operations Staff of the First Phase. The costs of Operations Staff at the Third Phase includes the First, Second and Third Phase Operation Staff costs.

Table 7-5. Annual O & M Cost Summary

Phase	Operations Staff	Maintenance Staff	Equipment Parts/ Physical Plant	Total Annual O&M
First	$60,000	$50,000	$1,305,000	$1,415,000
Second	$305,000	$109,000	$2,365,000	$2,779,000
Third	$305,000	$190,000	$2,559,000	$3,054,000
Final	$475,000	$365,000	$2,723,000	$3,563,000

System Management

A manager of the operators and maintenance technician will be required. It is desirable that this individual also have an engineering background so that broader system support and long-range upgrades can be handled. The role of the manager is to provide day-to-day supervision and scheduling of operations and maintenance activities, to coordinate with other agencies and organizations, to develop plans and policies for incident management and freeway monitoring, and to financially manage the operation by developing budgets and being responsible for operating within these budgets.

The manager will also be available to support the operator during a major incident, to provide higher level liaison with other agencies and the media, and to serve as a back-up person if regular operations personnel are not available. The manager will be responsible for training new operations personnel, and insuring that current staff are trained on new equipment and that refresher training is conducted for all personnel.

The manager will be responsible for supervision of maintenance activities, insuring that adequate spares are available and that the maintenance technician has all the tools, equipment, and test devices needed to perform effectively. The manager must make certain that the technician's training is current and up-to-date. When a crises occurs, the manager must serve as an expediter for factory support and repair services, and provide a buffer between the maintenance technician and other individuals, so that the technician can work without being disturbed When the maintenance technician is on vacation, sick-leave, at training, etc., the manager must be able to fill-in and provide basic levels of equipment support and repair.

Support staff, such as secretarial, clerical and receptionist personnel, can be provided on a shared basis from the existing organization where the ITS Center will be located. The requirements of the ATMS are not such that dedicated personnel are needed. A part-time equivalent is included in the budget to account for this labor component.

7.4.4 Procurement Methods

An important element in the implementation of the New Orleans ATMS is the method **to** be used for procurement. Several procurement techniques have been used throughout the country on related projects. These are outlined below:

Sole Source

The basis for a sole source procurement is the documented existence of only one technical or cost-effective solution to the requirements of a particular project. The most common basis for sole-source procurements are the requirements for compatibility with existing equipment, so that system-wide interoperability can be maintained. For an initial system-wide procurement, compatibility with existing equipment is not a factor, and sole-source procurement is not advisable or practical.
For later project phases, sole-source procurements will probably be necessary to maintain equipment compatibility for specific devices, such as CCTV camera controllers. Operating and maintenance problems caused by incompatible equipment are design and procurement issues for the initial system. Conversion or replacement of non-interoperable devices before the end of their useful life is an expensive penalty to be paid for lack of foresight.

Engineering / Contractor

This procurement method is the one typically used for highway projects. It is based on the concept that all critical system parameters can be fully specified and documented in a single set of contract documents (i.e., Plans, Specifications, and Estimates - PS & E package), that a single contractor is best suited to implement the project, and that the only criteria of significance for selecting the contractor is the initial bid price. The extensive experience with this process for highway construction has resulted in a very rapid set of procedures and rules within most highway agencies, severely restricting the flexibility of system designers and implementers.

Two-Step Approach

This method modifies the engineer/contractor technique by separating the technical evaluation step from the financial step. This approach provides an opportunity to reject proposals that do not meet the technical criteria for the project. This minimizes the risk of selecting a contractor whose bid is low, but who is not technically capable of performing the work. It also insures that the technical merits of each proposal are fully considered prior to award of a contract, instead of during the “material submittal” stage of a traditional highway construction contract.

Design / Build

In this approach, a single entity is selected to handle all the work associated with implementing the system. The design / builder is responsible for detail system design, procurement of all equipment, construction of all system elements, integration of the various sub-systems, and final system turn-up and operational cut-over. The fully functional system is then turned over to the operating

agency. A design/build concept simplifies the number of contracts and the steps associated with taking a system from concept to operations. This can be beneficial if the designer/builder fully understands the project concept, and has the experience to successfully handle the full scope. Often the design/builder can use streamline equipment purchase procedures, thereby speeding up the project schedule.
However, this approach limits the agency's role to that **of** limited oversight and monitoring activities of the design/builder. This can be detrimental since the agency personnel with direct operational experience and needs are typically not involved with the detail design and thus cannot provide input and feedback during design and implementation.

System Manager/System Integrator

This procurement method divides the project into several sub-projects for each of the various sub-systems, with the work overseen by a system manager who administers each contract and is responsible for integrating the several sub-systems into an overall, operating system. The most effective structure for this approach is to use a moderate sized "design team" consisting of agency and system manager personnel. The system manager converts the project plan into preliminary designs and defines sub-systems, develops PS&E packages for sub-systems, oversees bidding and award, supervises construction, selects and procures computer and communications hardware components, develops system software, integrates and tests sub-systems, and supervises operator training.

By assigning responsibility for total system success to the system manager, a single source of accountability and responsibility is defined. The involvement of agency personnel as part of the design team results in improved coordination and tighter cost controls. The agreement between the agency and the system manager is a negotiated contract, which can be easily adapted as project needs are refined. This provides increased flexibility to meet the specific project requirements, when compared to the typical fixed price turnkey or design/build contracts.

APPENDIX A

ute	Link From	Link To	Existing ADT (1995)	V/C	Peak Period Speed EB	Peak Period Speed WB	Future (2015) ADT	Future (2015) V/C	Truck %	Geometry Bus Volumes	No. of Lanes	Length (Miles)	Type of Road	Shoulder Presence >8' < 8'	Number of Signals	Accidents per Lane Mile
	US 51	I-55	42,500	0.50	55	60	56,000	0.66	14		6	0.56	Inter.	N/A	0	1.05
	I-55	I-310	42,500	0.50	55	60	55,600	0.65	14		6	10.12	Inter.	N/A	0	1.05
	I-310	LOYOLA	67,400	0.80	46	56	70,600	0.84	10		8	1.55	Inter.	10'	0	1.05
	LOYOLA	WILLIAMS	67,400	0 80	48	57	82,300	0.98	10		6	1.7	Inter.	10'	0	19.01
	WILLIAMS	POWER	99,500	1.18	48	41	101,000	1.20	8		6	1.3	Inter.	10'	0	19.01
	POWER	VETERANS	99,500	1.18	34	59	110,400	1.31	8		6	0 9	Inter.	10'	0	19.01
	VETERANS	CLEARVIEW	87,700	1.04	32	57	90,800	1.08	8		6	1.7	Inter.	10'	0	19.01
	CLEARVIEW	CAUSEWAY	97,100	1.15	18	49	101,100	1.20	8		6	1.9	Inter.	10'	0	19.01
	CAUSEWAY	BONNABEL	121,500	1.25	20	30	129,700	1.33	6		6	0 83	Inter.	10'	0	19.01
	BONNABEL	I-610	130,700	1.34	21	49	138,600	1 42	6		6	1.78	Inter.	10'	0	19.01
	I-610	METAIRIE RD	82,000	1.12	50	26	88,900	1.21	12		4/6	1 15	Inter.	10'	0	3.75
	METAIRIE RD	CARROLLTON	68,100	0.97	48	24	83,800	1.19	12		6/9	1.1	Inter.	10'	0	3.75
	CARROLLTON	US BUS 90	93,100	0.93	39	33	96,500	0 96	12		6/8	2	Inter.	N/A	0	3.75
	US BUS 90	POYDRAS	36,000	0.71	53	16	73,700	1 45	12	480	6	0.25	Inter.	N/A	0	3.75
	POYDRAS	CANAL	29,000	0.62	42	27	76,000	1 62	12	480	6	0.55	Inter.	N/A	0	3.75
	CANAL	ORLEANS	80,000	1.07	42	37	84,000	1.12	12	480	6	0.5	Inter.	N/A	0	3.75
	ORLEANS	ESPLANADE	76,000	0.96	31	26	78,000	0 99	12	480	6	0.5	Inter.	N/A	0	3.75
	ESPLANADE	N. CLAIBORNE	72,000	1.03	31	47	78,000	1.12	12	480	6	0 33	Inter.	N/A	0	3.75
	N. CLAIBORNE	ELYSIAN FIELDS	61,000	0.97	54	39	74,300	1.18	12	480	6	0.8	Inter.	N/A	0	3.75
	ELYSIAN FIELDS	I-610	61,100	0.77	29	35	63,300	0.80	12	480	6	1.05	Inter.	N/A	0	3.75
	I-610	LOUISA	107,300	1.35	38	39	104,400	1 31	12	480	8/6	1.25	Inter.	0/10'	0	3.75
	LOUISA	DOWNMAN	94,500	1.15	24	32	99,200	1.21	12	480	8	1.1	Inter.	10'	0	3.75
	DOWNMAN	CHEF MENTEUR	71,800	1.54	50	30	76,800	1.65	12	184	6	0.82	Inter.	0'	0	3.75
	CHEF MENTEUR	MORRISON	110,100	0.87	58	22	117,500	0.93	12	184	6	1.2	Inter.	10'	0	3.75
	MORRISON	CROWDER	78,200	0.93	59	36	155,000	1.84	12	184	6	1.3	Inter.	10'	0	3.75
	CROWDER	READ	66,400	0.78	57	49	135,300	1.59	12	184	6	1.27	Inter.	10'	0	3.75
	READ	BULLARD	59,900	0.71	49	54	120,900	1.43	12	68	6	1.23	Inter.	10'	0	3.75
	BULLARD	I-510	54,100	0.64	57	51	120,900	1.43	12		6	1.78	Inter.	10'	0	3.75
	I-510	MICHOUD	48,900	0.55			109,700	1.23	16		6	1.68	Inter.	10'	0	3.75
	MICHOUD	US 11	49,600	0.55			105,300	1.17	16		6	6	Inter.	10'	0	3 75
	US 11	OAK HARBOR	47,900	0.35			101,691	0.74	16		6/4	7.2	Inter.	N/A	0	4.38
	OAK HARBOR	LA 433	47,900	0.35			101,691	0.74	16		6	1.8	Inter.	10'	0	4 38
	LA 433	US 190	49,600	0.55			105,300	1.17	19		6	2.5	Inter.	10'	0	4.38
	US 190	I-12	44,600	0.37			94,685	0 79	19		6	1.7	Inter.	10'	0	4.38
	I-10	WEST END	73,500	1.29	33	38	79,100	1 39	12		6	0 25	Inter.	10'	0	1 87
	WEST END	CANAL	69,500	1.31	47	24	74,800	1 41	12		6	0 45	Inter.	10'	0	1 87
	CANAL	ST BERNARD	81,300	0.96	54	43	86,200	1 02	12		6	2.13	Inter.	10'	0	1.87
	ST. BERNARD	BROAD	66,300	0 83	54	55	70,000	0 88	12		6	0 8	Inter.	10'	0	1 87
	BROAD	ELYSIAN FIELDS	73,300	0 94	54	58	77,300	0 99	12		6	0 5	Inter.	10'	0	1.87
	ELYSIAN FIELDS	I-10	51,400	1.1	43	42	55,600	1.19	12		6	0 6	Inter.	10'	0	1.87
	US 90	AIRLINE HWY	28,200	0 21			N/A		15		4/5	8.6	Inter.	7/10'	1	2.31
	AIRLINE HWY	I-10	N/A	N/A			25,500		15		4	2.75	Inter.	N/A	0	2.31
	US 90	LAKE FOREST	11,700	0.22			13,500	0 25	12		4	1.25	Inter.	10'	0	0.79
	LAKE FOREST	I-10	12,800	0 22			12,500	0.21	12		4	1 25	Inter.	10'	0	0.79

Route	Link		Existing				Future (2015)			Geometry						Accidents
	From	To	ADT	V/C	Peak Period Speed		ADT	V/C	Truck	Bus	No. of	Length	Type of	Shoulder	Number of	per
			(1995)		EB	WB			%	Volumes	Lanes	(Miles)	Road	Presence >8' < 8'	Signals	Lane Mile
LA 47	I-10	HAYNES	N/A	N/A			N/A		12		4	1.3	MA	0'	0	0.79
US BUS 90	I-10	CLAIBORNE	47,600	0.75			72,700	1.15	7		4/6	0.5	PA(FW)	N/A	0	3.31
US BUS 90	CLAIBORNE	DRYADES	91,500	1.26			91,500	1.26	7		4/6	0.75	PA(FW)	N/A	0	3.31
US BUS 90	DRYADES	CAMP	83,000	1.26	10	14	81,700	1.24	7	90	4/6	0.5	PA(FW)	N/A	0	3.31
US BUS 90	CAMP	MISS. RIVER	98,100	1.71	40	19	98,200	1.71	7	90	6	1	PA(FW)	N/A	0	3.31
WB EXWY	MISS. RIVER	GEN DEGAULLE	110,800	1.75	25	30	88,700	1.40	12	90	10	1.75	PA(FW)	N/A	0	13.41
WB EXWY	GEN DEGAULLE	STUMP	61,200	0.90	56	30	68,700	1.01	12	102	6	1.35	PA(FW)	N/A	0	13.41
WB EXWY	STUMP	LAFAYETTE	59,600	0.73	59	53	63,900	0.78	12	102	6	0.75	PA(FW)	N/A	0	13.41
WB EXWY	LAFAYETTE	MANHATTAN	63,900	0.76	55	47	66,600	0.79	12	88	6	0.8	PA(FW)	N/A	0	13.41
WB EXWY	MANHATTAN	MCARTHUR	52,500	0.61	56	51	57,400	0.67	12	60	6	1.37	PA(FW)	N/A	0	13.41
WB EXWY	MCARTHUR	AVE. D	52,500	0.61	40	38	57,400	0.67	12	60	6	0.75	PA(FW)	N/A	0	13.41
WB EXWY	AVE. D	AMES	38,200	0.45	25	31	42,400	0.50	12	52	6	1.2	PA(FW)	N/A	0	13.41
WB EXWY	AMES	WESTWOOD	57,400	0.75	36	35	61,400	0.80	12	26	6/8	0.75	PA(FW)	0'	0	13.41
WB EXWY	WESTWOOD	VICTORY	44,700	1.44	36	34	48,100	1.55	12	26	6	0.6	PA	0'	1	13.41
WB EXWY	VICTORY	CENTRAL	44,700	1.12	28	28	48,100	1.21	12	26	6	0.38	PA	0'	1	13.41
WB EXWY	CENTRAL	TANGLEWOOD	47,000	1.18	25	28	50,500	1.27	12	26	6	0.25	PA	0'	1	13.41
WB EXWY	TANGLEWOOD	AVE. H	47,000	0.99	25	23	46,200	0.97	12	26	6	0.08	PA	0'	0	13.41
WB EXWY	AVE. H	AVE. D	39,000	0.99	25	35	41,900	1.06	12	26	6	0.25	PA	0'	1	13.41
WB EXWY	AVE. D	LOUISIANA	34,900	1.36	26	22	39,000	1.52	12	26	6	0.35	PA	0'	1	13.41
WB EXWY	LOUISIANA	BEECHGROVE	34,900	1.30	43	39	36,000	1.34	12	15	4	0.65	PA	10'	1	13.41
WB EXWY	BEECHGROVE	SEGNETTE	33,000	1.30	48	39	33,800	1.33	12	15	4	0.53	PA	10'	0	13.41
WB EXWY	SEGNETTE	US 90	33,000	1.4	48	39	26,700	1.13	12	15	4	0.7	PA	10'	1	13.41
CAUSEWAY	I-10	VETERANS	35,600	1.91			N/A		6	19	4	0.45	PA	0'	0	14.27
CAUSEWAY	VETERANS	W. ESPLANADE	36,500	0.94			58,200	1.50	6	19	4/6	0.85	PA	0'	0	14.27
CAUSEWAY	W. ESPLANADE	TOLL PLAZA	25,200	0.63			45,300	1.13	6	19	6	0.5	PA	0'	2	14.27
CAUSEWAY	TOLL PLAZA	I-12	21,300	0.36			N/A		6		4	28.5	PA(FW)	0/10'	1	0.54
US 61	US 51	I-310	N/A	N/A			N/A		10		4/5	11.22	PA	8/10'	8	2.34
US 61	I-310	WILLIAMS	34,700	1.31	28	29	20,900	0.79	6		4/5	5.13	PA	10'	7	9.75
US 61	WILLIAMS	DAVID	25,900	1.52	23	12	28,100	1.65	6	55	4	2.27	PA	10'	7	9.75
US 61	DAVID	CLEARVIEW	39,200	1.00	29	25	40,300	1.03	6	55	4/6	2.16	PA	8/0"	4	9.75
US 61	CLEARVIEW	CAUSEWAY	45,400	1.07	24	25	38,900	0.92	6	55	6	1.44	PA	0'	6	9.75
US 61	CAUSEWAY	I-10	49,800	1.29	31	15	48,300	1.25	6	55	8	3.14	PA	0'	7	9.75
VETERANS	PARISH LINE	LOYOLA	6,800	0.82			N/A		6		2/4	0.9	PA	0'	0	5.16
VETERANS	LOYOLA	WILLIAMS	12,800	0.68			11,700	0.62	6		4	1.63	PA	0'	3	5.16
VETERANS	WILLIAMS	I-10	28,300	0.93			28,100	0.92	6	46	4/6	1.8	PA	0/10'	5	5.16
VETERANS	I-10	CLEARVIEW	40,400	1.04			42,000	1.08	6	46	6	1.42	PA	0/10'	4	5.16
VETERANS	CLEARVIEW	CAUSEWAY	49,800	1.26			48,600	1.23	6	46	6	1.91	PA	0/10'	7	5.16
VETERANS	CAUSEWAY	WEST END	44,900	1.1			46,600	1.14	6	46	6	2.71	PA	0'	9	5.16
EARHART	DAVID	CLEARVIEW	37,700	0.67	22	21	42,300	0.75	6		4/6	2.2	PA(FW)	0'	2	1.36
EARHART	CLEARVIEW	CAUSEWAY	43,700	0.78	35	50	51,100	0.91	6		6	1.83	PA(FW)	0'	0	1.36
EARHART	CAUSEWAY	MONTICELLO	49,800	0.89	24	20	52,300	0.93	6		6/4	1.88	PA(FW)	0'	0	1.36
EARHART	MONTICELLO	CARROLLTON	25,200	0.81	19	15	52,300	1.68	6		4	1.95	PA	0'	2	1.36
EARHART	CARROLLTON	BROAD	30,700	1.20	15	4	22,500	0.88	6	64	4	1.55	PA	0/Parking Lanes	5	1.36

Route	Link		Existing				Future (2015)			Geometry						Accidents
	From	To	ADT	V/C	Peak Period Speed		ADT	V/C	Truck	Bus	No. of	Length	Type of	Shoulder	Number of	per
			(1995)		EB	WB			%	Volumes	Lanes	(Miles)	Road	Presence >8' < 8'	Signals	Lane Mile
EARHART	BROAD	CLAIBORNE	10,800	0.62	8	13	9,900	0.57	6	64	4	0.72	PA	Parking Lanes	1	1.36
US 90 WEST	I-310	PARISH LINE	24,400	0.95			30,200	1 18	10		5/4	7.5	PA	10'	N/A	5.53
US 90 WEST	PARISH LINE	WB EXPWY	39,800	1.33	38	33	42,000	1.40	7		4	6	PA	10'	N/A	11.41
US 90 WEST	WB EXPWY	LA 18	36,200	1 33	24	28	39,700	1.46	7		4	1.3	PA	10'	0	11.41
US 90 WEST	LA 18	JEFF HWY	46,400	1.19	19	23	51,500	1.32	7		4	1.8	PA	10/0"	1	11.41
US 90 WEST	JEFF HWY	CAUSEWAY	49,300	1.24	16	18	50,200	1.26	7	41	6	1 68	PA	0'	5	11.41
US 90 WEST	CAUSEWAY	MONTICELLO	44,600	1.15	16	17	45,500	1.17	7	41	6	1.78	PA	0'	6	11.41
US 90 WEST	MONTICELLO	CARROLLTON	32,900	1.00	16	19	35,300	1.07	7	41	6	0.83	PA	Parking Lanes	1	1.74
US 90 WEST	CARROLLTON	NAPOLEON	25,500	0.89	6	24	24,300	0.85	7	352	6	1.78	PA	Parking Lanes	4	1.74
US 90 WEST	NAPOLEON	LOUISIANA	20,200	0.59	23	21	20,100	0 59	7	352	6	0 4	PA	Parking Lanes	1	1.74
US 90 WEST	LOUISIANA	M.L. KING, JR.	20,200	1.05	8	28	23,500	1 22	7	352	6	0 72	PA	Parking Lanes	4	1.74
US 90 WEST	M.L. KING, JR.	US BUS 90	26,900	1.46	37	40	25,600	1 39	7	352	6	0.4	PA	Parking Lanes	0	1.74
US 11	I-12	I-10	17,900	0.53			N/A		9		2/4	12.2	MA	0/5-10'	15	5.47
US 11	I-10	US 90	3,530	0 11			N/A		9		2	5 36	MA	5'		5.47
US 90 EAST	US 190	US 11	2,590	0 20			N/A		8		4/2	16.74	MA	10/8'	0	0.36
US 90 EAST	US 11	I-510	6,700	0 05	35	37	18,100	0.14	8		4	3.67	MA	5/10'	2	2.25
US 90 EAST	I-510	I-10	42,700	1.19	32	20	N/A		8		4/6	5.03	PA	10/0'	10	2.25
US 90 EAST	I-10	DOWNMAN	N/A	1.44	15	18	N/A		6		6	0 53	PA	0'	0	2.25
US 90 EAST	DOWNMAN	FRANCE	39,000	1.14	17	33	40,600	1.19	6		6	0.63	PA	0'	1	2.25
US 90 EAST	FRANCE	FRANKLIN	32,000	1.02	25	16	33,500	1.07	6		6	1 45	PA	0'	5	2.25
US 90 EAST	FRANKLIN	ELYSIAN FIELDS	28,100	0.85	27	32	30,000	0.91	6		6	0 68	PA	0'	1	2.25
US 90 EAST	ELYSIAN FIELDS	ST. BERNARD	27500	0.85	9	15	29500	0.91182	6	318	6/4	1.2	PA	0'	6	2.25
US 90 EAST	ST. BERNARD	ESPLANADE	26,900	0.52	21	14	26,400	0 51	6	318	4	0.7	PA	0'	2	2.25
US 90 EAST	ESPLANADE	CANAL	29,600	1.43	13	17	29,600	1.43	6	318	4/6	1	PA	0'	4	2.25
US 90 EAST	CANAL	TULANE	N/A	1.04	23	11	N/A		6		6	0.35	PA	0'	2	2.25
US 90 EAST	TULANE	I-10	29,000	0.87	26	11	27,500	0.83	6		6	0.73	PA	0'	4	2.25
GENTILLY	US 90	ST. BERNARD	9,800	0 52			7,600	0.40	6		6	0.68	COL	Parking Lanes	1	2 25
GENTILLY	ST. BERNARD	BROAD	6,800	0.27			9,400	0.37	6		6	0.93	COL	Parking Lanes	2	2.25
I-10 FRONT R	MAYO	CROWDER	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
I-10 FRONT R	CROWDER	BUNDY	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
I-10 FRONT R	BUNDY	READ	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
I-10 FRONT R	READ	WRIGHT	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
I-10 FRONT R	WRIGHT	BULLARD	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
I-10 FRONT R	BULLARD	PARIS	N/A	N/A			N/A		5		N/A	N/A	COL	N/A	N/A	
HAYNE	PARIS	BULLARD	1,900	0.09			2,200	0.10	6	124	4	2.22	MA	0'	0	
HAYNE	BULLARD	READ	2,700	0 09			2,200	0.07	6	124	4	1.1	MA	0'	0	
HAYNE	READ	CROWDER	3,500	0 13			4,800	0 18	6	124	4	1.17	PA	0'	1	
HAYNE	CROWDER	DOWNMAN	6,500	0 33			8,600	0 44	6	124	4	1.93	PA	0'	2	
HAYNE	DOWNMAN	ELYSIAN FIELDS	12,800	0 61			16,300	0 78	6	124	4	2.43	PA	0/Parking Lanes	5	
ELYSIAN	LEON C. SIMON	FILMORE	5,400	0.27			5,200	0 26	6	168	4	0.85	PA	Parking Lanes	3	
ELYSIAN	FILMORE	MIRABEAU	8,700	0.39			8,200	0 37	6	168	4	0.35	PA	Parking Lanes	1	
ELYSIAN	MIRABEAU	GENTILLY	13,100	0 6			12,400	0 57	6	168	4	0 61	PA	Parking Lanes	2	
ELYSIAN	GENTILLY	I-610	15,600	0 68			15,000	0 65	6	168	6	0.65	PA	Parking Lanes	1	

Route	Link		Existing				Future (2015)			Geometry						Accidents
	From	To	ADT	V/C	Peak Period Speed		ADT	V/C	Truck	Bus	No. of	Length	Type of	Shoulder	Number of	per
			(1995)		EB	WB			%	Volumes	Lanes	(Miles)	Road	Presence >8' < 8'	Signals	Lane Mile
ELYSIAN	I-610	I-10	19,700	0.73			17,700	0 66	6	168	6	0.83	PA	Parking Lanes	1	
ELYSIAN	I-10	CLAIBORNE	12,600	0.66			12,600	0 66	6	168	6	0 52	PA	Parking Lanes	4	
ELYSIAN	CLAIBORNE	ST. CLAUDE	15,800	0.62			N/A		6	168	6	0.37	PA	Parking Lanes	1	
ELYSIAN	ST. CLAUDE	N. PETERS	N/A	0.45			N/A		6	168	6	0.52	MA	Parking Lanes	2	
CANAL ST.	CITY PARK	CARROLTON	15,500	0.51			14,300	0 47	6	532	6	0.9	PA	Parking Lanes	1	
CANAL ST.	CARROLTON	JEFF DAVIS	14,900	0.54			13,600	0 49	6	532	6	0.53	PA	Parking Lanes	1	
CANAL ST.	JEFF DAVIS	BROAD	12,422	0.44			13,500	0.48	6	532	6	0.55	PA	Parking Lanes	1	
CANAL ST.	BROAD	I-10	16,500	0 57			10,500	0 36	6	532	6	0.78	PA	Parking Lanes	3	
CANAL ST.	I-10	LOYOLA	N/A	0.71			23,200		6	532	6	0.37	PA	Parking Lanes	3	
CANAL ST.	LOYOLA	CONV. CENTER	N/A	1.07			25,100		6	532	6	0.75	PA	Parking Lanes	10	
POYDRAS	I-10	S. RAMPART	N/A	N/A	13	15	30,100		6		6	0.5	PA	Parking Lanes	4	6.94
POYDRAS	S. RAMPART	ST. CHARLES	N/A	N/A	11	7	23,200		6		6	0.41	PA	Parking Lanes	4	6.94
POYDRAS	ST. CHARLES	CONV. CENTER	N/A	N/A	8	17	20,500		6	146	6	0.41	PA	Parking Lanes	6	6.94
WB FRONT R	WESTWOOD	AMES	57,400	0.74			61,400	0 79	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	AMES	ROBINSON	24,100	0.61			27,000	0 68	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	ROBINSON	BARATARIA	26,000	0.66			28,300	0.72	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	BARATARIA	AVE D	27,000	1.05			28,700	1.12	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	AVE D	AVE A	30,400	1.01			32,200	1.07	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	AVE A	MCARTHUR	31,400	0.77			32,200	0.79	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	MCARTHUR	HARVEY CANAL	31,400	0.78			33,100	0.82	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	HARVEY CANAL	BROWN	33,700	0 84			37,100	0.92	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	BROWN	MAPLE	34,400	0.86			37,100	0.93	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	MAPLE	MANHATTAN	32,100	0.82			34,300	0 88	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	MANHATTAN	LAFAYETTE	30,000	0.76			37,000	0 94	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	LAFAYETTE	STUMPF	33,500	0.87			44,900	1 17	5		N/A	N/A	MA	N/A	N/A	
WB FRONT R	STUMPF	WHITNEY	17,900	0.62			23,500	0.81	5		N/A		MA	N/A	N/A	
WB FRONT R	WHITNEY	TERRY PKWY	N/A	N/A			N/A		5		N/A	N/A	MA	N/A	N/A	
LA 39	I-10	ELYSIAN FIELDS	31,700	1.47	16	23	34,400	1.60	6		6	0.52	PA	Parking Lanes	2	
LA 39	ELYSIAN FIELDS	INDUST. CANAL	34,300	1.6	17	18	36,000	1.68	6		4	2.13	PA	0'	7	
LA 39	INDUST. CANAL	PARISH LINE	38,400	1.67	18	11	35,700	1.55	6		4	1.5	PA	0'	5	
LA 39	PARISH LINE	PARIS ROAD	36,900	1.6	15	14	38,200	1.66	6		4	2.91	PA	0'	8	
LA 46	ELYSIAN FIELDS	INDUST. CANAL	31,600	1.76	19	19	28,100	1.57	6	356	4	2.01	PA	0'	7	
LA 46	INDUST. CANAL	PARISH LINE	36,100	1.85	21	26	35,900	1.84	6	356	4	1.48	PA	0'	3	
LA 46	PARISH LINE	PARIS ROAD	36,600	1.7	21	11	34,700	1.61	6	356	4	2.91	PA	0/4'	4	
I-55	I-10	PASS MANCHAC	14,900	0.22			20,000	0.29	18		4	13 9	Inter.	N/A	0	
I-55	PASS MANCHAC	I-12	14,600	0.21			40,500	0 60	18		4	13.2	Inter.	N/A	0	
I-12	I-55	CAUSEWAY	32,800	0.48			56,100	0 83	20		4	23.2	Inter.	10'	0	
I-12	CAUSEWAY	I-10	34,400	0.51			67,600	0 99	20		4	20.9	Inter.	10'	0	
I-510	U S. 90	ALMONASTER	24,500	0.45			32,700		12		4	1.12	Inter.	10'	0	
LA 47	ALMONASTER	PARISH LINE	26,500	0.46			22,400		12		4	2.37	PA	10'	0	
LA 47	PARISH LINE	CANAL							12		4	2.17	PA	10'	1	
LA 47	CANAL	LA 39				1			12		5	1.05	PA	10'	4	
LA 47	LA 39	LA 46	21,100	0.68			22,900		12		5	0 47	PA	10'	2	

APPENDIX B

	Questions	1 **State Police Troop B**	2 **Jefferson Parish DPW**	3 **Metro Scan**	4 **Regional Planning Commission**
		Capt Ryan/ Lt Holtzendorff	B K. Snead	Wm. H. Yeager, Jr.	Conrad Rein
1	**What do you or your agency see as the transportation problems in the region today and in the future?**	Metropolitan vehicle population has outgrown the functional capacity of existing roadways Demands will continue to increase disproportionally with time and finances required to update or expand the highway systems.	The provision of additional capacity to move automobiles and trucks within existing transportation corridors.	Inadequate capacity on limited access expressways - too few of them. Too few alternate through routes - understaffed police and maintenance agencies.	Increasing congestion due to lack of infrastructure improvements, coordination of traffic operations, ability to handle incidents, fragmentation of planning efforts, insufficiency of public transit and alternative modes.
2	**Who do you view are the transportation users (Customers) that you are serving?**	area residents, regular commuters, interstate transportation of cargo, vacationers and visitors	General public primarily auto owners and commercial vehicle operators.	Commuters	The traveling public (including alternate modes); commercial vehicles and operators; regional entities such as DOTD, Parishes, municipalities, the transit community, emergency agencies, toll facilities.
3	**Refer to Attachment A**				
4	**Does your agency have any planned or on-going ITS activities in the Region?**	yes	yes	maybe	yes

	Questions	State Police Troop B	Jefferson Parish DPW	3 Metro Scan	4 Regional Planning Commission
5	**Do any of your activities involve other agency coordination? If yes, describe the procedures.**	requently call on S/O??? or municipal PD to andle certain pressing situations when no state nit is available or in near proximity for nmediateemergencyresponse.	yes - see attached b	We obtain accident and construction info. from police nd other state and municipal agencies and broadcast this info to radio listeners.	yes, The IM Study requires coordination with state DOTD, Parishes and municipalities. The New Orleans signal project requires coordination with the City. RTA's ITS study needs to be coordinated with R PC.
6	**What is your agency's role in providing transportation services?**	Respond to violations of the highway regulatory odes, remove accidents & breakdowns as expeditiously as possible provide traffic control as required to allow for the most rapid flow of affic.	Traffic operations and ansportation planning for efferson Parish.	Broadcasting current info to drivers as to problems they will encounter.	Regional planning and PRE ?? implementation of projects.

	Questions	1 State Police Troop B	2 Jefferson Parish DPW	3 Metro Scan	4 Regional Planning Commission
7	**Do you see that role being expanded?**	Yes. In direct accordance with the ever growing population of motor vehicles in this area	Expansion will be based primarily on population growth of both the Parish and the region (Metro New Orleans area).	Perhaps through more and better info.	yes
8	**What issues do you foresee that have the potential to derail or slow down the development of a future regionally coordinated transportation management and information system?**	The biggest barrier is probably going to be funding. Secondly would be communication between agencies, in that most still operate on individual radio frequencies with little or no access to other departments.	Funding, political boundaries	All of the above plus the expected arrival of a GOP administration in Washington.	Funding of ITS competing w/infrastructure, jurisdictional fragmentation 8 cooperation, lack of ability to operate and maintain eqmt, untrained/ inadequate staffing, lack of appreciation of lower-end tech. applications, lack of coordination among agencys

	Questions	1 State Police Troop B	2 Jefferson Parish DPW	3 Metro Scan	4 Regional Planning Commission
9	**Do you see a need to change the current organizational structure in your agency or in the region to support ITS initiatives?**	**No**	**No**	**7**	Organizational relations need to be ratronallzed on a technical basis to allow for closer cooperationbetweenagencies.
10	**Do you see a role for the private sector?** If yes, **what? how? where? If no, why?**	**Yes** Specifically from the standpoint of acceptance and education of the motoring public.	**Yes** To provide the variety of services required in connection with these proposed programs.	Our company is a privately owned corporation providing traffic info to city and vicinity radio stations and through them to motorists in their cars.	**Yes** The private sector can assist ITS efforts and provide expertise and funding for ITS initiatives
1	**Do you feel your staff is capable of managing, operating and maintaining a high tech approach to transportation management?**	Yes, with some degree of education and understanding of it's basic operation.	Yes, based on previous experience adapting to technical and other changes over time	Yes, we currently use video cameras at strategic locations controlled and viewed from our HQ, plus an airplane surveillance, plus info obtained from police and other agencies.	Yes. although some of the other agencies will have a lot of work to do in this area. Their capabilities need to be strengthened considerably. RPC organizational structure, is not currently flexible enough to allow innovative technicalcapabilities.

		3		
Questions	State Police Troop B	Jefferson Parish DPW	Metro Scan	Regional Planning Commission
I: What goals do you have for ITS Technology	To allow us to more efficiently and effectively perform our sworn responsibility.	Incident management; General: Increased capacity of xisting facilities.	I was unaware of ti until I received this questionnaire. Perhaps it could faciliiate our gathering of information.	To assist in reducing congestion and improving the functionality of the system as well as provide users with more Information an travel options.

	Questions	5 Regional Transit Authority	8 N.0 Dept. of Streets	10 St. Tammany Parish
		Edward J. Bayer		
			As of this point in time, the sum total of the exposure of representatives of this agency to emerging ITS or IVHS concepts has been limited to seminars and symposiums at which the presentations have been very general and broad-spectrum in nature. It is obvious that ongoing, compounded quantum leaps in electronic technology even now are making possible a wide range of new applications to an ever-expanding array of practical situations. Very little, however, has been made available in terms of concrete or welldeveloped information on particular systems or components which may be available for designated purposes. It is therefore difficult, if not impossible, in most cases to frame responses to these questions in a detailed and specific manner	
1	**What do you or your agency see as the transportation problems in the region today and in the future?**	Congested roadways which impede the flow of traffic and hinder the operation of transit vehicles.	Ongoing maint. of existing agency services, particularly maint. of roadways and traffic control devices, at current and foreseeable budgetary levels even as the demand for such services increases, driven by escalating traffic volume & congestion levels. Lack of availability of sufficient right-of-way in appropriate corridors to provide increased roadway capacity to parallel long-range traffic volume projections. Inability of public agencies to sustain and maintain technological advances implemented through ISTEA and other such future legislation.	Population growth will lead to higher volumes of commuters o both local roads and major arterials; less reliance on traditional mass transit due to funding cutbacks
2	**Who do you view are the transportation users (Customers) that you are serving?**	Residents of, and visitors to, New Orleans and Kenner, LA	Every person who is either a driver, passenger, or operator or a consumer of goods conveyed upon any private, public transit, public agency, or commercially operated vehicle which travels upon the public roadways of Orleans Pansh	Commuters, ADA eligible population
3	**Refer to Attachment A**			
4	**Does your agency have any planned or on-going ITS activities in the Region?**	.Yes	Yes	,No

	Questions	5 Regional Transit Authority	8 N.0 Dept. of Streets	10 St. Tammany Parish
5	**Do any of your activities involve other agency coordination? If yes, describe the procedures.**	Coordination in planning effort with Regional Planning Commission, New Orleans Dept. of Streets, and City of Kenner	This dept. interacts with many other organizations in many ways. A partial list and brief description of the process follows: LaDOTD, Downtown Development District, Vieux Carre Commission; overlapping jurisdictions-coordination of all activities in #6. Port of New Orleans, Orleans Levee District; Adjacent jurisdictions-coordination of all activities in answer #6 which transcend boundaries. Regional Planning Commission, Highway Safety Commission; funding coordination. Regional Transit Authority; interfacing of transit related activities, New Orleans Public Service, Bell South, Cox Cable, Sewerage and Water Board; coordination of underground excavation Service cut repair Detour plan deployment??. Mayor's Office; Administrative support. Chief Administrative Office; administrative support, capital project support. Law Department; defense of legal claims and suits. Police Department; special event planning, traffic control support. Fire Department; special event planning. Parkway and Parks Commission; coordination of underground excavation, removal of visual obstructions to traffic control devices Dept of Safety and Permits; application of zoning requirements. City Planning Commission; capital project support, coordination of developmental projects. Dept. of Utilities; assist in regulation of utilii company activity. Dept. of Property Management; facility support. Equipment Maintenance Division; rolling stock support.	Yes, RPC, DOTD, Council on Aging, FTA, FHWA
6	**What is your agency's role in providing transportation services?**	RTA operates public transit service in New Orleans and Kenner, LA	The Dept. of Streets provides engineering for roadway constructton, reconstruction, and resurfacing projects, supervision and inspection of such projects; maint. of existing roadways; establishment, implementation and enforcemt of parking regulation policy; issuance of permits for curb cuts, utility cuts, street closures, construction actwities, film industry actwdies, truck vendors, and movement of oversized loads; design implementation. operation, and maintenance of traffic control devices	1) Primary transportation agency in Parish (local roads coordination with LADOTD on state and federal roads): 2) Initiating two new transit programs (park and rides and ADA service); 3) Alternative transportationprogram (Tammany ???)

	Questions	5 Regional Transit Authority	8 N.0 Dept. of Streets	10 St. Tammany Parish
7	**Do you see that role being expanded?**	**Not** at this time	Having received the directive to structure the 1996 operating budget at 85% of the 1995 level, it is difficult to conceive of maintaining an acceptable level of service with respect to the items listed above let alone contemplate expansion. At present, the practical approach can only be to seek ways and means to utilize available ITS technology to supplement the reduced level of resources in the ongoing performance of traditional services. Clearly, these functions cannot be abandoned in favor of more exotic pursuits until and unless some of the more basic tasks can be assumed by other agencies or private personnel.	yes
8	**What issues do you foresee that have the potential to derail or slow down the development of a future regionally coordinated transportation management and information** system?	Funding,Cooperation, Coordination, Differing goals for system, Technology acceptance	Political interfacing - non-technical personnel with legislative or executive power have historically displayed a tendency to control or steer such projects with administrative decisions based on inappropriate criteria. Maintenance -one-time funding made available for high-tech improvements is independent of the agency operating budget which must necessarily support maintenance efforts. The ever-diverging trend of available capital funding vs. downspiraling budgetary levels is a condition which must be addressed in a broad perspective if these technological advances are to be successful. Cooperation -jurisdictional squabbling driven by provincialism. In terms of current tech. personnel in neighboring or counterpart agencies, probable that the majority of these types of problems will occur at a political, as opposed to a technical level	Funding (federal) is in jeopardy, each of funds at local and regional level.

		5	8	10
	Questions	**Regional Transit Authority**	**N.0 Dept. of Streets**	**St. Tammany Parish**
9	**Do you see a need to change the current organizational structure in your agency or in the region to support ITS initiatives?**	No	It is apparent that, from a very general perspective, the most efficient and judicious means of implementing any area-wide system or mode of control is to do so in a homogenous. all-encompassing manner. This could theoretically include the consolidation of similar personnel assignments across jurisdictional lines Clearly such an arrangements could be very difficult to achieve given the various civil service systems and inherent regulations involved. While certain individuals within existing organizations would likely stand out as obvious candidates to assume key positrons within various regional ITS components, current agency manpower levels almost universally necessitate that the typical employee till multiple roles. To assume additional duties or expand in what some may perceive to be an area of lesser priority will thus create critical voids at the most basic levels. A complete reevaluation of internal functions and personnel assignments may therefore be in order	No
IO	**Do you see a role for the private sector?**			"
	If yes, **what? how? where? If no, why?**	Private sector will supply and maintain ITS equipment	The ongoing routine of daily responsibility combined with necessarily understaffed personnel levels which typically plague public agencies render research and/or investigation into available technological modes which are applicable to jurisdictional needs exceedingly difficult This is one area in which the private sector has historically been active and, in view of foreseeable funding trends, must remain so. In reference to the answer to the previous question, either the "hands-on" ITS positions or the vacancies created by he shifting of agency personnel into such positions may also be areas which can only be addressed by enlisting private reinforcement.	Possibly, construction and maintenance
11	**Do you feel your staff is capable of managing, operating and maintaining a high tech approach to transportation management?**	Yes, dispatchers presently operate high-tech Motorola communications equipment.	There exists within this dept. a small nucleus of highly competent personnel who are generally conscientious and possess a well-developed level of expertise in basic electronic technology, and therefore the aptitude to adapt quickly and easily to new systems of the type to which this questionnaire is addressed. For reasons previously given in answers 7.9, and 10. however, their skills may not be readily applicable to such tasks	Yes, St. Tammany Parish has one of the best computer systems in region along with a separate office of Transportation with management capabilities

	Questions	5 Regional Transit Authority	8 N.O. Dept. of Streets	0 St. Tammany Parish
12	**What goals do you have for ITS Technology?**	Facilitate the movement of Transit vehicles, improve transit Security improve vehicle monitoring of mechanical systems, provide transit information to patrons.	As stated in the introductory paragraph, the term "ITS technology' has only vague connotations at this time. It is therefore difficult to outline specific goals and inappropriate to espouse a particular position or project a future course of action until individual hardware systems and their applicability to our situation have been demonstrated. As referenced throughout the survey, our budgetary situation dictates that we adopt a conservative posture with regard to the procurement or implementation of a particular component system simply because it represents a technological breakthrough and is now available. We must rather seek those enhancements which will assist us in facilaating and making more efficient the tasks which we are mandated by the City Charter to perform. Within this context, individual areas of need should be identified, defined, and prioritized. The most appropriate existing ITS components can then be tailored to accommodate these situations in the most efficient and cost-effective manner possible.	No (due to funding constraints)

2

	Questions	12 LDOTD District 02	13 Greater N.O. Expwy Commission	15 LDOTD Planninq Division	16 Crescent City Connection
			Bryan Clament	C.A. Orillion	Alan LeVasseur
1	What **do you or your agency see as the transportation problems in the region today and in the future?**	1) Need to upgrade signal systems to incorporate interconnect and central/closed loop control features. 2) Need to increase capacity at certain bottlenecks in the system. 3) Need to establish detection and response system for incidents at critical points in the system. 4) Need to provide monitoring and motorist information on traffic conditions on major links in the system.	1) Causeways ability to maintain an appropriate level of service as West St. Tammany and Causeway traffic increases. 2) Using Causeway as an emergency evacuation route.	a) preservation and maint. of exist, facilities b) Increased efficiency in utilization of existing facilities c) Poliiil / social ramifications of traff. demand mplementation schemes d) resolving difficulties associated w/the privattation of transportation systems	Traffic congestion and ncreased pollution caused by automobile emissions.
2	**Who do you view are the transportation users (Customers) that you are serving?**	1) Passenger vehicle users: commuters, tourists, discretionary local trips (shopping, etc). 2) Commercial vehicle users: through trucks, local deliveries, tour buses. 3)Transit/paratransit users: transit buses, commuter Vanpools, light rail, taxicabs 4) Alternate modes: pedestrians, bicyclists 5) Modal Interface users - rail/grade crossings, water/movable bridges.	Predominantly West St. Tammany residents that work or go to school in Jefferson and Orleans Panshes	Everyone is a recipient of the benefits (inconveniences) of a properly maintained and operated transportation system. Both directly and indirectly the general public, economically, socially, and otherwise is impacted by the transportation network. Consequently, our customers are not limited to transportation users only.	Commuters crossing the Mississippi River via the Crescent City Connection bridges and ferrys
3	**Refer to Attachment A**				
4	**Does your agency have any planned or on-going ITS activities in the Region?**	yes	Yes	See RPC comments	Yes

2

Questions	2 .DOTD District 02	13 Greater N.O. Expwy Commission	15 LDOTD Planning Division	6 Crescent City Connection
Do any of your activities involve other agency coordination? If yes, describe the procedures.	Coordination of signal timing-consult with traffic ngineers from other jurisdictions to provide coordination cross jurisdictional boundaries, we also consult with other agencies on plans for construction detours and traffic operations for special events	Coordinate traffic control and traffic management with Jefferson Parish and the City of Mandeville.	MPO	No
6 **providing transportation services? What is your agency's role in**	lanning, design, construction, maintenance and peration of highways, bridges, tunnels and ferries Also ssisting local governments in some of these activities.	Operate and maintain the Causeway Toll Bridges	See RS 32:2.a???	Plan construct, operate, naintain and polices bridges and ferries within the Parishes of Orleans, Jefferson and St. Bernard.

2

	Questions	12 LDOTD District 02	13 Greater N.O. Expwy Commission	15 LDOTD Planning Division	16 Crescent City Connection
7	**Do you see that role being expanded?**	Yes. We have seen increasing involvement in providing both planning and real-time operations roles. Because of increased congestion, the public is expecting more responsive traffic controls, better driver information, and improved response to solve recurring and non-recurring congestion	No	No	No
8	**What issues do you foresee that have the potential to derail or slow down the development of a future regionally coordinated transportation management and information system?**	1) Lack of commitment to maintenance, particularly on the part of the State and the City of New Orleans. 2) Lack of funding to hire and pay technicians in operation and maintenance of complicated electronic systems. 3) Lack of coordination/cooperation at higher levels of management (working levels have a good spirit of cooperation but are not often supported by superiors). 4) Legislative limits on staffing will restrict the ability of DOTD to lead efforts on a regional basis.	1) Funding is and will remain a major barrier. 2) Legislative boundaries will have an impact on any regional approach. 3) Implementation will always be subject to motorists accepting change	All of the referenced issues.	Funding will be difficult to obtain Cooperation will be difficult as local agenda is more important than regional cooperation.

	Questions	12 LDOTD District 02	13 Greater N.O. Expwy Commission	15 LDOTD Planninq Division	16 Crescent City Connection
9	**Do you see a need to change the current organizational structure in your agency or in the region to support ITS initiatives?**	DOTD and the City of New Orleans must place sign and signal maintenance under the authority of traffic engineering/operations personnel in order to improve responsiveness in the maintenance area. DOTD needs a headquarters level consolidation of Traffic Engineering, Traffic Design, and Traffic Services (maintenance) into a single authority.	No	No	No
10	**Do you see a role for the private sector?** **If yes, what? how? where? If no, why?**	I perceive that the private sector will be involved in the construction of major facilities and in contractual services such as towing, providrng motorist info. on kiosks, etc. The major operational duties should remain with the public sector due to economy, and the need for government to retarn expertise in this area.	Other states have private toll roads. Why not Louisiana7	**Yes** However, the how, when, where, etc. still unanswered.	**Maybe** Private sector's role will be limited by ability to raise capital and receive a reasonable return on investment
II	**Do you feel your staff is capable of managing. operating and maintaining a high tech approach to transportation management?**	The engineering staff is as capable as any in the State Additional staff will need to be committed to operating and maintaining such a system, but management could accommodate this approach.	Current staffing is limited to operating and maintainrng the Causeway. Any "high-tech' initiative must be approved by the state legislature	Yes	Yes, Currently doing this wrth ETTM

Questions	12 LDOTD District 02	13 Greater N.O. Expwy Commission	15 LDOTD Planning Division	16 Crescent City Connection
What goals do you have for ITS technology?	Ensure safe and efficiently movement of people and goods, respond effectively to recurring and non-recurring disruptions in the system, provide for special events transportation needs, provide useful information to users of the system on a real time basis.	Federal funding for a "metro approach" to improve the New Orleans area transportation network	See Secretary's strategic plan.	Video enforcement system used in conjunction with ETTM. Access control for exclusive HOV / Translt lanes.

ITS STRATEGIC PLAN FOR METROPOLITAN NEW ORLEANS

RANKINGS OF USER SERVICES BY AGENCY

		AGENCIES																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
User Services Bundles	User Services	State Police Troop B	Jefferson Parish DPW	Metro Scan	Regional Planning Commission	Regional Transit Authority	N.O. Police Dept.	St. Bernard Parish	N.O. Dept of Streets	AAA	St. Tammany Parish	Jefferson Parish Transit	LDOTD District 02	Greater N.O. Expwy Commission	LA Motor Transport Assoc.	LDOTD Planning Division	Crescent City Connection	Highway Safety Commission	Totals	Composite Rank
Travel and Transportation Management	En-Route Driver Information	9	6	1	4	2			22		4		15	9		4	8		84	7.64
	Route Guidance	8	4	6	10	13			12		5		4	7		3	7		79	7.18
	Traveler Services Information	18	18	22	5	17			22		22		8	8		5	9		154	14 00
	Traffic Control	1	5	3	2	1			1		2		1	4		2	10		32	2.91
	Incident Management	2	1	2	1	3			2		3		2	6		1	5		28	2.55
	Emissions Testing & Mitigation	22	17	22	18	4			11		17		22	10		16	15		174	15.82
Travel Demand Management	Pre-Trip Travel Information	14	13	22	3	9			22		6		13	16		10	6		134	12.18
	Ride Matching and Reservation	13	19	22	12	8			22		10		14	18		15	14		167	15.18
	Demand Management and Operations	7	20	22	13	5			22		1		7	17		14	11		139	12.64
Public Transportation Management	Public Transportation Management	12	16	22	8	6			6		14		9	19		7	12		131	11.91
	En-Route Transit Information	19	12	22	11	12			21		12		11	20		13	17		170	15.45
	Personalized Public Transit	11	21	22	14	18			22		9		18	21		17	16		189	17.18
	Public Travel Security	6	11	22	15	7			5		11		20	22		11	13		143	13.00
Electronic Payment	Electronic Payment Services	20	22	22	17	14			21		13		10	1		20	1		161	14.64
Commercial Vehicle Operations	Commercial Vehicle Electronic Clearance	21	7	22	19	20			10		21		12	15		19	21		187	17.00
	Automated Roadside Safety Inspection	10	14	22	21	19			9		18		17	14		21	22		187	17.00
	On-Board Safety Monitoring	17	9	22	22	16			7		19		16	11		22	19		180	16.36
	Commercial Vehicle Administrative Processes	16	8	22	20	21			22		20		19	12		8	20		188	17.09
	Hazardous Material Incident Response	3	2	22	9	15			8		15		3	5		9	4		95	8.64
	Freight Mobility	15	3	22	6	22			22		16		5	13		6	18		148	13.45
Emergency Management	Emergency Notification and Personal Security	4	10	4	7	11			4		7		21	3		12	2		85	7.73
	Emergency Vehicle Management	5	15	5	16	10			3		8		6	2		18	3		91	8.27

ASSESSMENT OF THE REGIONAL "ITS" PROGRAM

AGENCIES Attachment B questions	1 **State Police Troop B**	2 **Jefferson Parish DPW**	3 **Metro Scan**	4 **Regional Planning Commission**	8 **N.O Dept. of Streets**
	AGENCIES			ARE THESE TWO the same study?	
Project Name		Incident Management System	MetroScan Traffic	City of N.O Traffic Signal Study	Computerized Traffic Signals Phase II
Location / Limits		Metro New Orleans	New Orleans / Jefferson / St. Bernard	New Orleans	Orleans Parish / Parish-wide
Owner / Responsible Agency	State of Louisiana / LSP	Regional Planning Commission for Greater N.O.	Traffic Cameras, Inc.	City of N.O. Streets Dept.	City of N.O./ Department of Streets
Contact Person		Walter Brooks	Bill Yeager, Operations Mgr.	Elmer Darwin	Elmer N. Darwin
Telephone Number		(504) 568-6611	(504) 581-1542		(504) 565-6840
Type of Project	Incident Management	Incident Management	private company - radio broadcast of info.	Signal Systems	Traffic Signal Systems
Project Goals & Objectives	Faster response to emergency situations	See Contact Person	Info. for drivers	Improved Signal System	Upgrade of signal display, coordination of signal operation, centralization of signal parameter control
Status of each Project	In Design	Planning Study	operational	Planning Study	Phases I, II, and III in design
Project Components	Hardware, Software, Signs	N/A	TV cameras, airplane, 2-way radios, broadcast stations	Hardware, Software	Signal display hardware, signal control hardware, detection mode (cameras/loops), software, communication media, standards / specifications
Control Center?	yes		?	?	While a separate project for a control center has been established, it is unclear at this time which ITS components will be housed therein. Inasmuch as current signal system central control and communications hardware require much less floor space than that of similar equipment in the past, this project alone probably does not warrant an exclusive stand alone control center.
If Yes, Location	Troop Headquarters	N/A	629 S. Claiborne Ave		838 South Genois Street
Hours of Operation	24 hours	N/A	5:30 am to 6:30 pm		Continuous
Estimated Costs					
Construction		N/A		?	$2,000 /yr 10 yrs (RPC allocation)
Operation / Maintenance		N/A		?	Op: $100K /yr (Engineer, Engineering Technician) Main $480K /yr (Maintenance contract, 23 personnel)
Related Projects		N/A			38 intersection signal upgrade (in construction)
Agency Interaction		N/A	obtain info from police and Highway agencies	City of N.O , RPC	LaDOTD, RPC
Incident Management Features	Call Boxes, Milepost Markers, Response Plan	N/A	info for drivers	no	Alternate routes

ASSESSMENT OF THE REGIONAL "ITS" PROGRAM

AGENCIES / Attachment B questions	4 Regional Planning Commission	4 Regional Planning Commission	5 Regional Transit Authority	12 LDOTD District 02	12 LDOTD District 02
Project Name	I.M. Study	RTA ITS Study	ITS Feasibility Study	Traffic Signal Systems Upgrades	Automatic Toll Collection
Location / Limits	New Orleans Area	New Orleans	New Orleans and Kenner, LA.	Major Routes in Jefferson adjoining parishes	US 90 B (Crescent City Connection)
Owner / Responsible Agency	DOTD	RTA	Regional Transit Authority	DOTD District 02	Crescent City Connection Division, DOTD
Contact Person	Jim Joffrion	Ed Bayer	Valerie Moten, PM	Steven Strength	Alan Levasseur
Telephone Number			(504) 243-3723	437-3105	364-8100
Type of Project	IM	ITS Public Transit System	Public Transit System (AVL/AVI)	Signal Systems	ETTM·
Project Goals & Objectives	IM	Technology Review	Identify system that best meets RTA's needs	Closed loop and traffic responsive interconnected signals for traffic control	Efficiency of toll booth operations
Status of each Project	Planning Study	Planning Study	Under Planning Study	1 project under construction; 3 in design, 5 under planning	Operational
Project Components	Hardware, Standards, agreements	?	Hardware for AVL / AVI, Software for AVL / AVI	Signal controllers; Communications interconnect and master to office	Detection (Loop and AVI readers)
Control Center?	no	?	No (not currently)	yes	?
If Yes, Location		?		DOTD District 02 Headquarters	Crescent City Connection, Headquarters
Hours of Operation		?		7:45 am - 4:15 pm M-F and as needed	
Estimated Costs Construction	?	?	not yet determined	$10,000-50,000 per intersection	
Operation / Maintenance			not yet determined	$2,000-3,000 per year per intersection	
Related Projects		?		Vehicle Priority preemption; Transit implications	
Agency Interaction	RPC, DOTD City of N O. Jefferson Parish	RPC		Manual coordination with Parish, City systems	Provide historical data within agency
Incident Management Features	all	?	Onboard communications system linked to central dispatch	System detection for volumes, density to identify congested locations in real time Adjust timings to handle traffic diversions.	Possible conversion of real-time data to determine flow rates, density, obstruction, delays.

AGENCIES Attachment B questions	12 LDOTD District 02	13 Greater N.O. Expwy Commission	16 Crescent City Connection	16 Crescent City Connection
Project Name	Transit / HOV lanes	Electronic Toll and Traffic Management	Bridge Emergency Service Team (BEST)	Toll Tags
Location / Limits	US 90 B (Crescent City Connection)	North and South Toll Plazas	Claiborne Avenue to Terry Parkway	Crescent City Connection Bridge
Owner / Responsible Agency	Crescent City Connection Division, DOTD	Greater New Orleans Expressway Commission	Crescent City Connection Division / LaDOTD	Crescent City Connection Division / LaDOTD
Contact Person	Alan Levasseur	Bryan Clement	Alan J. LeVasseur	Alan J. LeVasseur
Telephone Number	364-8100	(504) 835-3116	(504) 364-8100	(504) 364-8100
Type of Project	Public Transit / HOV possible AVI		Incident Management	ETTM
Project Goals & Objectives	Priority for high occupancy vehicles		Response to traffic incidents	Pre-payment of tolls
Status of each Project	Lanes under construction - operational aspects under planning/study	Operational	Operational	Operational (since Jan. 4, 1989)
Project Components	Fixed signs, AVI detection, possible video monitoring, agreements with transit operators, HOV operators.	AVI	Standards/ Specifications - vehicle with operator	Signs (informational), loop detectors, RF ?? antenna, Transponders, software, standards / specifications, agreements
Control Center?	?	yes	yes	yes
If Yes, Location	Crescent City Connection Division, Headquarters	South Toll Plaza	Crescent City Connection Division	Crescent City Administration Building
Hours of Operation		24 hours / day	6:30 am - 10 30 am & 3.00 pm - 7:00 pm	8.00 am - 4 00 pm (M-F)
Estimated Costs Construction				$ 1 million
Operation / Maintenance			$20,000 /yr	$ 150,000 / yr
Related Projects	Crescent City Connection Toll Plaza AVI		Emergency roadside call boxes	Video enforcement system
Agency Interaction	CCCD, DOTD, Transit and HOV operators			none
Incident Management Features	Response plan, possible use of lanes to divert main bridge traffic	Service patrols, Mile Post Markers, Emergency call boxes, Variable Message Signs	service patrol	none

APPENDIX C

Table C-i Annualized Benefit:Cost Calculations

Phase	Route	From	To	Fully Instrumented Annual Benefit:Cost	Less Than Fully Instr Annual Benefit:Cost	Fully Instrumented Annual Benefit (B)	Less Than Fully Instrum Annual Benefit (B)	Length(mi)		Fully Instrument Annual Benefit/Mile	Less Than Fully Instru Annual Benefit/Mile
First	I-IO	I-610	Chef Mentour Hw	744	10.28	$1,251,447	$625,723	3 2		$394,778	$197,389
First	US 90 East	I-I 0	Franklin Ave	0.19	0.18	$7,724	$3,862	2.6		52,959	51,480
First	Gentilly Blvd.	US 90	N Broad St	13.28	26.56	$137,570	$68,785	1.6		$85,447	$42,724
First	I-61 0	I-IO	I-IO	1.71	4.25	$352,296	$176,148	4.7		$74,461	$37,241
First	I-IO	I-610	I-610	6.83	10.17	$2,819,051	$1,409,525	8 2		$342,534	$171,267
First	US 90 East	I-610	I-IO	6.67	5.68	$470,996	$235,498	4.7		$101,072	$50,536
First	Elysian Fields Av	Leon C Simon Dr	N. Peters St	4.60	3.56	$295,081	$147,540	4.7		$62,783	$31,392
First	Canal St.	City Park	Convention Ctr	3.58	2.46	$204,029	$102,015	3 9		$52,585	$26,292
First	Poydras St.	I-IO	Convention Ctr	1.27	0.76	$62,601	$31,301	1.3		$47,425	$23,713
First	I-IO	Veterans	I-61 0	36 48	49.69	$11.582,579	$5.791,290	6 2		$1,865,150	$932,575
First	Veterans Mem.	I-IO	LakeAvenue	401	8.66	$1,008,946	$504,473	6.0		$167,044	$83,522
Second	I-IO	Chef Menteur Hw	Michoud Blvd	a.95	14.50	$3,454,361	$1,727,1 80	a.5		$408,317	$204,158
Second	US 90 East	us11	I-IO	0.17	0.33	$40.555	$20,277	10.0		$4,055	$2,028
Second	I-10 Front Rds	MayoRoad	Paris Road	52.08	260.41	$1,348,919	$674,460	5.4		$251,664	$125,832
Second	Hayne Blvd.	Paris Road	Elysian Fields Av	41.85	3858	$3,197,743	$1,598,872	a.9		$361,327	$180,663
Second	I-10	I-310	Veterans	2.43	3.91	$627,407	$313,704	5.5		$115,121	$57,560
Second	Veterans Mem.	St. Charles Line	I-IO	1.93	3.21	$390,527	5195,263	4.3		$90,191	$45,095
Second	Causeway	I-IO	I-I 2	305	11.20	$492,992	$246,496	30.3		$16,270	$8,135
Second	US Bus. 90	I-IO	Mississippi River	48.07	24 03	$1,058,255	$529,127	2 8		$384,820	$192,410
Second	West Bank Exp	Mississippi River	us 90	85.41	114.77	$9,511,958	$4,755,979	12.5		$760,348	$380,174
Second	US 90 West	us 90	Jefferson Hwy	37.74	89.64	$464,333	$232,166	31		$149,785	574,892
Second	West Bank Frnt Rd	Westwood Drive	Terry Pkwy	306.76	153.38	$794,503	$397,252	4 4		$180,569	$90,284
Second	LA 39	I-IO	Paris Road	11.40	10.42	$863,998	$431,999	71		$122,379	$61,190
Second	LA46	Elysian Fields Av	Pans Road	10.90	9.45	5783,227	$391,614	6 4		5122,379	$61.190
Second	US 61	I-310	I-10	510	527	$641,191	$320,595	14.1		545,346	$22,673
Second	Earhart Expwy	David Drive	Claiborne Ave	31 76	34.74	$2,879,464	$1,439,732	10.1		$284,251	$142.126

NEW ORLEANS ITS STUDY

Table C-1 Annualized Benefit:Cost Calculations

Phase	Route	From	To	Fully Instrumented Annual Benefit:Cost	Less Than Fully Instr Annual Benefit:Cost	Fully Instrumented Annual Benefit (B)	Less Than Fully Instrum Annual Benefit (B)	Length(mi)		Fully Instrument Annual Benefit/Mile	Less Than Fully Instru Annual Benefit/Mile
Second	US 90 West	Jefferson Hwy	US Bus. 90	28.64	21.63	$2,633,493	$1,316,746	7.6		$346,969	$173,484
Third	I-IO	US 51	I-31 0	5.08	2.81	5342,005	$171,002	10.7		$32,023	$16,011
Third	US 61	US 51	I-31 0	5.63	3.03	5251,370	$125,685	11.2		522,404	$11,202
Third	US 90 west	I-310	West Bank Exp	6.01	11.75	$517,511	$258,755	13.5		$38,334	$19,167
Third	I-31 0	US 90	I-10	365	5.70	$250,797	$125,398	11.4		522,097	$11,048
Third	I-510	US 90	Almonaster Ave	1.03	0.79	$65,262	$32,631	3.6		518,028	$9,014
Third	LA 47	Almonaster Ave	LA 46	33.06	190.10	$984,738	5492,369	6.1		$162,498	$81,249
Final	I-IO	Michoud Blvd	I-l 2	83.50	45 01	$3,730,778	$1,865,389	19.2		$194,311	$97,156
Final	us11	I-l 2	US 90	606	3 27	$270,889	$135,444	17.6		$15,426	$7,713
Final	US 90 East	us 190	us 11	0.10	0.05	$2,419	$1,210	16.7		$145	$72
Final	I-55	I-IO	I-12	7.69	3.84	$318,493	$159,247	27.1		$11,753	$5,876
Final	I-12	I-55	Causeway	7.35	382	$613,638	$306,819	23.2		$26,450	$13,225
Final	I-12	Causeway	I-IO	9.04	4.76	$579,769	$289,885	20.9		$27,740	$13,870
	TOTAL			12.60	14.12	$55,302,913	$26,895,506	369.1		$149,824	$72,864

• • - Detection Systems, CCTV and Fiber Optic Communications NOT Included in the 'Less Than Fully Instrumente

"Less Than Fully Instrumented" Benefits equal	50%	of "Fully Instrumented" Benefits
Annualization Factor for 10 yrs	0.1295	(5% Interest)
Delay saved/incident assumed	5	minutes

NEW ORLEANS ITS STUDY
Table C-2 Total Capital Costs

Route	From	To	Fully Instrumented Capital Costs	Less Than Fully Instru Capital	Roadway Markers	HAR Transmitter	VMS fixed	Weather Detection	Traffic • * Detection	CCTV"	Fiber Optic • * Communication
I-10	I-610	Chef Mentour Hw	$1,299,000	$470,000			$450,000	$20,000	$120,000	$75,000	$634,000
US 90 East	I-IO	Franklin Ave	$31 0,000	$170,000			$150,000	$20,000	$90,000	550,000	
Gentilly Blvd.	us 90	N Broad St	$80,000	$20,000			50	520,090	$60,000	$0	
I-610	I-10	I-IO	$1,591,000	$320,000			$300,000	$20,000	$150,006	$175,000	$946,000
I-10	I-61 0	t-610	$3,186,000	$1,070,000			$1,060,000	$20,000	$270,000	$200,000	$1,646,000
US 90 East	I-610	I-10	$545,000	$320,000			$300,000	$20,000	$150,000	$75,000	
Elysian Fields Av	Leon C Simon Dr	N. Peters St	$495,000	$320,000			$300,000	520,000	$150,000	525,006	
Canal St.	Clty Park	ConventionCtr	$440,000	$320,000			$300,000	$20,000	$120,000	50	
Poydras St.	I-IO	ConventionCtr	$380,000	5320,090			$300,000	$ 2 0 , 0 0 0	$60,000	50	
I-10	Veterans	I-610	$2,452,000	$900,000		$300,000	$600,000	$0	$210,000	$100,000	$1,242,000
Veterans Mem.	I-10	Lake Avenue	$1,943,000	$450,000			$450,000	$0	$210,000	$75,000	$1,208,000
I-10	Chef Menteur Hw	Michoud Blvd	$2,982,000	$920,000			$900,000	$20,000	$270,000	$100,000	$1,692,000
US 90 East	us 11	I-10	$1,895,000	$470,000			$450,000	$20,000	$300,000	$125,000	$1 ,000,000
I-10 Front Rds	Mayo Road	Pads Road	$200,000	$20,000			50	$20,000	5180,000	50	
Hayne Blvd.	Parts Road	Elysian Fields Av	$590,000	$320,000			$300,000	$20,000	$270,000	50	
I-10	I-310	Veterans	$1,990,000	$620,000			$600,000	$20,000	$180,000	$100,000	$1,090,000
Veterans Mem.	St. Charles Line	I-IO	$1,561,000	$470,000			$450,000	$20,000	$150,000	$75,000	$866,000
Causeway	I-10	I-12	$1,250,000	$170,000			$160,000	$20,000	5930,000	5160,000	
US Bus. 90	I-10	Mississippi River	$170,009	$170,000			51 50,000	$20,000		$0	
West Bank Exp	Mississippi River	u s 9 0	$860,000	$320,000			$300,000	$20,000	$390,000	$150,000	
us 90 west	US 90	Jefferson Hwy	$95,000	$20,000			$0	$20,000		575.006	
West Bank Frnt Rd	Westwood Drive	Terry Pkwy	$20,000	$20,000			$0	$20,000		$0	
LA 39	I-IO	Parts Road	$585,000	$320,000			$300,000	$20,000	$240,000	525.000	
LA46	Elysian Fields Av	Paris Road	$555,000	$320,000			$300,000	$20,000	$210,000	525,000	
US 61	I-310	I-10	$970,000	$470,000			$450,000	$20,000	5 4 5 0 . 0 0 0	550,000	
Earhart Expwy	David Drive	Claiborne Ave	$700,000	$320,000			5300.000	$20,000	5330,000	$50,000	

NEW ORLEANS ITS STUDY
Table C-2 Total Capital Costs

				Fully	Less Than							
				Instrumented	Fully Instru	Roadway	HAR	VMS	Weather	Traffic • '		Finer Optic • *
e	Route	From	To	Capital Costs	Capital Costs	Markers	Transmitter	fixed	Detection	Detection	CCTV'	Communication
nd	us 90 west	Jefferson Hwy	US Bus. 90	$710,000	$470,000			$450,000	$20,000	$240,000	$0	
	I-10	US 51	I-310	$520,000	$470,000			$450,000	520,000		$50,000	
	US 61	**US 51**	**I-310**	5345000	**$320,000**			5300.000	$20.000		$25.000	
	us 90 west	I-310	West Bank Exp	$665,000	$170,000			$150,000	$20,000	$420,00	$75,000	
	I-310	US 90	I-IO	$530,000	$170,000			$150,000	520,006	5360,000	$0	
	I-510	US 90	Almonaster Ave	$490,000	$320,000			$300,000	$20,000	$120,000	$50,000	
	LA47	Almonaster Ave	LA 46	5230,000	**$20,000**			$0	520,000	$210,000	$0	
	I-10	Michoud Blvd	I-12	5345,000	5320,000			$300,000	$520.080		$25,000	
	us11	I-12	US 90	5346,000	$320,000			$300,000	$20,000		**$25,000**	
	US 90 East	us 190	us 11	$195,000	$170,000			$150,000	520,000		525,000	
	I-55	I-10	I-12	$320,008	$320,000			5300,000	$20,000		$0	
	I-I 2	I-55	Causeway	$645,000	$620,000			$600,000	520,000		$25,000	
	I-12	Causeway	I-10	5496,008	$470.000			$450,000	$20,000		$25.000	
	TOTAL			$38,901,800	$13,790,000	$922,800	$300,000	$12,750,000	$740,060	$6,840,000	$2,025,000	$10,324,000
				Unit Capital Costs		$2,500	550,000	$150,000	520,000	$15,000	525,000	$200,000
				Units		per mile	per transmit	per sign	per station	per station	percamera	per mile

- **Detection Systems, CCTV and Fiber Optic Communications NOT Included in the 'Less Than Fully Instrumented'**

Fully Instrumented Capital Costs Includes $5.000.000 for the ITS Center and Operating Software

"Less Than Fullv Instrumented" Benefits eaual 50% of "Fullv Instrumented" Benefits

Annualization Factor for 10 yrs | **0.1295** | **(5% Interest)**

Delay saved / incident assumed | **5** | **minutes**

NEW ORLEANS ITS STUDY
Table C-3 Annualized Capital Costs

Route	From	To	• * Fully Instrumented Annual costs (C)	Less Than Fully Instrum Annual costs (C)	Roadway Markers	HAR Transmitter	VMS fixed	Weather Detection	Traffic Detection	CCTV •	Fiber Optic l * *Communication
I-IO	I-610	Chef Mentour Hw	$168,221	$60,865	$0	$0	568,275	52,590	$15,540	$9,713	$82,103
US 90 East	I-IO	Franklin Ave	$40,145	$22,015	50	50	519,425	$2,590	$11,655	$6,475	$0
Gentilly Blvd.	US 90	N Broad St	$10,360	$2,590	50	50	$0	$2,590	$7.770	$0	$0
I-61 0	I-I 0	I-IO	$206,035	$41,440	50	$0	$38,850	$2,590	$19,425	$22,663	$122,507
I-10	I-610	I-610	$412,587	$138,665	50	$0	$135,975	$2,590	$34,965	$25,900	$213,157
US 90 East	I-610	I-IO	$70,578	541,440	50	50	$38,850	$2,590	$19,425	$9,713	$0
Elysian Fields Av	Leon C Simon Dr	N. Peters St	$64,103	541,440	$0	$0	$38,850	$2,590	$19,425	$3,236	50
Canal St.	City Park	Convention Ctr	$56,980	$41,440	$0	$0	536,856	$2,590	515.540	$0	$0
Poydras St.	I-IO	Convention Ctr	549,210	541,440	50	50	$38,850	$2,590	$7,770	$0	$0
I-IO	Veterans	I-610	$317,534	$116,550	$0	$38,850	577,700	$0	$27,195	$12,950	$160,839
Veterans Mem.	I-IO	Lake Avenue	$251,619	$58,275	$0	$0	556,275	$0	$27.195	$9,713	$156,436
I-IO	Chef Menteur Hw	Michoud Btvd	$386,169	$119,140	$0	$0	$116,560	$2,599	534,965	$12,950	$219.114
US 90 East	US11	I-I 0	$245.403	$60,865	$0	$0	$58,275	$2,590	$38,850	$16,186	$129,500
I-I 0 Front Rds	Mayo Road	Paris Road	$25,900	$2,590	$0	$0	50	$2,590	$23,310	$0	$0
Hayne Blvd.	Pads Road	Elysian Fields Av	576.405	541,440	50	50	$36.850	$2,590	$34,965	$0	$0
I-IO	t-310	Veterans	$257,705	**$80,290**	$0	$0	$77,700	$2,590	$23,310	$12,950	$141,155
Veterans Mem.	St. Charles Line	I-IO	$202,150	$60,865	$0	$0	$58,275	$2,590	$19,425	$9,713	$112,147
Causeway	I-IO	I-12	$161,875	$22,015	$0	$0	$19,425	$2,590	**$120,435**	$19,425	50
US Bus. 90	I-IO	Mississippi River	$22,015	$22,015	50	50	$19.425	$2,590	50	$0	$0
West Bank Exp	Mississippi River	US 90	$111,370	541,440	$0	$0	$38,850	$2.590	550,505	519,425	50
US 90 West	US 90	Jefferson Hwy	$12,303	$2,590	50	50	$0	$2,590	50	$9,713	$0
West Bank Frnt Rd	Westwocd Drive	Terry Pkwy	$2,590	$2.590	$0	$0	$0	$2,590	$0	$0	$0
LA 39	I-I 0	Pads Road	$75,758	$41,440	$0	$0	$38,850	$2,590	$31.080	$3,236	$0
LA46	Elysian Fields Av	Paris Road	$71,873	$41,440	50	50	$38,850	52,590	$27,195	$3,238	$0
US 61	I-310	I-IO	$125,615	$60,865	$0	$0	$58,275	$2,590	$58,275	$6,475	$0
Earhart Expwy	David Drive	Claiborne Ave	$90,650	$41.440	$0	$0	$38,850	$2,590	$42,735	$6,475	$0

Table C-3 Annualized Capital Costs

				** Fully Instrumented Annual Costs (C)	Less Than Fully Instrum Annual Costs (C)	Roadway Markers	HAR Transmitter	VMS fixed	Weather Detection	Traffic ** Detection	CCTV **	Fiber Optic ** Communication
	Route	From	To									
d	US 90 West	Jefferson Hwy	US Bus. 90	$91,945	$60,865	$0	$0	$58,275	$2,590	$31,080	$0	$0
	I-IO	us 51	I-310	$67,340	$60.865	50	$0	$58,275	$2,590	$0	$6,475	$0
	US 61	us 51	I-310	$44,678	$41,440	$0	$0	$38,850	$2,590	$0	$3,238	$0
	US 90 West	I-310	West Bank Exp	$86,118	$22,015	50	$0	$19,425	$2,590	$54,390	$9,713	50
	I-310	US90	I-IO	$68,635	$22,015	50	50	$19,425	$2,590	$46,620	50	$0
	I-51 0	US90	Almonaster Ave	$63,455	$41,440	$0	$0	$38,860	$2,590	$15,540	$6,475	$0
	LA47	Almonaster Ave	LA 46	$29,785	52,590	$0	50	50	$2,590	527,195	50	50
	I-IO	Michoud Blvd	I-12	$44,678	541,440	50	50	$38,850	$2,590	$0	$3,238	$0
	us11	I-12	us 90	$44,678	$41,440	$0	$0	$38,850	$2,590	50	$3,238	50
	US 90 East	us 190	us 11	525,253	522,015	50	50	$19,425	$2,590	$0	$3,238	$0
	I-55	I-IO	I-12	541,440	541,440	50	50	$38,850	$2,590	$0	$0	$0
	I-12	I-55	Causeway	583,528	580.290	50	50	577,700	52,590	$0	$3,238	$0
	I-12	Causeway	I-IO	$64,103	$60,865	$0	$0	$58,275	$2,590	$0	$3,238	$0
	TOTAL			$4,390,283	$1905,308	$119,503	$38.850	$1,651,125	$95,830	$885,780	5262,238	$1,336,958
				Annualized Unit Costs		$324	$6,475	$19,425	$2,590	51,943	53,238	525,900
				Units		per mile	per transmit	per sign	per station	per station	per camera	per mile
				Unit Capital Costs		52,500	$50,000	$150,000	$20,000	$15,000	$25,000	$200,000
				*• * Detection Systems, CCTV and Fiber Optic Communications NOT Included in the 'Less Than Fully Instrumented'								
				"Less Than Fully Instrumented" Benefits equal 50% of "Fully Instrumented" Benefits								
				Annualization Factor for 10 yrs		0.1295	(5% Interest)					
				Delay saved/incident assumed		5	minutes					

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