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16. Abstract

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The Feasibility Study for Development of an ITS Center in Lafayette

Summary Report

by
Xiaoduan Sun

Department of Civil Engineering
University of Louisiana at Lafayette
Lafayette, LA 70504

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ABSTRACT

This report documents the development of a feasibility study of the Lafayette Intelligent Transportation Systems (ITS) Center. Due to the size of Lafayette, the study was done with an approach slightly different from the majority of ITS studies conducted for large urban areas. After a thorough evaluation of the current transportation systems, two surveys were conducted by the core ITS stakeholders. Rather than going through a conceptual process, the local stakeholders went through a detailed ITS data survey to identify and prioritize ITS user services for the proposed Lafayette ITS Center. The data survey was designed by closely following the National ITS Architecture. The survey, strongly recommended by the local traffic engineers, concretely reveals the existing ITS elements, the current ownership of the existing ITS data, and what data will be needed at the different ITS development stages. Based on the results of the survey, the market packages were developed followed by the architectures.

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IMPLEMENTATION STATEMENT

The implementation of this project will lead to the establishment of ITS in Lafayette. As noted in this report, a decentralized ITS operation may be developed as a short-term implementation goal due to cost considerations. However, the long-term goal of ITS development may include a centralized location for effective operation. Thus, it is important to keep long-term goals in mind during the first stage of deployment.

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INTRODUCTION

ITS is the application of management strategies and technologies to increase the efficiency and safety of national, regional, and local transportation systems. Rather than solving transportation problems solely by building additional roadway capacity, ITS strives to use existing facilities more efficiently by applying technology and effective management strategies to collect, transfer, process, and share historic and real-time transportation information. This involves the use of computers, communications, sensors, information and control technologies, and a structured approach to manage planning, development, operations, and maintenance of ITS systems and projects.

Despite the demonstrated success of ITS in large urban areas, very few systematic studies have been conducted on the feasibility of implementing ITS technologies in medium or small size urban areas. Compared to metropolitan areas, these smaller urban areas have different transportation needs and operations. For instance, only a small portion of the population utilizes public transit services, and driving alone is the strongly preferred choice of the traveling public. Therefore, the application of ITS technologies to a transit system in a small urban area will provide new challenges. Because small urban areas have different needs, a comprehensive study analyzing these needs and investigating possible ITS applications is well justified.

OBJECTIVE

The goal of this project is to investigate the feasibility and potential benefits of the application of ITS to specific transportation problems in Lafayette. In other words, National ITS Architecture will be applied as the framework to:

- Identify needs of the Lafayette transportation system
- Investigate and document existing ITS elements
- Prioritize ITS services and research appropriate ITS technologies for Lafayette
- Develop local ITS Architecture
- Identify ITS market packages which satisfy local needs and priorities
- Identify possible and potential institutional barriers of ITS implementation at the local and state levels.

SCOPE OF WORK

The project includes the following tasks:

Task 1: Existing transportation system evaluation
Task 2: Identification of Lafayette's existing ITS elements
Task 3: Collection and compilation of local ITS data
Task 4: Local ITS services identification and market package analysis
Task 5: Definition of the local ITS architecture structure
Task 6: Technology review for local ITS deployment

METHODOLOGY

Lafayette Parish

Lafayette Parish consists of the metropolitan area of Lafayette and six smaller surrounding areas. Based on the 1998 U.S. Census Bureau estimate, the population of the parish is 186,600, and the population of the Lafayette Metropolitan Statistic Area (MSA) is 375,700. The Lafayette MSA includes the parishes of Lafayette, Acadia, St. Landry, and St. Martin.

The city of Lafayette is the fourth largest city in the state of Louisiana and is the heart of the eight-parish, southwestern region known as Acadiana. It is the center of trade, medical service, education, and commercial establishment for more than 600,000 people living in Acadiana. Lafayette is known across the nation and around the world for its unique Cajun and Creole cultures, music festivals, and historical background.

Two freeways, I-10 and I-49, intersect in Lafayette, making it a strategically important transportation point for traffic flow from all directions. Lafayette is also a gateway for hurricane evacuation of southwest Louisiana. Local traffic has been on the rise for the past several years due to fast economic growth, resulting in a lower level of service on the arterial network. The urban area's poor physical layout compounds traffic congestion. Land use development is based on French linear land divisions, which have resulted in major thoroughfares spliced together over the past fifty years. No grid pattern of local or arterial streets exists that would allow alternative routes for traffic. A traffic accident on any link of the existing arterial network can critically impact the entire system within a short period of time.

For the past two years, the newly established Department of Traffic and Transportation under the Lafayette Consolidated Government (LCG) has conducted various projects to improve the traffic problems in Lafayette. These projects, ranging from simple lane reconfiguration at intersections to the ambitious new signal timing plans for the entire signal system, have had a positive effect on local traffic flow. However, as the population grows and business activities increase, the peak-hour traffic congestion on several major arterial streets and freeway exits will worsen. ITS has provided promising solutions to these problems.

Traffic and Transportation Characteristics

Characteristics of Lafayette Urban Street Network

The Lafayette urban street network consists of two freeways and over a dozen arterial streets. Business centers have been developed throughout the city. Unlike larger metropolitan areas, there is no distinguished Central Business District (CBD). Business establishments are scattered over the city. Many residential subdivisions are located behind and/or adjacent to commercial land use areas. Due to the lack of a beltway or a circumference highway around the Lafayette metropolitan area, the majority of Lafayette arterial streets carry both local and through traffic. These arterial streets cause congestion through their accessibility to various major traffic areas. Johnston Street, Ambassador Caffery Parkway, University Avenue, Pinhook Street, and Kaliste Saloom Road are examples of such arterial streets. For example, the average density of access point (excluding signalized intersections) on Johnston Street between Ambassador and University is about 15.4 per mile.

Heavy traffic on the major arterial streets in Lafayette has reduced their capacities. In addition, constant interaction between vehicles from the surrounding business establishments and vehicles on the street system slows down the flow of traffic and increases the risk of vehicle collision and crashes.

Another problem with the network is the lack of bridges crossing the Vermilion River, which divides Lafayette. The city of Lafayette was originally established on the north side of the river. For the past twenty years, there have been land use developments on the south side of the river along Kaliste Saloom Road, Pinhook Road, and Vero School Road. There are currently no bridges crossing the river within the heavily traveled area (between Ambassador and Pinhook). The layout of the Lafayette urban network provides few feasible alternatives for people traveling from one point to another. Any minor traffic incident has a significant impact on system traffic flow, especially during peak-hours. The street network performance was studied by each intersection's level of service, average speed, and peak-hour volumes. The results clearly show that the majority of the intersections of major streets are already experiencing excessive delays, and the average running speed on these major streets is lower (some segments are more than 50% lower) than the posted speed limits. The GPS surveys were taken under Lafayette's normal peak-hour traffic conditions without vehicle incidents and/or adverse weather effects. Delays and travel speeds would be much worse if traffic incidents or bad weather were involved. It is common knowledge that the worst traffic is occurs during Saturday's peak shopping hours along several major streets close to the

Acadiana Mall. The intersection delays can last as long as three or more cycle lengths (over 3 minutes) during these normal-peak shopping hours.

Public Transit Systems

The Lafayette Transit System (LTS) is a publicly funded transit fleet with 16 buses and 23 drivers. It makes approximately 1.8 million passenger trips annually. Service is provided throughout the city of Lafayette with the first bus leaving the transit terminal at 6:30 a.m. and the last bus departing at 6:00 p.m. The system runs Monday through Saturday with fourteen fixed routes during the week and ten fixed routes on Saturday.

LTS's radial route structure is focused around a central transfer station located at the intersection of Garfield Street and Lee Street near downtown Lafayette. The system is designed to allow a time-transfer at the terminal. The service is operated on a 30-minute interval. Like all small or medium-sized urban areas in the country, the utilization of public transit is very small. Based on the 1990 Census, only 2.4 percent of commuters use the transit service.

The small ridership provides the revenue. Other funding for the City of Lafayette Transit System comes from various sources, including the Lafayette Consolidated Government (LCG), Federal Transit Administration (FTA), and Louisiana Department of Transportation and Development (LaDOTD).

In 1997, the LCG contracted Wilbur Smith Associates for a comprehensive Lafayette Transit Study. The goals of that study were as follows:

- Provide efficient, reliable, and convenient transit service to persons with no means of transportation available
- Utilize City-Parish resources in a sound and fiscally responsible manner
- Enhance regional mobility for elderly and disabled persons
- Unitize innovative funding strategies to maximize sources of revenue to efficiently maintain existing services and expand outlying areas of the parish
- Promote regional transportation mobility through expansion of transit throughout Lafayette Parish
- Improve public awareness of LTS services throughout Lafayette Parish and enhance the image and perception of public transportation

Based on the demand analysis, this study has recommended expansion of the service into the parish, which includes the seven new areas:

- City of Carencro
- City of Scott

- City of Duson
- Southpark Business Park
- City of Broussard
- City of Youngsville
- Northpark Industrial Park

The last two areas are considered as the long-term expansion. The first five areas will be served by the three proposed routes: the Carencro Route, Duson/Scott Route, and Broussard/Southpark Route.

Traffic Management for Special Events

Because the City of Lafayette is the capital of Acadiana, there are many festivals throughout the year. Mardi Gras in Lafayette has grown to become the second largest Mardi Gras celebration in Louisiana. It is also the home of the Icegators, the first hockey team in Louisiana. Traffic management for special events is provided by the city police through contracts with event promoters.

Existing ITS Elements

Existing Traffic Signal Systems

The traffic signal control system plays a key role in managing Lafayette traffic flow since the majority of traffic volume occurs on the principal arterial streets. Most of the signal-controlled intersections are currently experiencing heavy traffic with multi-lane crossing sections. The capacity at signalized intersections generally determines the capacity of the arterial streets. High Volume/Capacity, (V/C), ratios at the signalized intersections signify that most principal arterial streets operate at or above the capacities during peak-hour periods.

Presently, a centralized computer-control system exists for signals in Lafayette. This system was initially designed in the early 70's and implemented in the early 80's. The system underwent significant upgrading in 1996. Currently, the system controls 170 signals throughout the city of Lafayette. These signals are operated in either semi- or fully-actuated control using loop detectors. The majority of them are in coordinated modes throughout the day.

The signal coordination and timing plans are executed through communication between the signal controller and the central computer. The communication between the computerized signal control center and each controller in the field is achieved via the local franchised cable

TV (CATV) service provider. The bandwidth used for traffic signals is 24-30 MHz and 114-120 MHz. The signal timing patterns are transformed from the master controller to the local controller to produce a coordinated system.

The signals within the communities of Carencro, Broussard, Duson, Scott, and Youngsville are operated independently and are maintained by the La DOTD.

Traffic Signal Timing Analysis/Implementation Project

In 1999, the Traffic and Transportation Department of the LCG contracted two engineering firms to develop new traffic signal timing plans. It is an ambitious and important transportation improvement project. The project includes the use of Synchro, PASSER, TRANSYT-7F, and CORSIM/TSIS software analysis. This project, upon completion, will retime up 171 intersections, which will retime for the AM peak, PM peak, and some off-peak and weekend time periods for individual signal locations approved by the LCG. Based on the project requirements, each timing plan will include a cycle length, offset, split phase sequence, and reference phase.

Other

Due to its relatively small size, the scope of Lafayette traffic control has been limited to conventional traffic signals and signs. There is no Traffic Congestion Management (TCM) system required like those established in many large urban areas of Louisiana including the cities of New Orleans and Baton Rouge. Other than loop detectors placed at intersections for managing traffic signal timing, no other type of traffic control device has been deployed for monitoring traffic flow. There is no probe vehicle surveillance and no Closed Circuit Television (CCTV) system. As of now, information on traffic flow and accidents is disseminated by several local radio stations. A brief summary of the inventory of ITS functions is given in Table 1.

Table 1
Summary of the inventory of ITS functions

Functional Area	Elements		Description
Management and Operations	Centers	La DOTD	None
		City	City Signal System (VMS)[a]
	Mobility Assistance Controls		None
	Incident Management		No organized coordination
Surveillance and Monitoring	Vehicle Detectors	Freeway	None
		Arterial Street	As a part of VMS
	CCTV[b]	Freeway	None
		Arterial Street	In the planning
	Wireless		Cellular to 911
	Vehicle Probes		None
Information Delivery	Information to Home/Work		None
	Information to drivers		Radio (by station)
	Information to media		News release (by city)
	Information to transit users		None
	Flooding Information (river level)		By the Bayou Vermilion District and USGS
Control	Signal Operations for Hurricane		Special timing plans
	Signal Operation to incident		None
	Ramp metering		None
	Adaptive Signal Operations		
	Railway Preemption		In the planning
Data Communications	Video	Freeway	None
		Arterial Street	In the planning
	Traffic	Freeway	None
		Arterial Street	Spread Spectrum
	Control	Freeway	None
		Arterial Street	Spread Spectrum
	Other		
Interagency Communication	To local agencies (Fire, 911, ambulance, police)		By phone and email
	To state agencies and other cities		None

[a] VMS : Variable Message Sign
[b] CCTV: Closed Circuit TV

Lafayette Parish Communication District (LPCD)

As an entity of the state of Louisiana, the Lafayette Parish Communication District (LPCD), by law, is responsible for 911 and other public safety telecommunications within Lafayette Parish. In addition, the LPCD operates under an intergovernmental agreement with LCG whereby LPCD performs the emergency management and communication system functions for LCG. LPCD is governed by a nine-member board of commissioners including:

- Sheriff of Lafayette Parish
- Fire Department (Robert Benoit)
- Police Chief (Ronal Boudreaux)
- UL Lafayette Police Chief (Police Chief, Joey Sturm)
- City-Parish President's Appointees (Mike Mouton & Carroll Guilbeau)
- Parish Volunteer Fire Department (Norwood Menard)
- State Police Troop I (Captain Frank Vaughan)
- Acadian Ambulance (Richard Zuschlag)

Funding for LCPD comes from the tax collected from 5% of basic phone services, which currently translates to $0.80 per residential line and $1.75 per business line. LCPD employs 24 personnel, including 14 operators for the 911 center who work 24 hours a day, 7 days a week.

The LPCD, established following the election in 1982, was the first 911-service center created in Louisiana after voters approved that a telephone tax be authorized by the state legislature in 1978. Since then, the state legislature has passed various acts regulating the service. Total revenues collected from the tax increase steadily at an average of 4% annually in the parish. During the past three years, this growth has approached 7% primarily because of cellular telephone expansion.

The LPCD has recently enhanced the 911-service (E911) by providing Automatic Number Identification (ANI) capability. When a call comes in from a wired phone, the street address automatically appears on the 911 call taker's computer screen. ANI saves time and reduces error. Efforts are being made to include calls from any type of wireless phone in this system (WE911).

Communication between the LPCD and the four dispatch centers (Fire Department, Police, Sheriff, and ambulance) are electronically (not physically) consolidated. The LPCD functions as an information center. There are basically two systems that work together to collect and distribute information. They are the Computer Assisted Dispatch (CAD) system and the Automatic Vehicle Location (AVL) mapping system.

Computer Aid Dispatch System (CAD). The Computer Aid Dispatch System is a "redundant server availability fault tolerant" computer system. It is used by the LPCD, Sheriff, Police, and Fire Department dispatch centers for incident calls, resource tracking, and emergency management. Three blocks of information show on each dispatcher's computer screen. One block shows the available number of responding units and their positions, the second shows the progress status of the responding unit, and the third indicates the nature of the call/event. Information on the CAD system is in the format and is shared by the LPCD and three dispatch centers simultaneously.

Automatic Vehicle Location Systems (AVL). The Automatic Vehicle Location System uses Global Positioning System (GPS) to track all in-service public safety vehicles (fire truck, police and sheriff's vehicles). The system is customarily developed by Trimble, which has a base station set up at LPCD and 300 receivers installed in fire trucks and police and sheriff's vehicles. The vehicles' real-time locations are graphically displayed on a parish map and updated approximately every 15 seconds. This system is fully integrated with the CAD system. Each phone operator at LPCD and dispatcher at the three centers, Lafayette Police, Fire, and Acadiana Ambulance have both CAD and AVL information on their computers.

Communication between dispatch centers and their service vehicles is carried out by Mobile Data Communication. In addition to a GPS receiver, each of the three has a mobile data terminal (via radio) that is integrated with the CAD system so that the emergency responders can visualize the actual call data as entered by the 911 call operator with all supplemental information available to them as well. Emergency responders can also key in their on-site messages and conduct inquiries whereby law enforcement officers can directly query a state and national crime computer for information.

Communication between LPCD and other entities strictly follows the TCPIP (Transport Control Protocol and Internet Protocol) standards regardless of the media used. Different communication media are utilized currently by the Lafayette Emergency Management Center including cable, phone lines, radio, microwave, and cellular phone. More specifically, this includes:

a. Radio (between the LPCD, dispatch centers and between in-service vehicles)
b. Cellular phone (between caller and LPCD)
c. Fiber optical cable (Between Sheriff and LPCD)
d. Cable (between Ambulance and LPCD)
e. Microwave (between city police and LPCD)

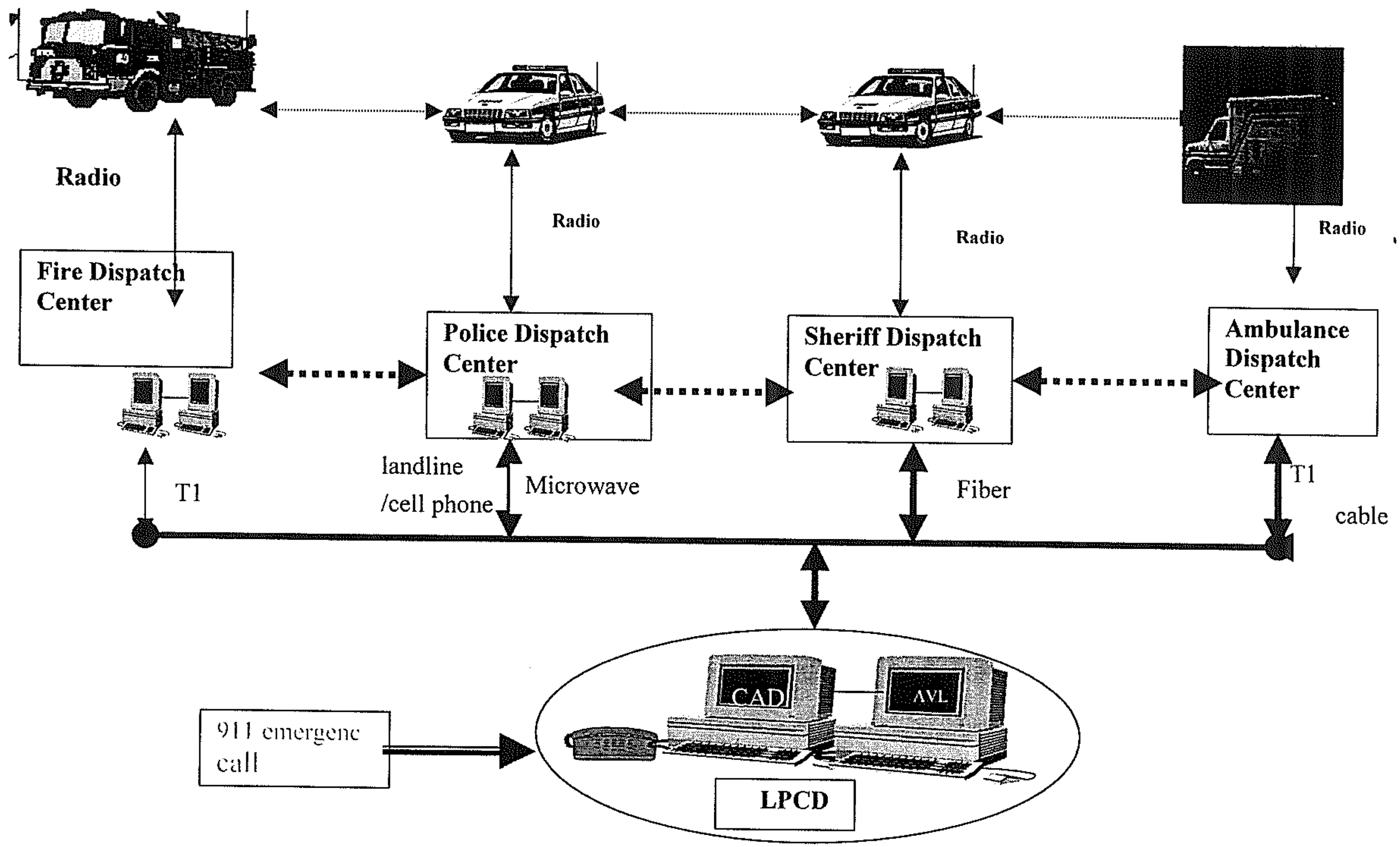

Figure 1
Communication links between LPCD and the rest of the system

The Potential Role of LPCD in Lafayette ITS Development

After several meetings with the LPCD, the project team quickly realized the significant role that LPCD can play in building the Lafayette ITS operations. There are many ITS elements already existing in the current Lafayette Parish 911 operations. These elements include emergency management and parish-wide collaboration among agencies in handling emergency incidents. The state-of-the-art technologies used by the LPCD provide a great vehicle for developing ITS infrastructure in Lafayette. It is clear that the future Lafayette ITS Center should be operationally and functionally integrated with the LPCD's existing operations.

First, LPCD can function as a key member of the local ITS system. Because it is governed by a nine-member board of commissioners including the sheriff of Lafayette Parish, the fire departments (both city and parish), the State Police, and Acadian Ambulance, the LPCD can represent emergency services stakeholders. Therefore, the three key partners in building the Lafayette ITS could be the LCG's Traffic and Transportation Department, LaDOTD District Office, and LPCD.

Another benefit of integrating LPCD with the future ITS development in Lafayette is the use of existing emergency response systems. A major component of ITS technologies is data transformation among agencies and users. Traffic incident management, a key element for the Lafayette ITS Center, requires communication between the traffic control center and police, fire, and medical services. Communication links already established between the 911 service and all dispatches can be used by the ITS center easily, which can not only save money, but also prevent duplication of effort.

Including LPCD in building the local ITS architecture from the beginning of the project has proven to be an excellent suggestion. Due to the size of the area, the scope of ITS operations in Lafayette would be somewhat different from proposed ITS centers in large metropolitan areas. It appears more efficient to have a decentralized ITS operation in Lafayette. The "bottom-up" ITS data survey that is presented in the next section of this report reveals that many required ITS data items are currently collected, compiled, and processed by the LPCD.

ITS Surveys

One of the key components of the ITS feasibility study is to identify and prioritize the ITS services which are most effective in better managing local traffic problems. To carry out this task, two surveys were conducted with core stakeholders in Lafayette. The surveys presented in this section were designed following the National ITS Architecture.

A Short Survey on ITS Goals and Objectives

The Intelligent Transportation Systems target a broad range of highway transportation problems. Due to budgetary constraints, it is not feasible or necessary to achieve all objectives outlined by ITS America. Each urban area should select its own ITS strategies based on the unique characteristics of its transportation system. To this end, a short survey on ITS goals and objectives was conducted. The intent of this survey was to investigate how local stakeholders and transportation engineers prioritize these objectives. During the survey, the participants were asked to rate the importance of the five ITS goals and the ten objectives under each goal by a numerical value. Assigning one to each goal or objective indicates that all five goals or ten objectives are equally important. A total of nine stakeholders completed this survey.

The final weighted number for each objective is the average score of all participants. According to the survey, the most important tasks for Lafayette ITS are to reduce travel delays caused by traffic congestion and emergency service and to improve highway safety. The survey results further demonstrate the importance of the collaboration with the LPCD. As mentioned in previous sections of this report, the LPCD has been very active in providing emergency services with state-of-the-art technologies in the Lafayette Parish. Adding traffic control elements to the current emergency management service can be efficiently accomplished under the proposed Lafayette ITS Center.

A Detailed ITS Data Survey

The ITS goals and objectives survey introduced above defines the general direction for ITS development. To move forward, it is necessary to establish working procedures. Most ITS studies have been conducted by identifying user services, physical and logical architecture, and market packages. The National Architecture provides a framework for this systematic approach. Following these studies, the user services are identified and prioritized by the evaluation of the local transportation system's deficiencies.

This process has worked well for many ITS studies conducted in large urban areas. However, a direct approach may be more practical in identifying and prioritizing the ITS user services for small urban areas. This direct approach, strongly recommended by the LCG

Traffic Transportation Department Staff, is to investigate the needs for ITS user services through a detailed ITS data survey. By going through such a detailed data survey, the needed ITS user services could be concretely identified and prioritized by local stakeholders. With tangible survey results in hand, it would be easier to plan and implement the ITS infrastructure and to reach their short-and long-term projects' goals.

This detailed data survey is called a "bottom-up" method because user services are investigated through data that are placed at the bottom of the architecture structure. This method, unlike many other urban areas' ITS studies, uses the ITS data as a core element to mirror the ITS needs of local stakeholders.

Summary

Since ITS user services are designed to focus on highly complex transportation systems, many of them are not feasible or necessary for small urban areas. The ITS service identification process that has worked well in many large urban areas should be replaced by a more direct method such as the detailed data survey adopted by this project.

The two surveys described in this chapter have clearly identified the needs of the ITS service particular to Lafayette. The surveys also lay the foundation for the development of the ITS architecture that will be discussed later in this report.

The final weighted number for each objective was the average score of all participants. According to the survey, the most important tasks for Lafayette ITS are to reduce travel delays caused by traffic congestion and emergency service, and to improve highway safety. The survey results further demonstrate the importance of collaboration with LPCD. As mentioned in the previous section of this report, the LPCD has been very active in providing emergency services with state-of-the-art technologies in Lafayette Parish. Adding traffic control elements to the current emergency management service to enact these goals can be accomplished under the Lafayette ITS Center.

Market Package Plan

Market Package

User services are too broad in scope to be convenient in ITS planning. Additionally, they often do not translate easily into existing institutional environments and do not distinguish between major levels of functionality. In order to address these concerns, a finer set of deployment-oriented ITS service building blocks, which are called "market packages," are defined from the original user services in the National ITS Architecture *[3]*.

Market Packages are sets of equipment packages required to work together (typically across different subsystems that, as basic components of the physical architecture in the National Architecture, will be introduced in the next section) to deliver a given transportation service, and the major architecture flows between them and other important external systems. In other words, they identify the pieces of the National ITS Architecture required to implement a service. Market Packages address the specific service requirements of traffic managers, transit operators, travelers, and other ITS stakeholders, and can be related back to the ITS user services and to their more detailed requirements *[3]*.

Market packages are influenced by the availability of basic supporting infrastructure, the evolution of technology, the emergence of industry standards, the institutional context of implementation, and market demand. Some market packages, which represent available techniques and would not experience dramatic institutional changes, are likely to be developed early. At the other end of the spectrum, several of the market packages represent advanced products or services that will not be available for some time. Many of the market packages are also incremental so that more advanced packages can be efficiently implemented by building on common elements that were deployed earlier with more basic packages *[3]*.

Market Package Screening

Selecting market packages that are most appropriate and beneficial to the area being studied is no small task. In practice, this task can be achieved through a series of screenings (criteria that must be met for a market package to pass). For the Lafayette ITS development, the screening of the market packages entails *mapping to the user services*, *mapping to the ITS survey results*, and *mapping to the identified problems.*

Results of Market Package Screening

With the application of these three approaches, the task of market screening resulted in 13 market packages for the Lafayette area. They are:

- *Network Surveillance*
- *Surface Street Control*
- *Traffic Information Dissemination*
- *Incident Management System*
- *Standard Railroad Grade Crossing*
- *Transit Vehicle Tracking*
- *Transit Fixed Route Operations*
- *Demand Response Transit Operation*

- *Broadcast Traveler Information*
- *Interactive Traveler Information*
- *Emergency Response*
- *Emergency Routing*
- *ITS planning.*

Market Packages Development

Based on the revealed priorities from the survey, the level of deployment of each market package is estimated for three selected time frames as shown below:

Initial deployment means that a market package first exists in an operational setting. The key word is operational--the package is neither an experimental nor a demonstration project. Moreover, the financial and institutional structures are operational as well; for example, funding responsibilities are being borne by the individuals/groups in the way that is designed for the life of the system, not just the start-up period.

Threshold deployment is a level of deployment that triggers a new level of service quality or the introduction of a new service component. Deployment thus incorporates market penetration, that is, the service is actually used rather than just available. Threshold deployment is the minimal level of deployment for efficient operation of that market package and may also constitute the minimal level of deployment for efficient operation of a related package (as a result of interdependencies).

Full deployment is achieved when there is widespread use of that market package in excess of threshold conditions to achieve system efficiency.

Four major factors affecting market package deployment were considered for the market package development in the Lafayette area: (1) Market Package Synergy, (2) Technology Constraints, (3) Interoperability Issues, and (4) Institutional Issues [*3*].

In consideration of these four factors, a timetable was developed for the 13 selected market packages.

Lafayette ITS Architecture

This section identifies the desired functional capabilities for the Lafayette ITS development and develops the Lafayette ITS architecture. Based on the developed architecture, four ITS projects were proposed.

Identify Desired Functional Capabilities

The ITS data survey, which was introduced previously, identifies a number of ITS functions. All of the functions are depicted in the logical diagram (Appendix B, available upon request). To establish these functions, a dozen market packages were identified in the last section. These market packages can be considered generic descriptions of the potential ITS capabilities to be achieved in Lafayette. However, for transportation practitioners, ITS projects are more comprehensible than market packages in that they represent more detailed descriptions of the functional capabilities. To incorporate actual ITS projects into the Lafayette ITS development, the generic ITS functions identified through the ITS survey need to be defined to view the so-called local functional capabilities. Based on the institutional structure in Lafayette, four major functional capabilities are defined as:

- Advanced Transportation Management/Traveler Information System
- Surface Street Control
- Transit Operations
- Emergency Management

To accommodate the above functions, four corresponding ITS projects are suggested. They are the *ITS Center Project*, *Traffic Signal Improvement Project*, *Transit Operations Project*, and *Emergency Management Project*. These projects can be implemented through the identified market packages. Each project is a collection of one or more market packages.

The defined functional capabilities and suggested ITS projects are incorporated into the development of the Lafayette ITS architecture, which provides a framework for the deployment of the market packages through the ITS projects.

ITS Architecture

The major purpose of defining a local architecture for Lafayette is to provide a framework for the delivery of the market packages identified in the market package plan. It is beneficial to incorporate project concepts into the architecture for the implementation. The development of the local ITS architecture is based on the National Architecture, which defines two components: logical architecture and physical architecture.

Logical Architecture. The logical architecture of the National ITS Architecture defines a set of functions and information flows that respond to the user service requirements. It should be independent of institutions and technology. For local ITS development, the logical architecture should be designed to the local ITS service needs [*3*].

Physical Architecture. A physical architecture provides agencies with a physical representation of how the system should provide the required functionality. In the National ITS Architecture, a physical architecture takes the processes identified in the logical architecture and assigns them to physical entities called *subsystems*. In addition, the data flows from the logical architecture that originates from one subsystem and ends at another are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems *[3]*.

In the National ITS Architecture, the physical architecture is described by two layers: the transportation layer and the communications layer. Each of these is briefly described below.

Transportation Layer

The transportation layer of the physical architecture shows the relationships among the transportation-management related elements. It is composed of subsystems for travelers, vehicles, transportation management centers, and field devices, as well as external system interfaces at the boundaries (called *terminators* in the documentation). It may include:

- Field devices for traffic monitoring and motorist information dissemination
- Traffic signal and ramp metering controllers
- Transportation management centers
- Emergency management centers

Communications Layer

The communications layer of the physical architecture provides the communication services that connect the transportation layer components. This layer depicts the communications necessary to transfer information and data among transportation entities, traveler information, emergency service providers, and other service providers such as towing and recovery. The communications layer identifies system interface points where national standards and communications protocols can be used *[3]*.

Lafayette ITS Architectural Development

The Lafayette ITS architectural development includes the development of logical and physical architecture. In addition, a functional architecture was also presented from a technological perspective.

Logical Architecture Development. The logical architecture for the Lafayette area is developed based on the logical diagram of the ITS data survey that is described in detail previously. It replaces the original ITS functions with the defined functions, detailed earlier in this section, and modifies the corresponding flow data.

Physical Architecture Development. The physical architecture for Lafayette, Louisiana, is developed by following a new development process, which is centered on the market packages.

There are three steps in the development:

1. Identifying the existing ITS elements from an inventory of existing transportation systems.

2. Mapping the existing and future services to physical architectural components (subsystems, terminals, equipment, and architecture flows) through each market package and combining identified components, which results in a preliminary physical architecture.

3. Designing the preliminary physical architecture to local requirements and existing systems to establish the local physical architecture.

The Project Architecture Development. As noted previously, market packages are grouped and incorporated to form ITS projects for implementation. In addition, they are used as building blocks for structuring the local ITS architecture. However, for the stakeholders, who will have main responsibility over implementation, a project architecture may be more welcome because it depicts the detailed information for implementation.

Technology Review

A range of technologies, each with unique performance, cost, and maturity characteristics, can be used to implement ITS. However, the biggest concern for many ITS planners is how to adapt to continuously advancing technologies such as computing and communications.

It is possible that for some services, the required technologies may not exist or may be too costly and/or unreliable for commercial applications. Market packages that are dependent on such technologies require further research and development to provide the enabling technology and integrate it into a commercially viable deployment package. Fortunately, the technologies identified for the majority of Lafayette ITS market packages are currently available at low risks.

CONCLUSIONS

The results of the feasibility study for the development of an ITS center in Lafayette led to the following conclusions.

Development of Lafayette ITS Center is Feasible and Necessary

The results of ITS surveys conducted show the need for ITS development in Lafayette. The typical problem areas are traffic and incident management. In order to meet these needs, it is necessary to establish an ITS center which helps to deploy the market packages identified previously. This center will perform basic operations such as traffic management, information dissemination, and data archiving. The proposed ITS center, LPCD, Traffic and Transportation department under LCG, and other local ITS stakeholders will be integrated as a whole ITS following the proposed local ITS architecture.

Utilization of Existing ITS Elements

Many ITS technologies are already in use in Lafayette. For example, LPCD already uses many ITS-related technologies, including computer-aided dispatch system and automatic vehicle location system. However, these technologies are not being used in conjunction with the operation of the transportation system. Once incorporated into the local ITS function, these technologies will help local traffic operators provide ITS services more efficiently and effectively.

Institutional Barrier Issue

Because of the wide range of those involved in implementation of ITS systems, there are a number of institutional constraints that can inhibit deployment. Potential major constraints include user benefits, cost/benefit allocations, energy and environmental impacts, standards, education and staffing, and regulatory constraints. Therefore, ITS implementation requires overcoming potential institutional barriers to achieve more efficient operations and/or interoperability. Institutional barrier will not be an issue in the development of the Lafayette ITS Center. Currently, most of the key potential stakeholders in Lafayette are public agencies under the LCG. Through this feasibility study, these parties have already indicated their willingness to work together under the ITS umbrella. Therefore, it is feasible to establish a sound cooperative partnership for the Lafayette ITS development. In the future, more private agencies will be involved in the ITS development for long-term deployment plans. The need for public-private sector cooperation may be a challenge facing the long-term implementation goals of ITS.

RECOMMENDATIONS

The following recommendations are offered as a result of this project.

Lafayette ITS Backbone Communication System

To connect the proposed ITS center to other existing centers, a backbone communication system should be established. Compared with twisted pair or coaxial cable systems, fiber optic communication systems are very advantageous. It provides high bandwidths, which allow data to be transmitted at high speeds. The transmission range is rarely a limitation, provided that communication hubs or fiber optic repeaters are installed. Based on these advantages, a fiber optic cable system of communication is recommended as the backbone communication system for the Lafayette ITS Development. Future work will deal with determining the fiber optic network configurations and defining its system architecture.

Institutional Relations Options

The Lafayette ITS architecture clearly defines the need for sharing transportation data and control over ITS devices. The sharing of data presents fewer jurisdictional and technical issues while the sharing of control generally requires detailed agreements, rules, and a very reliable technical solution. Two methods are recommended: the Trusted Information Service Provider (ISP) and Center-to-center (C2C) interfaces.

Trusted ISP Communication Links. Sharing traffic data and information has been identified as an important operation of the ITS center in Lafayette. The recommended method of accomplishing this is through the implementation of a trusted ISP. The trusted ISP would be the primary location for the distribution of real-time dynamic information to public agencies and private ISPs. This process would require the proposed ITS center, LPCD, transit, and other agencies to publish data and information to the trusted ISP. Data and information will then be available to any agency or private ISP who chooses to subscribe to it. By providing a single source of data for the entire region, this structure will reduce direct information requests between agencies and, therefore, also reduce the time burden that agency to agency and private ISP information sharing can create.

Center-to-Center Communication. As shown in the Lafayette architecture, the proposed ITS center and other centers should work toward sharing device control. Protocols need to be developed for this type of communication. Factors that influence protocol development include:

- Characteristics of systems to be linked
- Functions to be supported

- System life cycle considerations
- System performance
- Communication infrastructure and demand

ITS Data Archiving

The Lafayette ITS architecture has identified the need to enable transportation management systems to capture and archive information for future analysis and planning. Therefore, a data warehouse should be established in the proposed ITS center to house the data collected and owned by a single agency. The ITS data warehouse, as a key component of the proposed ITS center, needs to be developed for short-term goals.

Alternative Funding

The funding for the Lafayette ITS Center can come from several sources. Considering the broad ITS functions, the funding for building the Lafayette ITS Center can come from difference government agencies at all levels. Thus, one of the key implementation tasks is to identify the funding agencies and to gain support from these agencies.

ACRONYMS, ABBREVIATIONS, & SYMBOLS

AVL:	Automatic Vehicle Location
CAD:	Computer Aid System
CBD:	Central Business District
CCTV:	Closed Circuit Television System
FTA:	Federal Transit Administration
GPS:	Global Position System
ITS:	Intelligent Transportation Systems
LCG:	Lafayette Consolidated Government
LPCD:	Lafayette Parish Communication District
VMS:	Variable Message Sign

REFERENCES

1. National ITS Architecture Documentation, "Executive Summary," December, 1999.
2. Richard Margiotta, "ITS As a Data Resource," Federal Highway Administration, April, 1998.
3. National ITS Architecture Documentation, "Implementation Strategy," December, 1999.

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