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16. Abstract

The primary goal of this research project is to lay the foundation for establishing a state-of-the-art Intelligent Transportation Systems (ITS) lab at the Louisiana Transportation Research Center (LTRC), where data will be collected, analyzed, and reported as part of the ITS effort in Louisiana. The ITS lab is envisioned to serve as a central repository for traffic data collected in the state of Louisiana. The data will be transformed into useful information that is instrumental to procedures and applications that benefit the Department of Transportation and Development (DOTD), the local government, and the general public. The lab is also anticipated to be a tool to retain, recruit, and inspire interest in the field of advanced traffic management systems for students in Louisiana as well as potential graduate students from outside Louisiana.

In this project, the research team highlighted the importance of ITS data and the significant efforts made by several state agencies and universities in the past few years to establish similar robust data archival systems and make them available to stakeholders. Several universities followed suit and established their own ITS labs to collect data to support their research needs. Examples were found in state universities such as Portland State University, University of California at Irvine, Florida International University, Washington State University, etc. Based on a thorough review and assessment of the existing hardware and communication infrastructure at the designated location of the lab, several recommendations for hardware upgrades and software acquisition were identified. The project also identified the necessary equipment and cost to build the lab. Moreover, to properly and securely maintain the continuous operation of the ITS lab, a set of policies were recommended for the ITS lab users/operators.

As a proof of concept, the research team was successful in setting up an automated procedure to stream traffic data in real time from Baton Rouge Advanced Traffic Management Center (ATMC) to LTRC every 30 seconds from a total of 62 detectors along the corridors of I-10, I-12, and I-110 in the Baton Rouge area. Other data sources were also identified and include the southern region of Louisiana, which is currently monitored by the ECONOLITE Data Collection and Management System (DCMS). Another viable data source that was identified are weigh-in-motion (WIM) stations used throughout Louisiana for truck weight enforcement.

During the course of this project, the research team identified several applications that can be supported by the ITS data to be collected at the lab. Such applications include, but are not limited to, highway incident detection and management, travel time estimation and prediction, work zone management, ramp metering, crash analysis, new concepts such as managed lanes and congestion pricing, highway breakdown and recovery analysis, traffic signal optimization, calibration of microscopic simulation models, implementation of new pavement design procedures, and others.

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Establishing an Intelligent Transportation Systems (ITS) Lab at LTRC

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ABSTRACT

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ACKNOWLEDGMENTS

This project was completed under the support from the Louisiana Department of Transportation and Development (DOTD) and the Louisiana Transportation Research Center (LTRC). The research team also gratefully acknowledges the assistance received from the Project Review Committee (PRC) members for their valuable feedback and all other DOTD personnel involved during the course of this project.

IMPLEMENTATION STATEMENT

The lab will serve primarily the metropolitan and state transportation authorities in their service to the traveling public. The information will assist transportation officials in developing applications that improve their service to the public (e.g., providing current and expected future traffic conditions and developing operational strategies for the existing infrastructure). The lab will also serve academics, researchers, and practitioners in providing access to raw and processed data of traffic flow. The lab is also anticipated to be a tool to retain, recruit, and inspire interest in the field of advanced traffic management systems for students in Louisiana as well as potential graduate students from outside Louisiana. The short-term measure of success of the lab will be reflected by the capability to stream traffic data in real time from traffic monitoring sites that are connected to the Traffic Management Centers (TMC). Also, the lab will offer technical reporting capabilities that assist users in extracting the most relevant information needed from such data.

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INTRODUCTION

With traffic congestion growing where residents live and work, communities are demanding more efficient transportation systems to provide greater mobility, reduced delays, and safety. The utilization of Intelligent Transportation Systems (ITS) can improve the safety, security, and efficiency of road travel. The U.S. Department of Transportation (DOT) depicts Intelligent Transportation Systems as an integrated system to improve safety and mobility and to enhance productivity through the use of advanced information and communication technologies. Intelligent Transportation System's encompass a broad range of wireless and wire line communications-based information and electronics technologies. When integrated into the transportation system's infrastructure and in vehicles themselves, these technologies have the ability to relieve traffic congestion, improve safety, and enhance American productivity.

Traffic surveillance and monitoring systems are key components of existing architectures of ITS, which primarily rely on an array of information and communication technologies. Highways, a primary source of mobility in urban areas, have received special attention in the nationwide ITS instrumentation efforts, which now provide traffic management agencies with a plethora of high resolution data over time and space. Currently, such data is simply being archived or disposed of and, therefore, are not effectively utilized to support critical traffic management functions such as travel time estimation/prediction, personalized traffic information dissemination, highway performance evaluation, and automated incident detection, to name a few.

In the state of Louisiana, the ITS program has been rapidly evolving in the past few years. Major ITS instrumentation efforts have been made on highways and state highways in order to allow state transportation authorities to better serve the traveling public. In order to achieve this goal, there is a pressing need to use current and future ITS data to improve various operational and management functions at the traffic management center and other state agencies. This requires state agencies to collect, store, and analyze as much ITS data as possible to maximize the efficiency of existing transportation networks. Examples of such data include, but are not limited to, traffic data from highways such as I-10 and I-12 in the Baton Rouge area. This has raised a need for a permanent facility to house and process ITS data collected from remote locations within the state of Louisiana. Such a facility is envisioned to serve academics, researchers, and practitioners in different capacities as well as lend itself as a tool to inspire interest in the field of advanced traffic management systems among students from within and outside Louisiana.

OBJECTIVES

The primary goal of this research project is to investigate and lay the foundation for establishing a state-of-the-art ITS lab at Louisiana Transportation Research Center (LTRC), where data will be collected, analyzed, and reported as part of the Intelligent ITS effort in Louisiana. The purpose of the lab is to develop and demonstrate procedures that successfully transform existing ITS data into useful information, and then pass the procedures on to agencies in order to apply them on a routine basis. It is also expected that the lab will be utilized to complete analysis functions for DOTD and other local agencies to develop, evaluate, and refine procedures for more effectively utilizing the ITS system offline. To accomplish this goal, the following objectives will be achieved:

1. Examine the current hardware and communication infrastructure at the intended location of the new ITS lab.
2. Conduct a thorough investigation into the current state-of-the-art ITS labs in other states in order to acquire as much information as possible on the hardware and software components necessary to build the new facility at LTRC.
3. Identify and acquire the main hardware and software components that are required to operate the new ITS lab as well as identify any compatibility issues with the existing infrastructure.
4. Establish operating and maintenance policies for the lab, including details on user access privileges and how ITS data will be collected, stored, and mined for immediate and future use.
5. Define a set of applications or functions that ITS data will support and are of significant importance to both travelers and traffic management agencies.

SCOPE

The scope of this study is limited to the state of Louisiana. The ITS lab at LTRC is intended to operate according to the specifications and standards set by the state of Louisiana and to be compatible with the existing technology and communication infrastructure. ITS data that will be collected and archived at the new lab will be retrieved from different sources within the state of Louisiana. The data will support various applications that are beneficial to DOTD.

METHODOLOGY

Background

Over the past few years, the concept of ITS introduced an array of technological components into aspects of the planning, operation, maintenance, safety, and design of our surface transportation system. As the backbone of ITS, information and communication technologies have substantially overcome the data acquisition obstacles through a wide spectrum of advanced data collection and communication devices. This has tremendously increased the ability to manage and control major transportation system facilities in real time. Most of the ITS implementation efforts were intended for major urban highways to provide effective solutions to the perpetually escalating problems of urban congestion. Currently, several hundred highway miles are instrumented with traffic surveillance devices, all of which are primarily installed to achieve the following goals: to improve the operation, safety, and productivity of the highway system.

As the ITS instrumentation efforts continue to pervade the urban highway system nationwide, real-time data from hundreds of miles of highway is simply being either archived or discarded. Currently, little information has been utilized from the considerable amount of information that can be extracted from this data. This is primarily due to the lack of advanced data mining methods that are specifically developed to maximize the utility of information from existing surveillance systems. Such methods must be capable of manipulating large amounts of data for the purpose of extracting the most useful information and removing information redundancies. Essentially, the need for new methods was not justified in the past when the transportation data acquisition process, in the absence of today's technology, was quite a challenge. Today, another challenge is how to process the over abundance of data in order to extract the most useful information and maximize the efficiency of Traffic Management Centers (TMCs) operations and management functions. This can only be achieved through advanced analytical techniques and performance measures that are capable of extracting the most valuable information from real time and archived data, while reducing the overwhelming level of redundancies therein.

Traffic management and control functions undertaken by TMCs and other related agencies are performed through a series of sequential and parallel tasks that involve processing information from collected data and then making decisions, if necessary. A wide spectrum of transportation-related applications can benefit from the vast amount of data offered by ITS. Such data will help researchers and practitioners in this field respond to many challenges they face in current times as a result of the pressing congestion problems. Some of these challenges are exemplified by questions such as: (1) how can we extract the most relevant information that supports the operational functionalities of TMCs and other interested transportation agencies, given the vast amount of data and despite the tremendous redundancies therein; (2) how can we utilize the extracted information to advance our level of understanding of the traffic characteristics under a wide spectrum of operating conditions; and (3) how can we use the extracted features to advance our level of understanding of traffic behavior in the context of other related applications, such as accident analysis and incident detection?

The importance of ITS data has been long recognized by researchers and practitioners in the field. On one hand, traffic management agencies are constantly seeking new opportunities to improve their real-time operation and management functions and advance the methods used to assess the impact of minor/major capital improvements. On the other hand, researchers continue to seek data to improve their capabilities to better understand the behavior of traffic under non-stationary transient stages, to identify certain factors or conditions that may impact safety, to distinguish between the traffic characteristics during recurrent and non-recurrent conditions, and to develop comprehensive and composite measures of the level of service.

Significant efforts have been made by several state agencies and universities in the past few years to establish robust archival systems for such data and make it available to stakeholders to support a variety of applications. California, Texas, Florida, Virginia, and Georgia are a few states among many others that have recognized the need to archive such data on a continuous basis. Several universities have followed suit and established their own ITS labs to collect data that supports their own research needs. Examples can be found in state universities such as Portland State University, University of California at Irvine, Florida International University, Washington State University, etc.

ITS Labs at Academic Institutions

Recently, there has been a growing interest in establishing ITS labs in other states. Those labs are usually established at academic entities such as universities or research centers. In addition to archiving ITS data in real time, ITS labs offer an academic environment to researchers who are interested in transportation research. The plethora of data offers support for modeling and developing several applications in the field. This section cites a few successful efforts for ITS labs that were established recently at universities for demonstration purpose only. Such an effort is similar to that being undertaken by LTRC to build an ITS lab.

Portland State University (PSU). PSU has a regional archiving center for ITS data in the Portland region [*1*]. The center archives real-time data from 485 detectors, each reporting traffic observations at 20-second intervals. It also collects weather information with ITS data and stores it into a relational SQL database at the rate of 200 MB of raw data per day. The center allows users to query the database for a host of highway related performance measures such as delay, travel times, speed, and volumes in time series or aggregated form. The system is also expandable to many data sources that may include incident logs and weigh-in-motion data. Recently, several applications that utilized ITS data at PSU included:

1. Exploiting Live Plus Archive Data for Intelligent Transportation Systems
2. Evaluating Traffic Signal Improvements for Freight Mobility
3. Evaluation the Effectiveness of the Safety Investment Program (SIP)
4. Community and School Traffic Safety Partnership
5. Establishing the Link between Urban Form, Street Connectivity, Roadway Design, and Pedestrian Safety
6. Combined Arterial Performance
7. Ice Detection and Warning System Evaluation
8. Combined Regional Data Archive (PORTAL) Enhancement
9. Assessment and Refinement of Real Travel Time Algorithms for Use in Practice
10. Using Existing ITS Commercial Vehicle Operation (ITS/CVO) Data to Develop Truck Travel Time Estimates and Other Freight Measures
11. Using Archived ITS Data to Measure the Operational Benefits of a System-wide Adaptive Ramp Metering System
12. Freight Data Collection Infrastructure and Archive System
13. Understanding the Safety Effects of Roadway Illumination Reduction
14. Motor Vehicle Crash Fatalities and Injuries: An Analysis of the Relationship of Roadway, Driver, Vehicle, and Emergency Medical Services in Oregon Counties
15. Determining Optimum Safety Countermeasures for Speed Related Crashes: Comparison of Identification and Ranking Methodologies for Speed Related Crash Locations

The work done by the ITS lab is funded by numerous agencies and relies on strong collaborations with transportation agencies and other researchers from universities around the world. Research projects are done in three distinctive areas: (1) ITS data, operations, and traffic flow; (2) freight; and (3) safety. Examples of projects in the area of ITS data, operations, and traffic flow include studying the impact of traffic oscillations on highway systems, monitoring arterial performance using data from automatic vehicle location devices and inductive loop detectors, measuring the effect of sun glare on traffic flow, validating highway travel time, and testing traffic signal pole failure, to name a few.

The area of freight transportation research activities include development of methods to quantify the impact of congestion, time windows, and delivery sizes on freight vehicle miles traveled, and evaluation of traffic signal improvements for freight mobility and techniques for mining truck data to improve freight operations and planning. The area of safety research includes analysis of the relationship of roadway, driver, vehicle, and emergency medical services in Oregon counties and their effect on motor vehicle crash fatalities and injuries; impacts and issues related to changes in interstate speed limits; understanding the safety effects of roadway illumination reductions; and safety effectiveness from a behavioral perspective of marked vs. unmarked crosswalks at unsignalized intersections.

University of California. Another example can be found at the Institute of Transportation Studies, a University of California organized research unit with branches at Irvine, Davis, and Berkeley [*2*]. Research at the institute covers a broad spectrum of transportation issues. The ITS Advanced Transportation Management System (ATMS) laboratories at Irvine provide state-of-the-art facilities for teaching, research, and development of high-technology applications in transportation. The laboratories include workstations tied directly to a modern traffic management center and to the local California Department of Transportation (CALTRANS) district's freeway traffic management center. The laboratories also contain a network of Unix-based workstations and personal computers and a variety of software in transportation engineering and control. A statewide video-teleconferencing facility, video camera, recorders, monitors, and accessories enable research in advanced traffic detection, monitoring, and analysis. Additional features of the ATMS laboratories include advanced traffic signal controllers and a variety of traffic data collection devices. Current funded research projects at Irvine focus upon:

1. Intelligent transportation systems, particularly advanced transportation management systems
2. Analysis and simulation of urban traffic networks
3. Transportation system operations and control
4. Artificial intelligence/expert systems in transportation
5. Travel demand forecasting and analysis of complex travel behavior
6. Transportation/land use interactions, particularly those which encourage alternative modes of travel

7. Planning and evaluation of advanced public transit systems
8. Transportation pricing and regulation

Florida International University (FIU). The ITS laboratory at Florida International University includes live video and data streams from ITS centers in Southeast Florida. The laboratory is set up with a rear projection video wall display (see Figure 1). The laboratory also includes servers, workstations, real-time traffic management software, video wall control software, database management and mining tools, simulation programs, and other modeling and analysis software development tools. The laboratory provides an opportunity for ITS operation research and ITS education of graduate and undergraduate students *[3]*. Some of the main lab hardware components are:

- One video wall display (2 Cubes, 70" each)
- One video wall controller
- Communication equipment
- Twelve workstations
- Two servers

Figure 1
ITS lab at Florida International University

Outline of Study

In order to achieve the stated research project objectives, the research team has completed the following set of tasks:

1. Examine Current Hardware and Communication Infrastructure
2. Visit Selected ITS Labs in Other States
3. Design and Acquire Hardware and Software Components
4. Setting Operating Policies
5. Define a Set of User and System Applications

Each of the five tasks is described in detail next.

Current Hardware and Communication Infrastructure

In this task, the research team conducted a thorough evaluation of the existing hardware and communication infrastructure at the designated location of the ITS lab at the LTRC facility. The proposed location for the ITS lab is the present-day conference room at LTRC. The main data source was identified as the Advanced Traffic Management Center (ATMC) in Baton Rouge. This was a critical task to determine how ITS data can be streamed in real time to the new ITS lab and to anticipate any technical issues that should be resolved before setting up the lab equipment. The task also examined current connectivity issues between the LTRC facility and DOTD for the purpose of collecting ITS data from the Baton Rouge Traffic Management Center and possibly other locations, if necessary. Based on the exchange of information with DOTD and meetings with the project review committee members, the following issues were identified:

- There are two types of data that can be streamed in real time to the ITS lab at LTRC: Text and Video. Text data includes observations of traffic parameters at sites where detectors are installed. This typically includes volume, lane occupancy, and speed data collected from each lane at each of the detector sites. Video data refers to live streaming from video cameras used to monitor traffic conditions at specific sites.
- Video data is expected to consume more bandwidth and, therefore, requires rewiring and/or installing a switch to expand the bandwidth. A cost estimate to completely rewire the LTRC building is provided later in this report. Even with the current bandwidth, it may be possible to receive video data at LTRC from the ATMC but at the expense of video quality. Streaming video data may also require a client license for either Chameleon 360 or Teleste MoRIS viewer.

- On the other hand, text data from radar video detectors can be readily accessible through the Management Information System for Transportation (MIST) at ATMC. Currently, the detectors transmit data in real time to the ATMC using MIST. A workstation was set up LTRC to test the connectivity between LTRC and ATMC since both facilities are already on DOTD's private network. The testing was successful and routing this data to LTRC over the DOTD network was accomplished using a procedure described in detail later. In this data file, volume, speed, and lane occupancy, observations are compiled from all detectors once every 30 seconds. A total of 62 sites are currently feeding traffic data to ATMC.
- Other types of data may also be acquired from ATMC (e.g., AUTOSCOPE data from signalized intersections).

Description of Current Real-Time Traffic Data Streaming Process

This section describes the current real-time traffic data streaming process from the highway system in the metropolitan area of Baton Rouge to the new ITS lab at LTRC. Figure 2 shows a schematic of the traffic data flow diagram. The traffic data is currently collected from radar video detectors that are installed at specific locations along the corridors of I-10, I-12, and I-110, as described in detail later. Traffic data are compiled from radar video detectors every 30 seconds and transmitted in real time through fiber optics to ATMC. This is accomplished using MIST, developed and installed by Telvent Farradyne, Inc. The 30-second data packets are compiled by MIST and aggregated every 15 minutes to produce averages of flow rates, lane occupancies, and speeds for each lane. During the initial setup of the ITS lab, the research team developed a script to stream the 30-second data packets in real time over the DOTD network. The process is repeated every 30 seconds and involves retrieving the 30-second detector data file from a remotely shared drive at ATMC to the new server at the ITS lab. The data is then compiled into a log file that is appended every 30 seconds with the new data packet. A new data log file is automatically generated for each day.

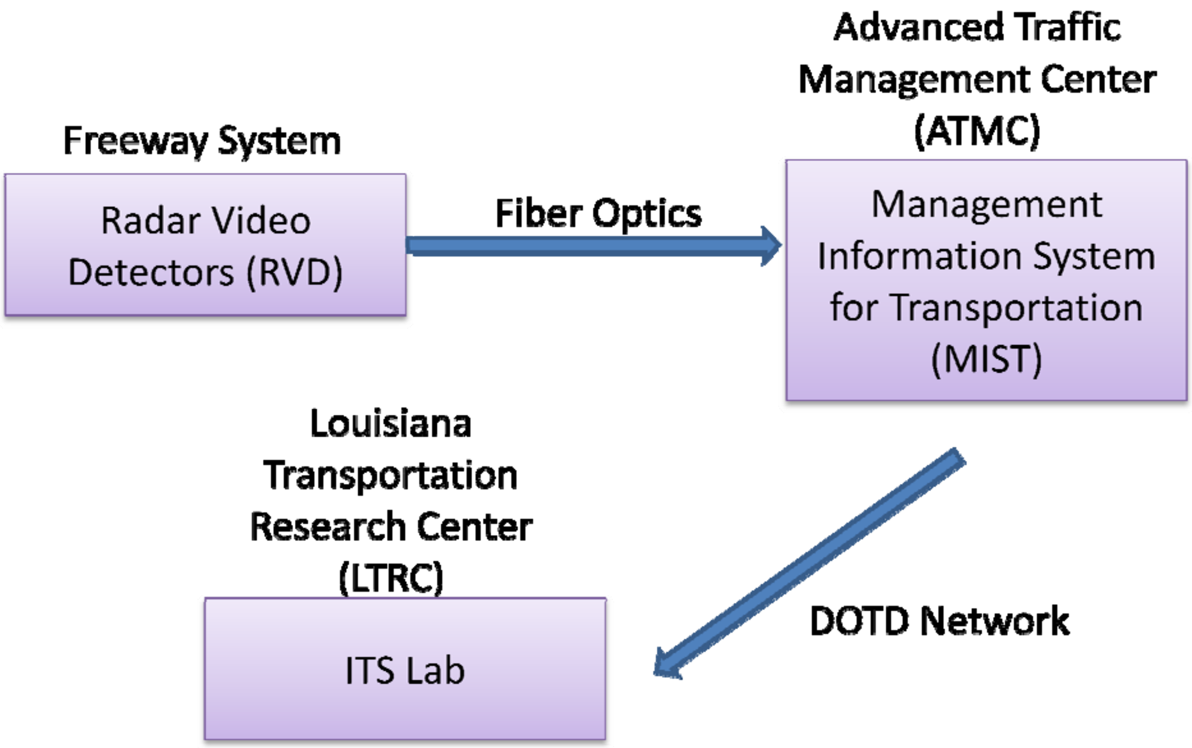

Figure 2
Traffic data flow diagram

Detector Locations

The current highway system, composed of segments of I-10, I-12, and I-110 in Baton Rouge, is monitored with radar video detectors mounted at 62 different sites. Figure 3 shows a map of sites where detectors are mounted along the highway segments of I-10, I-12, and I-110, along with their device IDs. The exact location of each of the 62 sites shown on the map is provided in Table 1, which also shows the coordinates of the all devices (latitude and longitude). Each site includes all detectors used to monitor traffic for one direction of travel. Each detector can collect traffic observations from one or more lanes using designated zones, one for each lane. A detailed list of all detectors and zones can be found in Appendix B.

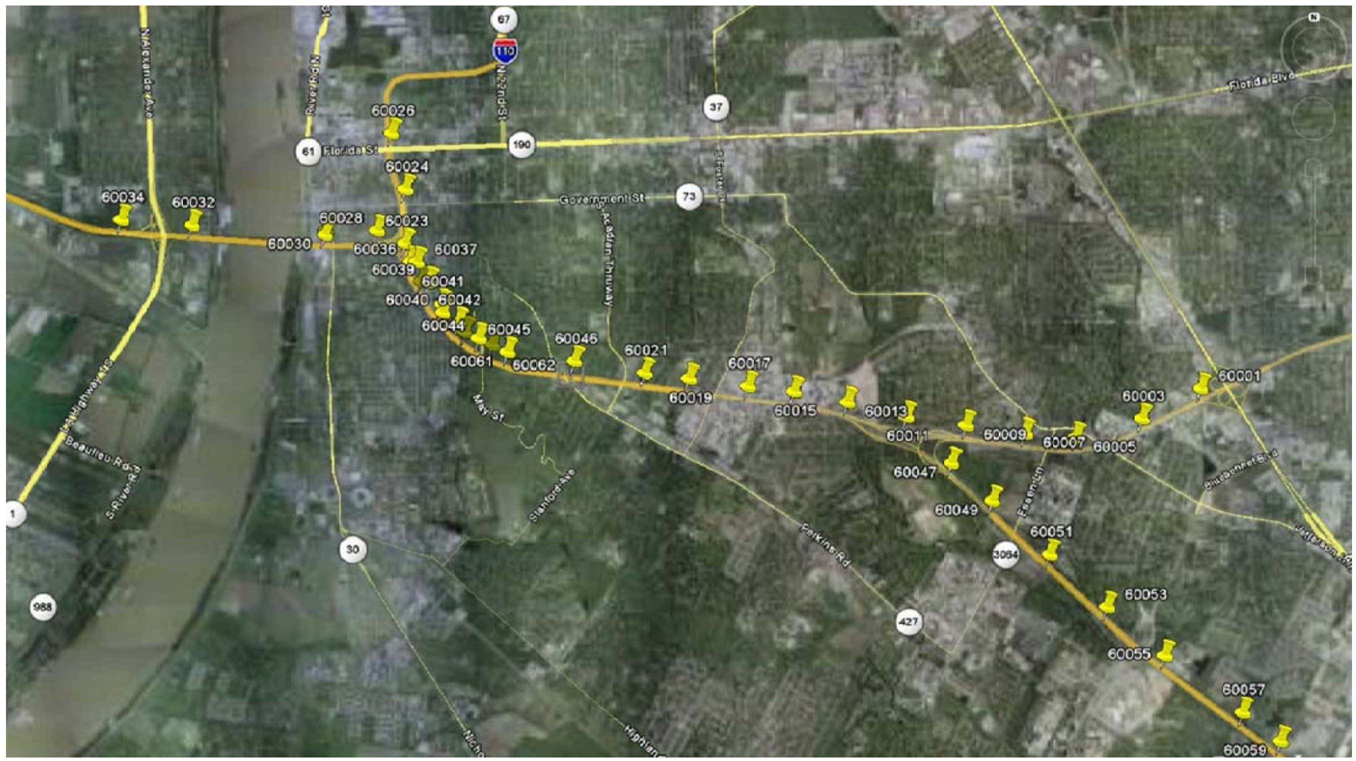

Figure 3
Detector locations on I-10, I-12, and I-110

Table 1
Detector locations along the I-10, I-12, and I-110 corridors

Device ID	*Location Name*	*Latitude*	*Longitude*
60001	I-12 WB AT AIRLINE HIGHWAY	30.42225	-91.07883333
60002	I-12 EB AT AIRLINE HIGHWAY	30.42225	-91.07883333
60003	I-12 WB AT DRUSILLA LANE	30.419	-91.08625
60004	I-12 EB AT DRUSILLA LANE	30.419	-91.08625
60005	I-12 WB AT JEFFERSON HIGHWAY	30.41696667	-91.09456667
60006	I-12 EB AT JEFFERSON HIGHWAY	30.41696667	-91.09456667
60007	I-12 WB AT ESSEN LANE	30.41741667	-91.10093333
60008	I-12 EB AT ESSEN LANE	30.41741667	-91.10093333
60009	I-12 WB AT EAST OF THE SPLIT	30.4183	-91.1084
60010	I-12 EB AT EAST OF THE SPLIT	30.4183	-91.1084
60011	I-12 WB WEST OF SPLIT	30.41925	-91.11583333
60012	I-12 EB WEST OF SPLIT	30.41822222	-91.11633333
60013	I-10 WB WEST OF THE SPLIT	30.42077778	-91.12325
60014	I-10 EB WEST OF THE SPLIT	30.42077778	-91.12325
60015	I-10 WB EAST OF COLLEGE DRIVE	30.42194444	-91.13005556
60016	I-10 EB EAST OF COLLEGE DRIVE	30.42194444	-91.13005556
60017	I-10 WB AT COLLEGE DRIVE	30.42258333	-91.13622222
60018	I-10 EB AT COLLEGE DRIVE	30.42258333	-91.13622222
60019	I-10 WB WEST OF COLLEGE DRIVE	30.42333333	-91.14311111
60020	I-10 EB WEST OF COLLEGE DRIVE	30.42333333	-91.14311111
60021	I-10 WB AT ACADIAN THRUWAY	30.42394444	-91.14869444
60022	I-10 EB AT ACADIAN THRUWAY	30.42394444	-91.14869444
60023	I-110 SB AT I-10\I-110 SPLIT	30.43793333	-91.17878333
60024	I-110 NB AT I-110 AT GOVERNMENT STREET	30.44380556	-91.17872222
60025	I-110 SB AT I-110 AT GOVERNMENT STREET	30.44380556	-91.17872222
60026	I-110 NB AT I-110 AT NORTH BOULEVARD	30.44983333	-91.18047222
60027	I-110 SB AT I-110 AT NORTH BOULEVARD	30.44983333	-91.18047222
60028	I-10 EB AT I-10\I-110 SPLIT	30.43933333	-91.18227778
60029	I-10 WB AT I-10\I-110 SPLIT	30.43933333	-91.18227778
60030	I-10 EB AT I-10 AT NICHOLSON DRIVE	30.43886111	-91.18891667
60031	I-10 WB AT I-10 AT NICHOLSON DRIVE	30.43933333	-91.18869444
60032	I-10 EB AT I-10 AT LA 1	30.43991667	-91.20552778
60033	I-10 WB AT I-10 AT LA 1	30.43991667	-91.20552778
60034	I-10 EB AT WEST END OF M.R.B.	30.4405	-91.21444444
60035	I-10 WB AT WEST END OF M.R.B.	30.4405	-91.21444444
60036	I-10 EB AT TERRACE AVENUE.	30.43595	-91.17806667
60037	I-10 WB AT TERRACE AVENUE	30.43591667	-91.1773
60038	I-10 EB AT LOUISE STREET	30.43383333	-91.1767
60039	I-10 WB AT LOUISE STREET	30.43373333	-91.17576667
60040	I-10 EB AT WASHINGTON STREET	30.43043333	-91.174
60041	I-10 WB AT WASHINGTON STREET	30.43151667	-91.17421667
60042	I-10 WB AT THE DALRYMPLE ON-RAMP	30.42926667	-91.17193333
60043	I-10 EB AT THE DALRYMPLE OFF-RAMP	30.42830556	-91.17116667
60044	I-10 WB AT THE DALRYMPLE OFF-RAMP	30.42765	-91.16933333
60045	I-10 WB BETWEEN PERKINS AND DALRYMPLE	30.42619444	-91.16591667
60046	I-10 EB AT PERKINS ROAD	30.42522222	-91.1575
60047	I-10 EB @ 1-12 ON RAMP	30.41421667	-91.11016667

Device ID	*Location Name*	*Latitude*	*Longitude*
60048	I-10 WB @ I-12 OFF RAMP	30.41421667	-91.11016667
60049	I-10 EB @ ESSEN LANE OFF RAMP	30.41011667	-91.10506667
60050	I-10 WB @ ESSEN LANE ON RAMP	30.41011667	-91.10506667
60051	I-10 EB @ ESSEN LANE ON RAMP	30.40433333	-91.09783333
60052	I-10 WB @ ESSEN LANE OFF RAMP	30.40433333	-91.09783333
60053	I-10 EB @ BLUEBONNET BLVD OFF RAMP	30.39865	-91.09065
60054	I-10 WB @ BLUEBONNET BLVD ON RAMP	30.39865	-91.09065
60055	I-10 WB @ PICARDY ON RAMP	30.39338333	-91.08335
60056	I-10 EB @ PICARDY OFF RAMP	30.39338333	-91.08335
60057	I-10 WB WEST OF SIEGEN LN ON RAMP	30.38725	-91.07365
60058	I-10 EB WEST OF SIEGEN LANE OFF RAMP	30.38725	-91.07365
60059	I-10 WB WEST OF SIEGEN LANE OFF RAMP	30.38413333	-91.06883333
60060	I-10 EB WEST OF SIEGEN LANE ON RAMP	30.38413333	-91.06883333
60061	I-10 EB BETWEEN PERKINS AND DALRYMPLE	30.42619444	-91.16591667
60062	I-10 WB AT PERKINS ROAD	30.42522222	-91.1575

Highway Traffic Data

MIST collects traffic data every 30 seconds from all field devices, lane by lane. The detector data is packaged in one file called “detector.dat.” This file is automatically overwritten every 30 seconds as a new data packet arrives. At the ITS lab, the remote server runs a script that periodically checks the remote shared drive where the detector file is written, downloads it to a local folder, and then inserts its content into the main data log file. The structure of the detector file is as follows:

- Field 1: Prefix header showing the time stamp in hh:mm:ss format
- Field 2: Device ID (with detector ID and lane ID)
- Field 3: Not used
- Field 4: Not used
- Field 5: Average speed in mph
- Field 6: Detector Operational Status (failed = Y, otherwise = N)
- Field 7: Vehicle count
- Field 8: Lane occupancy in percentage

Table 2 shows a sample of the detector data file collected on September 15, 2008 starting at time 15:42:30. The table only shows the non-empty fields in the file. Field 1 is composed of the time stamp for the data packet, followed by a prefix header (not used). Field 2 contains the device ID and a reference to the lane number (last two digits). For instance, the device ID in the first row (6004701) refers to the detector ID (47) and lane (01).

Table 2
Sample of detector data file

Field 1		Field 2	Field 5: Average Speed (mph)	Field 7: Vehicle Count	Field 8: Lane Occupancy (percent)
Time	Prefix header	Device ID			
15:42:30-	B238I4DD:	6004701	65	8	3.0
15:42:30-	B238I4DD:	6004702	63	6	4.0
15:42:30-	B238I4DD:	6004703	53	7	7.0
15:42:30-	B238I4DD:	6002801	58	9	10.0
15:42:30-	B238I4DD:	6002802	41	9	18.0
15:42:30-	B238I4DD:	6002803	69	2	1.0
15:42:30-	B238I4DD:	6003601	60	8	7.0
15:42:30-	B238I4DD:	6003602	67	2	3.0
15:42:30-	B238I4DD:	6003603	13	13	36.0
15:42:30-	B238I4DD:	6003604	0	0	0.0
15:42:30-	B238I4DD:	6004001	21	15	18.0
15:42:30-	B238I4DD:	6004002	38	13	18.0
15:42:30-	B238I4DD:	6004003	49	17	16.0
15:42:30-	B238I4DD:	6004004	0	0	0.0
15:42:30-	B238I4DD:	6001501	8	8	35.0
15:42:30-	B238I4DD:	6001502	6	8	42.0
15:42:30-	B238I4DD:	6001503	10	11	39.0
15:42:30-	B238I4DD:	6001504	33	14	28.0
15:42:30-	B238I4DD:	6001505	52	9	9.0
15:42:31-	B238I4DD:	6002901	61	14	14.0
15:42:31-	B238I4DD:	6002902	56	11	7.0
15:42:31-	B238I4DD:	6003701	0	0	0.0
15:42:31-	B238I4DD:	6003702	63	10	4.0
15:42:31-	B238I4DD:	6003703	51	9	4.0
15:42:31-	B238I4DD:	6003704	46	9	13.0
15:42:31-	B238I4DD:	6003705	53	11	7.0

Data Collection Procedure

In order to collect traffic data from each of the detectors, communication had to be established between LTRC and ATMC over the DOTD network. Since the detector data file was generated by MIST, remote access to the folder where the detector file was created every 30 seconds was necessary. Therefore, the detector file folder was shared to allow remote mapping of the network drive. At the ITS lab, a workstation was set up as a server to retrieve the detector data file in real time. Two scripts were written to complete the data streaming process as explained next.

Network Drive Mapping Script. The first script (see Appendix A) is called "LaunchMistCollect.bat." This batch file is scheduled to run on system startup and it launches the data streaming process by mapping the remote network drive to the ITS lab server with the IP (10.92.5.12). The remote folder is "trafdata" and user account is username: "**trafdata**" and password: "**.1trafdata1.**" The script then calls another script "MistCollect.bat" (see Appendix A) to start the data streaming process.

Data Streaming Script. The "MistCollect.bat" script is written to retrieve the detector data file automatically every 30 seconds. This process involves deleting the local detector data file, checking if a new detector data file has been created on the remote drive, and, if so, moving the detector file to a local folder where all data files are stored. This process is repeated once every 5 seconds to ensure that the newly created detector file is downloaded to the local workstation before it gets overwritten by a new one. The contents of the new detector file are then extracted and appended to the daily data log file. The script creates a new log file daily at midnight. The script is also designed to generate error reports that are useful for debugging.

Other Traffic Data Sources

It is also proposed that the new ITS lab be used to house traffic-related data from other sources within the state of Louisiana. This will allow the new lab to serve as a data warehouse for a wide spectrum of research applications that the archived data can support. This section presents two data sources, among many others, that can be tapped into for data collection and archiving at the new lab.

Southern Region of Louisiana

The southern part of Louisiana is currently monitored by 25 AUTOSCOPE devices as shown in Figure 4. Table 3 also shows the exact location (latitude and longitude) for each detector associated with the 25 AUTOSCOPE devices. These devices are properly installed and calibrated at 25 sites, each monitored by detectors assigned to each lane in each direction. Traffic data are constantly polled from each detector and transmitted electronically to a Web server that is part of Data Collection and Management Service (DCMS), developed and maintained by Econolite [*4*]. DCMS gathers traffic data in real time into a Web server running behind a Web interface (see a screenshot of the Website in Figure 5). The traffic data collected by DCMS include traffic volume (with vehicle classification), average speed, and lane occupancy. This data can also be routed to the ITS lab for archival and future use in research applications.

Figure 4
Location of the active devices

Table 3
Location of AUTOSCOPE video detectors

No.	Detector Number	Description of Location
1	106	EB I-10 @ Henderson Thru Lane 1
2	105	EB I-10 @ Henderson Thru Lane 2
3	105	EB I-10 @ I-12/I-59 EB I-10 Lane 1
4	106	EB I-10 @ I-12/I-59 EB I-10 Lane 2
5	107	EB I-10 @ I-12/I-59 EB I-10 Total
6	107	EB I-10 @ I-49 EB I-10 Cloverleaf merge lane
7	110	EB I-10 @ I-49 EB I-10 Total
8	108	EB I-10 @ I-49 EB I-10 Lane 1
9	109	EB I-10 @ I-49 EB I-10 Lane 2
10	105	EB I-10 @ LaPlace Thru Lane 1
11	106	EB I-10 @ LaPlace Thru Lane 2
12	119	EB I-10 @ Loyola Drive EB Thru Lane 1
13	120	EB I-10 @ Loyola Drive EB Thru Lane 2
14	121	EB I-10 @ Loyola Drive EB Thru Lane 3
15	124	EB I-10 @ Loyola Drive Lane 1 WB CONTRA-FLOW
16	123	EB I-10 @ Loyola Drive Lane 2 WB CONTRA-FLOW
17	122	EB I-10 @ Loyola Drive Lane 3 WB CONTRA-FLOW
18	118	EB I-10 @ Loyola Drive WB Thru Lane 1
19	117	EB I-10 @ Loyola Drive WB Thru Lane 2
20	116	EB I-10 @ Loyola Drive WB Thru Lane 3
21	105	EB I-10 @ US Hwy 165 EB I-10 Lane 1
22	106	EB I-10 @ US Hwy 165 EB I-10 Lane 2
23	107	EB I-10 @ US Hwy 165 EB I-10 Total

No.	Detector Number	Description of Location
24	105	EB I-12 @ US Hwy 190 - West Side EB I-12 Lane 1
25	106	EB I-12 @ US Hwy 190 - West Side EB I-12 Lane 2
26	107	EB I-12 @ US Hwy 190 - West Side EB I-12 Total
27	105	EB I-12 @ I-55 - East Side EB I-12 Lane 1
28	106	EB I-12 @ I-55 - East Side EB I-12 Lane 2
29	107	EB I-12 @ I-55 - East Side EB I-12 Total
30	105	EB I-12 @ I-55 EB I-12 Lane 1
31	106	EB I-12 @ I-55 EB I-12 Lane 2
32	107	EB I-12 @ I-55 EB I-12 Total
33	105	I-10 @ US Hwy 171 - EB and WB EB I-10 Lane 1
34	106	I-10 @ US Hwy 171 - EB and WB EB I-10 Lane 2
35	109	I-10 @ US Hwy 171 - EB and WB WB I-10 Lane 1
36	108	I-10 @ US Hwy 171 - EB and WB WB I-10 Lane 2
37	110	I-10 @ US Hwy 171 - EB and WB WB I-10 Total
38	107	I-10 @ US Hwy 171 - EB and WB EB I-10 Total
39	119	I-49 @ US Hwy 190 - I-49 NB Total
40	115	I-49 @ US Hwy 190 - I-49 SB Total
41	118	I-49 @ US Hwy 190 - NB and SB I-49 NB Exit
42	117	I-49 @ US Hwy 190 - NB and SB I-49 NB Lane 1
43	116	I-49 @ US Hwy 190 - NB and SB I-49 NB Lane 2
44	114	I-49 @ US Hwy 190 - NB and SB I-49 SB Lane 1
45	113	I-49 @ US Hwy 190 - NB and SB I-49 SB Lane 2
46	109	NB I-49 @ I-10 NB I-49 Cloverleaf merge lane
47	110	NB I-49 @ I-10 NB I-49 Lane 1
48	111	NB I-49 @ I-10 NB I-49 Lane 2
49	112	NB I-49 @ I-10 NB I-49 Lane 3
50	113	NB I-49 @ I-10 NB I-49 Total
51	105	NB I-55 @ I-12 NB I-55 Lane 1
52	106	NB I-55 @ I-12 NB I-55 Lane 2
53	107	NB I-55 @ I-12 NB I-55 Total
54	107	SB I-49 @ I-10 SB I-49 Cloverleaf merge lane
55	108	SB I-49 @ I-10 SB I-49 Lane 1
56	109	SB I-49 @ I-10 SB I-49 Lane 2
57	110	SB I-49 @ I-10 SB I-49 Total
58	105	SB I-55 @ I-12 SB I-55 Lane 1
59	106	SB I-55 @ I-12 SB I-55 Lane 2
60	107	SB I-55 @ I-12 SB I-55 Total
61	105	SB I-55 @ Ponchatoula Thru Lane 1
62	106	SB I-55 @ Ponchatoula Thru Lane 2
63	110	US Hwy 171 @ I-10 - NB and SB NB US Hwy 171 Lane 1
64	108	US Hwy 171 @ I-10 - NB and SB NB US Hwy 171 Lane 2
65	109	US Hwy 171 @ I-10 - NB and SB NB US Hwy 171 Total
66	105	US Hwy 171 @ I-10 - NB and SB SB US Hwy 171 Lane 1
67	106	US Hwy 171 @ I-10 - NB and SB SB US Hwy 171 Lane 2
68	107	US Hwy 171 @ I-10 - NB and SB SB US Hwy 171 Total
69	116	US Hwy 190 @ I-49 - EB and WB EB US Hwy 190 Lane 1
70	115	US Hwy 190 @ I-49 - EB and WB EB US Hwy 190 Lane 2
71	117	US Hwy 190 @ I-49 - EB and WB EB US Hwy 190 Total
72	111	US Hwy 190 @ I-49 - EB and WB WB US Hwy 190 Lane 1
73	112	US Hwy 190 @ I-49 - EB and WB WB US Hwy 190 Lane 2

No.	Detector Number	Description of Location
74	113	US Hwy 190 @ I-49 - EB and WB WB US Hwy 190 Lane 3
75	114	US Hwy 190 @ I-49 - EB and WB WB US Hwy 190 Total
76	107	WB I-10 @ I-12/I-59 WB I-10 Lane 1
77	108	WB I-10 @ I-12/I-59 WB I-10 Lane 2
78	109	WB I-10 @ I-12/I-59 WB I-10 Lane 3
79	110	WB I-10 @ I-12/I-59 WB I-10 Total
80	111	WB I-10 @ I-49 WB I-10 Cloverleaf merge lane
81	105	WB I-10 @ I-49 WB I-10 Lane 1
82	106	WB I-10 @ I-49 WB I-10 Lane 2
83	112	WB I-10 @ I-49 WB I-10 Total
84	103	WB I-10 @ Loyola Drive EB Thru Lane 1
85	104	WB I-10 @ Loyola Drive EB Thru Lane 2
86	115	WB I-10 @ Loyola Drive EB Thru Lane 3
87	116	WB I-10 @ Loyola Drive WB Thru Lane 1
88	117	WB I-10 @ Loyola Drive WB Thru Lane 2
89	118	WB I-10 @ Loyola Drive WB Thru Lane 3
90	106	WB I-10 @ Ramah Thru Lane 1
91	105	WB I-10 @ Ramah Thru Lane 2
92	105	WB I-10 @ US Hwy 165 WB I-10 Lane 1
93	106	WB I-10 @ US Hwy 165 WB I-10 Lane 2
94	107	WB I-10 @ US Hwy 165 WB I-10 Total
95	105	WB I-12 @ US Hwy 190 - West Side WB I-12 Lane 1
96	106	WB I-12 @ US Hwy 190 - West Side WB I-12 Lane 2
97	107	WB I-12 @ US Hwy 190 - West Side WB I-12 Total
98	105	WB I-12 @ I-55 WB I-12 Lane 1
99	106	WB I-12 @ I-55 WB I-12 Lane 2
100	107	WB I-12 @ I-55 WB I-12 Total

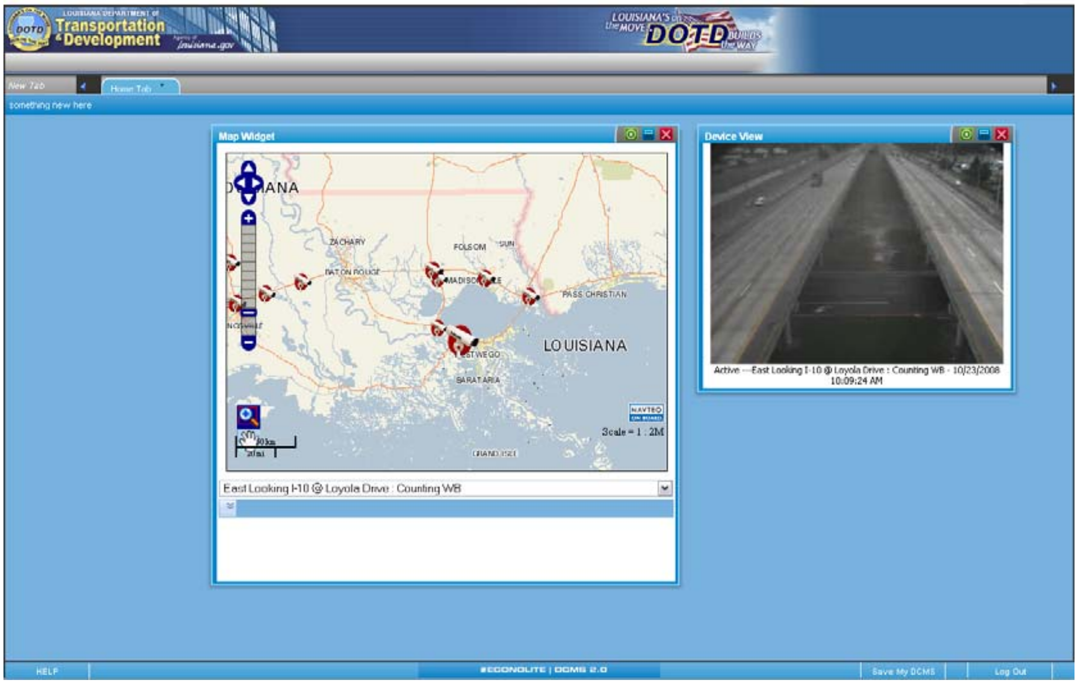

Figure 5
Screenshot of the Web page of ECONOLITE DCMS

DCMS also offers live snapshots of traffic at each of the monitored sites. The snapshots are refreshed periodically. Snapshots taken at I-10 at US Hwy 171 in eastbound and westbound directions at 9 a.m. and 9 p.m., respectively, are shown in Figure 6 and Figure 7.

Figure 6
Device view—lanes of I-10 at US Hwy 171 (EB and WB) at 9 a.m.

Figure 7
Device view—lanes of I-10 at US Hwy 171 (EB and WB) at 9 p.m.

The DCMS Web site can also generate worksheets summarizing the traffic information (Average Flow Rate, Total Volume, Arithmetic Mean Speed, Class A Count, Class B Count, Class C Count, Class D Count, Class E Count, Class R Count, Average Time Headway, Average Time Occupancy, Space Mean Speed, Space Occupancy, Density, and Level of Service) for each detector and specified time periods. Aggregate results can be obtained for 15-minute, 30-minute, and 1-hour periods. A screenshot for worksheet generated for two detectors at EB I-10 at Henderson is shown in Figure 8. The results can also be presented graphically on a chart as shown in Figure 9 and Figure 10.

Worksheet

Detector	Average Flow Rate	Total Volume	Arithmetic Mean Speed	Space Mean Speed	Density	Level of Service
EB I-10 @ Henderson Thru Lane 2	797	66	69.54467	67.06783	11.917	1
EB I-10 @ Henderson Thru Lane 1	666	55	57.97617	57.69567	11.53558	1
Total	**731.50**	**121**	**63.76**	**62.38**	**11.73**	

1

Figure 8
A sample worksheet of its data from detectors of EB I-10 at Henderson

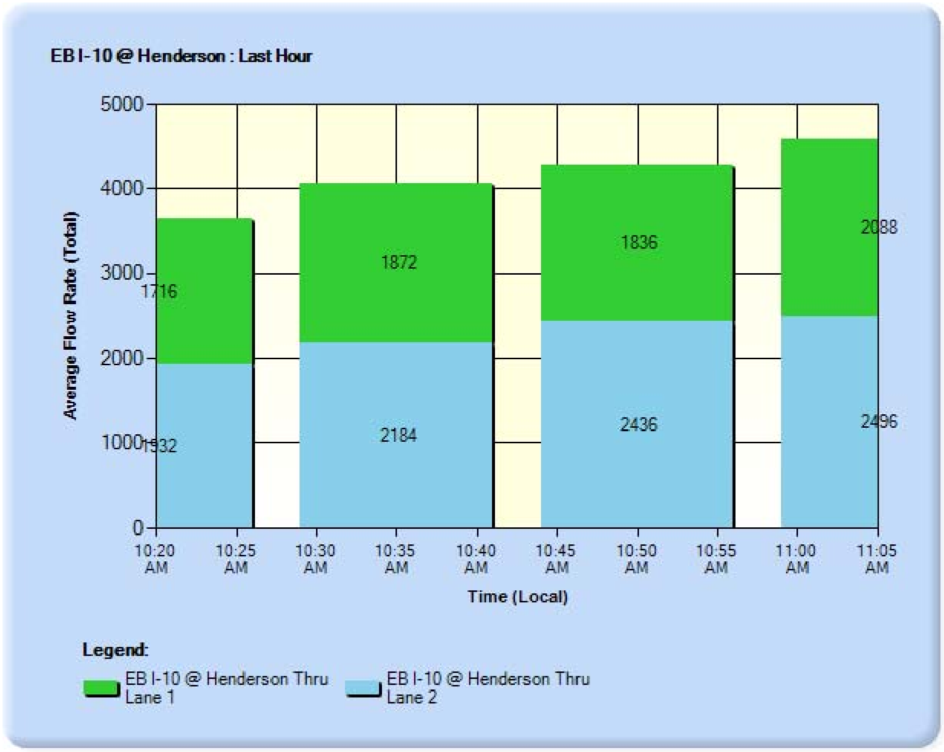

Figure 9
Average flow rate from detectors on EB I-10 at Henderson

Figure 10
Hourly volumes for two days from detectors on EB I-10 at Henderson

Traffic Data for New Pavement Design Procedures

In response to the new pavement design requirements by the Mechanistic Empirical Pavement Design Guide (MEPDG), additional traffic data are mandated to develop the axle load spectra for truck traffic. This data are often collected from Weigh in Motion (WIM) stations. It is anticipated that the amount of data that can be collected from the WIM sites will be enormous and, therefore, a mechanism for automated collection and archiving will be essential. It is, therefore, proposed that the new ITS lab at LTRC also house the axle load spectra data for future use in research applications and pavement design purposes. This section summarizes the existing practices of traffic data collection in Louisiana. The traffic data sampling information was provided by DOTD team working under the traffic data collection program. The current sampling procedures adopted by DOTD in gathering traffic data are as follows:

- 100 WIM sites (out of which 60 collect only weight data and the remaining 40 collect both weight and vehicle classification data)
- 200 Automatic Vehicle Classification (AVC) sites that collect vehicle classification data
- 5000 sites that collect traffic volume data

Traffic data are collected over a span of three years. Portable sensors are primarily used to collect weight data and vehicle classification data at sites monitored continuously for 48 hours. Inductance loop, road tube, and quartz piezoelectric are the three types of sensors that are currently being used at portable WIM stations. This data could also be collected from DOTD and stored periodically at the ITS lab for future design usage and research purposes. Some of the details about the sources of traffic data are described next.

Weigh-In-Motion Data. Traffic loading is a critical factor in determining the depth of pavement sections. Therefore, truck axle weights are significant for the data collection process. This process is the most expensive, time consuming, and complex part compared to other data collection activities such as vehicle classification and volume count. The objective of the truck weight data collection program is to obtain a reliable estimate of the distribution of vehicle and axle loads per vehicle for truck categories within a defined roadway. The axle weight of trucks is measured with reference to the vehicle type, number of axles, and axle spacing over a period of time. This is used mainly to determine the normalized axle load distribution or spectra for each axle type and each truck class.

Axle load spectra classify traffic loading in terms of the number of load applications of various axle configurations (single, dual, tridem, and quad) within a given weight classification range. For the load spectra, axle load distribution factors should be determined to represent the percentage of total axle applications within each load interval for a specific axle type (single, tandem, tridem, and quad) and vehicle class (classes 4 to 13). The load intervals for each axle type are defined as follows: single axles (3,000 lb. to 40,000 lb. at 1.000-lb. intervals), tandem axles (6,000 lb. to 80,000 lb. at 2,000-lb. intervals), and tridem and quad axles (12,000 lb. to 102,000 lb. at 3,000-lb. intervals). The data are particularly measured at WIM stations. Louisiana collects WIM data from three different sources: (1) portable sites, (2) weight enforcement sites, and (3) long term pavement performance (LTPP) sites. This data can be collected and archived at the ITS lab for easy access and retrieval in research and design applications. Each of the three WIM data sources is briefly described in the following subsections.

Portable WIM Data. A review of portable WIM traffic data collected from 2004 to 2006 shows 33 portable WIM stations used in 2006, 30 stations in 2005, and 33 in 2004. Table 4 explains the functional classification code for each designated road while Figure 11, Figure 12**,** and Figure 13 show the approximate portable WIM site locations for years 2006, 2005, and 2004.

Table 4
Functional classification code

Location	Functional classification	Code
RURAL	Principal Arterial - Interstate	1
	Principal Arterial - Other	2
	Minor Arterial	6
	Major Collector	7
	Minor Collector	8
	Local System	9
URBAN	Principal Arterial - Interstate	11
	Principal Arterial - Other Highways or Expressways	12
	Principal Arterial - Other	14
	Minor Arterial	16
	Collector	17
	Local System	19

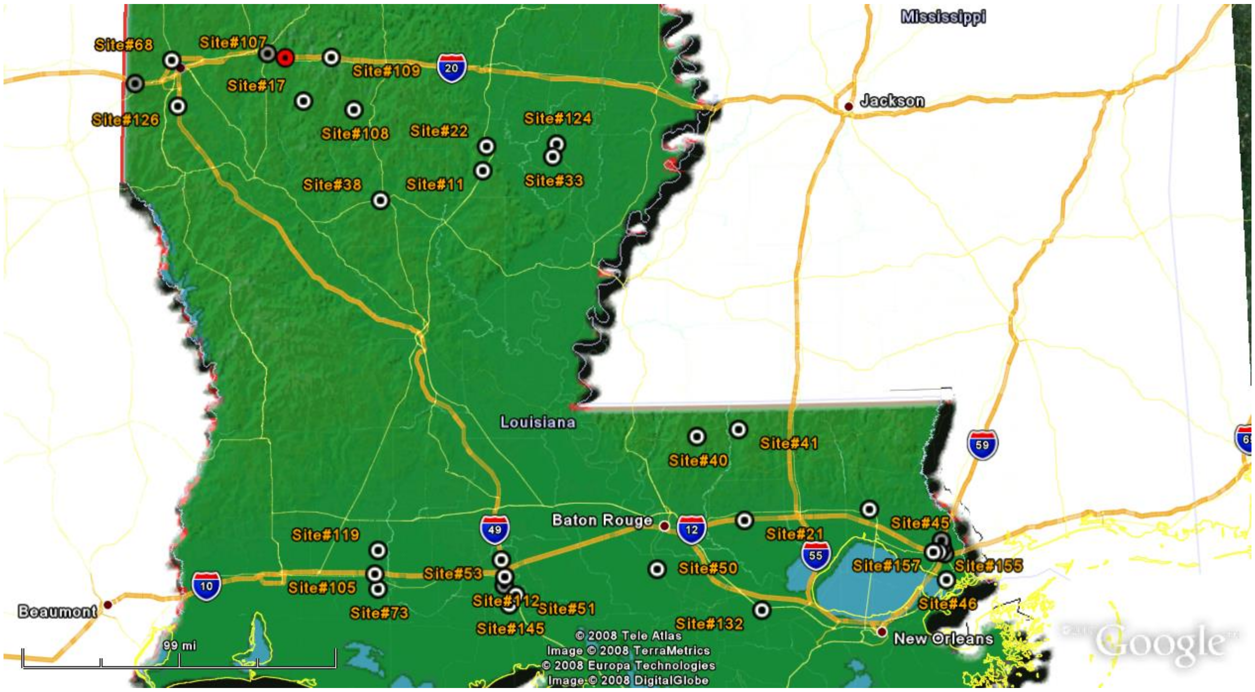

Figure 11
Portable WIM data collection sites for year 2006

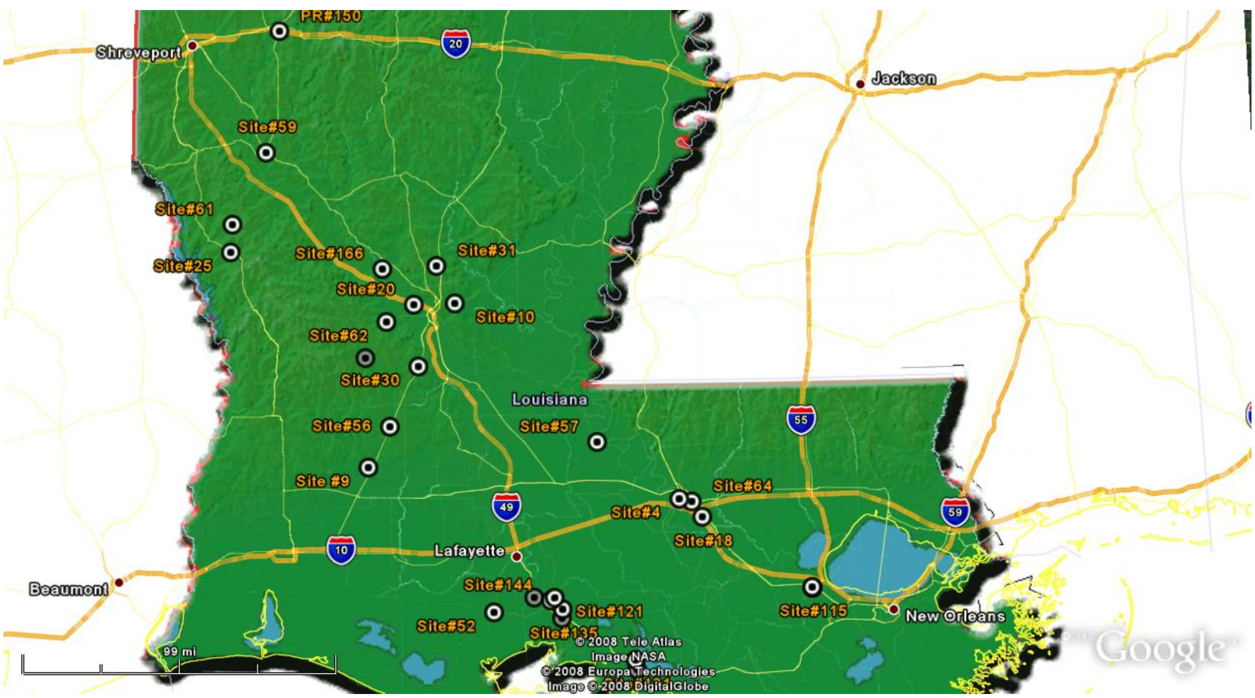

Figure 12
Portable WIM data collection sites for year 2005

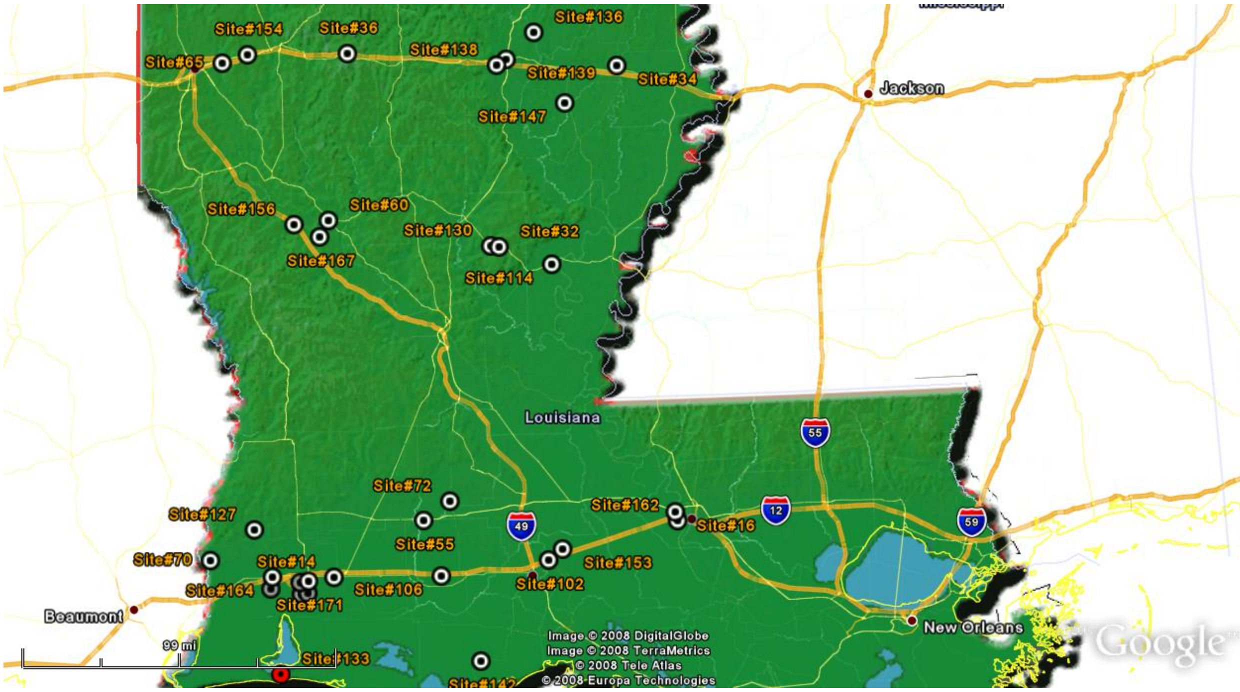

Figure 13
Portable WIM data collection sites for year 2004

Enforcement WIM Data. The main objective of the truck weight enforcement program is to limit the amount of damage caused by overweight loads to the infrastructure and to improve public safety on highways. These WIM scales operate continuously upstream of static enforcement scales. In Louisiana, there are currently 13 enforcement stations located primarily on the interstates and other principal arterials. These stations are set according to International Road Dynamics (IRD) standards. Steel single load cell sensors are used for monitoring truck weights throughout Louisiana and are accurate within a range of +/- 6 percent with respect to corresponding axle. The data collected by this equipment appears to be very similar to what would be obtained by permanent WIM stations. The data collected using the WIM/AVI sensors is only stored for 3 months as it is used for sorting purposes only. If the data are collected and stored on a regular basis from each station at the new ITS lab, it could be used for design and research purposes. Given that there are no permanent WIM stations in Louisiana, the weight enforcement stations can be used as a viable substitute. This can be achieved by connecting the DOTD network to all the WIM enforcement sites and downloading the data periodically. The data may be stored in the database server at LTRC in the ITS lab. The conversion of raw data to useful data can be done with proper licensing and using IRD software. Table 5 provides approximate locations of the enforcement WIM stations, and Figure 14 illustrates the location of the enforcement stations on a map.

Table 5
Location of WIM enforcement sites

Site No.	Highway	Location	Direction
EN1	I-20	Greenwood, Caddo Parish, LA	East / West
EN2	I-20	Delta, Madison Parish, LA	East / West
EN3	US-71	Pineville, Rapides Parish, LA	North/South
EN4	LA-12	Starks, Calcasieu Parish, LA	East / West
EN5	I-10	Toomey, Calcasieu Parish, LA	East / West
EN6	I-10	Breaux Bridge, St. Martin parish, LA	East / West
EN7	I-55	Kentwood, Tangipahoa parish, LA	North/South
EN8	I-12	Baptist, Tangipahoa Parish, LA	East / West
EN9	I-10	Laplace, St. John Parish, LA	East / West
EN10	US-61	Laplace, St. John Parish, LA	North/South
EN11	I-59	LA/MS Joint port at border	South Bound only
EN12	I-10	LA/MS Joint port at border	West Bound only
EN13	I-10	55501, I-10 West, Slidell, LA	North/South

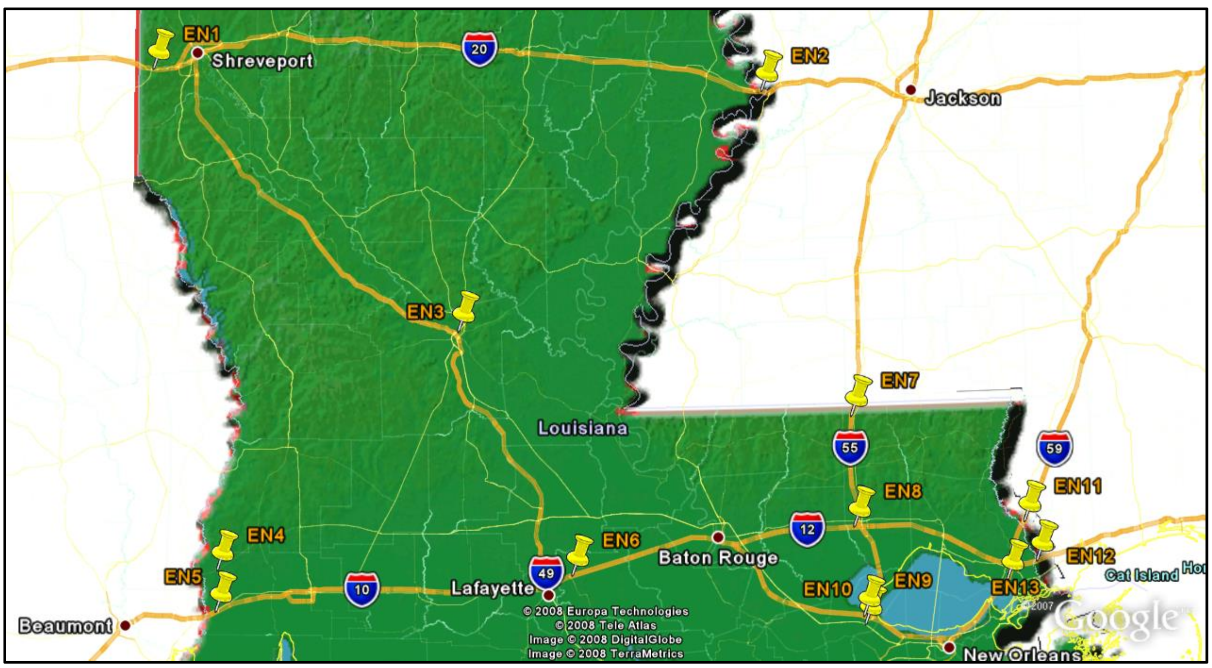

Figure 14
WIM enforcement stations within Louisiana

Long Term Pavement Performance (LTPP) Data. LTPP is a program that collects and processes data describing the structure, service conditions, and performance of 2,513 pavement test sections in North America in order to better understand the pavement performance [5]. Highway engineers use these data and analyzed results to make decisions that lead to more cost-effective and better performing pavements. The LTPP program was designed as a 20-year Strategic Highway Research Program (SHRP) project in 1987.

In Louisiana, a LTPP site having a permanent WIM scale is located along US-171 in the outside north bound lane near Moss Buff in Calcasieu Parish. This site was established recently and is the first permanent WIM site in Louisiana. The existing roadway along the WIM site is asphalt concrete, and its lane width is 12 feet. The shoulder is also asphalt concrete with 10-feet width. The site is instrumented with the Kistler Quartz WIM system.

Vehicle Classification and Traffic Volume Data. In addition to WIM data, vehicle classification data are also required for pavement design procedures and includes the number and types of vehicles over a period of time. Classification is required to determine the normalized truck class distribution all over the state with respect to functional class. There are currently 200 Automatic Vehicle Classification (AVC) sites that collect vehicle classification data within Louisiana. This data may also be stored at the ITS lab.

DISCUSSION OF RESULTS

Layout and Hardware Specifications of the ITS Lab

This section briefly describes the layout and the hardware specifications of the proposed ITS lab. Cost estimates are also provided here based on the anticipated need to establish a fully functional ITS lab that is capable of streaming both video and text data.

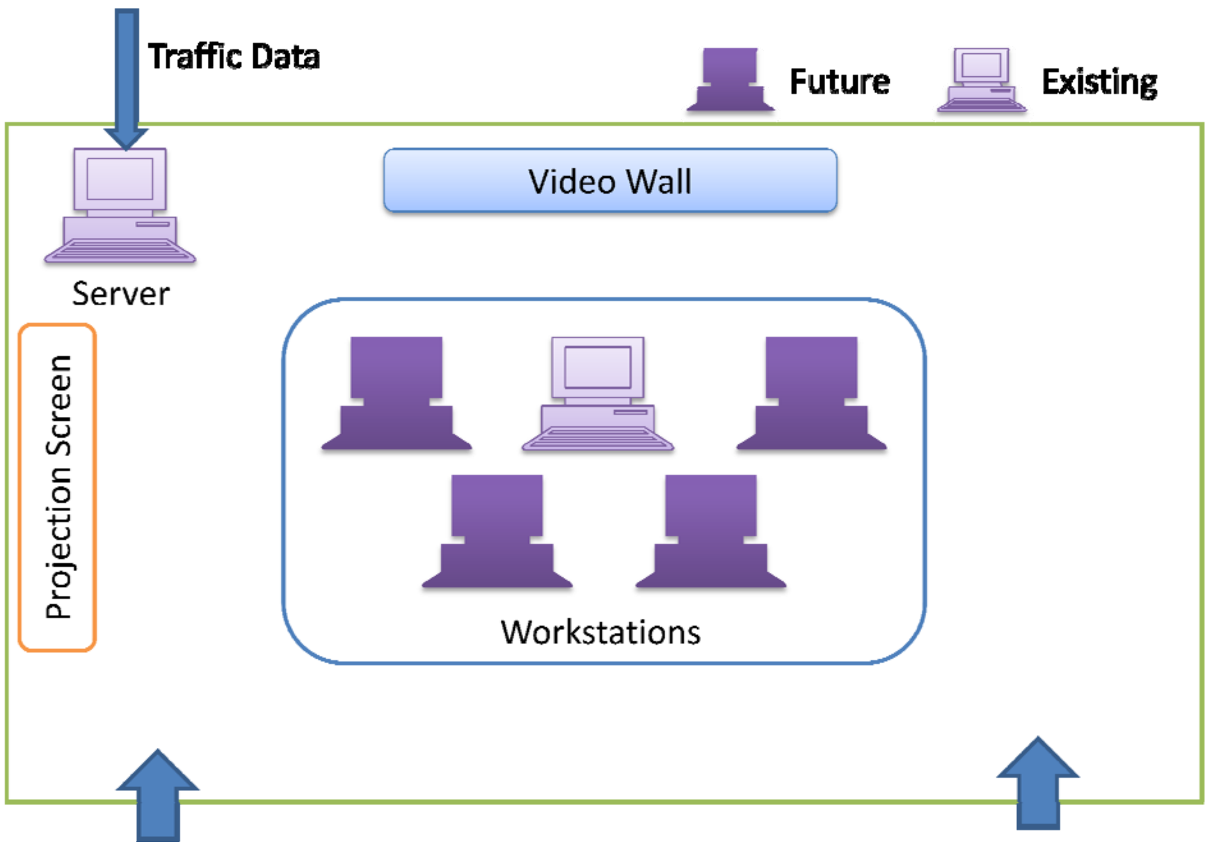

Figure 15
Layout of the proposed ITS lab

Video Wall

At minimum a 2 ft. x 2 ft. video wall would be recommended. This video wall will be built using 42″-52″ LCD displays producing an overall diagonal size of 84″-104″. It would be controlled by a single workstation. Cost estimates for such a system would range from approximately $20k - $70k depending on the final number and type of displays used.

Database Server

The proposed ITS lab must also have a database server to compile both video and text data from all available sources as necessary. During this initial phase of establishing the ITS lab, the research team acquired a high performance database server. The server has a dual processor (Xeon) 2.33 GHz, 4 GB RAM, and nearly 1.2 TB of disk space. The server is currently connected to the DOTD network to compile detector data from I-10, I-12, and I-110 in real time, as described earlier. The server is also running Microsoft SQL server 2005 standard edition, which was licensed separately. The SQL server will ultimately be used to store traffic data in database tables for faster and more efficient access by ITS applications in the future. Currently, traffic data are compiled into log files in text format that required manual import into the SQL database tables. This process will be automated to push data into the SQL server in real time.

Workstations

It is also proposed in the ITS lab layout that a total of five workstations be acquired to support the anticipated research needs of graduate students who will be working on future applications of ITS. The workstations will provide graduate students the computational power and ease of access to traffic data on the database server. The workstations will also be equipped with the necessary software to carry out various data analysis procedures for each application. Examples include statistical analysis software, microscopic simulation software, and others. During the course of this initial phase of the ITS lab project, the research team acquired one workstation that was set up and configured to have access to the database server. Four additional workstations are proposed to complete the ITS lab.

Communication Equipment and Hardware

In order for the ITS lab to operate most effectively, the networking infrastructure at the LTRC building needs to be upgraded. It was initially recommended by the LSU Information Technology (IT) staff and DOTD staff to completely rewire the LTRC facility so that it would comply with code and LSU standards and be compatible with current technology. An estimate of $208,000 was provided by LSU IT, and this information was provided to LTRC for review and consideration. A new network switch was recently deployed at the LTRC building. At a minimum, it is recommended that new wiring infrastructure be installed for the ITS lab itself. It would cost approximately $20,000- $30,000 to do this. If this rewiring is done, it will provide additional bandwidth for receiving video from the TMC. With help from LTRC and DOTD, routing in the private network was configured so that video from the

TMC can be received at the LTRC TTEC building. This allows video to be received in the proposed ITS lab as well.

ITS Lab Operating Policies

To properly and securely maintain the continuous operation of the ITS lab, a set of policies must be outlined and followed by the ITS lab users/operators. Such policies include access privileges to data as well as normal administrative procedures of the system. Since the lab is housed at the LTRC facility, all LTRC rules and regulations will apply to the lab as well. This includes access restrictions outside operating hours and access permissions to researchers. The ITS lab will also require a manager to oversee the development and operation of the lab on a continuous basis. It is proposed that the lab be initially operated under the direction of Dr. Ishak, a faculty member of the Department of Civil and Environmental Engineering (CEE) at LSU, with assistance from Chris Schwehm, an associate director for the Division of Engineering Services at LSU, and one graduate student. Once the lab is established and operational, a designated manager may be appointed by LTRC to assume responsibility for the day-to-day operation of the facility. It is also envisioned that faculty members of CEE and members of LTRC will be involved in the activities of the lab on a project-by-project basis.

To ensure continuity of the lab operation, the research team on this project strongly recommends that one graduate student (preferably of senior status) be appointed to assist the interim lab manager, Dr. Ishak, with the data collection and preliminary analysis processes. Once the lab is fully established and operational, additional graduate students may be employed by LTRC on research projects supported by the lab. The estimated annual budget for the lab operation is $40,000, which includes one summer month salary for Dr. Ishak, one month salary for Chris Schwehm, and support for one graduate student.

Benefits and Applications of Intelligent Transportation Systems

In this task the research team identified a set of applications that rely heavily on the ITS data the lab will be collecting. Such applications are beneficial to both transportation system users (travelers) and providers (public agencies). A brief description of each application is provided in this section to demonstrate a few examples of potential research projects that the new lab can support. Examples of such applications include performance measurements of existing facilities, automatic incident detection systems, short-term prediction of traffic conditions, travel time estimation and prediction, and others. Input from DOTD was sought during the course of this project to identify short- and long-term research needs that can be addressed via the ITS lab.

Overview of ITS Applications

According to the US DOT, applications of ITS systems can be incorporated in both infrastructure and vehicles. Examples of such applications include:

- Arterial Management—manages traffic along arterial roadways, employing traffic signals and various means of communicating information to travelers. These systems make use of information collected by traffic surveillance devices and disseminate important information about travel conditions to travelers via dynamic message signs (DMS) or highway advisory radio (HAR).
- Highway Management—functions such as traffic surveillance systems, traffic control, lane management, special event transportation systems, and devices such as changeable destination signs make up highway management systems.
- Transit Management—services include surveillance and communications, such as automated vehicle location (AVL) systems, computer-aided dispatch (CAD) systems, and remote vehicle and facility surveillance cameras, which enable transit agencies to improve the operational efficiency, safety, and security of the nation's public transportation systems.
- Incident Management—reduces the effects of incident-related congestion by decreasing the time to detect incidents, the time for responding vehicles to arrive, and the time required for traffic to return to normal conditions.
- Emergency Management—includes hazardous materials management, the deployment of emergency medical services, and large-scale and small-scale emergency response and evacuation operations.
- Electronic Payment and Pricing—employs various communication and electronic technologies to facilitate commerce between travelers and transportation agencies, typically for the purpose of paying tolls and transit fares.
- Traveler Information—uses a variety of technologies, including internet Websites, telephone hotlines, as well as television and radio, to allow users to make more informed decisions regarding trip departures, routes, and mode of travel.
- Information Management—supports archiving and retrieving data generated by other ITS applications and enables ITS applications that use archived information.

Some applications enabled by ITS information management include decision support systems, predictive information, and performance monitoring.

- Crash Prevention and Safety—detects unsafe conditions and provides warnings to travelers to take action to avoid crashes.
- Roadway Operations and Maintenance—applications focus on integrated management of maintenance fleets, specialized service vehicles, hazardous road conditions remediation, and work zone mobility and safety. These applications monitor, analyze, and disseminate roadway and infrastructure data for operational, maintenance, and managerial uses.
- Road Weather Management—activities include road weather information systems (RWIS), winter maintenance technologies, and coordination of operations within and between state DOTs.

- Commercial Vehicle Management—ITS applications are designed to enhance communication between motor carriers and regulatory agencies. Examples include electronic registration and permitting programs, electronic exchange of inspection data between regulating agencies for better inspection targeting, electronic screening systems, and several applications to assist operators with fleet operations and security.
- Intermodal Freight—ITS can facilitate safe, efficient, secure, and seamless movement of freight. Applications being deployed provide for tracking of freight and carrier assets, such as containers and chassis, and improve the efficiency of freight terminal processes, drayage operations, and international border crossings.

Potential ITS Applications and Benefits

In light of the parallel efforts by the state in the area of ITS, the research team identified a set of applications and functions that could be potentially beneficial to the transportation system users and providers. A brief description of each application is provided next.

Automatic Incident Detection Systems. Automated incident detection on highways relies on algorithms that process real-time traffic information in order to detect the occurrence of incidents as quickly as possible. Such a function is typically integrated into existing traffic surveillance systems at traffic management centers. The incident detection algorithms rely on traffic data such as speed, flow, and occupancy from each lane. Data are often collected from detectors that are installed at selected locations along the highway system. Some of the benefits of incident detection systems are the reduction of the effects of incident-related congestion and the response time to clear the incident.

Research in the area of development of automated incident detection is dated as far back as the early 1990s. A few examples are provided here for demonstrative purposes only. Kothuri et al. used ITS archived data that was extracted from an archived computer, automatic vehicle location systems, inductive loop detectors, and weather archives to measure the effectiveness of incident detection systems [*6*]. Miller and Abkowitz used ITS data from sensors and closed circuit televisions to study the implementation of automatic incident detection [*7*]. These data were used to describe a decision support protocol as a management tool to help facilitate intelligent management systems' implementation and operation. Petty et al. used extensive ITS field data involving probe vehicles, incident observations, and loop detectors for estimating the impacts of incident management measures [*8*]. Their methodology determined a benefit to cost ratio of highway service patrols at the San Francisco bay area highway section. Pal et al. used disablements, abandonments and crash data to investigate highway incident characteristics and their influence in planning incident management program [*9*]. The results indicated that the type of incident, the position of the incident, and the time of day also influenced the incident clearance time. Han et al. used ITS fatality data, including police accident reports, state vehicle registration files, state highway department data, death certificates, coroner/medical examiner reports, and emergency medical service reports, to measure incident responses and calculate operational performance through ITS systems [*10*]. Their results indicated that new technologies along with the navigator system led to improved performance of traffic operations.

Travel Time Estimation and Prediction. This application addresses the need of travelers to receive updates on current and short-term predictive travel times on the transportation network. Such information is critical to the route choice decisions for travelers at both pre-planning and en-route stages. It has the potential to improve traffic conditions and reduce travel delays by facilitating better utilization of the network available capacity. A few examples of research work conducted in this area are cited next. Vanajakshi used ITS flow, occupancy and speed values obtained from detectors for travel time estimation and prediction [*11*]. The research explained that a complete system for the estimation and prediction of travel time from loop detector data is detailed and results were validated using simulated data from CORSIM simulation software. Oh and Park used ITS travel time data obtained from a real-time traffic surveillance system based on vehicle inductive signatures and vehicle re-identification technique to investigate the effects of travel time patterns of predictability [*12*]. The proposed approach effectively supported in conducting better travel time prediction. Ben-Akiva et al. used ITS travel time data to study travel time estimation and prediction [*13*]. A model system DynaMIT was used in a case study to demonstrate the importance of predictive guidance and its potential. Lin et al. used ITS data of the flow condition at the intersection, the proportion of net inflows into the arterial from cross streets, and the signal coordination level to estimate arterial travel time for advanced traveler information systems [*14*]. Barkan et al. used ITS data of on or off ramp locations to study the travel time estimation and prediction and get optimal routes to a particular destination by cell phones [*15*]. The final result of the cell phone implementation was a screen that delivered a time prediction for the desired route of travel in the collector lanes, based on three different prediction algorithms.

Work Zone Management. Work zone management is a part of roadway operation and maintenance, which has been a subject for research that aims at reducing congestion and improving safety. ITS data have been used to study the behavior of traffic at work zones. Several strategies were proposed to improve traffic flow and safety at work zones. ITS data collected from various detectors, sensors, radars, videos have been used to improve operational performance of traffic at work zones, and its importance can be seen in research examples. Turochy and Sivanandan used ITS space mean speed data that was collected from unmanned radar to obtain speed profiles radars to study work zones [*16*]. From this research, an analysis of the data from the unmanned radar in highway work zones showed there was a reduction in mean speeds by about 3mph. Carlson et al. used ITS speed data that was collected from alternative routes at work zones [*17*]. Their final result showed speed trailers used at rural high-speed temporary work zones produced speed reductions of about 5 mph inside the work zone. Benekohal et al. used ITS headway, speed, and capacity data from video captured by video cameras to analyze the traffic flow at work zones [*18*]. ITS data from piezoelectric sensors and light detection and ranging (LIDAR) guns to study work zones were used to develop a new approach toward work zone capacity estimation, which provided more control and freedom to planners and designers. Schnell et al. used ITS speed, headway, and density data, which was collected from two video recorders, to analyze the traffic flow at work zones [*19*]. The results proved that the calibrated microscopic simulation packages underestimated the actual length of queues that formed in the real world, and that the macroscopic QueWZ92 produced more accurate estimates than the microscopic packages. Horowitz et al. used ITS vehicle count data collected from tube detectors to analyze flow at work zones [*20*]. The analysis of peak period data found that alternative route selection rates were between 7 percent and 10 percent of the highway traffic, depending upon the location and day of week.

Crash Prevention and Safety. Crash prevention and safety systems have the ability to detect unsafe conditions and provide warnings to travelers to take action to avoid crashes. ITS data from the detection systems at intersections can be used to reduce approach speeds at rural intersections. ITS data collected from various detectors, sensors, radars, videos have been used to improve safety performance of traffic using crash prevention and safety. Tribbett used speed data to evaluate dynamic curve warning systems [*21*]. Some measures of effectiveness which were utilized to evaluate these systems including frequency of crashes/erratic maneuvers, operating speeds, public acceptance and response, and maintenance requirements. Hanscom used speed data to evaluate whether the rural stop sign at controlled intersections had an effect on traffic flow [*22*]. Potential treatments were evaluated based on their applicability, key features, speed effects, safety benefits, multimodal impacts, and maintenance issues. Lu et al. used field crash and traffic data to do safety evaluation for highway safety performance [*23*]. Field data and the questionnaire survey were conducted to obtain model parameters, and expert panel field evaluations were performed to validate the performance of these models. Kweon used fatalities per million population and injury crashes per million registered vehicles as crash rates to examine the annual safety performance [*24*]. This study examined 20 candidate crash rates for an annual safety performance measure for Virginia using autoregressive error models and empirical data from 1971 through 2006; it was found that the injury rate per driver and the crash rate per vehicle miles travelled seemed appropriate for safety performance measures, respectively, for Virginia. Camelia et al. used comprehensive crash data to create a database and recommend various counter measures [*25*]. Their study analyzed and recommended a series of safety-related countermeasures and solutions for the top 10 high-crash locations throughout the region.

Improving Highway Operation with Ramp Metering. The process of controlling the rate of vehicles on the ramp with the use of traffic signals is known as ramp metering. To optimize the highway flow and minimize the traffic congestion, metering on ramps can be either fixed or responsive. Signal timing algorithms and real-time data from mainline loop detectors are often used in the intelligent transportation systems lab for the purpose of research. Some of the benefits of ITS data in ramp metering include reduction of highway bottlenecks, the associated safety improvement, and travel time reductions. For instance, Rudjanakanoknad and Cassidy used ITS video to process other traffic data and study the effect of ramp metering on capacity [*26*]. The findings were the first real evidence that ramp metering could favorably affect the capacity of an isolated merge and also point to control strategies that might generate higher outflows for more prolonged periods and increase merge capacity even more. Zhang and Levinson used ITS flow and occupancy data to study the effect of ramp metering on capacity of the highways and its mechanism [*27*]. It was found that meters increase the bottleneck capacity by postponing and sometimes eliminating bottleneck activations accommodating higher flows during the pre-queue transition period and increasing queue discharge flow rates after breakdown. Zong et al. used ITS flow and speed data to study the effect of ramp metering [*28*]. The results of the evaluation indicated that the integrated operations were most effective under the medium traffic demand scenario by preventing or delaying the onset of ramp-metering queue flush, thereby reducing highway breakdown and system delays. Banks used ITS flow and traffic delay data to study the effect of ramp metering [*29*]. The results showed that there were circumstances in which minimization of delay did not coincide with minimization of congestion on the mainline and those relationships between delay and mainline congestion depend on the combination of metering mechanisms in effect. Cassidy used ITS flow data and delay data to study the savings in delays and at bottlenecks due to ramp metering [*30*]. The results showed that no single metering logic can suitably address all conditions that arise on different highways.

Managed Lanes. ITS data are beneficial in the application of managed lanes as it can be used to study its effectiveness and to develop new strategies. Benefits of ITS data include development of methods to reduce congestion with demand repackaging strategies. For example, Goodin et al. studied strategies of enforcing carpool preference of managed lanes operations; their results showed that their study in California had the most positive experience in simplifying the enforcement process and reducing violation rates compared to the High Occupancy Vehicle (HOV) lane to High Occupancy Toll (HOT) lane conversions [*31*]. Martin et al. used ITS video data that included traffic volumes, speeds, and densities to develop a forecasting model for managed lanes [*32*]. Their forecast model was able to make easier predictions about violation rate, and speed. Brydia and Song used ITS data collected from DOT to study the interpolability issues on managed lane facilities [*33*]. The key feature of this research was to develop a matrix defining the critical interoperability concerns for a managed lanes facility. Yin and Lou used ITS loop detector data to study the strategies of dynamic tolling for managed lanes [*34*]. Two approaches to determine dynamic pricing strategies for managed lanes, to provide superior free-flow travel services, and efficiently utilize the capacities were supported by simulation results. Ungemah et al. used ITS data regarding HOV preference in managed lane facilities to examine incentives and preferential treatments of carpools in managed lane facilities [*35*]. Their research highlighted the existing body of knowledge regarding carpooling, facilities, and incentives designed to encourage carpooling and carpooling’s contributions to the societal benefits.

Congestion Pricing. Congestion pricing is an important application of ITS that determines the amount of toll motorists have to pay for using a certain particular length of a highway at a certain time of the day. It is a demand-based strategy designed to encourage a shift of peak period trips to off-peak periods, to divert traffic away from congested facilities, and to promote the use of alternative modes such as high occupancy vehicles during the peak demand periods. The benefits of ITS data in congestion pricing can be evaluated by studying its effectiveness and impact of variable pricing on the traffic volumes to develop forecasting models and models to estimate the cost of tolls. Benefits of ITS data in congestion pricing can be highlighted by listing some of the studies that used ITS data.

For example, Roth and Villoria used ITS average traffic speed data to study a commercialized urban road network that was subjected to conditional pricing [*36*]. Their calculations on the basis of reported values of time for different vehicle classes and other factors proved that a charge would be likely to increase traffic speeds by 44 to 101 percent. Burris and Senson used ITS traffic data to study the impact of variable pricing in Lee county [*37*]. This ITS data provided an insight into the many unknowns surrounding variable pricing and the difficulties that were encountered attempting to measure its impact. Supernak et al. used a wide range of ITS traffic data like traffic volumes, travel modes, vehicle speed, HOV violations, and traffic incidents to study the I-15 congestion pricing project [*38*]. The main objectives were to maximize use of HOV lanes and to test whether allowing solo drivers to use the HOV lanes' excess capacity can help relieve congestion on the main lanes. Their results proved that the LOS of the HOV lanes were unaffected and had a slight reduction of traffic in main lanes. Kazimi et al. used ITS traffic data to study willingness to pay to reduce commute time and its variance based on I-15 congestion pricing project [*39*]. These data were used to estimate mode choice models that include the choice of paying to travel on a less-congested HOT lane. Adler et al. used ITS traffic data on travel patterns to study travelers reactions to congestion pricing concepts for New York's Tappan Zee Bridge [*40*]. ITS data were used to find that many travelers have some flexibility in when they can make their trips and will exercise that flexibility in response to tolls that vary by the time of day.

Highway Breakdown Analysis. Traffic breakdown occurs when density increases and speed decreases during the transition phase from uncongested free-flow conditions to congested conditions. ITS data in the form of traffic flow data from traffic detectors (inductive loops, radar, or video devices) are instrumental to studying probability of traffic breakdowns on highways and identifying the most probable cause for such breakdowns. Some benefits of ITS data in this area are highlighted here. For example, Ramakrishnan and Banks used ITS loop detector data to study the relationship between the mean flow rate and probability of breakdown at highway bottlenecks [*41*]. Their results showed that a significant correlation between the level and duration of pre-queue flow was found in only one case, suggesting that the relationship between mean flow and the probability of breakdown is weak or nonexistent. Bassan et al. used ITS occupancy and speed data to analyze the density fluctuations and breakdown thresholds on congested highways [*42*]. The calibration results showed the obtained threshold values of densities and corresponding speeds that triggered the breakdown process. Lorenz and Elefteriadou used ITS speed and volume data to define highway capacity as a function of breakdown probability [*43*]. Their research developed preliminary models for each site describing the probability of breakdown versus observed flow rate and examined the implications of this probabilistic approach to breakdown on the current definition of highway capacity. Persaud et al. used ITS traffic data to explore the phenomenon of breakdown in highway traffic [*44*]. This research aimed at exploring in more detail the implications of metering traffic flow at levels below that at which breakdown occurs. Their research showed that one-minute median lane flows, 20 percent larger than queue discharge flows, have only a 10 percent probability of breakdown, and one-minute flows equal to the mean queue discharge flows have a negligible probability of breakdown. Elefteriadou and Lertworawanich used ITS speed and flow data to define, measure, and estimate highway capacity [*45*]. Breakdown flow, observed maximum pre breakdown flow, and observed maximum discharge flow were the three flow parameters examined to determine the more appropriate one to find the capacity of a highway.

Optimizing Traffic Signal Control. ITS data can also be used in traffic signal evaluation optimization applications to measure the effectiveness of different signal timing optimization strategies. Benefits of ITS data in this application are demonstrated in many examples. For instance, Yun et al. used aggregated ITS traffic count data to evaluate activated traffic controllers by hardware in loop simulation [*46*]. Their research demonstrated the performance of the adaptive maximum feature using HILS consisting of an EPAC300 traffic controller and the VISSIM microscopic simulation model. The results indicated that the adaptive maximum feature was able to provide traffic signal control operations as efficient as normal maximum green intervals optimized by SYNCHRO. Wolshon and Taylor used ITS loop detector data and video data to analyze intersection delay under real-time adaptive signal control [*47*]. This research studied the difference in certain delay parameters between Sydney Coordinated Adaptive Traffic System (SCATS) signal control and a less adaptive signal control strategy. The conclusion was that the average total intersection delay, on a system wide basis, was higher under SCATS control than under the simulated fixed time control strategy. Skabardonis used ITS volume and occupancy data to analyze the benefits of ITS in the case of traffic signal control systems [*48*]. This research analyzed three major types of signal control improvements, namely optimization of existing signal timing plans, signal coordination, and traffic responsive control. Based on their results from a case study, signal timing optimization of coordinated signal systems produced an average of a 7.7 percent drop in travel time, 13.8 percent reduction in delays, 12.5 percent reduction in stops, and 7.8 percent decline in fuel use for a typical weekday. Zhou et al. used ITS real-time data from traffic controllers to study the intelligent adaptive traffic signal controls [*49*]. Traffic control parameters were optimized using new traffic patterns and a fuzzy-neural algorithm. Results showed significant achievements on traffic delay reductions and overall performances that included more than a 35 percent traffic delay reduction. Rakha et al. used instantaneous ITS speed and acceleration data to evaluate traffic signal control impacts on energy and emissions [*50*]. Their study estimated fuel and emissions levels as a function of instantaneous speed and acceleration in a consistent fashion for both field data and simulated data. Their results showed that for steady-state conditions the tool predicted vehicle fuel consumption and emissions consistently with field data that were obtained.

Calibration of Traffic Simulation Models. Benefits of ITS data also extend to the area of traffic simulation calibration. The benefits of ITS data in this application can be shown by a few examples such as the study by Park.et al., which used ITS traffic counts from video cameras and counters to calibrate a microscopic simulation model of a coordinated actuated signal system [*51*]. The research study used a systematic approach for conducting simulation model calibration and validation procedures on the basis of experimental design and optimization; they then applied the approach to an isolated intersection using a VISSIM simulation model. The simulation model calibration and validation procedure was proven to be effective for an arterial network under both VISSIM and CORSIM simulation models. Kim and Rilett used ITS loop detector data to calibrate microscopic traffic simulation model and OD matrix simultaneously [*52*]. This research developed a methodology to calibrate the OD matrix jointly with model behavior parameters using a bi-level calibration framework that was proved to be successful. Ben Akiva et al. used ITS loop detector data to calibrate microscopic traffic simulation models with aggregate data [*53*]. This research proposed for a framework for the calibration of microscopic traffic simulation models using aggregate data with the help of the MITSIM Lab, a microscopic traffic simulation model. Their results from the case studies also demonstrated improved computational performance and a need for further research. Chu et al. used ITS traffic flow data from video to calibrate a microscopic traffic simulation [*54*]. Their research presented a systematic, multi-stage procedure for the calibration and validation of PARAMICS simulation models. This procedure was proved successful to a certain extent, and a need for future research was mentioned. Kim and Rilett used ITS data to calibrate a traffic micro-simulation by a genetic algorithm based approach

[55]. Their paper presents a methodology using ITS data to calibrate micro-simulation models based on the genetic algorithm using two micro-simulation models of CORSIM and TRANSIMS.

CONCLUSIONS AND RECOMMENDATIONS

The primary goal of this research project is to lay a foundation for establishing a state-of-the-art lab at LTRC, where traffic data can be collected, analyzed, and reported in real time and on a continuous basis as part of the ITS effort in Louisiana. The purpose of the lab is to ultimately develop and demonstrate procedures that successfully transform existing ITS data into useful information for viable applications, and then pass the procedures on to agencies in order to apply them on a routine basis. The lab is also expected to complete analysis functions for DOTD and to develop, evaluate, and refine procedures for more effectively utilizing the ITS system offline. In essence, the lab will primarily serve the metropolitan and state transportation authorities in their service to the traveling public. The information will assist transportation officials in developing applications that improve their service to the public (e.g., providing current and expected future traffic conditions and developing operational strategies for the existing infrastructure). The lab will also serve academics, researchers, and practitioners in providing access to raw and processed data of traffic flow. The lab is also anticipated to be a tool to retain, recruit, and inspire interest in the field of advanced traffic management systems for students in Louisiana as well as potential graduate students from outside Louisiana. The short-term measure of success of the lab will be reflected by the capability to stream traffic data in real time from traffic monitoring sites that are connected to the TMC. Also, the lab will offer technical reporting capabilities that assist users in extracting the most relevant information needed from such data.

During the course of this project, the research team highlighted the importance of ITS data, which has been long recognized by researchers and practitioners in the field. Significant efforts have been made by several state agencies and universities in the past few years to establish robust archival systems for such data and make it available to stakeholders to support a variety of applications. California, Texas, Florida, Virginia, and Georgia are a few states among many others that have recognized the need to archive such data on a continuous basis. Several universities have followed suit and established their own ITS labs to collect data that supports their own research needs. Examples were found in state universities such as Portland State University, University of California at Irvine, Florida International University, Washington State University, etc.

Based on a thorough review and assessment of the existing hardware and communication infrastructure at the designated location of the lab, the following issues were identified and summarized below:

- There are two types of data that can be streamed in real time to the ITS lab at LTRC: text and video. Text data includes observations of traffic parameters at sites where detectors are installed. This typically includes volume, lane occupancy, and speed data collected from each lane at each of the detector sites. Video data refers to live streaming from video cameras used to monitor traffic conditions at specific sites.
- Since video data is expected to consume more bandwidth, rewiring and/or installing a switch to expand the bandwidth is strongly recommended. Streaming video data may also require a client license for either Chameleon 360 or Teleste MoRIS viewer.
- Currently, text data can be readily accessed from various sources as it requires relatively small bandwidth. As a proof of concept, the research team was successful in setting up an automated procedure to stream traffic data in real time from Baton Rouge ATMC to LTRC. Two high-end workstations were set up as servers for traffic data, and the data streaming process was successful in downloading data packets every 30 seconds from a total of 62 detectors along the corridors of I-10, I-12, and I-110 in the Baton Rouge area.
- Other data sources were also identified and include the southern region of Louisiana, which is currently monitored by the ECONOLITE system (DCMS). The system consists of 25 sites monitored by video detectors that are accessible via a Web interface. This data source can also be tapped into and data can be routed to the new ITS lab in real time. Another viable data source that was identified is the use of weigh-in-motion (WIM) stations throughout the state of Louisiana for truck weight enforcement. Those sites, in addition to the portable and LTPP sites, provide crucial axle load data that are currently essential to the new pavement design procedures. Such data are not routinely stored at one central location or in a format that is readily accessible for development of axle load spectra of trucks.

During the course of this project, the research team identified several applications that can be supported by the ITS data to be collected at the lab. Such applications include, but are not limited to, highway incident detection and management, travel time estimation and prediction, work zone management, ramp metering, and crash analysis. Additionally, there are new concepts such as managed lanes and congestion pricing, highway breakdown and recovery analysis, traffic signal optimization, calibration of microscopic simulation models, implementation of new pavement design procedures, and others.

In order to build the ITS lab at LTRC, the following equipment and costs are estimated:

- The estimated cost of rewiring to increase the bandwidth for video streaming is in the range of $20,000 - $30,000.

- In order to display video data in the ITS lab, a video wall will be required. Depending on the video display technology, the cost may also vary from $20,000 to $70,000. The exact cost will be determined based on the desired type of display technology.

- Additional workstations will be required for graduate students who are conducting research in the lab. It is estimated that four workstations will be adequate, each at an estimated cost of $2000.

To properly and securely maintain the continuous operation of the ITS lab, a set of policies must be established for the ITS lab users/operators. The policies include access privileges to data as well as normal administrative procedures of the system. Since the lab will be housed at the LTRC facility, all LTRC rules and regulations must apply to the lab as well. The ITS lab will also require a manager to oversee the development and operation of the lab on a continuous basis. It is proposed that the lab be initially operated under the direction of Dr. Ishak, a faculty member of the Department of Civil and Environmental Engineering at LSU, with assistance from Chris Schwehm, an associate director for the Division of Engineering Services at LSU, and one graduate student. Once the lab is established and operational, a designated manager may be appointed by LTRC to assume responsibility for the day-to-day operation of the facility.

To ensure continuity of the lab operation, the research team on this project strongly recommends that one graduate student (preferably of senior status) be appointed to assist the interim lab manager with data collection and preliminary analysis processes. Once the lab is fully established and operational, additional graduate students may be employed by LTRC or on research projects funded by LTRC. The estimated annual budget for the lab operation is $40,000, which includes one summer month salary for Dr. Ishak, one month salary for Schwehm, and support for one graduate student.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ATMC	Automatic Traffic Management Center
ATMS	Advanced Transportation Management System
AVC	Automatic Vehicle Classification
AVL	Automatic Vehicle Location
CAD	Computer Aided Dispatch
CEE	Civil and Environmental Engineering
CALTRANS	California Department of Transportation
CVO	Commercial Vehicle Operation
DCMS	Data Collection and Management Service
DMS	Dynamic Message Signs
DOTD	Department of Transportation and Development
HAR	Highway Advisory Radio
HOT	High Occupancy/Toll
HOV	High Occupancy Vehicle
ITS	Intelligent Transportation System
IRD	International Road Dynamics
LOS	Level of Service
LTRC	Louisiana Transportation Research Center
LTPP	Long Term Pavement Performance
MEPDG	Mechanistic Empirical Pavement Design Guide
MIST	Management Information System for Transportation
OD	Original Destination
PRC	Project Review Committee
RVD	Radar Video Detector
RWIS	Roadway Weather Information System
SHRP	Strategic Highway Research Program
SIP	Safety Improvement Program
TMC	Traffic Management Center
WIM	Weigh-in-motion

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APPENDIX A

Script to Launch Traffic Data Collection from MIST at ATMC

Filename: "LaunchMistCollect.bat"

```
@echo off

call wait 60

net use z: /delete >> c:\trafficdata\errors.txt

net use z: \\10.92.5.12\trafdata .1trafdata1. /user:trafdata >> c:\trafficdata\errors.txt

c:

cd "\TrafficData"

call mistCollect.bat detector.dat
```

Filename: "MistCollect.bat"

```
@echo off

echo If this window is closed the real-time MIST data collection process will be stopped

echo To re-start it run: launchMistCollect.bat

if [%1]==[/?] set _empty=Syntax is: %0 "Real-time-mist-file-name" &goto :message

if [%1]==[] set _empty=Syntax is: %0 "Real-time-mist-file-name" &goto :message

set mistFH=%1

if not exist %mistFH% goto :file_not_exist

:start_compare

if exist z:\detector.dat del c:\trafficdata\detector.dat >null

if exist z:\detector.dat move z:\detector.dat c:\trafficdata\ > nul
```

```
set crtDay=

rem collects month from "dow mm/dd/yyyy" format of the current date

for /F "usebackq tokens=2,3,4 delims=/ " %%g in (`date /T`) do set crtDay=%%g-%%h-%%i

if not exist buffer.txt copy nul buffer.txt        > nul

set mistOUT=MIST[%crtDay%].txt

set mistLOG=MIST[%crtDay%].log

if not exist %mistOUT% copy nul %mistOUT% > nul

FC  /b %mistFH% buffer.txt| FIND "FC: no dif" > nul

IF ERRORLEVEL 1 (

goto :s_files_are_different

) ELSE (

echo %time%[wait: MIST file not updated yet, check back in 5 sec] >> %mistLOG%

timeout 5 > nul

goto :start_compare

)

:s_files_are_different

echo %time%[ready: clone the freshly updated MIST file to the buffer] >> %mistLOG%

copy %mistFH% buffer.txt /b /y >>%mistLOG%

echo %time%[ready: use the buffer to update the current day MIST data] >> %mistLOG%

copy %mistOUT%+buffer.txt  /b /y  >> %mistLOG%

goto :start_compare

:message
```

echo %_empty%

timeout 10

exit /b

:file_not_exist

echo "Real-time MIST file does not exist!"

exit /b

Filename: “wait.bat”

@ping 127.0.0.1 -n 2 -w 1000 > nul

@ping 127.0.0.1 -n %1% -w 1000> nul

APPENDIX B

Detailed Description of Highway Detector Locations

This appendix shows the radar video detectors (RVD) installed on I-10, I-12, and I-110. The table shows the detector ID, detector name (describing the detector location), the lane number, zone number, detector type, milepost, and export feature. The data presented in this table were obtained from the ITS section of DOTD.

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
6000101	I-12 WB AT AIRLINE HIGHWAY	1	1	P	37	TRUE
6000102	I-12 WB AT AIRLINE HIGHWAY	2	2	P	37	TRUE
6000103	I-12 WB AT AIRLINE HIGHWAY	3	3	P	37	TRUE
6000201	I-12 EB AT AIRLINE HIGHWAY	1	1	P	37	TRUE
6000202	I-12 EB AT AIRLINE HIGHWAY	2	2	P	37	TRUE
6000203	I-12 EB AT AIRLINE HIGHWAY	3	3	P	37	TRUE
6000301	I-12 EB AT DRUSILLA LANE	1	1	P	32	TRUE
6000302	I-12 EB AT DRUSILLA LANE	2	2	P	32	TRUE
6000303	I-12 EB AT DRUSILLA LANE	3	3	P	32	TRUE
6000304	I-12 EB AT DRUSILLA LANE	4	4	P	32	TRUE
6000401	I-12 EB AT DRUSILLA LANE	1	1	P	32	TRUE
6000402	I-12 EB AT DRUSILLA LANE	2	2	P	32	TRUE
6000403	I-12 EB AT DRUSILLA LANE	3	3	P	32	TRUE
6000501	I-12 WB AT JEFFERSON HIGHWAY	1	1	P	27	TRUE
6000502	I-12 WB AT JEFFERSON HIGHWAY	2	2	P	27	TRUE
6000503	I-12 WB AT JEFFERSON HIGHWAY	3	3	P	27	TRUE
6000601	I-12 EB AT JEFFERSON HIGHWAY	1	1	P	27	TRUE
6000602	I-12 EB AT JEFFERSON HIGHWAY	2	2	P	27	TRUE
6000603	I-12 EB AT JEFFERSON HIGHWAY	3	3	P	27	TRUE
6000604	I-12 EB AT JEFFERSON HIGHWAY	4	4	P	27	TRUE
6000701	I-12 WB AT ESSEN LANE	1	1	P	23	TRUE
6000702	I-12 WB AT ESSEN LANE	2	2	P	23	TRUE
6000703	I-12 WB AT ESSEN LANE	3	3	P	23	TRUE
6000704	I-12 WB AT ESSEN LANE	4	4	P	23	TRUE
6000801	I-12 EB AT ESSEN LANE	1	1	P	23	TRUE
6000802	I-12 EB AT ESSEN LANE	2	2	P	23	TRUE
6000803	I-12 EB AT ESSEN LANE	3	3	P	23	TRUE
6000804	I-12 EB AT ESSEN LANE	4	4	P	23	TRUE
6000901	I-12 WB EAST OF THE SPLIT	1	1	P	19	TRUE
6000902	I-12 WB EAST OF THE SPLIT	2	2	P	19	TRUE
6000903	I-12 WB EAST OF THE SPLIT	3	3	P	19	TRUE
6000904	I-12 WB EAST OF THE SPLIT	4	4	P	19	TRUE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
6001001	I-12 EB EAST OF THE SPLIT	1	1	P	19	TRUE
6001002	I-12 EB EAST OF THE SPLIT	2	2	P	19	TRUE
6001003	I-12 EB EAST OF THE SPLIT	3	3	P	19	TRUE
6001004	I-12 EB EAST OF THE SPLIT	4	4	P	19	TRUE
6001101	I-12 WB WEST OF THE SPLIT	1	1	P	14	TRUE
6001102	I-12 WB WEST OF THE SPLIT	2	2	P	14	TRUE
6001103	I-12 WB WEST OF THE SPLIT	3	3	P	14	TRUE
6001201	I-12 EB WEST OF THE SPLIT	1	1	P	14	TRUE
6001202	I-12 EB WEST OF THE SPLIT	2	2	P	14	TRUE
6001203	I-12 EB WEST OF THE SPLIT	3	3	P	14	TRUE
6001301	I-10 WB WEST OF THE SPLIT	1	1	P	1596	TRUE
6001302	I-10 WB WEST OF THE SPLIT	2	2	P	1596	TRUE
6001303	I-10 WB WEST OF THE SPLIT	3	3	P	1596	TRUE
6001304	I-10 WB WEST OF THE SPLIT	4	4	P	1596	TRUE
6001305	I-10 WB WEST OF THE SPLIT	5	5	P	1596	TRUE
6001401	I-10 EB WEST OF THE SPLIT	1	1	P	1596	TRUE
6001402	I-10 EB WEST OF THE SPLIT	2	2	P	1596	TRUE
6001403	I-10 EB WEST OF THE SPLIT	3	3	P	1596	TRUE
6001404	I-10 EB WEST OF THE SPLIT	4	4	P	1596	TRUE
6001501	I-10 WB EAST OF COLLEGE DRIVE	1	1	P	1591	TRUE
6001502	I-10 WB EAST OF COLLEGE DRIVE	2	2	P	1591	TRUE
6001503	I-10 WB EAST OF COLLEGE DRIVE	3	3	P	1591	TRUE
6001504	I-10 WB EAST OF COLLEGE DRIVE	4	4	P	1591	TRUE
6001505	I-10 WB EAST OF COLLEGE DRIVE	5	5	P	1591	TRUE
6001601	I-10 EB EAST OF COLLEGE DRIVE	1	1	P	1591	TRUE
6001602	I-10 EB EAST OF COLLEGE DRIVE	2	2	P	1591	TRUE
6001603	I-10 EB EAST OF COLLEGE DRIVE	3	3	P	1591	TRUE
6001604	I-10 EB EAST OF COLLEGE DRIVE	4	4	P	1591	TRUE
6001701	I-10 WB OF COLLEGE DRIVE	1	1	P	1588	TRUE
6001702	I-10 WB OF COLLEGE DRIVE	2	2	P	1588	TRUE
6001703	I-10 WB OF COLLEGE DRIVE	3	3	P	1588	TRUE
6001704	I-10 WB OF COLLEGE DRIVE	4	4	P	1588	TRUE
6001801	I-10 EB OF COLLEGE DRIVE	1	1	P	1588	TRUE

Detector ID	*Detector Name*	*Lane*	*Zone*	*Detector Type (P=Pair Detector)*	*Mile Post Marker*	*Export*
6001802	I-10 EB OF COLLEGE DRIVE	2	2	P	1588	TRUE
6001803	I-10 EB OF COLLEGE DRIVE	3	3	P	1588	TRUE
6001901	I-10 WB WEST OF COLLEGE DRIVE	1	1	P	1584	TRUE
6001902	I-10 WB WEST OF COLLEGE DRIVE	2	2	P	1584	TRUE
6001903	I-10 WB WEST OF COLLEGE DRIVE	3	3	P	1584	TRUE
6001904	I-10 WB WEST OF COLLEGE DRIVE	4	4	P	1584	TRUE
6002001	I-10 EB WEST OF COLLEGE DRIVE	1	1	P	1584	TRUE
6002002	I-10 EB WEST OF COLLEGE DRIVE	2	2	P	1584	TRUE
6002003	I-10 EB WEST OF COLLEGE DRIVE	3	3	P	1584	TRUE
6002004	I-10 EB WEST OF COLLEGE DRIVE	4	4	P	1584	TRUE
6002101	I-10 WB OF ACADIAN THRUWAY	1	1	P	1580	TRUE
6002102	I-10 WB OF ACADIAN THRUWAY	2	2	P	1580	TRUE
6002103	I-10 WB OF ACADIAN THRUWAY	3	3	P	1580	TRUE
6002201	I-10 EB OF ACADIAN THRUWAY	1	1	P	1580	TRUE
6002202	I-10 EB OF ACADIAN THRUWAY	2	2	P	1580	TRUE
6002203	I-10 EB OF ACADIAN THRUWAY	3	3	P	1580	TRUE
6002301	I-110 SB AT I-10\I-110 SPLIT	1	1	P	9999	TRUE
6002302	I-110 SB AT I-10\I-110 SPLIT	2	2	P	9999	TRUE
6002401	I-110 NB AT GOVERNMENT STREET Zone 1	1	1	P	9999	FALSE
6002402	I-110 NB AT GOVERNMENT STREET Zone 2	2	2	P	9999	FALSE
6002403	I-110 NB AT GOVERNMENT STREET Zone 3	3	3	P	9999	FALSE
6002404	I-110 NB AT GOVERNMENT STREET Zone 4	4	4	P	9999	FALSE
6002501	I-110 SB AT GOVERNMENT STREET Zone 1	1	1	P	9999	FALSE
6002502	I-110 SB AT GOVERNMENT STREET Zone 2	2	2	P	9999	FALSE
6002503	I-110 SB AT GOVERNMENT STREET Zone 3	3	3	P	9999	FALSE
6002601	I-110 NB AT NORTH BOULEVARD Zone 1	1	1	P	9999	FALSE
6002602	I-110 NB AT NORTH BOULEVARD Zone 2	2	2	P	9999	FALSE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
6002603	I-110 NB AT NORTH BOULEVARD Zone 3	3	3	P	9999	FALSE
6002701	I-110 SB AT NORTH BOULEVARD Zone 1	1	1	P	9999	FALSE
6002702	I-110 SB AT NORTH BOULEVARD Zone 2	2	2	P	9999	FALSE
6002703	I-110 SB AT NORTH BOULEVARD Zone 3	3	3	P	9999	FALSE
6002801	I-10 EB AT I-10\I-110 SPLIT Zone 1	1	1	P	9999	FALSE
6002802	I-10 EB AT I-10\I-110 SPLIT Zone 2	2	2	P	9999	FALSE
6002803	I-10 WB AT I-10\I-110 SPLIT Zone 3	3	3	P	9999	FALSE
6002901	I-10 WB AT I-10\I-110 SPLIT Zone 1	1	1	P	9999	FALSE
6002902	I-10 WB AT I-10\I-110 SPLIT Zone 2	2	2	P	9999	FALSE
6003001	I-10 EB AT NICHOLSON DRIVE	1	1	P	9999	TRUE
6003002	I-10 EB AT NICHOLSON DRIVE	2	2	P	9999	TRUE
6003003	I-10 EB AT NICHOLSON DRIVE	3	3	P	9999	TRUE
6003004	I-10 WB AT NICHOLSON DRIVE	4	4	P	9999	TRUE
6003101	I-10 WB AT NICHOLSON DRIVE	1	1	P	9999	TRUE
6003102	I-10 WB AT NICHOLSON DRIVE	2	2	P	9999	TRUE
6003103	I-10 WB AT NICHOLSON DRIVE	3	3	P	9999	TRUE
6003104	I-10 EB AT NICHOLSON DRIVE	4	4	P	9999	TRUE
6003201	I-10 EB AT LA 1	1	1	P	9999	TRUE
6003202	I-10 EB AT LA1	2	2	P	9999	TRUE
6003203	I-10 WB AT LA 1	3	3	P	9999	TRUE
6003301	I-10 WB AT LA 1	1	1	P	9999	TRUE
6003302	I-10 WB AT LA 1	2	2	P	9999	TRUE
6003303	I-10 EB AT LA1	3	3	P	9999	TRUE
6003401	I-10 EB AT WEST END OF M.R.B.	1	1	P	9999	TRUE
6003402	I-10 EB AT WEST END OF M.R.B.	2	2	P	9999	TRUE
6003403	I-10 EB AT WEST END OF M.R.B.	3	3	P	9999	TRUE
6003501	I-10 WB AT WEST END OF	1	1	P	9999	TRUE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
	M.R.B.					
6003502	I-10 WB AT WEST END OF M.R.B.	2	2	P	9999	TRUE
6003503	I-10 WB AT WEST END OF M.R.B.	3	3	P	9999	TRUE
6003601	I-10 EB AT TERRACE AVENUE	1	1	P	9999	TRUE
6003602	I-10 EB AT TERRACE AVENUE	2	2	P	9999	TRUE
6003603	I-10 EB AT TERRACE AVENUE	3	3	P	9999	TRUE
6003604	I-110 NB AT TERRACE AVENUE	4	4	P	9999	FALSE
6003701	I-110 NB AT TERRACE AVENUE	1	1	P	9999	FALSE
6003702	I-110 NB AT TERRACE AVENUE	2	2	P	9999	FALSE
6003703	I-10 WB AT TERRACE AVENUE	3	3	P	9999	TRUE
6003704	I-10 WB AT TERRACE AVENUE	4	4	P	9999	TRUE
6003705	I-10 EB AT TERRACE AVENUE	5	5	P	9999	TRUE
6003801	I-10 EB AT LOUISE STREET	1	1	P	9999	TRUE
6003802	I-10 EB AT LOUISE STREET	2	2	P	9999	TRUE
6003803	I-10 EB AT LOUISE STREET	3	3	P	9999	TRUE
6003804	I-10 WB AT LOUISE STREET	4	4	P	9999	TRUE
6003901	I-10 WB AT LOUISE STREET	1	1	P	9999	TRUE
6003902	I-10 WB AT LOUISE STREET	2	2	P	9999	TRUE
6003903	I-10 WB AT LOUISE STREET	3	3	P	9999	TRUE
6003904	I-10 WB AT LOUISE STREET	4	4	P	9999	TRUE
6004001	I-10 EB AT WASHINGTON STREET	1	1	P	9999	TRUE
6004002	I-10 EB AT WASHINGTON STREET	2	2	P	9999	TRUE
6004003	I-10 EB AT WASHINGTON STREET	3	3	P	9999	TRUE
6004004	I-10 EB AT WASHINGTON STREET	4	4	P	9999	TRUE
6004101	I-10 WB AT WASHINGTON STREET	1	1	P	9999	TRUE
6004102	I-10 WB AT WASHINGTON STREET	2	2	P	9999	TRUE
6004103	I-10 WB AT WASHINGTON STREET	3	3	P	9999	TRUE
6004201	I-10 WB AT THE DALRYMPLE ON-RAMP	1	1	P	9999	TRUE
6004202	I-10 WB AT THE DALRYMPLE ON-RAMP	2	2	P	9999	TRUE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
6004203	I-10 WB AT THE DALRYMPLE ON-RAMP	3	3	P	9999	TRUE
6004204	I-10 WB AT THE DALRYMPLE ON-RAMP	4	4	P	9999	TRUE
6004301	I-10 EB AT THE DALRYMPLE OFF-RAMP	1	1	P	9999	TRUE
6004302	I-10 EB AT THE DALRYMPLE OFF-RAMP	2	2	P	9999	TRUE
6004303	I-10 EB AT THE DALRYMPLE OFF-RAMP	3	3	P	9999	TRUE
6004401	I-10 WB AT THE DALRYMPLE OFF-RAMP	1	1	P	9999	TRUE
6004402	I-10 WB AT THE DALRYMPLE OFF-RAMP	2	2	P	9999	TRUE
6004403	I-10 WB AT THE DALRYMPLE OFF-RAMP	3	3	P	9999	TRUE
6004404	I-10 WB AT THE DALRYMPLE OFF-RAMP	4	4	P	9999	TRUE
6004501	I-10 WB BETWEEN PERKINS AND DALRYMPLE Zone 1	1	1	P	9999	FALSE
6004502	I-10 WB BETWEEN PERKINS AND DALRYMPLE Zone 2	2	2	P	9999	FALSE
6004503	I-10 WB BETWEEN PERKINS AND DALRYMPLE Zone 3	3	3	P	9999	FALSE
6004601	I-10 EB AT PERKINS ROAD Zone 1	1	1	P	9999	FALSE
6004602	I-10 EB AT PERKINS ROAD Zone 2	2	2	P	9999	FALSE
6004603	I-10 EB AT PERKINS ROAD Zone 3	3	3	P	9999	FALSE
6004701	I-10 EB @ I-12 ON RAMP	1	1	P	9999	TRUE
6004702	I-10 EB @ I-12 ON RAMP	2	2	P	9999	TRUE
6004703	I-10 EB @ I-12 ON RAMP	3	3	P	9999	TRUE
6004801	I-10 WB @ I-12 OFF RAMP	1	1	P	9999	TRUE
6004802	I-10 WB @ I-12 OFF RAMP	2	2	P	9999	TRUE
6004803	I-20 WB @ I-12 OFF RAMP	3	3	P	9999	TRUE
6004901	I-10 EB @ ESSEN LANE OFF RAMP	1	1	P	9999	TRUE
6004902	I-10 EB @ ESSEN LANE OFF RAMP	2	2	P	9999	TRUE
6004903	I-10 EB @ ESSEN LANE OFF RAMP	3	3	P	9999	TRUE
6005001	I-10 WB @ ESSEN LANE ON RAMP	1	1	P	9999	TRUE
6005002	I-10 WB @ ESSEN LANE ON RAMP	2	2	P	9999	TRUE
6005003	I-10 WB @ ESSEN LANE ON	3	3	P	9999	TRUE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
	RAMP					
6005101	I-10 EB @ ESSEN LANE ON RAMP	1	1	P	9999	TRUE
6005102	I-10 EB @ ESSEN LANE ON RAMP	2	2	P	9999	TRUE
6005103	I-10 EB @ ESSEN LANE ON RAMP	3	3	P	9999	TRUE
6005201	I-10 WB @ ESSEN LANE OFF RAMP	1	1	P	9999	TRUE
6005202	I-10 WB @ ESSEN LANE OFF RAMP	2	2	P	9999	TRUE
6005203	I-10 WB @ ESSEN LANE OFF RAMP	3	3	P	9999	TRUE
6005301	I-10 EB @ BLUEBONNET BLVD OFF RAMP	1	1	P	9999	TRUE
6005302	I-10 EB @ BLUEBONNET BLVD OFF RAMP	2	2	P	9999	TRUE
6005303	I-10 EB @ BLUEBONNET BLVD OFF RAMP	3	3	P	9999	TRUE
6005401	I-10 WB @ BLUEBONNET BLVD ON RAMP	1	1	P	9999	TRUE
6005402	I-10 WB @ BLUEBONNET BLVD ON RAMP	2	2	P	9999	TRUE
6005403	I-10 WB @ BLUEBONNET BLVD ON RAMP	3	3	P	9999	TRUE
6005501	I-10 WB @ PICARDY ON RAMP	1	1	P	9999	FALSE
6005502	I-10 WB @ PICARDY ON RAMP	2	2	P	9999	FALSE
6005503	I-10 WB @ PICARDY ON RAMP	3	3	P	9999	FALSE
6005601	I-10 EB @ PICARDY OFF RAMP	1	1	P	9999	FALSE
6005602	I-10 EB @ PICARDY OFF RAMP	2	2	P	9999	FALSE
6005603	I-10 EB @ PICARDY OFF RAMP	3	3	P	9999	FALSE
6005701	I-10 WB WEST OF SIEGEN LN ON RAMP	1	1	P	9999	FALSE
6005702	I-10 WB WEST OF SIEGEN LN ON RAMP	2	2	P	9999	FALSE
6005703	I-10 WB WEST OF SIEGEN LN ON RAMP	3	3	P	9999	FALSE
6005801	I-10 EB WEST OF SIEGEN LN OFF RAMP	1	1	P	9999	FALSE
6005802	I-10 EB WEST OF SIEGEN LN OFF RAMP	2	2	P	9999	FALSE
6005803	I-10 EB WEST OF SIEGEN LN OFF RAMP	3	3	P	9999	FALSE
6005901	I-10 WB WEST OF SIEGEN LANE OFF RAMP	1	1	P	9999	FALSE

Detector ID	***Detector Name***	***Lane***	***Zone***	***Detector Type (P=Pair Detector)***	***Mile Post Marker***	***Export***
6005902	I-10 WB WEST OF SIEGEN LANE OFF RAMP	2	2	P	9999	FALSE
6005903	I-10 WB WEST OF SIEGEN LANE OFF RAMP	3	3	P	9999	FALSE
6006001	I-10 EB WEST OF SIEGEN LANE ON RAMP	1	1	P	9999	FALSE
6006002	I-10 EB WEST OF SIEGEN LANE ON RAMP	2	2	P	9999	FALSE
6006003	I-10 EB WEST OF SIEGEN LANE ON RAMP	3	3	P	9999	FALSE
6006101	I-10 EB BETWEEN PERKINS AND DALRYMPLE Zone 1	1	1	P	9999	FALSE
6006102	I-10 EB BETWEEN PERKINS AND DALRYMPLE Zone 2	2	2	P	9999	FALSE
6006103	I-10 EB BETWEEN PERKINS AND DALRYMPLE Zone 3	3	3	P	9999	FALSE
6006201	I-10 WB AT PERKINS ROAD Zone 1	1	1	P	9999	FALSE
6006202	I-10 WB AT PERKINS ROAD Zone 2	2	2	P	9999	FALSE
6006203	I-10 WB AT PERKINS ROAD Zone 3	3	3	P	9999	FALSE