SYSTEMS ENGINEERING ANALYSIS

US 61 Signal System

Kenner-LaPlace

FINAL

September 2010

Presented to:

Louisiana Department of Transportation
And Development

ABMB ENGINEERS, INC.

ABMB 25
ENGINEERS, INC.

September 27, 2010

Ms. Elizabeth Delaney
ITS Project Management Engineer
LA Dept of Transportation and Development
1212 E. Highway Dr.
Baton Rouge, LA 70802

RE: TO 701-65-1498, FAP ITS-9906(549) SYSTEM ENGINEERING SUPPORT FOR SIGNAL SYSTEMS STATEWIDE

Dear Ms. Delaney:

We are very pleased to submit the final system engineering analysis for the US 61 Traffic Signal System (Marathon Ave to Williams Blvd).

All comments received to date have been addressed as part of this submittal.

The requirements and operations addressed in this document will readily support the envisioned TMC operations for the final constructed and integrated traffic signal system.

We can provide further assistance at your request.

Yours truly,

ABMB ENGINEERS, INCORPORATED

Jonathan Fox P.E., PTOE
Director of ITS Services

Cc:
John Broemmelsiek, FHWA
Steve Strength, DTOE District 02
Scott Boyle, DTOE District 62

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1 Acronyms and Abbreviations

Wherever the following abbreviations or acronyms are used in this document, they are interpreted as follows:

ATMS	Advanced Traffic Management System
CCTV	Closed Circuit Television
D02	DOTD District 02
D62	DOTD District 62
DMS	Dynamic Message Signs
DOTD	Department of Transportation and Development
DTOE	District Traffic Operations Engineer
GUI	Graphical User Interface
ITS	Intelligent Transportation Systems
LA	Louisiana
N.O.	New Orleans
RTMC	Regional Transportation Management Center
RQMT	Requirement
SOP	Standard Operating Procedures
TMC	Traffic Management Center
TOC	Traffic Operations Center
US	United States

2 Physical Architecture

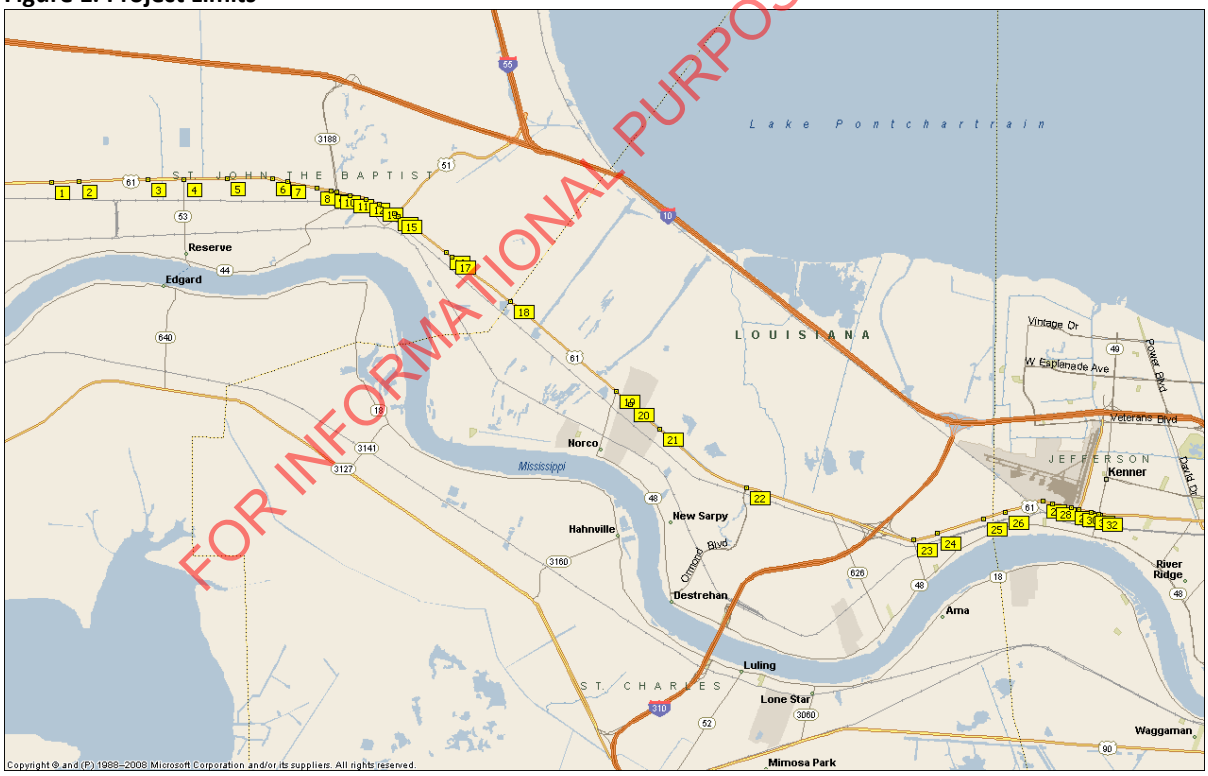
2.1 Architecture Creation Process

The Project ITS Architecture is based primarily on *the New Orleans Regional ITS Preliminary Implementation Plan,* developed in 2002 referenced herein as the regional ITS architecture. The U.S. National ITS Architecture and the Louisiana Statewide ITS Architecture were also used to supplement the regional ITS architecture where necessary.

2.1.1 Identify the Portion of the Regional ITS Architecture

Turbo Architecture was used to create an initial architecture that includes the portion of the regional ITS architecture that is relevant to the US 61 (Airline Hwy) Signal Upgrades Project. Project documents, including the construction proposal and plans (S.P. No. 007-02-0097 et. al.), were used to determine the portion of the regional ITS architecture that would apply to the US 61 traffic signal system upgrade project. The focus of this analysis is on the US 61 signals, the system software, and the operators, with regard to their responses to system alarms/events. The overall project limits are shown in **Figure 1.**

Figure 1: Project Limits



The project limits include signalized intersections in St. John the Baptist, St. Charles, and Jefferson Parishes along US 61 (Airline Highway) from Marathon Ave. to Williams Blvd. The intersections included are as follows:

1. US 61 at Marathon
2. US 61 at Terre Haute
3. US 61 at LA 637
4. US 61 at LA 53
5. US 61 at Dupont Entrance
6. US 61 at Belle Pointe Blvd
7. US 61 at Rue De Sainte
8. US 61 at Magnolia Street
9. US 61 at LA 3223 (Elm Street)
10. US 61 at LA 3188 (Belle Terre Blvd)
11. US 61 at LA 3224 (Hemlock)
12. US 61 at Ormond Blvd
13. US 61 at Cambridge Place
14. US 61 at US 51
15. US 61 at LA 44 (Old US 51)
16. US 61 at Windsor Blvd
17. US 61 at LA 636-1 (McReine Road)
18. US 61 at Laplace Weigh Station
19. US 61 at LA 48 (Apple Street)
20. US 61 at Shell Oil Entrance
21. US 61 at LA 627 (Prospect Street)
22. US 61 at Ormond Blvd (Destrehan Area)
23. US 61 at LA 50 (Almedia Road)
24. US 61 at Riverbend Blvd
25. US 61 at James Bus Park
26. US 61 at Alliance Street
27. US 61 at Farrar Avenue
28. US 61 at Airport Drive
29. US 61 at Hollandey Street
30. US 61 at Airport Access Road
31. US 61 at Daniel Street
32. US 61 at LA 49 (Williams Blvd)

2.2 The US 61 Traffic Signal System Upgrade Project ITS Architecture

2.2.1 Stakeholders

The stakeholders associated with the project are indicated below:

- DOTD ITS Section
- DOTD District 02 (D02) Traffic Operations
- DOTD District 62 (D62) Traffic Operations
- DOTD Statewide Traffic Management Center (TMC)
- DOTD New Orleans Transportation Management Center (N.O. TMC)

2.2.2 US 61 Traffic Signal System Upgrade Project Inventory Elements

The regional ITS architecture inventory identifies the existing and planned systems in the region as a list of “inventory elements”. The inventory elements of central interest are the “DOTD District 02 Traffic Signal System (US 61)” and the “DOTD District 62 Traffic Signal System (US 61)” elements. **Table 1: US 61 Traffic Signal System Upgrade Project Inventory Elements** identifies the inventory elements from the regional ITS architecture that are associated with this project. A comment for each element explains its relevance and identifies any potential issues associated with it as defined in the regional ITS architecture.

Many of the elements in the regional ITS architecture are named as organizations (e.g., Regional Transportation Management Center (RTMC)), not physical systems (e.g., Traffic Signal System). This is due to how the system is defined and who the end users are. For this project the organization elements should be interpreted to represent operators and maintainers as parts of the system and the motorist as the end user of the system.

Table 1: US 61 Traffic Signal System Upgrade Project Inventory Elements

Element	Status	Description	Comment
DOTD District 02 Signal Shop	Existing	This element represents a traffic operations center or traffic engineering division within the district office that is responsible for traffic management activities within the district's jurisdiction. The typical activities include traffic data collection, traffic signal operations, and other traffic management related activities. This also includes communicating with other departments like maintenance for roadway maintenance activities.	This element is an instance of the "LaDOTD, D02 Traffic Operations Center (TOC)" found in the ITS regional architecture. Note the TOC is now physically within the RTMC facility.
DOTD District 02 Traffic Operations Engineer	Existing	This is the DOTD District Traffic Operations Engineer (DTOE) in charge of all state owned and operated traffic signals within the assigned district. The District 02 traffic operations engineer is located within the RTMC facility.	This element is an instance of the "LaDOTD, D02 Traffic Operations Center (TOC)" found in the ITS regional architecture.
DOTD District 02 Traffic Signal System (US 61)	Existing	This element includes the traffic signals under control of DOTD District 02 that will be installed or interconnected for this project.	This element is an instance of the "LaDOTD, D02 TOC Field Equipment" found in the ITS regional architecture. Future updates to the regional architecture should consider renaming this element
DOTD District 62 Signal Shop	Existing	This element represents a traffic operations center or traffic engineering division within the district office that is responsible for traffic management activities within the district's jurisdiction. The typical activities include traffic data collection, traffic signal operations, and other traffic management related activities. This also includes communicating with other departments like maintenance for roadway maintenance activities.	This element is an instance of the "LaDOTD, D62 State Highway Signal Control System Equipment" found in the ITS regional architecture
DOTD District 62 Traffic Operations Engineer	Existing	This is the DOTD engineer in charge of all state owned and operated traffic signals within the assigned district.	This element is currently not included in the regional architecture. It will need to be added when the architecture is updated.
DOTD District 62 Traffic Signal System (US 61)	Existing	This element includes the traffic signals under control of DOTD District 62 that will be installed or interconnected for this project.	This element is an instance of the "LaDOTD, D62 State Highway Signal Control System Equipment" found in the ITS regional architecture

Element	Status	Description	Comment
DOTD Statewide TMC	Existing	This element represents the Statewide TMC located in the DOTD headquarters annex building in Baton Rouge. For this project, the Statewide TMC will provide supplemental support to the N.O. TMC. The Statewide TMC operates 24/7.	This element is currently not included in the regional architecture. It will need to be added when the architecture is updated.
DOTD New Orleans TMC	Existing	This element represents the N.O. TMC within the RTMC facility. For this project, the N.O. TMC will monitor and control the traffic signal system. The N.O. TMC will begin 24/7 operation in September 2010.	This element is an instance of the Regional Transportation Management Center as found in the ITS regional architecture.

2.2.3 US 61 Traffic Signal System Upgrade Project Inventory Interfaces

This section includes an architecture flow diagram that defines the interfaces that are included in the US 61 Traffic Signal System Upgrade Project. In the diagram, "Planned" interfaces are shown where interfaces will actually be implemented as part of the project. These project interfaces are set against the context of existing interfaces related to the project. All of the architecture flows in **Figure 2** are described in **Table 2**.

Figure 2: Project Interfaces

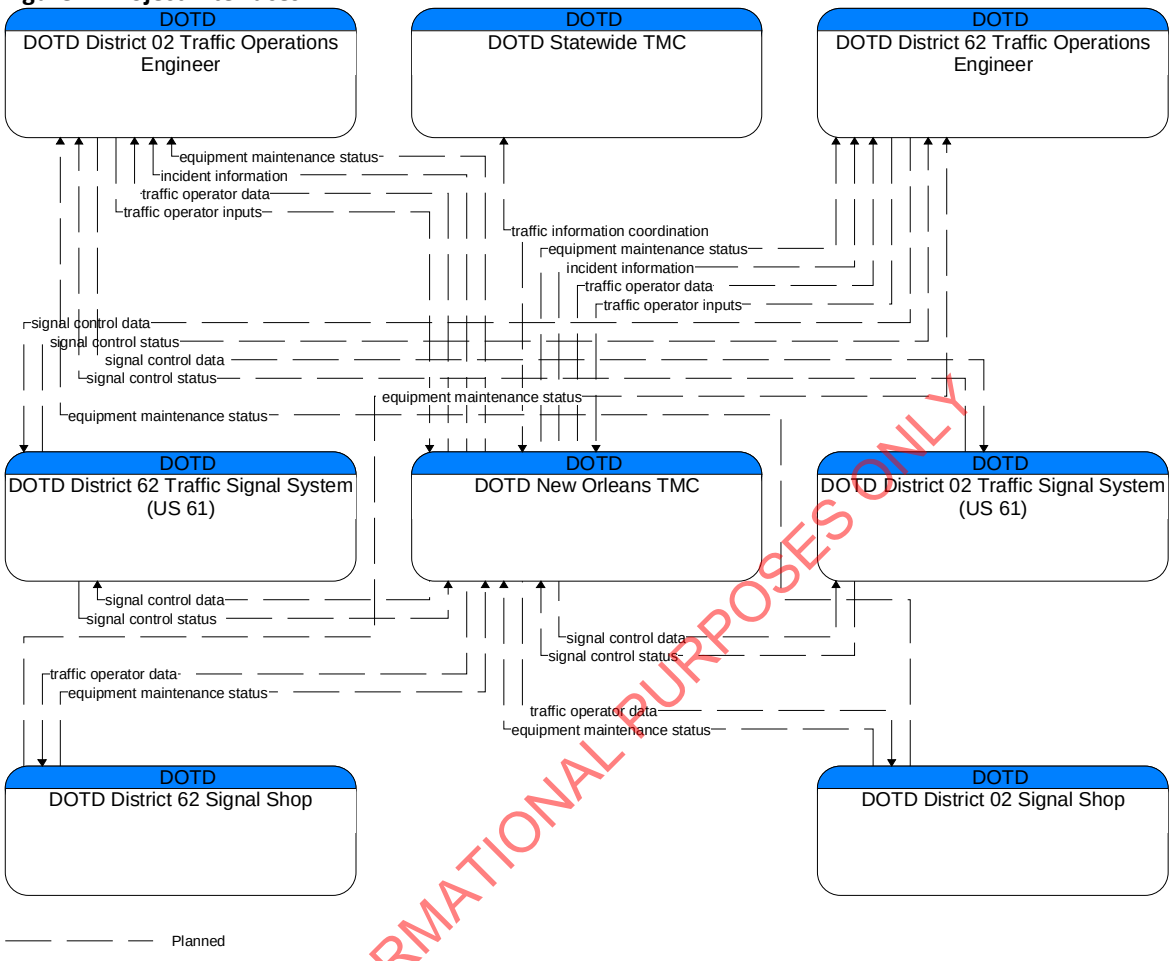


Table 2: Architecture Flow Definitions

Name	Description
Equipment Maintenance Status	Current status of field equipment maintenance actions.
Incident Information	Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large-scale natural or human-caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.
Signal Control Data	Information used to configure and control traffic signal systems.
Signal Control Status	Status of surface street signal controls including operating condition and current operational state.
Traffic Control Coordination	Information transfers that enable remote monitoring and control of traffic management devices. This flow is intended to allow cooperative access to, and control of, field equipment during incidents and special events and during day-to-day operations. This flow also allows 24-hour centers to monitor and control assets of other centers during off-hours, allows system redundancies and fail-over capabilities to be established, and otherwise enables integrated traffic control strategies in a region.
Traffic Information Coordination	Traffic information exchanged between TMCs. Normally would include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.
Traffic Operator Data	Presentation of traffic operations data to the operator including traffic conditions, current operating status of field equipment, maintenance activity status, incident status, video images, security alerts, emergency response plan updates and other information. This data keeps the operator apprised of current road network status, provides feedback to the operator as traffic control actions are implemented, provides transportation security inputs, and supports review of historical data and preparation for future traffic operations activities.
Traffic Operator Inputs	User input from traffic operations personnel including requests for information, configuration changes, commands to adjust current traffic control strategies (e.g., adjust signal timing plans, change DMS messages), and other traffic operations data entry.

3 Concept of Operations

3.1 Scope

3.1.1 Overview

The US 61 Traffic Signal System project is an upgrade to an existing signal system. This project requires integration with existing systems however, architecture flows will only occur between the eight subsystems as shown in **Figure 2:** Project Interfaces. This project includes adding new Streetwise servers at District 62 and the RTMC.

Fiber optic communication connections to the traffic signal system allows the DOTD New Orleans RTMC to monitor, control, collect data, and implement response plans to the events that occur on US-61 within the project limits. This document details the flow of information between the TMC operator and the traffic signal controller. This document describes the types of operator alarms, procedures for communicating alarms to appropriate parties, and the level of control the TMC operator will have over the traffic signal system.

3.1.2 Audience for this Concept of Operations

- State Agency Stakeholders
- DOTD District 02 Traffic Engineering
- DOTD District 62 Traffic Engineering
- DOTD New Orleans TMC
- DOTD ITS Section
- DOTD Statewide TMC

3.2 Existing Operations

DOTD currently operates 32 traffic signals within the project limits. 18 of these signals are in St. John the Baptist Parish under District 62 jurisdiction. The remaining 14 signals are in St. Charles and Jefferson Parishes under District 02 jurisdiction. The signals, prior to upgrading, require traffic engineering staff to be on site to monitor and make timing parameter changes for each traffic signal. Once the timing parameters were programmed, the signals would remain unchanged unless traffic volumes and/or patterns changed or malfunctions occurred.

Since the existing signals do not have remote communications or remote monitoring capabilities of the field equipment status, the traffic engineering staff relied primarily upon motorist complaints for equipment malfunctions and needed timing modification. 911 and police department dispatch provided notification of emergencies and engineering staff conducted periodic corridor drive through for monitoring. The traffic engineer staff would go on-site to inspect, monitor, pull controller data, and adjust signal timing as needed.

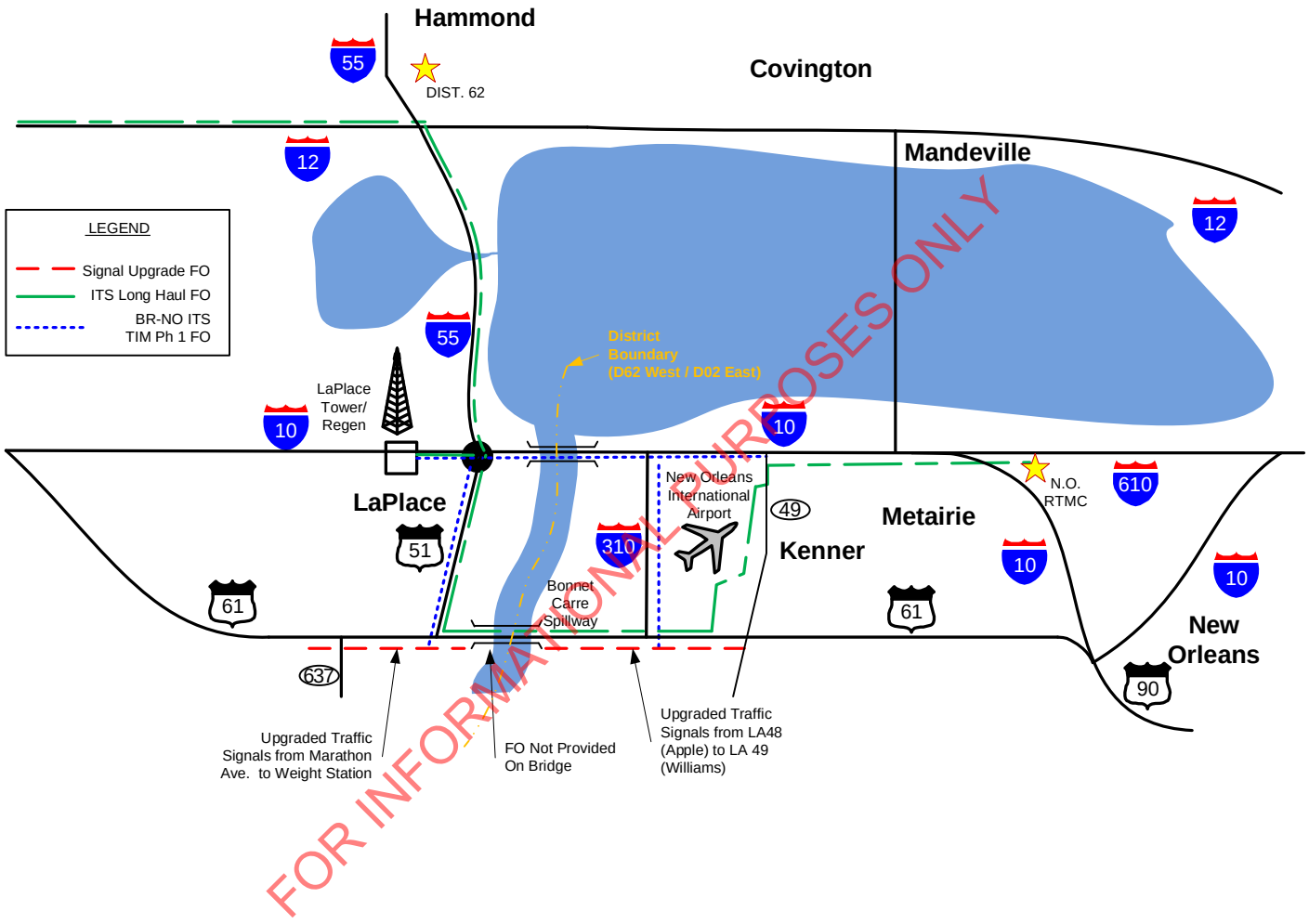
3.3 System Overview

This project includes the installation of new signal equipment hardware, software, and communications to the existing signalized intersections identified in **Figure 1:** Project Limits. The communications installation includes intersection to intersection interconnections as well as connection to the DOTD ITS network and to the RTMC and District 62 from a remote connection (**Figure 3**: System Overview). The resulting system is an advanced traffic management system (ATMS). It allows for remote traffic signal controller interface from both DOTD DTOE offices and the RTMC. The ATMS software, Streetwise, allows for the same level of controller programming capability as a

technician has to directly modify the controller in the field. A Streetwise administrator is able to assign users and configure levels of access by user login ID.

Note that TMC operations staff shall be limited to only monitoring and changing the currently running phasing pattern as directed by the DTOE.

Figure 3: System Overview



3.3.1 Roles and Responsibilities

The roles and responsibilities as related to this signal upgrade project have been outlined in the table below. It should be noted that the roles and responsibilities listed are not fully inclusive of all the roles and responsibilities of the stakeholders.

Table 3: Project Roles and Responsibilities

Stakeholder	Roles	Responsibilities
DOTD ITS Section	• Management	• Construction oversight • Manage TMC operations staff • Performing maintenance o Communications
DOTD District 02 Traffic Operations	• Operations • Maintenance	• Perform Streetwise administrator role (DTOE) • Develop timing schemes and plans • Direct TMC operations to change phasing patterns • Perform maintenance on traffic signal system o Initial response and investigation to complaints o Perform routine maintenance o Manage traffic signal shop and technicians
DOTD District 62 Traffic Operations		
New Orleans TMC	• Operations	• System monitoring • Coordinate with District Traffic Operations Engineer on traffic conditions and Streetwise alarms • Change phasing patterns as directed by the District Traffic Operations Engineer
Statewide TMC	• Support	• Statewide monitoring • Coordinate with New Orleans TMC on traffic conditions

3.4 Operational Environment

The traffic signal system upgrade project is located along a 22-mile stretch of US-61 between LA 637 and Williams Blvd. DOTD currently has existing field devices as well as fiber communications along this route.

Southern Louisiana weather conditions demand field hardened rating to maintain an acceptable life span. High winds and poor soil conditions are also typical design considerations.

3.5 Needs

The needs for the US-61 corridor are outlined within this section. It should be noted that those needs are in support of the operational scenarios. However, the deployment of this project may not satisfy all these needs.

1 The Districts need continuous monitoring and control of the traffic signal system.

2 The Districts need the ability to monitor traffic signal system status.

3 The Districts need the ability to control signal timing.

4 The Districts need real time traffic information (speed, occupancy, count, vehicle type).

5 The Districts need to work together to jointly respond to critical alarms that may occur.

6 The Districts need to work together along the route to jointly maintain the signal system.

7 The Districts need to work together along the route to jointly control the signal system.

8 The Districts need to be proactive in the operations of the signal system.

9 Communications network is needed to control the signal system operation from one or more central locations.

10 The Districts need a reporting system to track historic signal systems operations.

11 The Districts need supervisory staff to oversee the operation of the signal system.

12 The Districts need to have the tools to develop and program signal timing plans in the signal system.

3.6 Requirements

Based on the project needs as well as traffic congestion and the envisioned operations, requirements were developed for this project. The RTMC receives information from the US 61 Traffic Signal System. The requirements of this center is as follows:

1 Operational reporting requirements

1.1 Upon receipt of a critical alarm, the TMC operator shall report the critical alarm within 5 minutes to the appropriate district staff members

1.1.1 Critical alarms for D02 signals during normal business day hours (8am – 5pm) shall be verbally reported to the on-site traffic engineer staff when available

1.1.1.1 When the on-site traffic engineer staff is not available, the TMC operator shall report the critical alarm to the D02 signal maintenance shop staff via radio

1.2 Critical alarms for D02 signals outside of normal business day hours shall be reported to D02 Bridge City switchboard operator via telephone

1.3 Critical alarms for D62 signals shall be reported to the D62 switchboard operator via telephone

1.4 The TMC operator shall compile the system alarms daily at noon in an electronic spreadsheet

1.4.1 The TMC operator shall save compiled alarm spreadsheet to server

1.4.2 The TMC operator shall send compiled D02 alarm spreadsheet to the assigned D02 traffic engineer via email

1.4.3 The TMC operator shall send compiled D02 alarm spreadsheet to the D02 Operations Specialist via email

1.4.3.1 In addition to email notification, the TMC operator shall verbally communicate alarm status with the D02 signal maintenance shop staff present at the TMC

1.4.4 The TMC operator shall send compiled D62 alarm spreadsheet to the D62 DTOE via email

2 Signal system programming requirements

2.1 The DOTD DTOEs shall program the US 61 traffic signal system

2.1.1 The DOTD DTOE shall develop timing plans for the traffic signal system within his district jurisdiction

2.1.2 The timing plans shall contain the following:
- phasing patterns
- cycle lengths
- actuation parameters
- time of day schedules

3 Operations supervision requirements

3.1 The DOTD DTOE shall direct the TMC operators to change the currently running phasing pattern at the specified signalized intersection

3.2 The DOTD DTOE shall direct the TMC operators to revert the specified signalized intersection to the normally scheduled phasing pattern

3.3 Under the supervision of the DTOE, the TMC operator shall adjust phasing patterns of the US 61 traffic signal system as directed by the DOTD DTOE responsible for the respective signal(s)

4 System communication requirements

4.1 There shall be communications among the following system elements within the project area:
- Signal controllers
- Servers at District and Regional TMCs
- Signal system detectors
- Operator workstations

5 ATMS workstation requirements

5.1 The ATMS workstation shall display signal controller status

5.1.1 The ATMS workstation shall display current operating timing information from the signal controller

5.1.2 The ATMS workstation shall generate the following critical alarms from the signal controller:
- Controller Fault
- Detector Synchronous Data Link Control Fault

5.1.3 The ATMS workstation shall generate the following non-critical alarms from the signal controllers:
- Power Up Alarm
- Stop Timing
- Cabinet Door Activation
- Coordination Failure
- A minimum of three user defined External Alarms
- Closed Loop Disabled
- Manual Control Enable
- Cycle Fault
- Cycle Failure

- Coordination Fault
- Electrically Erasable Programmable Read-Only Memory Cyclic Redundancy Check Fault
- A minimum of two Rail Preempt alarms
- A minimum of four High-Priority Preempt alarms

5.1.4 The ATMS workstation shall generate an alarm when there is a loss of communication with the signal controller

5.1.5 The ATMS workstation shall generate an alert when communication with the signal controller is re-established

5.2 The ATMS workstation shall display the following traffic information from the signal controllers:
- Vehicle speed
- Vehicle dwell time (Occupancy)
- Vehicle count
- Vehicle type

5.3 The ATMS workstation shall control the operation of the signal controllers

4 Operations

4.1 Operations Procedures

At the direction of DOTD, the TMCs throughout the state are required to uniformly operate. The use of standard operations procedure (SOP) manuals aids in uniform operations. Since the Baton Rouge TMC has been in operation for several years, its SOP has been vetted and all TMCs are operating under its policies and procedures. The only variance expected in the SOPs will be items specific to coordination with local agencies, the ITS equipment, and TMC operations software.

Since traffic signal systems are currently not included within the SOP, this document will detail the operating procedures. Later, these operating procedures will be updated and merged into the TMC operations manuals.

The primary function of the TMC operator with regard to the signal system is to monitor and view alarms from the ATMS graphical user interface (GUI). As part of this role, certain alarms have been identified as critical or non-critical in Section 3.6, Requirements. Critical alarms shall be reported **immediately** to the district traffic engineer staff. Critical alarms include controller faults and detector synchronous data link control faults. When traffic engineering staff is present, verbal notification may be used. When traffic engineering staff is not present, coordination shall be via radio (when available) or by calling the District switchboard. The TMC operator shall compile non-critical system alarms daily at noon to a MS Excel spreadsheet, archive on the assigned server, and email the list to the assigned district traffic engineering staff.

The TMC operators shall monitor the ATMS GUI and available surveillance cameras of the ATMS corridors. Upon detecting abnormal traffic congestion and/or traffic signal equipment malfunctions, the TMC operator shall verify using available surveillance cameras. The TMC operator shall immediately contact the appropriate district switchboard operator to report the event to the DTOE. The DTOE may instruct the TMC operator to manually adjust signal phasing patterns. At the instruction of the DTOE, the TMC operator shall adjust signal phasing pattern. Signal phasing pattern changes may be made to isolated signals or a predefined group as directed by the DTOE. The DTOE shall also direct when the TMC operator shall return the traffic signals to the normal operating timing plan for that time of day.

4.1.1 ATMS GUI User Procedures

Procedures for Streetwise can be found in the Streetwise User's Manual. This manual is available as a PDF through the Streetwise GUI Help menu. Chapter 3 has been provided as **Appendix C** to this document. It covers basic operations. Note the interface for TMC operator will be limited to only allow changes in phasing pattern. They will be able to view all other features.

4.1.2 CCTV Camera Procedures

Procedures for use of the Closed Circuit Television (CCTV) cameras can be found in the SOP for the TMC.

4.2 Operations Policy

4.2.1 Background

Traffic signal operations have dramatically advanced as controllers have become increasingly sophisticated. Technological improvements have increased the reliability of field equipment,

decreasing the demand on field operations staff. Modern traffic signal equipment, surveillance equipment, and reliable communications allow for off-site monitoring and remote programming.

4.2.2 Goals and Objectives

Allowing TMC operations access to the ATMS enhances traffic signal operations by adding personnel to monitor real time traffic controller status while making timing modifications at the direction of traffic engineering staff. Also, this allows the traffic engineering staff to immediately respond to problems, saving both time and funding.

4.2.3 Roles and Responsibilities

Districts and TMCs throughout the state need the ability to monitor and control traffic signal systems within their defined regions. They need to be able to monitor signal system status and control signal timing. They also need the ability to gather real time traffic operation such as speed, occupancy, count, and vehicle type.

The implementation of an ATMS provides remote access and monitoring of traffic signal field equipment. The software GUI allows operators to monitor and receive alarms from each controller. These alarms include built in system alarms as well as user programmable alarms. The software also allows remote signal phasing pattern control from the operator console. User access can be restricted and login credentials are customizable.

4.2.4 Implementation

As part of traffic signal upgrades projects, DOTD will include communications as well as ATMS software. Priority shall be given based on equipment age, congestion, daily travel volumes, and the importance of the routes as part of the road network system.

Appendix A

Traceability Matrix

Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title
1	Needs_1	Monitoring and control	5.1.1	RQMT_4	Current timing information						
			4.1	RQMT_28	Connectivity of ATMS signal system						
			5.2	RQMT_29	Display of traffic information						
			5.3	RQMT_30	Control of the signal controllers						
2	Needs_2	Monitor system status	5.1	RQMT_3	Display controller status	5.1.1	RQMT_4	Current timing information			
						5.1.2	RQMT_5	Critical Alarms			
						5.1.3	RQMT_6	Non-Critical Alarms			
						5.1.4	RQMT_7	Communications alarm			
						5.1.5	RQMT_8	Reconnect alert			
3	Needs_3	Control signal timing	3.3	RQMT_1	Signal Phasing patterns						
4	Needs_4	Real time traffic information	5.3	RQMT_30	Control of the signal controllers						
5	Needs_5	Development of signal plans	2.1.1	RQMT_21	Development of signal plans	2.1.2	RQMT_22	Timing plans			
			2.1.2	RQMT_22	Timing plans						
6	Needs_6	Supervisory staff	3.3	RQMT_1	Adjustment of phasing patterns						
7	Needs_7	Reporting	1.4	RQMT_14	Daily system alarm reporting	1.4.1	RQMT_15	Storing daily system alarm reports			
						1.4.2	RQMT_16	Daily system alarms for D02 reporting			
						1.4.3	RQMT_17	Reporting daily system alarms to D02 Operations Specialist			
						1.4.4	RQMT_18	Daily system alarms for D62 reporting	1.4.3.1	RQMT_19	Notification alternatives
			1.4.1	RQMT_15	Storing daily system alarm reports						
			1.4.2	RQMT_16	Daily system alarms for D02 reporting						
			1.4.3	RQMT_17	Reporting daily system alarms to D02 Operations Specialist						
			1.4.4	RQMT_18	Daily system alarms for D62 reporting	1.4.3.1	RQMT_19	Notification alternatives			
8	Needs_8	Communications to signal system	4.1	RQMT_28	Connectivity of ATMS signal system						
9	Needs_9	Proactive signal control	3.3	RQMT_1	Adjustment of phasing patterns						
10	Needs_10	Joint control of signal system	5.1.1	RQMT_4	Current timing information						
			2.1	RQMT_20	Programming the signal system	2.1.1	RQMT_21	Development of signal plans	2.1.2	RQMT_22	Timing plans
						2.1.2	RQMT_22	Timing plans			
			2.1.1	RQMT_21	Development of signal plans	2.1.2	RQMT_22	Timing plans			
			2.1.2	RQMT_22	Timing plans						
			4.1	RQMT_28	Connectivity of ATMS signal system						
			5.2	RQMT_29	Display of traffic information						
			5.3	RQMT_30	Control of the signal controllers						
Needs_11	Needs_11	Joint maintenance of the signal system	5.1.3	RQMT_6	Non-Critical Alarms						
			1.4	RQMT_14	Daily system alarm reporting	1.4.1	RQMT_15	Storing daily system alarm reports			

Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title	Outline ID	Rqmt ID	Title
						1.4.2	RQMT_16	Daily system alarms for D02 reporting			
						1.4.3	RQMT_17	Reporting daily system alarms to D02 Operations Specialist			
						1.4.4	RQMT_18	Daily system alarms for D62 reporting	1.4.3.1	RQMT_19	Notification alternatives
			1.4.1	RQMT_15	Storing daily system alarm reports						
			1.4.2	RQMT_16	Daily system alarms for D02 reporting						
			1.4.3	RQMT_17	Reporting daily system alarms to D02 Operations Specialist						
			1.4.4	RQMT_18	Daily system alarms for D62 reporting	1.4.3.1	RQMT_19	Notification alternatives			
Needs_12	Needs_12	Joint response to critical alarms	5.1.2	RQMT_5	Critical Alarms						
			1.1	RQMT_9	Reporting of critical alarms	1.1.1	RQMT_10	Reporting critical D02 alarms	1.1.1.1	RQMT_11	Alternate D02 critical alarm reporting
			1.1.1.1	RQMT_11	Alternate D02 critical alarm reporting						
			1.3	RQMT_13	Reporting D62 critical alarms						
			1.4.3.1	RQMT_19	Notification alternatives						

Appendix B

Traffic Signal Controller Alarms

13 Controller Event/Alarm Descriptions

Event / Alarm #	Alarm Name	Comments	Hardware Specific
1	Power Up Alarm.	Is active when power is applied to the controller. Transitions upon power-up and power-down may be logged.	
2	Stop Timing	Indicates that one of the stop time inputs is active.	
3	Cabinet Door Activation	This is brought into the NEMA input called "lamps" or "indicator". Naztec typically uses this input for the cabinet door switch in TS1 cabinets.	
4	Coordination Failure	This alarm indicates that coordination is failed. There are two ways in which coordination may fail: 1) The TS2 method in which two cycle faults have occured during coordination, but not when coordination is inactive. 2) A servicable call has not be serviced in 3 cycles. This is the traditional Naztec method, which predates the NEMA TS2 method.	
5	External Alarm # 1		
6	External Alarm # 2		
7	External Alarm # 3		
8	External Alarm # 4		
9	Closed Loop Disabled	This alarm, when active, indicates that the Closed-loop Enable parameter is set to OFF.	
10	External Alarm # 5		
11	External Alarm # 6		
12	Manual Control Enable	Alarm active when *Police Push Button* is ON	
13	Coordination Free Switch Input	Alarm active when System/Free Switch is FREE	
14	Local Flash Input	Asserted by monitor or cabinet switch when in flash	SDLC or I/O Mode
15	CMU or MMU Flash Input	Alarm is active when the the controller receives an SDLC message from the MMU that it is in flash	SDLC or I/O Mode
16	MMU Fault	Indicates a Conflict Monitor Fault has occurred when CVM is NOT asserted by the controller and Stop-Time is applied.	SDLC
17	Cycle Fault	TS2 Alarm. It indicates that a servicable call has not been serviced in approximately two cycle times and coordination was active at the time.	
18	Cycle Failure	TS2 Alarm. It indicates that a servicable call has not been serviced in approximately two cycle times and that coordination was not active at the time.	
19	Coordination Fault	Indicates that a cycle fault occurred during coordination.	

20	Controller Fault	Intersection is in Flash due to a critical controller fault. This fault includes Field Check, Response Frames, Proc Diagnostics.	
21	Detector SDLC Fault	Indicates SDLC communication with at least one of the Detector BIUs is faulted. This is a non-critical fault and will not cause the intersection to flash.	SDLC
22	MMU SDLC Fault	SDLC communication with the MMU has experienced a Response Frame Fault. This is a critical fault and will cause the controller to flash.	SDLC
23	Terminal Facility (cabinet) SDLC Fault	SDLC communication with one or more of the Terminal and Facilities BIUs is faulted. This is a critical fault and will cause the controller to Flash.	SDLC
24	SDLC Response Frame Fault	Report from SDLC interface	SDLC
25	EEPROM CRC Fault	The background EEPROM diagnostic has detected an unexplained change in the CRC of the user-programmed database.	
26	Detector Diagnostic Fault	One of the controller detector diagnostics (No Activity, Max Presence or Erratic Count) has failed.	
27	Detector Fault From SDLC	One or more local detectors have been reported to be faulted by the Loop Amplifer and BIU. These faults include open loop, shorted loop, excessive inductance change, and watch-dog time-out.	SDLC
28	Queue Detector alarm	Associated with the queue detector feature. Data indicates which queue detector is generating the alarm.	
29	Ped Detector Fault	A ped detectors is faulted due to user program limits being exceeded. These include *No Activity*, *Max Presence* and *Erratic Count* on screen MM->5->4.	
30	Coord Diagnostic Fault	Active when coord diagnostic has failed	
31	Cabinet Flash Alarm	Active after a delay timer expires (see MM->1->6->7) if the monitor, or a controller fault, causes the cabinet to flash.	Ver 61
37	Reserved	Reserved	
38	Pattern Change	Coordination Pattern changes are logged to the event and alarm buffers using this alarm number. The data byte stores the new pattern number.	
39	Reserved Apogee	Reserved	2070
40	Reserved Apogee	Reserved	2070
41	Temperature Alert #1	Temp Alert 1 – High Temp	Temp Alert
42	Temperature Alert #1	Temp Alert 1 – Low Temp	Temp Alert
43	Temperature Alert #1	Temp Alert 1 – Status Alarm	Temp Alert
44	Temperature Alert #2	Temp Alert 2 – High Temp	Temp Alert
45	Temperature Alert #2	Temp Alert 2 – Low Temp	Temp Alert
46	Temperature Alert #2	Temp Alert 2 – Status Alarm	Temp Alert
47	Coord Active	Set when coordination is active (not free)	
48	Preempt Active	Set when any preempt is active	
49	Preempt 1	Rail Preempt 1	

50	Preempt 2	Rail Preempt 2	
51	Preempt 3	High-Priority Preempt 3	
52	Preempt 4	High-Priority Preempt 4	
53	Preempt 5	High-Priority Preempt 5	
54	Preempt 6	High-Priority Preempt 6	
55	Preempt 7	Low-Priority or Transit Priority Preempt 7	
56	Preempt 8	Low-Priority or Transit Priority Preempt 8	
57	Preempt 9	Low-Priority or Transit Priority Preempt 9	
58	Preempt 10	Low-Priority or Transit Priority Preempt 10	
59	EEPROM Compare Fault	Checksum of firmware memory has changed	
60	Reserved		
61	Sync Transition	Alarm is ON when coord is active and in transition for times over 3 seconds. Alarm is OFF when coord is active and in SYNC.	
62-64	Reserved		
65-68	Reserved for Light Rail		
73	Controller Access	Active when a key is pressed until the *Display Time* expires (see Unit Paramters, MM/1/2/1)	
74	User Key Login	Active when user enters security key - records the User# in the data byte.	

Appendix C

Streetwise User Manual, Chapter 3 –Basic Controller Operations

Naztec Training and Operations Manual

For

StreetWise™

Advanced Traffic Management System (ATMS)

December 2007

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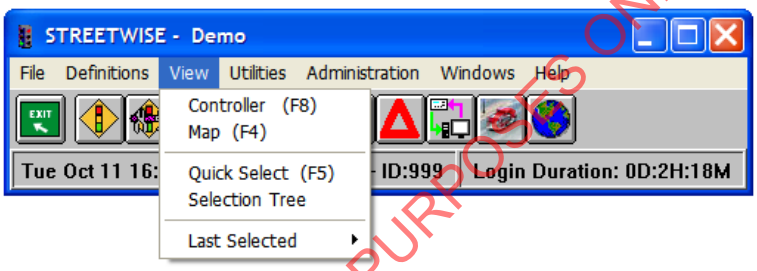
3 Basic Controller Operations

This chapter helps new users with basic controller operations such as:

- selecting controllers
- performing controller uploads and downloads and setting the time and date
- performing single and multiple intersection scans
- modifying the controller database.

3.1 Selecting Controllers from StreetWise

Controllers may be selected from the *View* menu or from a *System Map* accessed from the main client toolbar. Controllers may also be selected using the ID, a selection tree or last selected.



3.1.1 Selecting Controllers by Category

Choose View / Controller or select the "signal ahead" button from the main client toolbar.

Controllers may be selected by one of the categories shown in Figure 19.

Note that selection by *Group* or *Flex Group* displays a separate list of intersections assigned to the group. This is a time saving feature after the StreetWise system has grown to several hundred, or thousand, intersections.

Controllers may also be selected by *IP Address* and communication *Drop*.

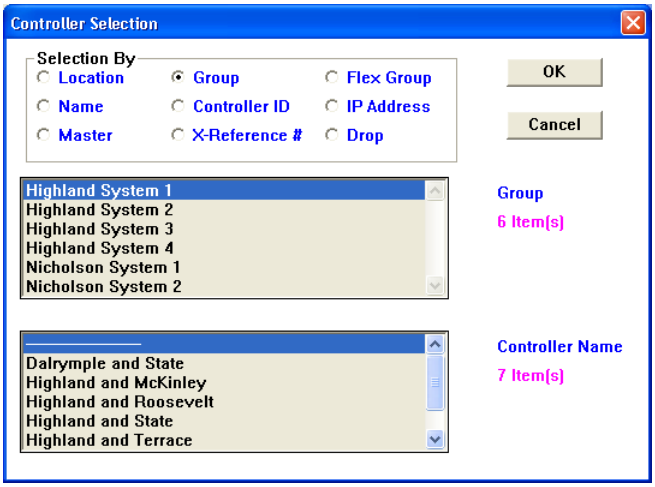


Figure 19: Select Controller by Group

By Name allows you to pick from a list of alphanumeric names assigned when the controllers were defined.

X-Reference # is an optional identification number assigned when the controller was defined.

Once a controller has been selected using the *Controller Selection* tool, a new intersection toolbar will be displayed. This toolbar is similar to the main client toolbar; however, selections only apply to the controller currently selected.

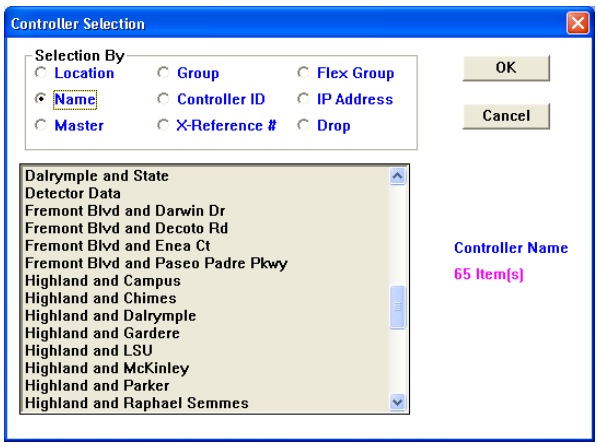


Figure 20: Select Controller by Name

3.1.2 Selecting Controllers from a System Map

A user may also select controllers by *System Map* rather than the *Category* method discussed in the previous section. *System Maps* are customized by the user and may be constructed from bitmap graphics or from GIS (ArcInfo or ArcView).

Choose View / Map or select the Globe Button from the main client toolbar

Select *Standard* for a bitmap image map or *GIS* if your system supports ArcInfo GIS. The *System Map* shown below is the "City of Plano Alarm Map", selected from the window shown in Figure 21.

Figure 21: Select Map

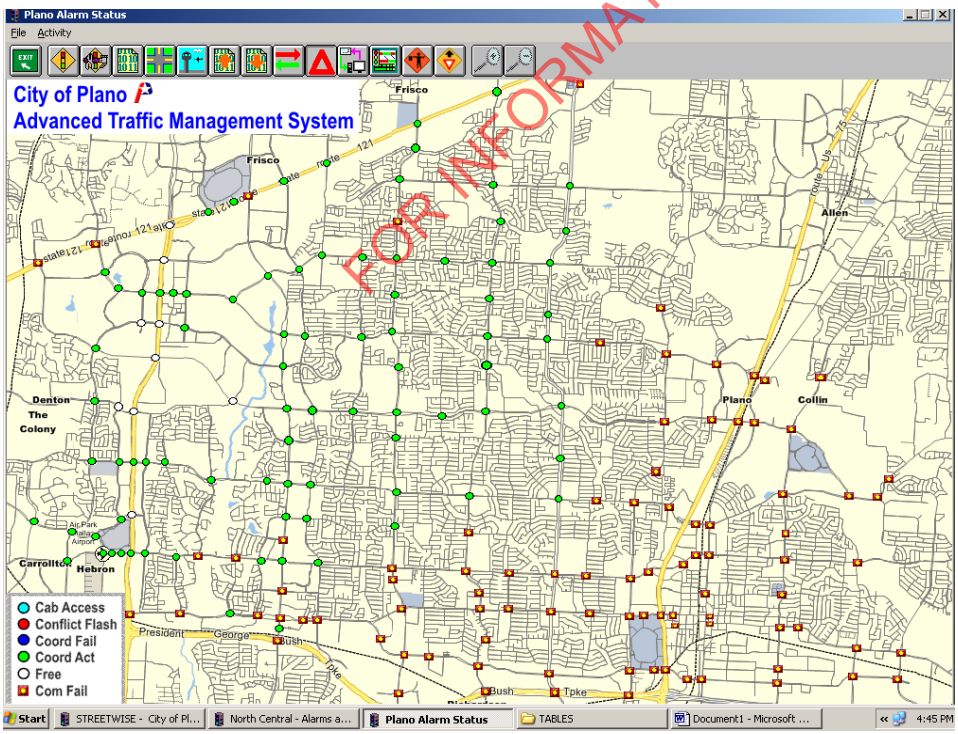


Figure 22: City of Plano System Map

3.1.3 Selecting Controllers by ID

Figure 23: Quick Select

Choose View / Quick Select or the [F5] key from the main client toolbar.

Enter the controller ID number and press the *Database Menu* button. This method quickly launches an intersection toolbar when the controller ID is known.

This method is popular for field applications when lighting conditions make navigation with a mouse difficult. A *Commands* button also provides a shortcut to upload and download commands.

3.1.4 Selecting Controllers by Selection Tree

Choose View / Selection Tree from the main client toolbar to modify the pull down menus as shown in Fig. 24.

Select *Activity* or one of the toolbar buttons, then select a controller by name, master group or ID.

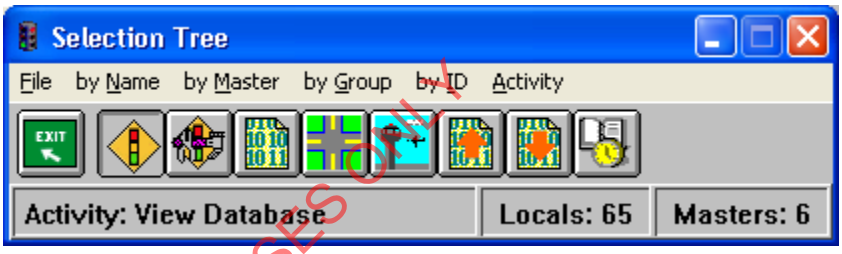


Figure 24: Selection Tree

3.1.5 Selecting a Controller by Last Selected

Choose View / Last Selected from the main client toolbar.

A list of the last five controllers selected will be displayed. Select any of these to launch an intersection toolbar for that intersection.

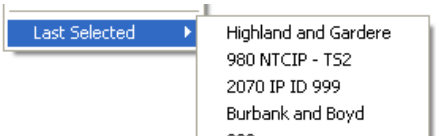


Figure 25: Last Selected View

3.2 The Intersection Toolbar

The *Intersection Toolbar* is displayed after the controller is selected. The controller name appears in the top bar and the intersection ID and drop number are displayed in the lower left corner.

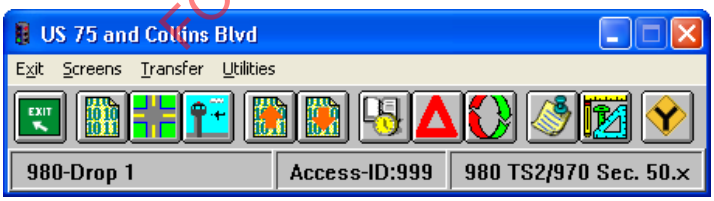


Figure 26: Intersection Toolbar - US 75 and Collins Blvd

The *Activity* buttons provided with the intersection toolbar are defined below. If you forget the definition of an *Activity* button, simply place the cursor over the button and StreetWise will display a definition at the bottom of the intersection toolbar.

	Exit the intersection toolbar		Alarm Status
	Data Screens (controller database)		Device Poll
	Intersection Scan Screens		Notes
	Intersection Control Screens		Drawings
	Upload / Download Database		Real Time Split Monitor
	Send Instant Report		

3.2.1 Using Data Screens to Access the Controller Database

Choose Screens / Data or select the *Data Screens* button from the intersection toolbar.

StreetWise provides three views of the controller database based on the *User Definition* settings discussed in section 2.4.1 as shown below. Each database screen is designed to closely follow the layout and terminology displayed in the controller menus. The user should refer to the *Naztec Controller Operations Manual* for details concerning the controller database.

Classic View

The *Classic View* shown below is presented when *Classic Selections* is checked in the *User Definition*. A *Category* is first selected in the *Data Screen* window. The user then selects the *Screen Name* desired under this *Category* and chooses to *Edit* or *View* one of the files shown below. The *Standard* file is typically used to edit the controller database. The example below shows the selections made to edit the *Phase Timings* for phases 1-8 in the *Standard* file.

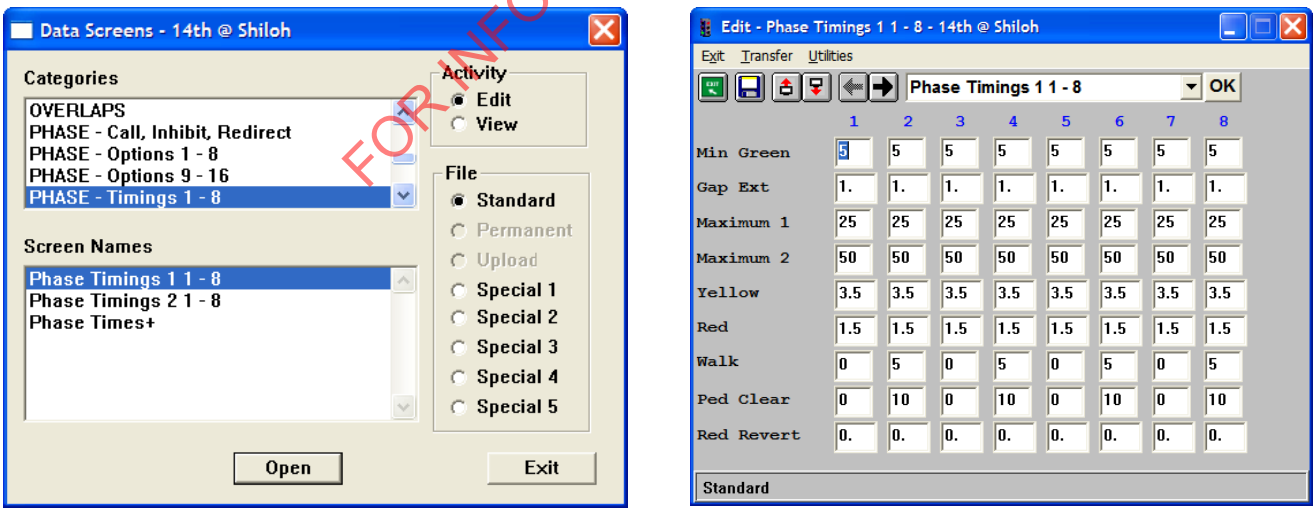


Figure 27: Classic View of the Controller Database

Data Screen Explorer View

The *Data Screen Explorer View* below is presented when *Classic Selections* is not checked and *Data Screen Explorer* is checked in the *User Definition*. (See section 2.4.1). This method should be intuitive to users familiar with *Windows Explorer*. The *Data Screen Explorer View* merges the data screen selection tree and the database screens. This view allows users to perform edits on different screens from the same window instead of launching a separate window like *Classic View*.

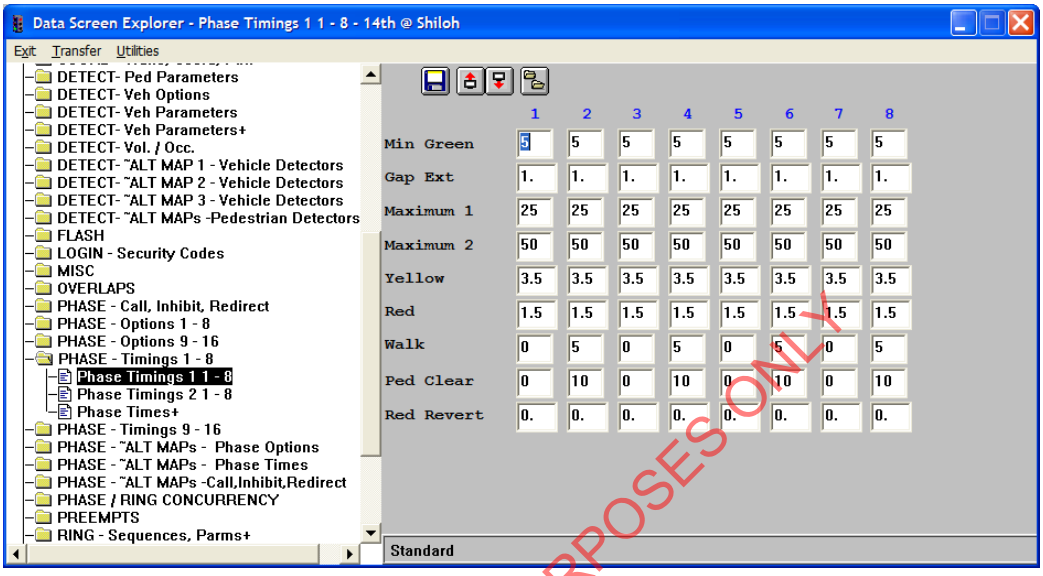


Figure 28: Data Screen Explorer View

Detailed Data Folder View

The *Detailed Data Folders* view below is shown when *Classic Selections* is not checked and *Data Screen Explorer* and *Detailed Data Folders* are both checked in the *User Definition*. The selection tree presented in this view closely resembles the menu structure of the TS2 and 2070 controller.

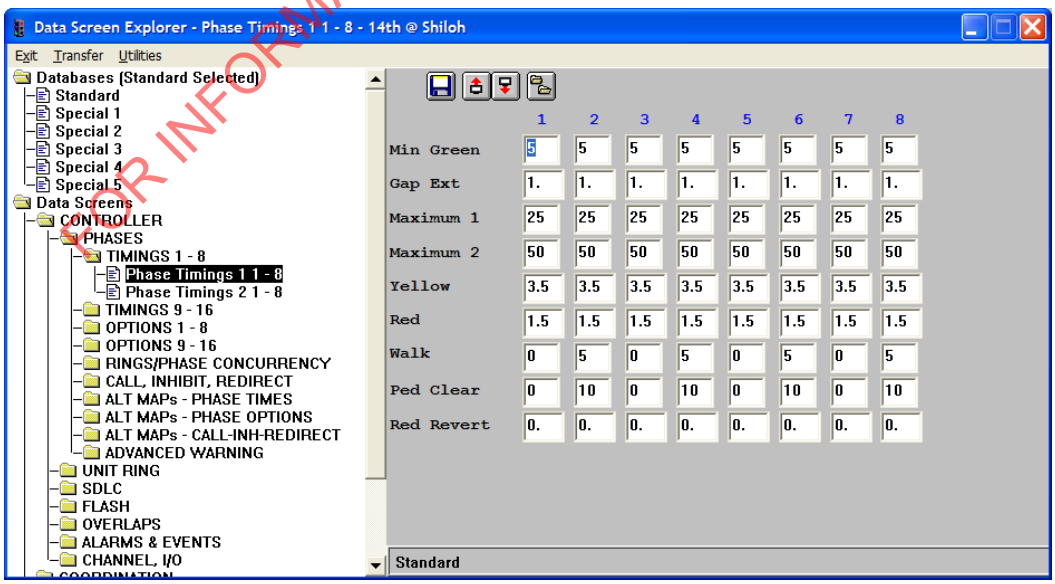


Figure 29: Detailed Data Folders View

The following buttons are provided with the explorer views shown above.

The *Save* button commits any changes made to a database screen. If the user forgets to save a change and selects a different database screen, a message will be displayed with options to save or discard the edits made to the screen

The *Upload* and *Download-With-Verify* buttons allow the user to upload or download only the current database screen from the field controller. Note that an upload does not update the current database screen. The user must select Utilities / Save Upload / Screen from the data screen pull down menu to commit the upload to the standard file.

The *Copy* button is a powerful feature allowing the user to copy changes made to the current database screen to multiple controller databases. Copies may be made to individual controllers or to masters, groups and flex groups. In addition, only a highlighted portion of the current screen may be copied.

3.2.2 Scan Screens

Scan Screens are used to display status from one or more intersections on the same comm channel. The refresh rate of these displays is dependent on the type of communications provided and the available bandwidth. The StreetWise *Administrator* assigns a priority to all communication requests and *Scan Screen* displays will be interrupted when a higher priority request such as upload/download is received.

Select Screens / Scan or select the *Scan Screen* button from the intersection toolbar.

A list of default *Scan Screens* provided with StreetWise is displayed. These screens were built using the *Scan Screen Builder* and may be customized using the builder if desired.

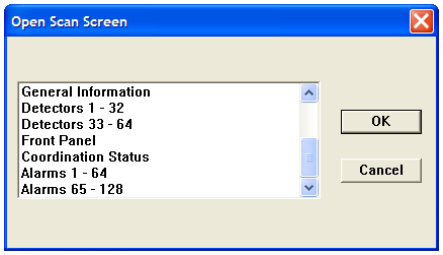


Figure 30: Open Scan Screens

Note that alarms are not typically scanned using the *Scan Screens* shown in this list, unless the user wishes to observe the real-time status of an alarm generated by the controller.

Front Panel Status Screen

The *Front Panel Status Screen* displays the same status as menu MM/7/9/5 on the TS2 or 2070 controller.

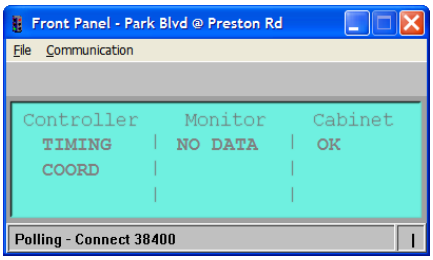


Figure 31: Front Panel Status

General Information Status Screen

The *General Information* screen is the most commonly used *Scan Screen* in the system.

General Information displays phase timing and coordination status combining the status shown on the MM/7/1, MM/7/2 and MM/1/5/3 controller menus.

Note that *Vehicle Calls* are phase calls not actual vehicle detector inputs. If you wish to scan individual detector inputs, you should select either the Detectors 1–32 or Detectors 33-64 scan screen.

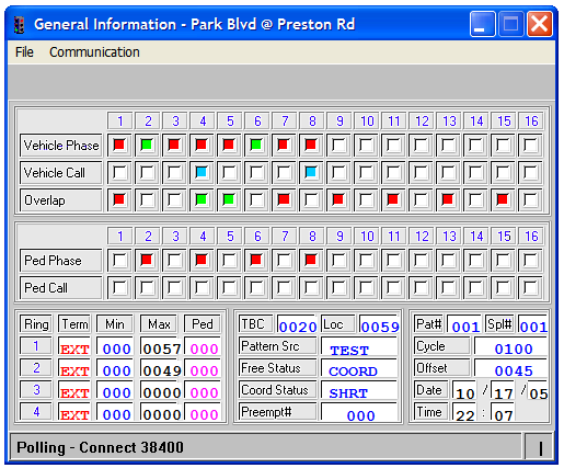


Figure 32: General Information Scan Screen

Coordination Status Screen

The *Coordination Status Screen* displays the same coord status as *General Information*.

In addition, the *Coordination Status Screen* also displays any alternate phase times, phase options, detector groups or call/inhibit tables associated with the active pattern.

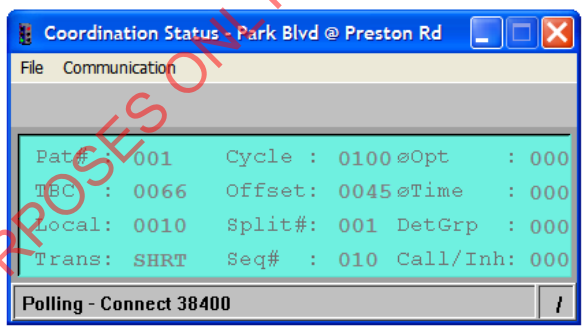


Figure 33: Coordination Status

Custom Scan Screens

Users may create custom scan screens using the *Scan Screen Builder* to portray the geometry of the intersection.

Any bitmap image may be used for the background of the screen. Hand drawn images such as the one shown in Figure 34 would be very difficult to provide for every intersection in the system. Screen captures of aerial photography can be obtained easily from a GIS system or Google (http://earth.google.com/).

In addition, the *Intersection Scan Screen Wizard* discussed in a later section can be used to quickly produce custom scan screens by specifying the number of approach lanes and signal displays present at the intersection.

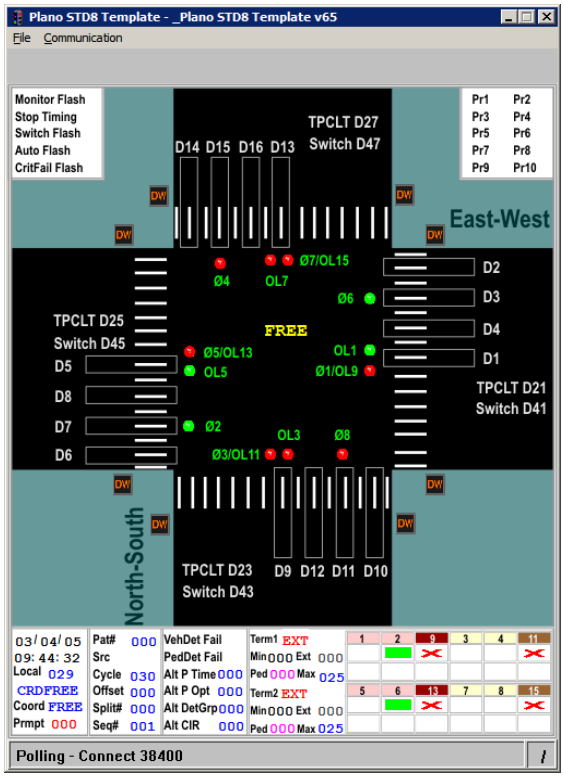


Figure 34: Custom Scan Screen

3.2.3 Control Screens

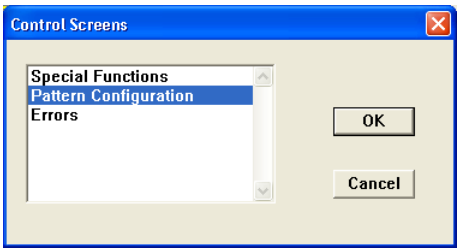


Figure 35: Control Screen

Control Screens allow the user to set the active pattern, special function outputs and phase calls in the field.

Choose Screens / Control or select the *Control Screen* button from the intersection toolbar.

A list of default *Control Screens* is displayed which have been built using the *Control Screen Builder*.

Choose *Pattern Configuration* and then *OK*.

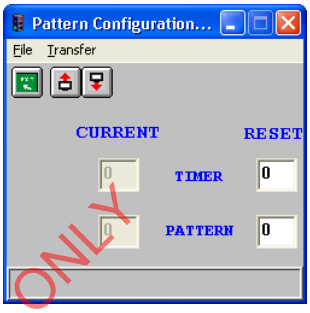


Figure 36: Pattern Configuration

The screen shown in Figure 36 allows the user to download a specified pattern for a given amount of time (in minutes). The download button may be used to download the data specified to the controller.

The *Pattern Configuration* screen can be used to send patterns to a single intersection. However, *Manual Control Screen* (Utilities / Manual Control from the main client toolbar) can be used to send patterns and preempts to groups of intersections.

3.2.4 Device Poll

Scan Screens poll continuously and therefore consume all available bandwidth on a communications channel when displaying their status. Instead, the user can choose Device Polls, which do not consume all available bandwidth on a communications channel. *Device Polls* may be gathered once or repeated after all intersections have been polled. Intersections polled by *Device Polls* are typically selected by *Group* or *Flex Group*.

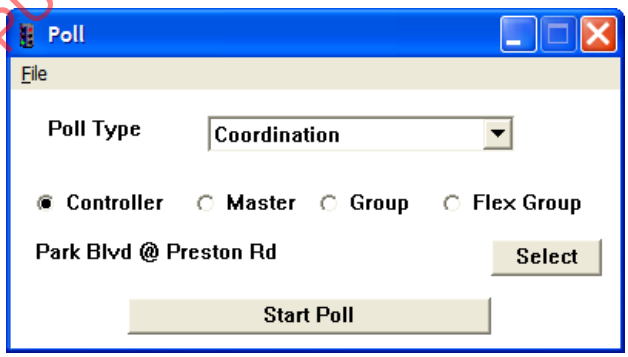


Figure 37: Device Poll

Choose Utilities / Device Poll or the *Device Poll* button from the intersection toolbar to display the *Device Poll* menu shown in Figure 37.

Device Poll gathers the status once for all controllers selected. The user then has the ability to select *Repeat Poll* or *Continuous* from the *File* menu. The user must select *File / Hangup* to cancel a continuous poll. The following *Device Polls* are available from the *Poll Type* list.

1) **Coordination** – polls the current coord status, coord state (free, sync or transition), cycle, offset, pattern# and source of the active pattern

2) **Time Check** – polls the controller time and date and displays the difference in green (if less than two seconds) or in red (if greater than 2 seconds). Many users issue a *Time Check* to quickly assess the state of the communication system because the reply message is short and a large group of controllers can be polled quickly.

3) **Temperature** – polls the temperature probe devices if present in the cabinet

4) **Versions** – polls current version and revision number of the firmware present in the controller

5) **Green Phase On** - polls the green status and displays "1" if green and "0" if not green.
System Map Returns – polls the green status and displays a "G" if green and an "R" if red.

Most users prefer to display green status from either a custom scan screen or from a system map running a continuous *GYR Returns* report from the scheduler. Custom scan screens can be developed for on-street closed loop systems with dial-up connections. However, continuous GYR returns require a large amount of bandwidth from the communication system.

6) **Alarms** – only used with legacy TS1 systems

7) **Real-Time Splits** – only used with legacy TS1 systems; use the split monitor described in 3.2.9

8) **Coordination Timers** – only used with legacy TS1 systems; use the *Coordination* device polls described in 1) above with TS2 and 2070 based systems.

3.2.5 Instant Reports

Instant Reports allow the user to immediately gather data from the field. The gathered data may then be queried from the StreetWise database. *Instant Report Events* may also be scheduled by time-of-day through the StreetWise *Scheduler*. These topics will be covered later in this manual.

Choose Utilities / Instant Report or select the *Instant Report* button to collect instant reports from a controller or group of controllers.

This option is also found on the client main toolbar under Utilities / Reports / Collect / Instant Report.

Figure 38: Instant Report

3.2.6 Alarm Status

Choose Utilities / Alarm Status or select the *Alarm Status* button from the intersection toolbar to view alarm status for this intersection.

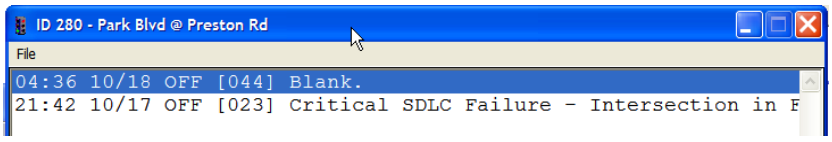


Figure 39: Alarms

The complete list of controller alarms is reprinted in Chapter 14 of this manual.

3.2.7 Basic Upload/Download Procedures

The *Transfer* menu and the *Upload* and *Download* buttons on the intersection toolbar

allow the user to exchange data between StreetWise and the field. StreetWise provides a file system that attempts to protect changes made to the database in the field. This topic is so important it is covered separately in the next chapter, *Understanding the StreetWise File System*.

Download No-Verify

Download No-Verify simply downloads the *Standard File* overwriting all data in the controller.

Choose Transfer / Download No-Verify to overwrite the database in the field.

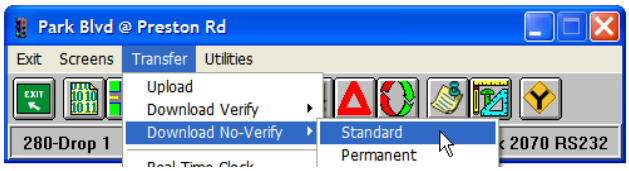


Figure 40: Download No-Verify / Standard

During a *Download No-Verify*, the *Communication Status* screen identifies the controller ID, name and download function. In the example shown as Figure 41, a total of 12,830K bytes of data is in the process of being transferred. The download is 14% complete.

All downloads and uploads perform extensive CRC (Cyclic Redundancy Checking) to insure that the received data is not corrupted. *Request Count* shows how many repeat attempts are made if the reply CRC from the receiver does not match the CRC computed by the sending device.

Note: The COMM_PACKET RETRY parameter in the server initialization file (server.ini) determines how many attempts will be made to resend a packet of data after a *Request Count* error

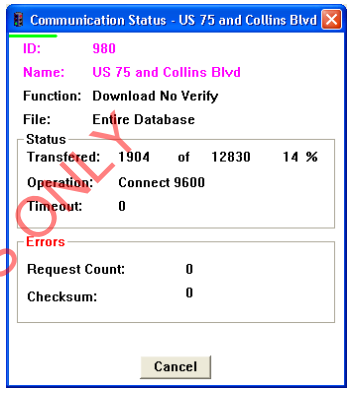


Figure 41: Download No-Verify

Download Verify

Download Verify first uploads the controller database to insure that the field database matches the last successful download from the central office (stored in the *Permanent File)*. If the *Upload File* and *Permanent File* database match, then the edited *Standard File* is downloaded to the field and saved as the new *Permanent File*.

Choose Transfer / Download Verify to upload and compare the database from the field before downloading the edited *Standard File*.

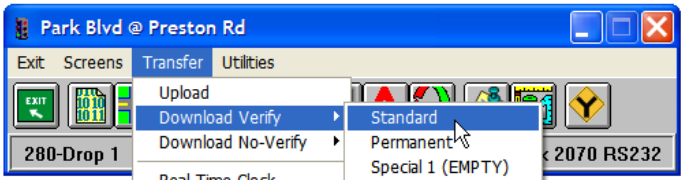


Figure 42: Download / Standard from the Controller

If the *Upload File* does not match the *Permanent File* (last successful download), a Database Mismatch error is displayed as shown in Figure 43.

If Database Mismatch is displayed, you can select *View Differences* to see the differences in the two files. This utility (Figure 44) allows you to isolate differences in the field database and the permanent file to determine if these differences need to be saved before the field database is overwritten.

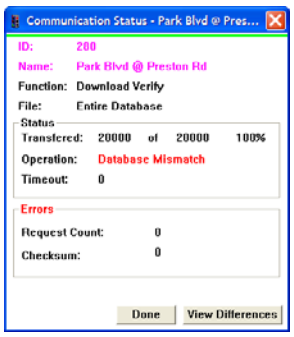
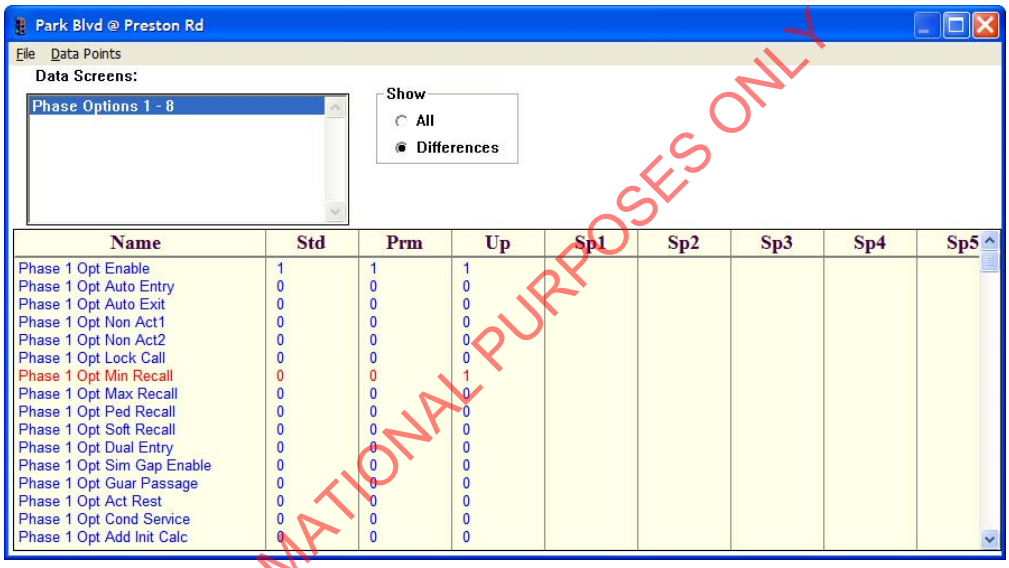


Figure 43: Download Verify (Database Mismatch)

For example, the *View Differences* screen below points out that a *Min Recall* set in the field does not match the last download from the system (saved in the Permanent File).



Name	Std	Prm	Up	Sp1	Sp2	Sp3	Sp4	Sp5
Phase 1 Opt Enable	1	1	1					
Phase 1 Opt Auto Entry	0	0	0					
Phase 1 Opt Auto Exit	0	0	0					
Phase 1 Opt Non Act1	0	0	0					
Phase 1 Opt Non Act2	0	0	0					
Phase 1 Opt Lock Call	0	0	0					
Phase 1 Opt Min Recall	0	0	1					
Phase 1 Opt Max Recall	0	0	0					
Phase 1 Opt Ped Recall	0	0	0					
Phase 1 Opt Soft Recall	0	0	0					
Phase 1 Opt Dual Entry	0	0	0					
Phase 1 Opt Sim Gap Enable	0	0	0					
Phase 1 Opt Guar Passage	0	0	0					
Phase 1 Opt Act Rest	0	0	0					
Phase 1 Opt Cond Service	0	0	0					
Phase 1 Opt Add Init Calc	0	0	0					

Figure 44: Compare Database Screen

Upload

Choose Transfer / Upload from the intersection toolbar to upload the database from the field to the *Upload File.*

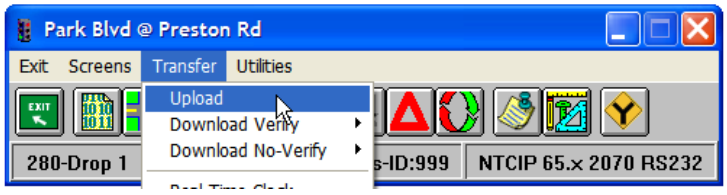


Figure 45: Upload From the Controller

When the upload is complete, you will see a screen similar to the one on the right.

The uploaded file in Figure 46 is 20,000 K and is stored in the *Upload File*, which is separate from the *Standard File* used to edit the database. This allows the user to compare differences between the controller data uploaded from the field and the *Permanent File* used to save the last database downloaded to the field.

The user may commit the *Upload File* as the new permanent and edit copy under the Utilities menu by selecting *Save Upload to Standard* and *Permanent*.

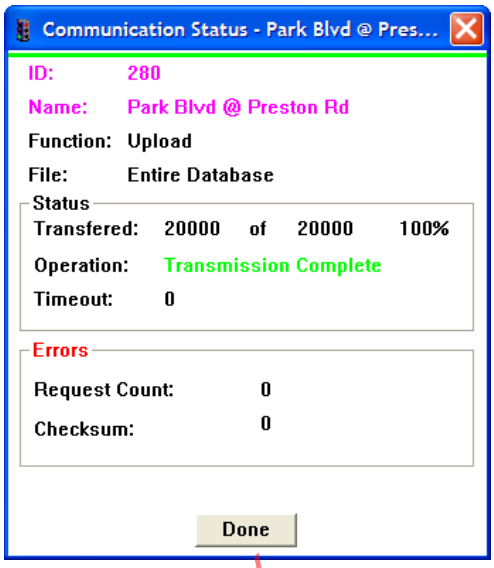


Figure 46: Upload Transmission Complete

3.2.8 Downloading the System Time to the Controller Real-Time Clock

Controller clock accuracy is the most important requirement for a coordinated signal system because the synchronization of the system is based on a midnight time reference. Therefore, the *Comm Server* clock needs to be synchronized with the national time standard (WWV) and the local controllers need to be synchronized with the *Comm Server* to maintain coordination.

Choose Transfer / Real-Time Clock from the intersection toolbar to download the *Comm Server* clock reference to the local controllers. When the real-time clock download is complete, you should see a status screen similar to the one at the right.

If you download the system clock from a client workstation, you are actually downloading the system clock on the *Comm Server*. If you download the real-time clock from a laptop or Palm device in the field, you should insure that the clock on the device is synchronized with the *Comm Server* to maintain coordination in your system.

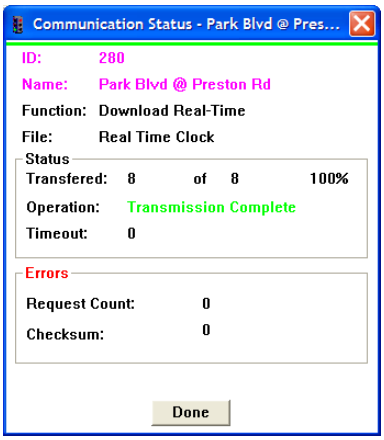


Figure 47: Real-Time Clock