EVALUATION REPORT

for the

REGIONAL TRANSIT SIGNAL PRIORITY IMPLEMENTATION PROGRAM (RTSPIP)

Version 2.0

December 2019

Chicago Metropolitan Agency for Planning

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DEVELOPED BY :

DEVELOPED FOR:

REGIONAL TRANSPORTATION AUTHORITY
175 W. JACKSON BLVD, SUITE 1650
CHICAGO, IL 60604

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1. INTRODUCTION

This Evaluation Report has been developed to present an evaluation of the Regional Transit Signal Priority Implementation Program (RTSPIP). The Regional Transportation Authority (RTA) of Chicago is leading the RTSPIP, which provides a framework for the implementation of a regionally coordinated and integrated Transit Signal Priority (TSP) system. The program will involve up to 100 miles of roadway and up to 500 signalized intersections across multiple jurisdictions.

The evaluation focuses on a set of performance measures that have been gathered to assess the impacts of TSP operations on transit and general vehicle travel times along multiple corridors in the region.

1.1. Background

The RTA, Chicago Transit Authority (CTA), Pace Suburban Bus, Illinois Department of Transportation (IDOT), Chicago Department of Transportation (CDOT), and other transportation agencies are working together to implement a regionally interoperable TSP system on 13 transit corridors in the Chicago region.

The RTA has facilitated a TSP Working Group with these agencies to define a Concept of Operations for a regionally interoperable TSP System, in addition to defining Technical System Requirements for TSP system components. The group has also developed a set of Regional TSP Standards and Implementation Guidelines that help to guide the implementation of a regionally interoperable TSP System by both CTA and Pace. Please refer to those separate Project Documents for more information on the program.

The RTSPIP is funded by a $36 million federal Congestion Mitigation and Air Quality Improvement Program (CMAQ) grant and $4 million from the RTA. These funds are being combined with other federal grants to the CTA and Pace for specific corridors.

1.2. Goals and Objectives

The overall goal of the program is to develop a regionally interoperable TSP system for Pace and CTA buses traveling through multiple jurisdictions that will improve transit performance in the region.

More specific goals and objectives that address the basic needs of Pace and CTA bus operations were outlined within the RTSPIP Concept of Operations and are included in Table 1 below. Each objective is discussed further in the following subsections.

Table 1 - RTSPIP Goals and Objectives of Interoperable TSP System

Goals	Objectives	Attainment
Develop and Implement a Regionally Interoperable TSP system for Pace and	Establish Regional TSP Standards and Implementation Guidelines for TSP System	Full
	Utilize, to the extent possible, existing on-board Automatic Vehicle Locator (AVL) systems and vehicle technology to generate TSP requests	Full

Table 1 - RTSPIP Goals and Objectives of Interoperable TSP System		
Goals	Objectives	Attainment
CTA Buses across multiple jurisdictions	Create standards-based communication protocols between buses and intersections	Partial
	Utilize readily available off-the-shelf communication technology (e.g., DSRC, Wi-Fi, cellular) for vehicle to intersection communications	Full
	Leverage TSP communications infrastructure for other transit ITS applications along a TSP corridor	TBD
Improve schedule / headway reliability, travel times and fuel efficiency	Reduce variability in transit travel times and running times, and reduce transit signal delay.	TBD
	Reduce transit and general vehicle travel times along the corridor and minimize negative impacts of TSP to private vehicles on arterials and cross streets	TBD
	Reduce transit and general vehicle fuel consumption along TSP corridors.	Data Unavailable

1.2.1. Establish Regional TSP Standards and Implementation Guidelines

The RTA worked with consultants and stakeholders at the beginning of the program to follow a Systems Engineering process in the development of key program documents to guide the procurement and deployment of a regional interoperable TSP system for Pace and CTA buses across multiple jurisdictions.

These documents include the RTSPIP Concept of Operations (ConOps) that defined the overall goals and objectives of the program, as well as the design concepts for vehicle to intersection communications of TSP requests in the region. Operational scenarios described the regional interoperability of TSP operations across multiple jurisdictions. Following the ConOps, the Technical System Requirements were then developed with program stakeholders to define the functionality of vehicle and intersection based hardware components, as well as central software components for overall system monitoring and control.

Based on the definitions provided by these program documents, the Regional TSP Standards and Implementation Guidelines document was developed and published. The Regional TSP Standards included the Regional TSP Message Set to be used by Pace and CTA in communicating TSP requests between buses and intersections, as well as communications equipment standards for both buses and intersections. Implementation guidelines were provided to assist agencies with steps to follow during the implementation phases of the program, such as how to install communications equipment to maximize the efficiency of vehicle-to-intersection communications.

This objective has been fully attained through the development of these program documents.

1.2.2. Utilize On-Board Vehicle Equipment

During the development of the ConOps document, program stakeholders expressed a desire to utilize existing on-board Automatic Vehicle Locator (AVL) hardware and vehicle-based communications equipment to communicate TSP requests to signalized intersections along TSP corridors. The use of this equipment would reduce the amount of vehicle-based equipment that agencies would need to maintain over the course of the program.

This objective has been fully attained through inclusion of Technical System Requirements that specify the use of on-board vehicle equipment for TSP requests. Furthermore, Pace and CTA have worked with their existing respective AVL vendors to implement TSP functionality on the existing on-board AVL equipment from 2017 through 2019.

1.2.3. Create Standards-based Communications Protocols

As part of the Regional TSP Standards defined for the program, the IEEE 802.11n communications protocol was recognized as a Regional TSP Standard that could enable regional TSP interoperability between Pace / CTA buses and multiple intersections throughout the Chicago region. The communications protocol was chosen given its maturity and use in several types of readily available off-the-shelf communications equipment, including the existing vehicle-based communications equipment used by both Pace and CTA.

Included within the Regional TSP Standards, a Regional TSP Message Set was designed for Pace and CTA to utilize in communicating TSP requests to signalized intersections throughout the region. Furthermore, a set of testing simulators were developed to facilitate the programming of the Regional TSP Message Set into both vehicle and intersection based equipment. The simulator guided the design and bench testing processes of implementing the Regional TSP Message Set prior to field implementation.

This objective has been partially attained, pending conversion to the Regional TSP Message Set and standard Wi-Fi using a Wireless Local Area Network (WLAN) or Virtual Local Area Network (VLAN) by CTA.

1.2.4. Utilize Off-the-Shelf Communications Technology

Related to the objectives of using existing on-board vehicle equipment and standards-based communications protocols, program stakeholders also expressed a desire to utilize readily available off-the-shelf communication technology (e.g., cellular, Wi-Fi, DSRC) for vehicle-to-intersection communications. This was desired by agencies to reduce the amount of hardware design and testing required prior to equipment deployment.

Given these objectives, Pace and CTA have utilized off-the-shelf communications equipment from common radio vendors such as Cisco and Motorola to facilitate vehicle-to-intersection communications in the region.

This objective has been fully attained by Pace and CTA through their use of off-the-shelf communications equipment as noted.

1.2.5. Leverage Communications Infrastructure for Other Transit ITS Applications

The design and implementation of vehicle-to-intersection communications infrastructure by Pace and CTA has been primarily for the purpose of regional TSP interoperability. Additional transit ITS applications along TSP corridors utilizing the TSP communications infrastructure have yet to be designed by Pace and CTA.

Attainment of this objective to leverage communications infrastructure for other transit ITS applications is yet to be determined.

1.2.6. Improve Various Performance Measures

In order to evaluate the effectiveness of TSP implementation, the following performance measures were chosen as the factors for consideration:

- 1-A: Average Bus Travel Time (corridor-level)
- 1-B: Bus Travel Time Variability (standard deviation)
- 1-C: Traffic Signal Delay
- 1-D: Number of Stops at Red Signals
- 2: General Vehicle Travel Times

These performance measures will be quantified in order to determine if the second set of goals for this TSP implementation program have been reached. Vehicle fuel consumption was also considered early in the program as a performance measure, but data on this measure was not available due to the difficulty of collecting appropriate fuel consumption data for specific TSP corridors.

Attainment of this objective to improve performance measures is yet to be determined, pending additional data collection and evaluation to be completed in 2020 and published by the RTA under separate cover.

1.3. Program Team

In order to gain perspective from all stakeholders, the program team for this work had to reflect all of the appropriate agencies. The following list details the parties involved in this program:

- Regional Transportation Authority (RTA)
- Chicago Transportation Authority (CTA)
- Pace
- City of Chicago DOT (CDOT)
- Illinois DOT (IDOT)
- Lake County DOT
- Cook County DOT
- DuPage County DOT
- Kane County DOT
- McHenry County DOT
- Federal Transit Administration (FTA)
- Chicago Metropolitan Agency for Planning (CMAP)
- Consultant Support
  - AECOM
  - TranSystems
  - Jacobs

1.4. Project Locations

The Regional TSP Implementation Program will cover a scope of nearly 100 miles of roadway and about 500 intersections. Figure 1 displays the locations of these corridors throughout the Chicago region.

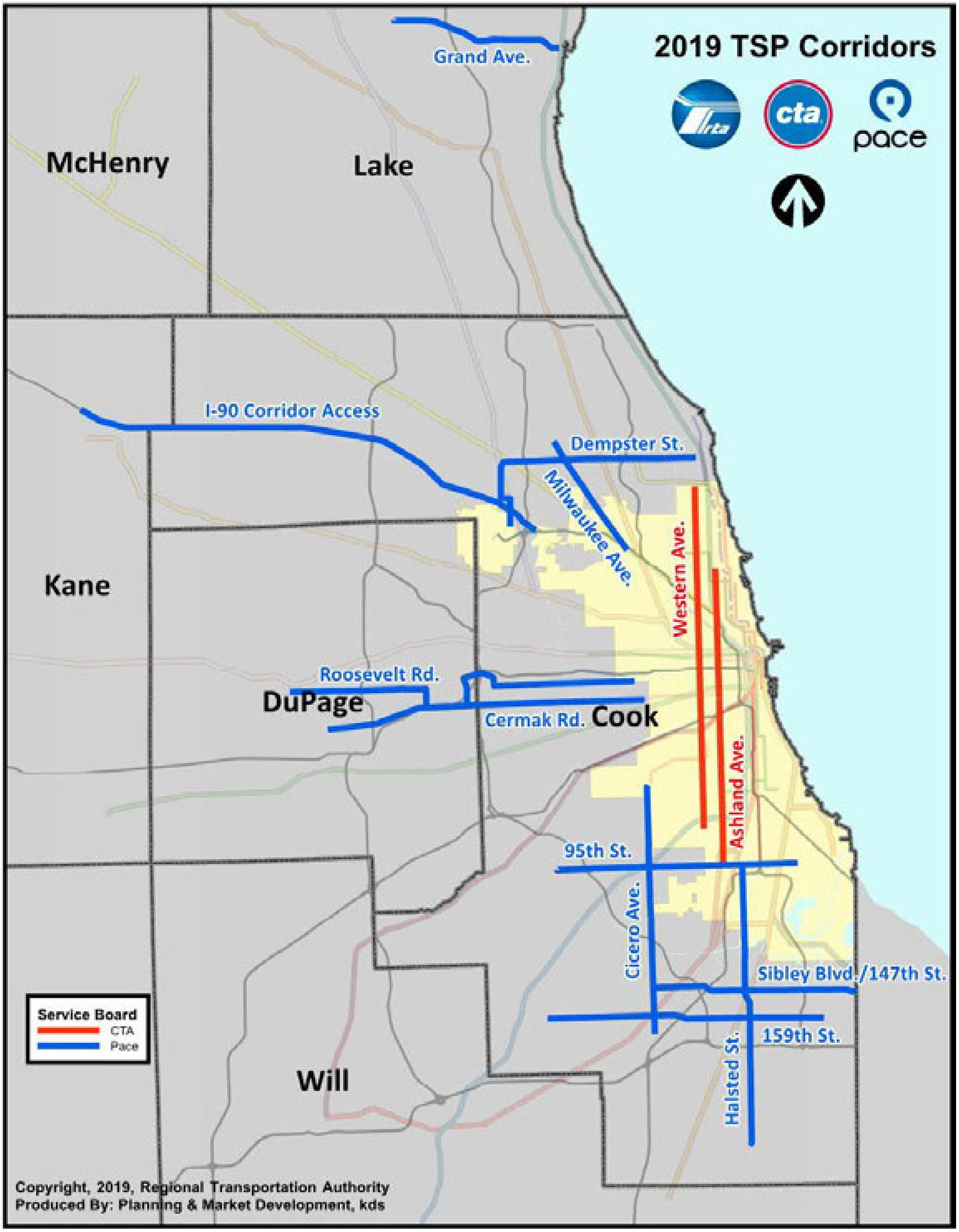


Figure 1 – RTSPIP Program Corridors for CTA and Pace

To date, TSP has been implemented on portions of South Ashland Avenue, Western Avenue and Milwuakee Avenue, as described below. Further details are provided in Table 4 in Section 2.2.3.

The 2 CTA Corridors for TSP Implementation are as follows:

Ashland Avenue: The Ashland Avenue TSP corridor extends from Irving Park Road to 95th Street. The corridor is split in half at Cermak Road / 22nd St. to allow for phased TSP implementation. The bus routes impacted by TSP are CTA routes 9 and X9. TSP was implemented on South Ashland Avenue by the CTA and CDOT in 2016 between Cermak Road and 95th Street.

Western Avenue: The Western Avenue TSP corridor extends from Howard Street to 79th Street. The bus routes impacted by TSP are CTA routes 49, 49B, and X49. TSP was implemented on Western Avenue by the CTA and CDOT in 2018.

The 11 Pace corridors for TSP implementation are as follows:

Cermak Road: The Cermak Road / 22nd Street TSP corridor extends along Cermak Road / 22nd Street from IL Route 56 (Butterfield Road) and Lambert Road to Cicero Avenue. The bus route impacted by TSP is Pace Route 322.

Cicero Avenue: The Cicero Avenue TSP corridor extends along IL Route 50 (Cicero Avenue) from 59th Street to 167th Street. The bus routes impacted by TSP are Pace routes 379, 382, 383, 384 and 385 and CTA route 54B.

Dempster Street: The Dempster Street TSP corridor extends along IL Route 58 (Dempster Street) from Sheridan Road to Elmhurst Road. The bus routes impacted by TSP are Pace routes 250 and 230.

Grand Avenue: The Grand Avenue TSP corridor extends along Grand Avenue from US 45 to Sheridan Road. The bus route impacted by TSP is Pace route 565.

Halsted Street: The Halsted Street TSP corridor extends along Halsted Street from 95th Street to the Chicago Heights Terminal. The bus routes impacted by TSP are Pace routes 352, 359, 348 and 890.

Milwaukee Avenue: The Milwaukee Avenue TSP corridor extends along Milwaukee Avenue (IL Route 21) from Golf Road to the Jefferson Park CTA Station. The bus routes impacted by TSP are Pace routes 270, 410 and 411. TSP was implemented on Milwaukee Avenue by Pace and CDOT in 2019. Proof-of-Concept testing is currently underway.

Roosevelt Road: The Roosevelt Road TSP corridor extends along IL Route 38 (Roosevelt Road) from Carlton Avenue to Laramie Avenue. The bus routes impacted by TSP are Pace routes 305 and 301.

95th Street: The 95th Street TSP corridor extends along 95th Street from 88th Avenue to Stony Island Avenue. The bus routes impacted by TSP are Pace routes 381 and 395.

147th Street: The 147th Street/Sibley Boulevard TSP corridor extends along IL Route 83 (147th Street/Sibley Boulevard) from Cicero Avenue to State Line Road. The bus routes impacted by TSP are Pace routes 350 and 354.

159th Street: The 159th Street TSP corridor extends along US Route 6 (159th Street) from 94th Avenue to IL Route 83 (Torrence Avenue). The bus route impacted by TSP is Pace route 364.

I-90 Transit Corridor Access: The I-90 Transit Access TSP corridor extends along the I-90 Tollway from Randall Road to the Rosemont CTA station. The bus routes impacted by TSP are Pace routes 600, 603, 605, 606, 607, 610 and 616.

1.5. Report Organization

The following sections of this report present the different facets of this TSP program.

- Section 2 presents the steps of implementing TSP in the Chicago region by describing the technology and the various bench and field testing that coincided with the implementation process.
- Section 3 describes the methodology for developing the selected performance measures.
- Section 4 describes the evaluation and analysis of the performance measures.
- Section 5 presents the findings from this program and recommends some next steps for TSP in the Chicago region.

2. TSP IMPLEMENTATION

This section of the report presents an overview of the implementation of TSP technology by Pace and CTA throughout the program.

2.1. TSP Technology Overview

The overall TSP System developed and deployed by Pace and CTA includes a number of hardware and software subsystems and components. These subsystems were guided by program planning documents created early in the program, such as the Concept of Operations (ConOps) and Technical System Requirements documents. Those documents defined the functionality of vehicle and intersection based hardware components, as well as central software components for overall system monitoring and control. Table 2 presents the terms from those documents that were used to define these subsystems.

Table 2 - TSP Subsystem and Technology Descriptions

Subsystem	Description
Priority Request Generator (PRG)	Describes how the TSP request shall be initiated from the transit vehicle through the existing AVL system. The PRG consist solely of the AVL system on Pace and CTA buses.
Priority Request Server (PRS)	Describes how the TSP request shall be processed at the signal cabinet. The PRS may consist solely of the signal controller, or could include additional intersection based TSP equipment.
TSP Protocols (PRO)	Describes what information is transmitted between the vehicles and intersections during TSP events. This includes the Regional TSP Message Set developed for the program utilized by both Pace and CTA.
Communications (COM)	Describes how communications equipment on the vehicle and near the intersection shall function to transmit information between the vehicles, intersections, and central offices.
TSP Central Software (SOFT)	Describes how software at a central office shall function to monitor TSP operations in the field.

2.1.1. CTA TSP Technology

This section identifies the subsystems designed and deployed by CTA for the program.

2.1.1.1 PRG Subsystem

CTA's PRG is contained within their Clever Devices AVL system on their buses. This PRG is responsible for generating the priority request based on schedule lateness.

Under a previous TSP demonstration project, the CTA developed a version of the PRG on the Clever Devices AVL system, which was tested along the Jeffery Jump corridor. Pre-existing communications equipment on buses and at traffic signals was utilized to send TSP requests to a traffic signal controller equipped with a previously developed version of a PRS.

The previously tested version of the PRG has remained in operation on CTA buses and is planned to be replaced with the PRG designed under the RTSPIP upon completion of bench and field testing by Clever Devices. A breakdown of the RTSPIP version of PRG bench, field and acceptance testing can be found in Section 2.2.

2.1.1.2 PRS Subsystem

For CTA, the PRS deployed along their TSP corridors consists of the Peek Advanced Traffic Controller (ATC) with PRS logic built into the traffic signal controller. This PRS is responsible for receiving TSP requests from the PRG.

As noted above, a previous version of a PRS was designed for the Peek ATC model signal controller under a prior demonstration project. The Peek ATC model controller and the previously developed PRS were deployed on Ashland Avenue and Western Avenue while CTA proceeded to develop the version of the PRS designed under the RTSPIP.

The previously tested version of the PRS was then replaced with the PRS designed under the RTSPIP upon completion of bench and field testing by Peek and Clever Devices. A breakdown of the PRS bench, field and acceptance testing can be found in Section 2.2.

2.1.1.3 Communications System

The CTA is implementing vehicle-based wireless router hardware from Sierra Wireless. These model MP70 communications routers are a replacement for a previous model of communications router – Rocket routers – that were provided to the CTA from the vendor Utility. The Sierra MP70 routers (compliant with IEEE 802.11 standards) are capable of wireless transmission to, and receipt of data from, intersection-based wireless hardware (Raspberry Pi devices, also compliant with IEEE 802.11 standards) for the purpose of requesting TSP from traffic signals.

The Sierra MP70 routers on CTA buses have been customized to allow a CTA-developed software to be installed on them and run in conjunction with the standard Sierra Wireless application layer software. This custom software, referred to as Blazeon, was developed by CTA staff for the purpose of maintaining the same manner of vehicle-to-intersection communications of TSP requests that was previously designed by Utility and known as UANET firmware.

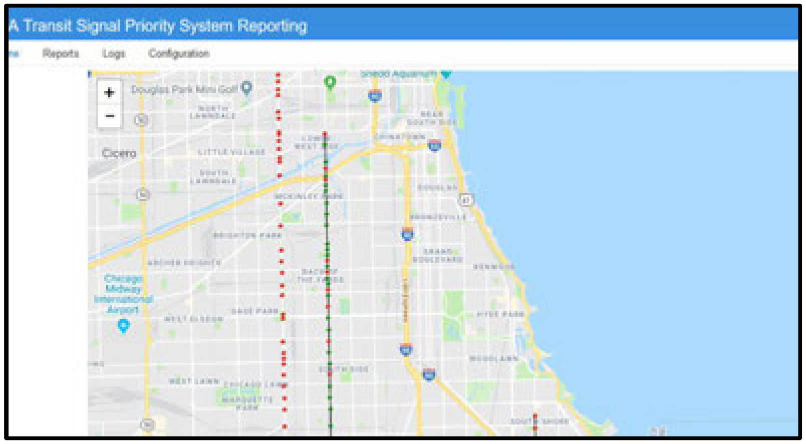
The CTA is currently reviewing updates to be made to the Sierra MP70 routers to enable them to communicate TSP requests through a WLAN or VLAN that connects the intersection-based communications equipment. The presence of WLAN along CTA TSP corridors will enable Pace buses to also communicate TSP requests to the same intersection-based communications equipment.

Communications equipment has also been installed at signalized intersections to receive TSP requests from Sierra MP70 routers. The equipment includes a Raspberry Pi device that acts to receive the TSP request and relay the call to the CTA PRS in the signal cabinet. An image of this communications equipment is shown in Figure 4 that illustrates CTA bench testing activity. The communications equipment is maintained in the field by the City of Chicago Division of Electrical Operations (DEO).

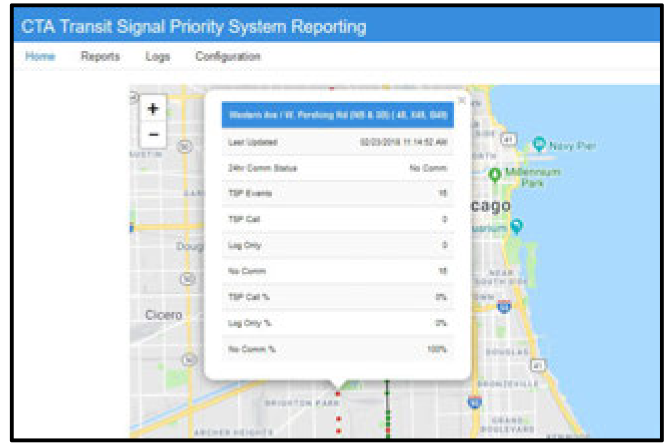
2.1.1.4 Central Software

The CTA has developed and implemented a web-based central software interface that allows for gathering data on TSP requests logged by the CTA PRS. This software can be used to review the frequency of TSP requests made by CTA bus routes and the PRG, and can be used to review the effectiveness of TSP operations for buses by the time of day and day of the week. Figure 2 depicts a selection of map and summary views that can be accessed by the CTA.

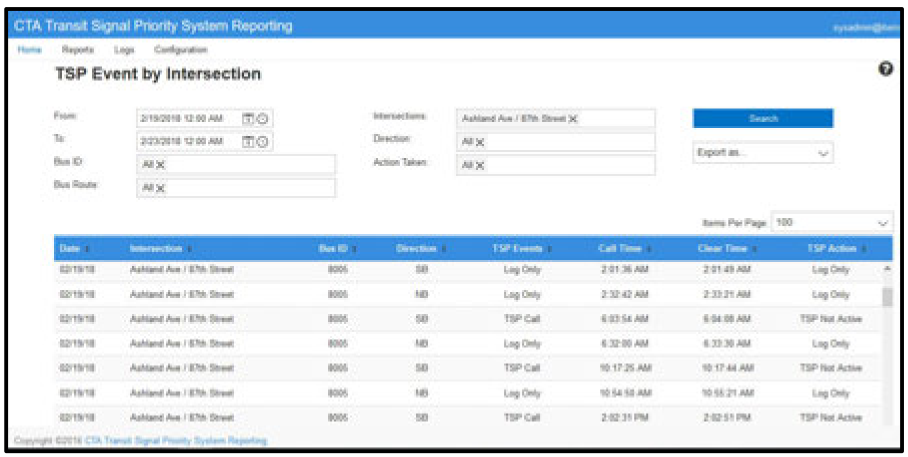
Figure 2 – Sample Views of CTA TSP Reporting Software



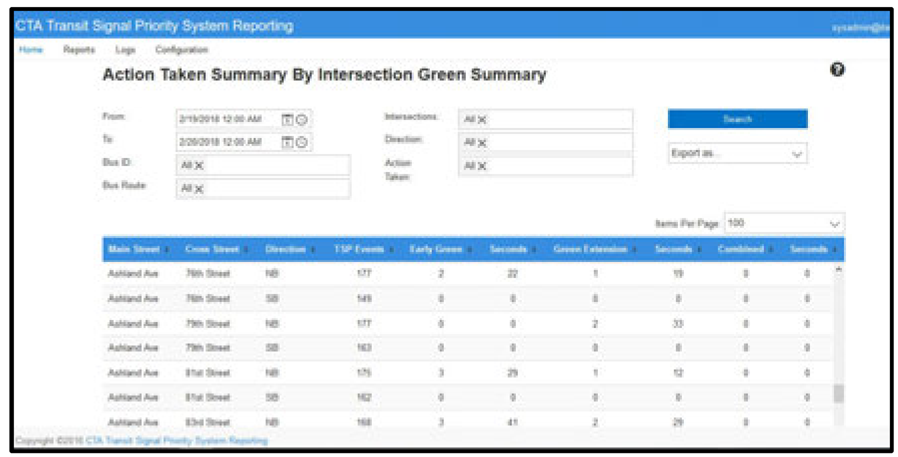
Regional Map View of Ashland / Western Avenue Corridors



Report View for Selected Intersection (Western & Pershing shown)



Summary View of TSP Events by Intersection (Ashland and 87th St. shown)



Summary View of Actions Taken by Intersection on Ashland Avenue

2.1.2. Pace TSP Technology

This section identifies the subsystems designed and deployed by Pace for the program.

2.1.2.1 PRG Subsystem

Pace's PRG is contained within the Trapeze AVL system on their buses. This PRG initiates the TSP request based on schedule lateness. A breakdown of the PRG bench, field and acceptance testing can be found in Section 2.2.

2.1.2.2 PRS Subsystem

Pace has deployed a Regional PRS device developed by Novax that exists alongside the traffic signal controller in the signal cabinet. Figure 3 shows this Regional PRS installed within a signal cabinet at Milwaukee Avenue and Maryland St. The PRS processes the TSP request at the signal cabinet. A breakdown of the PRS bench, field and acceptance testing can be found in Section 2.2.

Figure 3 – Regional PRS Device at Milwaukee Ave. and Maryland St.

Pace is planning to deploy a second type of Regional PRS that will be internal to an Econolite Cobalt ATC controller, similar to how the Peek ATC model controller has been designed to operate as a regional PRS at CDOT intersections for the CTA. This would require the Econolite Cobalt ATC to operate on a new type of operating system / firmware for IDOT known as eOS. In addition, Pace will plan to deploy a Siemens M60 ATC model controller on future Pace TSP corridors that will operate in a similar manner as the Peek ATC model controller with an internal PRS.

As of October 2019, IDOT is in the process of bench testing and field testing the Cobalt ATC controller with eOS firmware to verify that it will be safe for traffic signal operations. Following successful completion of this testing, Pace plans to field test operation of the Regional PRS software on an Econolite Cobalt ATC model controller at an intersection along the Grand Avenue corridor in Lake County, prior to implementing the Econolite Regional PRS at additional intersections.

2.1.2.3 Communications System

Pace has designed a Wireless Local Area Network (WLAN) around its TSP corridors for the purposes of establishing connections between vehicle-based and intersection-based communications devices to allow for the wireless transmission and receipt of data in the form of TSP requests.

Pace utilizes Cradlepoint wireless communications hardware devices on their buses to communicate TSP requests to Cisco wireless communications Access Point hardware installed at intersections to receive TSP requests and pass them along to the respective traffic signal controllers.

2.1.2.4 Central Software

Pace has developed and implemented a central software interface that allows for gathering data on TSP requests logged by the Pace PRS devices. Similar to the CTA, this software can be used to review the frequency of TSP requests made by Pace buses, and can be used to review the effectiveness of TSP operations for buses by the time of day and day of the week.

2.2. TSP Testing, Implementation and Validation

This section includes an overview of the bench and field testing performed by Pace and CTA as part of the overall TSP system implementation. Guidance documentation on the recommended sequence of TSP system component testing was provided early in the program through the development of the TSP System Verification Plan. In addition, an Interoperability Testing Plan was developed to guide the interoperability testing of Pace and CTA TSP System components.

Testing was also guided through the use of Virtual Testing Tools for both the PRG and PRS developed by Pace and CTA. These tools simulated the communication of TSP requests with either the PRG or PRS as they were under development by Pace and CTA. The use of the simulation tools also assisted in subsequent bench testing activities for the program.

Bench and field testing activities have been discussed using an interoperability testing timeline with TSP Working Group members. This was done throughout the course of the program to identify the necessary testing between PRG, PRS, and COM subsystem components.

2.2.1. Bench Testing

Bench testing of TSP System components by Pace and CTA is described in the sections below.

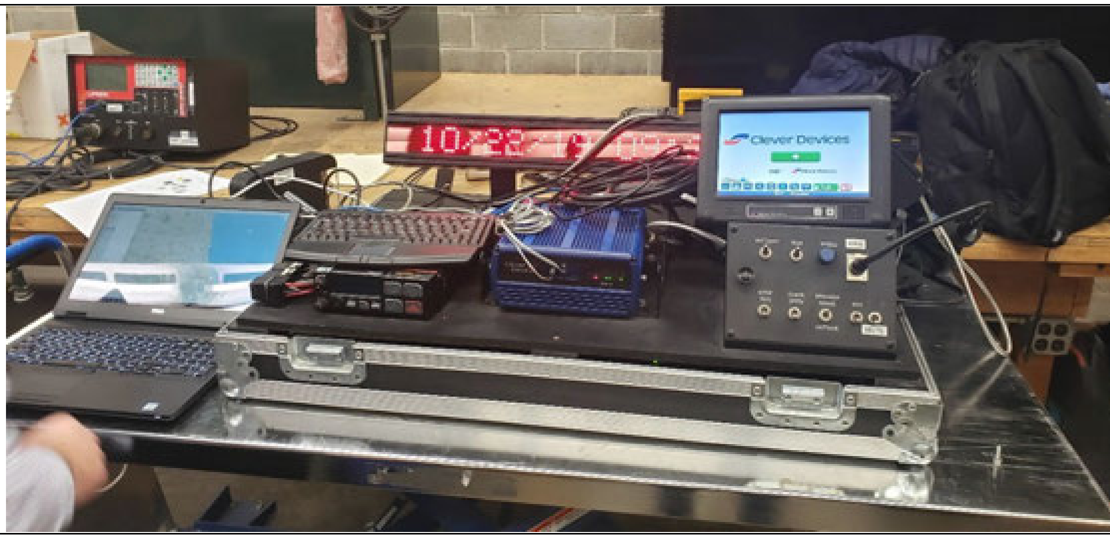
2.2.1.1 CTA PRS and Communications Equipment Bench Testing

The CTA conducted bench testing in October 2017 and February 2018 to observe the operation of the PRS implemented within the Peek ATC signal controller. Bench testing also included the use of Raspberry Pi and Sierra MP70 wireless communications equipment along with virtual testing tools to guide the simulation of TSP requests to the PRS. The PRS successfully received and acknowledged TSP requests using the noted vehicle and intersection based communications equipment.

2.2.1.2 CTA PRG Bench Testing

The CTA conducted bench testing in October 2019 of the PRG contained within their Clever Devices AVL system communicating the Regional TSP Message Set. Bench testing included the use of a Clever Devices AVL system, Raspberry Pi communications equipment, and a Peek ATC-1000 traffic signal controller. Figure 4 below presents the bench testing environment that was set up at the CDOT Division of Electrical Operations (DEO) Traffic Signal Shop.

Figure 4 – CTA PRG Bench Testing Pictures



Bench Test Setup

Clever Devices AVL System as PRG

Peek ATC Controller as PRS with Raspberry Pi Communications Equipment

The purpose of bench testing was to verify communication of the Regional TSP Message Set from the Clever Devices AVL system to the Peek ATC-1000 controller as the Regional PRS. Three Peek ATC controllers were set up for bench testing as Ashland & 44th, 45th, and 46th Streets.

2.2.1.3 Pace PRS and TSP Central Software Bench Test at Parsons (08/01/2018)

A bench test was conducted for Pace at the Parsons office to demonstrate that the requirements are fulfilled in relation to the Novax PRS and TSP Central Software. Parsons provided a test plan that details the requirements, the traceability matrix of the requirements and how these requirements were demonstrated.

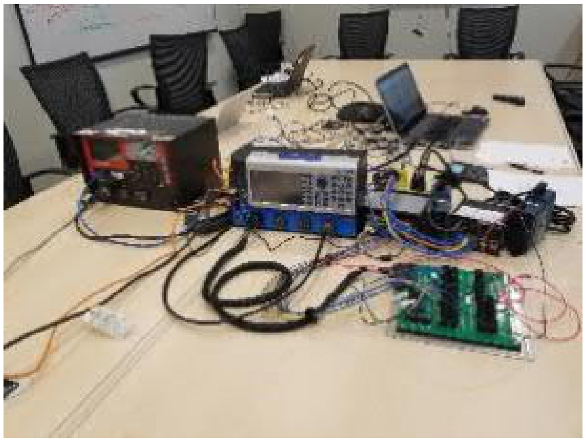
The test plan detailed the following parameters as the items to observe in testing:

- Receiving, logging, and acting upon priority request messages formatted in accordance with the RTA Technical Specification for the Regional Interoperable Message Set.
- Properly responding back to the PRG in accordance with the RTA Technical Specification for the Regional Interoperable Message Set.
- Properly requesting priority in response to priority request messages and, under certain conditions, denying priority in response to priority request messages.
- Properly logging data for each priority request in a TSP Event Log File and/or sending the logged events to the Central Software in "real time"
- Properly requesting priority in response to two transit vehicles approaching an intersection at the same time.
- Properly initiating priority request in response to priority request messages at intersections with near side bus stops.

Appendix A to this document details the notes from this testing. The notes break down the specific tests and whether these individual tests were successful or not. These notes were prepared by Jacobs/Iteris and distributed to involved parties.

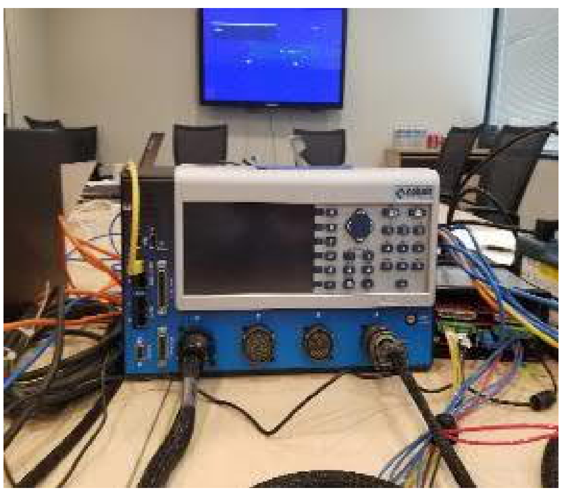
Images of the elements used in the Bench Test setup at Parsons are shown in Figure 5 in order to clearly depict what was utilized during the testing.

Figure 5 – Novax PRS and TSP Central Software Bench Test Pictures

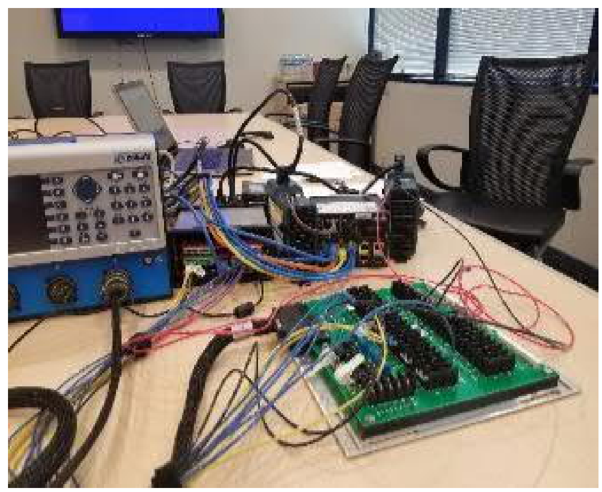


Bench Test Setup

Peek Controller



Cobalt (with EOS)



System Connections

2.2.1.4 Pace TSP Integrated Systems Bench Test at Meade (11/16/2018)

A bench test was conducted for Pace at the Meade Electric office to demonstrate TSP systems readiness for deployment on the Milwaukee Avenue Corridor.

- Appendix B contains the test plan, provided by Jacobs, that details the requirements for this bench testing.
- Appendix C details the specific tests and whether these individual tests were successful or not. The report was prepared by Jacobs/Iteris and distributed to involved parties.

Images of the elements used in this Bench Test setup at Meade are shown in Figure 6 in order to clearly depict what was utilized during the testing. Overall, this bench test successfully confirmed the capabilities of Pace's TSP system for different scenarios along Milwaukee Avenue at 5 different intersections.

Figure 6 – Pace TSP Integrated Systems Bench Test Pictures

Peek Controller (Gale Street)

Econolite Controller (Maryland Street)

PRS (Flashes yellow when TSP requested)


Pace Bus in a Box

Siemens M50 & M60 ATC

2.2.2. Field Testing

Field testing of TSP System components designed and deployed by Pace and CTA under the program are described in the sections below.

2.2.2.1 CTA TSP System Field Testing

In early 2018, the CTA and CDOT observed field testing of TSP system operations utilizing the previously developed PRG and COM equipment on buses with the Peek PRS and intersection-based communications equipment developed under the program. This included Raspberry Pi radios deployed at intersections along the South Ashland corridor between Cermak Road and 95th Street. Testing and logs of requests were observed through use of central monitoring software.

In late 2018, additional field testing of the Peek PRS event logging capabilities was performed after updates were made to the signal controller's logging capabilities.

In September and October 2019, the CTA conducted field testing of the CTA PRG and its communication of the Regional TSP Message Set to Peek PRS devices installed along Western Avenue. The field testing indicated that additional bench testing would need to be performed prior to implementing the PRG on all CTA buses with the Clever Devices AVL system.

2.2.2.2 Pace TSP Integrated Systems Field Test on Milwaukee Avenue (April 2019)

A field test / proof-of-concept test was conducted on the Milwaukee Avenue Corridor in April 2019 to demonstrate TSP system operations and readiness for deployment. This demonstration included the following intersections and types of intersection equipment listed in Table 3.

Table 3 – Milwaukee Avenue Intersections and PRS Equipment

IDOT Jurisdiction	Signal Controller Type	Additional PRS Equipment
Maryland St/ Church St	Cobalt ATC	Novax Regional PRS
Ballard Rd	Econolite ASC/3	Novax Regional PRS
Dempster St	Econolite ASC/3	Novax Regional PRS
Main St	Eagle EPAC M52	Novax Regional PRS
Oak Mill Mall Entrance	Eagle EPAC M52	Novax Regional PRS
Waukegan Rd	Econolite ASC/3	Novax Regional PRS
Touhy Ave	Econolite ASC/3	Novax Regional PRS
Harts Rd	Econolite ASC/3	Novax Regional PRS
CDOT Jurisdiction		
Elston/Melvina Ave	Peek ATC-1000 *	--
Austin Ave/Ardmore Ave	Peek ATC-1000 *	--
Bryn Mawr Ave	Peek ATC-1000 *	--
Gale St	Peek ATC-1000 *	--

*Note: Regional PRS internal to signal controller.

In addition to the PRS equipment installed at intersections, Pace installed wireless access points on signal mast arms and along the corridor to receive TSP requests from Pace buses traveling along the corridor. This equipment utilizes a 5 GHz frequency and is configured to receive communications from Pace buses equipped with corresponding communications equipment.

Additional communications equipment was installed within signal cabinets for the purpose of sending TSP data from the Regional PRS to the Pace central software interface for review. At IDOT intersections, this included Cisco network switches that connected with the Regional PRS devices to allow for communication with the Pace central software interface. IDOT fiber-optic cable previously installed on Milwaukee Avenue for traffic signal interconnects was spliced into the Cisco switch to connect IDOT intersections with Regional PRS equipment. A cellular modem was then installed within the signal cabinet at Maryland St. for the purpose of communicating all IDOT intersection-based TSP data to the Pace central software interface.

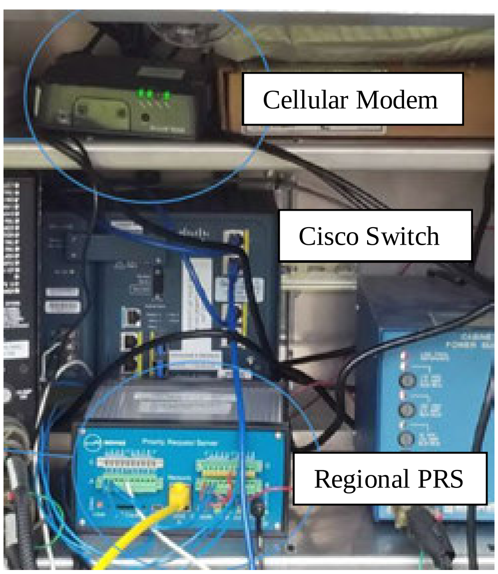
For the other intersections under CDOT jurisdiction, a Cisco switch and cellular modem was installed within the Gale St. signal cabinet to communicate TSP data from this intersection to the Pace central software interface.

Images of the communications equipment and the Regional PRS devices installed along Milwaukee Avenue are presented in Figure 7.

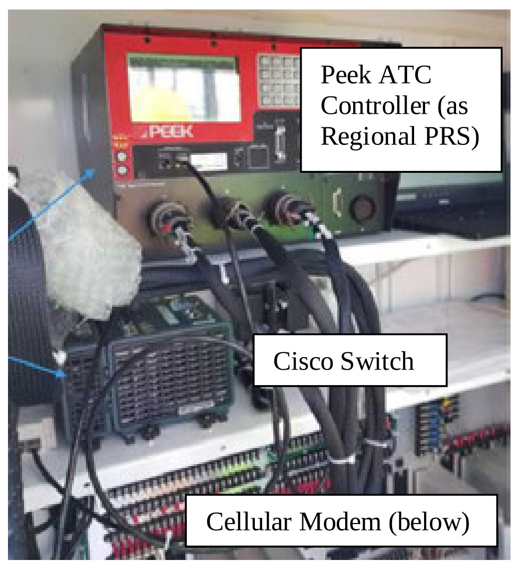
Figure 7 – Pace TSP Communications on Milwaukee Avenue

5GHz Access Point
at Maryland St. (IDOT Signal)

5GHz Access Point
at Austin Ave/Ardmore Ave. (CDOT Signal)



Cellular Modem (top) and Cisco Switch (middle) at Maryland St. (IDOT Signal)



Cisco Switch (middle) and Cell Modem at Gale St. (CDOT Signal)

Additional field testing by IDOT and Lake County DOT (LCDOT) has been requested on the Econolite Regional PRS due to its use of an operating system (eOS) that is new to both traffic departments. TSP field testing will occur on the Grand Avenue Corridor upon completion of IDOT bench and field testing of the eOS firmware for traffic signal operations.

2.2.3. Implementation

The implementation status of TSP system components under the program is summarized in Table 4.

Table 4 – Implementation Status of RTSPIP Components by CTA / Pace

Agency	Subsystem	Implementation Status	Locations
CTA	PRG	Regional TSP Message Set under development by Clever Devices. Bench and field testing underway in October / November 2019.	All CTA buses with Clever Devices AVL system equipment
	PRS	Implemented. Regional TSP Message Set functionality has been installed on Peek ATC model controllers.	1. Approx. 40 traffic signals along South Ashland Avenue from Cermak Rd. / 22nd St. to 95th St. 2. Approx. 100 traffic signals along Western Avenue from Howard St. to 79th St.
	COM	Implemented. Updates to equipment to enable a WLAN along CTA TSP corridors are needed to enable interoperability with Pace PRG and COM equipment.	1. Approx. 40 traffic signals along South Ashland Avenue from Cermak Rd. / 22nd St. to 95th St. 2. Approx. 100 traffic signals along Western Avenue from Howard St. to 79th St.
	SOFT	Implemented. Software available to CTA staff for review of TSP logs on Peek controllers and CTA AVL System.	Available to CTA transit planners at CTA offices with access to software
Pace	PRG	Completed bench testing in November 2018. Field testing of PRG and PRS components occurred in April 2019. Implementation of PRG on Pace buses to follow in Nov. / Dec. 2019.	All Pace buses with Trapeze AVL system equipment.
	PRS	Completed bench testing in November 2018. Field testing of PRG and PRS components occurred in April 2019.	To be implemented first along the Milwaukee Ave. Corridor.
	COM	Completed bench testing in November 2018. Field testing of PRG and PRS components occurred in April 2019.	To be implemented first along the Milwaukee Ave. Corridor.
	SOFT	Bench tested in August 2018. Software to be utilized as part of field testing in Nov. / Dec. 2019.	Available to Pace transit planners at Pace offices with access to software

2.2.4. Verification

Verification activities include the review of field testing and implementation by Pace and CTA to verify that Technical System Requirements defined earlier in the program are being met for the TSP System subsystem components. Guidance documentation on the recommended sequence of bench and field testing was provided through the development of a TSP System Verification Plan. In addition, an Interoperability Testing Plan was developed to guide the interoperability testing of Pace and CTA TSP System components.

A requirements traceability matrix has been developed to log the dates of testing and implementation activities by Pace and CTA, so that related Technical System Requirements can be traced to those activities to verify when the requirements were tested and implemented. The most recent version of the traceability matrix is included within Appendix D to this document.

2.2.5. Validation

Validation activities include the collection and analysis of performance measures that are described in Section 3 of this report. Performance measures can be used to validate whether specific goals and objectives for the project have been achieved through implementation of the TSP System.

Additional details on the data collected and evaluated for the program are presented in the following sections of this document.

3. TSP PERFORMANCE MEASURES

This section of the report presents an overview of the performance measures used to evaluate the TSP systems deployed by Pace and CTA against the following goal and its related objectives:

Program Goal: Improve schedule / headway reliability, and travel times

Objective #1: Reduce variability in transit travel times and running times, and reduce transit signal delay

Objective #2: Reduce transit and general vehicle travel times along the corridor and minimize negative impacts of TSP to private vehicles on arterials and cross streets

3.1. Performance Measure Descriptions

The following performance measures have been identified to guide the quantitative evaluation of Objectives #1 and #2 as noted above.

3.1.1. Average Bus Travel Time

The average travel time of buses along the defined TSP corridor is a measure that can support the evaluation of both Objectives #1 and #2. This measure can be presented for review in minutes by route and by direction of travel.

3.1.2. Bus Travel Time Variability

The standard deviation of the bus travel times along the defined TSP corridor is a measure that can be calculated based on a review of the transit travel times collected. This measure can be presented for review in minutes by route and by direction of travel.

3.1.3. Traffic Signal Delay

Traffic signal delay is defined as the average amount of time that buses spend at red traffic signals along the defined TSP corridor. This measure can be presented for review by route and by direction of travel.

3.1.4. Number of Stops at Red Signals

This measure is defined as the average number of stops made by buses at red traffic signals along the defined TSP corridor. This measure can be presented for review by route and by direction of travel.

3.1.5. General Vehicle Travel Time

This measure is defined as the average general vehicle travel time observed along the defined TSP corridor. This measure can be presented for review in minutes by direction of travel on the corridor.

3.2. Performance Measure Methodology

The following sub-sections provide detail on the methodology followed to collect quantitative data related to each of the performance measures identified in Section 3.1.

3.2.1. Average Bus Travel Time

Data for this performance measure was collected by utilizing AVL system data collected from both Pace and CTA during the program.

CTA's Average Bus Travel Time data collection for the South Ashland Avenue TSP corridor was broken down into four phases: Phase 1, 2, 3A, and 3B.

- Phase 1: The data collected for this phase was second-by-second CTA AVL baseline data that was collected on Oct. 29th, Nov. 10th, and Nov. 12th, 2015.
- Phase 2: The data collected for this phase reflects optimized traffic signals (without TSP) and was collected on March 16th, March 17th, and March 23rd, 2016.
- Phase 3A: TSP was implemented on the Ashland Avenue corridor on April 17th, 2016. Given this date, the data collected for this phase reflects optimized traffic signals with TSP and was collected between April 26th and April 28th, 2016.
- Phase 3B: The data collected for this phase reflects optimized traffic signals with TSP and Far-Side Stop Transition and was collected between May 31st and June 2nd, 2016.

CTA's Average Bus Travel Time data collection for the Western Avenue TSP corridor was broken down into two phases:

- Phase 1: The data collected for this phase was timepoint level CTA AVL baseline data that was collected within the Fall of 2018.
- Phase 2: The data collected for this phase was timepoint level CTA AVL data that was collected within the Fall of 2019. This phase of data reflects bus travel times after both the signal optimization and TSP deployment steps. These two deployments were implemented simultaneously at each intersection, along with controller replacements. The CTA will need to temporarily disable TSP in the future in order to capture travel times that reflect only the traffic signal timing optimization efforts without the influence of TSP on bus travel times.

Additional AVL data from the CTA AVL system at other periods of time in the program has been gathered and evaluated. This summary of CTA AVL data is contained with Appendix I to this Evaluation Report.

Pace's Average Bus Travel Time data collection for all TSP corridors was broken down into three phases: Phase 1, Phase 2, and Phase 3.

- Phase 1: The data collected for this phase was AVL timestamp data from posted timepoints for baseline conditions in 2012 / 2013. This data reflected transit travel times prior to traffic signal optimization on the corridors.
- Phase 2: The data collected for this phase was AVL timestamp data from posted timepoints after-signal optimization in 2014 / 2015.
- Phase 3: The data collected for this phase will be AVL timestamp data from posted timepoints after TSP Implementation.

3.2.2. Bus Travel Time Variability

The standard deviation of the average bus travel times, as noted in the prior section, was calculated to derive this performance measure for both Pace and CTA during the program.

Use of a Microsoft Excel spreadsheet and standard deviation formulas was utilized to calculate the standard deviation for this performance measure.

3.2.3. Traffic Signal Delay

For this performance measure, second-by-second data from the CTA AVL system was collected and then analyzed using a TSP Performance Measures Analytics Tool (PMAT) developed by IBI Group for the RTSPIP. This algorithm was used to capture the stop time of the appropriate bus per direction. The total stop time consists of both dwell time (the time that it takes for passengers to board and alight the bus) and traffic signal delay. Dwell time data was collected from the CTA APC and total stop time was collected from the CTA AVL data. Traffic signal delay was calculated by subtracting dwell time from total stop time. This data was collected for each of the four phases outlined in 3.2.1. Further detail on the algorithm is provided in Appendix E to this report.

For Pace buses, traffic signal delay could not be calculated in a similar manner given that the Pace AVL system does not yet record second-by-second data for analysis. Pace is planning to upgrade the functionality of their AVL system to gather second-by-second data for future analyses on the effect of TSP on this performance measure.

In future years, the Pace AVL data will be input by RTA and/or Pace staff into the data algorithm that has been defined within Appendix E in a similar manner as the CTA AVL Data.

3.2.4. Number of Stops at Red Signals

Similar to the Traffic Signal Delay performance measure, second-by-second data recorded by the CTA AVL system was collected and then analyzed using the TSP PMAT developed for the RTSPIP to calculate the number of stops due to red traffic signals. This data was collected for each of the four phases outlined in 3.2.1. Further detail on the TSP PMAT is provided in Appendix E to this report.

For Pace buses, the number of stops at red signals could not be calculated in a similar manner given that the Pace AVL system does not yet record second-by-second data for analysis. Pace is planning to upgrade the functionality of their AVL system to gather second-by-second data for future analyses on the effect of TSP on this performance measure.

In future years, the Pace AVL data will be input by RTA / Pace staff into the TSP PMAT that has been defined within Appendix E in a similar manner as the CTA AVL Data.

3.2.5. General Vehicle Travel Time

The CTA data collection for this performance measure was initially done using field travel time runs as the method of measurement. For the South Ashland Avenue corridor, the data before traffic signal optimization was collected on Oct. 28th, 2015 and November 11th, 2015 and the data after traffic signal optimization but without TSP implementation was collected on March 16th, March 17th, and March 23rd, 2016. Field travel time runs after traffic signal optimization with TSP implementation were initially scheduled to be performed, but were placed on hold to allow for CTA / CDOT to make some corrections to TSP operations at intersections along the corridor.

Pace data for this parameter was taken from previous signal timing optimization efforts conducted from 2012 through 2015 along Pace TSP corridors by an IDOT District One approved Signal Coordination and Timing (SCAT) consultant. The final reports from the signal optimization efforts provided the data that is cited within this report.

Given that these processes of collecting vehicle travel time data can be time and labor intensive, the TSP Working Group began looking into the collection of probe data from various third party companies to support the current and future evaluation along Pace and CTA TSP Corridors.

Through discussions with project stakeholders in 2019, the following sources of third-party data were identified for data collection along the following corridors:

1. CDOT HERE Data – CDOT began working in 2018 to access third-party data from HERE to evaluate travel times and vehicle speeds on various corridors within the City of Chicago. This was identified as a data source for travel times along the following corridors:
   a. CTA: Western Avenue (Howard to 79th)
   b. CTA: Ashland Avenue (Cermak to 95th)
   c. Pace: Multiple corridors that travel within City of Chicago limits as noted below:
      i. Milwaukee Ave. from Jefferson Park to the northern city limit
      ii. 95th St. from western City limit to Stony Island Ave.
      iii. Cicero Avenue from Midway Airport (59th St.) to 87th St. (city limit)
      iv. Halsted St. from 95th St. to the southern city limit
2. HERE Data in ritis.org – IDOT and CMAP began subscribing to a web-based database in 2019 through http://www.ritis.org that can provide access to the same level of HERE data along regional corridors. This type of data can be accessed through the ritis.org database by agencies with a database subscription. The Chicago Metropolitan Agency for Planning (CMAP) was identified as an agency with access to the database that could gather the probe data indicating general vehicle travel times along the Pace TSP and CTA corridors within the region.

It should be noted that the time period for the HERE data gathered along Pace and CTA TSP corridors vary based on the state of TSP deployment on those corridors. Travel time data from HERE has been gathered for the month of September 2019 along Pace TSP Corridors to maintain consistency in comparing before and after time periods. Data has also been gathered for Tuesdays, Wednesdays, and Thursdays given the relatively consistent travel patterns observed during these days of the week.

Along CTA TSP corridors, HERE Data was gathered at the earliest point in time of available data (April 2016) for the Ashland Avenue corridor. Signal timing optimization had been performed, but this time was also before TSP deployment. Along Western Avenue, HERE data was collected in September 2018 before signal timing optimization and TSP deployment, and compared against HERE data from September 2019 signal timing optimization and TSP deployment.

The time periods established for the collection of HERE data on CTA and on Pace TSP Corridors are listed in Table 5. Along Pace TSP corridors, data gathered for September 2019 establishes a baseline, or “before-TSP”, set of travel time data. Additional data could be gathered in a similar manner in 2020 and future years by CMAP after Pace has completed deployment of TSP equipment along those corridors. A comparison can then be performed on the impacts of TSP operations on general vehicle travel times along those corridors.

Table 5 – CTA / Pace TSP Corridor Limits and HERE Data Collection Points

CTA TSP Corridors	Baseline	Optimized Without TSP	Optimized With TSP
Ashland Avenue (Cermak to 95th)	--	April 2016	September 2019
Ashland Avenue (Irving Park Rd. to Cermak)	September 2019	TBD	TBD
Western Avenue (Howard to 79th)	September 2018		September 2019
Pace TSP Corridors (Full Corridor Limits)			
Milwaukee Avenue (Golf Mill to Jefferson Park CTA Station)	--	September 2019	TBD
159th Street (94th Avenue to Torrance Avenue)			
Sibley Boulevard / 147th St. (State Line Road to Cicero Ave.)			
Roosevelt Road (Laramie Avenue to Carlton Avenue)			
Cicero Avenue (59th Street to 167th Street)			
95th Street (88th Avenue to Stony Island Avenue)			
Grand Avenue (Lake County) (Sheridan Road to U.S. 45)			
Dempster Street (Ridge Avenue to Elmhurst Road)			
Cermak Road (Cicero Ave. to Butterfield Road / Lambert Road)			
Halsted Street (95th Street to Chicago Heights Terminal)			

*Note: A separate set of "near-term corridor limits" has also been identified within the full corridor limits noted in this table. These near-term limits are further defined in Section 4.2.5 of this report.

4. EVALUATION RESULTS

This section of the report presents the evaluation of the performance measure data collected for Pace and CTA TSP Corridors as described in the previous section to evaluate the following goal and its related objectives:

Program Goal: Improve schedule / headway reliability, and travel times

Objective #1: Reduce variability in transit travel times and running times, and reduce transit signal delay

Objective #2: Reduce transit and general vehicle travel times along the corridor and minimize negative impacts of TSP to private vehicles on arterials and cross streets

4.1. CTA Results

The results from TSP implementation along particular CTA corridors are included below in Tables 6 and 7 for Routes 9 and X9, respectively, on South Ashland Avenue. Tables 8 through 10 contain performance measures collected for Routes 49, X49, and 49B, respectively, on Western Avenue. Appendix F describes each corridor in further detail for reference.

Below is a summary of the CTA data collection periods for the baseline conditions (before signal optimization), the optimized without TSP, and the optimized with TSP operations.

Data Collection Periods	CTA Route 9	CTA Route X9	CTA Route 49	CTA Route X49	CTA Route 49B
Baseline	Nov. 2015	-	Fall 2018	Fall 2018	Fall 2018
Optimized w/out TSP	Mar 2016	Mar 2016	-	-	-
Optimized with TSP	Jun 2016	Jun 2016	Fall 2019	Fall 2019	Fall 2019

4.1.1. Average Bus Travel Time

Implementation of TSP along the South Ashland Avenue TSP corridor had mixed results regarding Average Bus Travel Time. The time periods that benefited from TSP Implementation were the northbound PM peak and both directions during the midday time period.

Along the Western Avenue corridor, transit travel times were reduced in both the AM and PM Peak periods in both directions for the Route X49, ranging between a 3.4 and 9 percent reduction.

The CTA Route 49 experienced a small increase in transit travel times in all periods of the day, while the Route 49B on the northern segment of Western Avenue saw a reduction in transit travel times in the northbound direction in both the AM and PM Peak periods.

4.1.2. Bus Travel Time Variability

Along the Ashland Avenue corridor, travel time variability was reduced in all periods of the day in both directions for the Route 9, ranging between a 12 and 77 percent reduction in this measure. Along the Western Avenue corridor, travel time variability was reduced in both the AM and PM Peak periods in both directions for the Route X49, ranging between a 14 and 50 percent reduction in this measure.

The CTA Route 49 experienced a small increase in travel time variability in all periods of the day, while the Route 49B on the northern segment of Western Avenue saw a reduction in travel time variability in the northbound direction in both the AM and PM Peak periods ranging between 6 and 7 percent.

4.1.3. Traffic Signal Delay (IBI Evaluation)

Similar to Average Bus Travel Time, this performance measure benefited from TSP on South Ashland Avenue during the northbound PM peak and in both directions during the midday time period.

Along Western Avenue, traffic signal delay was measured in the Fall of 2016 before signal timing optimization, but not at other periods of time after signal timing optimization or TSP deployment in 2019 due to difficulty in gathering and evaluating second-by-second data from the CTA along Western Avenue in 2019.

4.1.4. Number of Stops at Red Signals (IBI Evaluation)

The number of stops at red signals benefited from TSP implementation on South Ashland Avenue during the midday time period in both directions, as well as southbound during the AM peak and northbound during the PM peak time periods.

Along Western Avenue, the number of stops at red signals was measured in the Fall of 2016 before signal timing optimization, but not at other periods of time after signal timing optimization or TSP deployment in 2019 due to difficulty in gathering and evaluating second-by-second data from the CTA along Western Avenue in 2019.

4.1.5. General Vehicle Travel Time

Based on the general vehicle travel times collected in 2015 and 2016, this performance measure demonstrated the most consistent improvement after traffic signal optimization on South Ashland Avenue, with all time periods and directions showing benefit from TSP. Field travel time runs after traffic signal optimization with TSP implementation were initially scheduled to be performed, but were placed on hold to allow for CTA / CDOT to make some corrections to TSP operations at intersections along the corridor.

HERE data collected from the months of April 2016 and July 2016 to complete the comparison of general vehicle travel times after signal optimization and with TSP implementation. In addition, this data was compared to HERE data collected 2019, which illustrates an increase in general vehicle travel times since 2016 in most periods of the day.

Along Western Avenue, HERE data has been collected in the months of September 2018 as a baseline condition and is compared to Optimized with TSP in the month of September 2019. A significant reduction in general vehicle travel time was observed in the AM peak in the southbound direction between Berwyn Avenue and 79th St. along the Route 49 and X49. Slight reductions in general vehicle travel times were observed in both directions in the PM Peak period between Berwyn Avenue and 79th St. For the Western Avenue segment between Howard Street and Leland Avenue that includes Route 49B, a mixed set of results were observed during all periods of the day in both directions.

Table 6 – CTA South Ashland Avenue Route 9 Performance Measures Summary

South Ashland Avenue for CTA Route 9 (Cermak Rd. to 95th St.)										
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak		
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound	
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Nov. 2015	55.90	52.65	56.50	54.25	59.12	65.52	
		Optimized w/out TSP	March 2016	59.48	48.10	52.73	53.20	53.03	51.92	
		Optimized with TSP	June 2016	66.82	48.53	55.53	54.43	52.18	59.70	
		% Change – Baseline vs. Optimized w/o TSP		6%	-9%	-7%	-2%	-11%	-26%	
		Optimized w/o TSP vs. with TSP		11%	0.89%	5%	2%	-1.63%	13%	
		Baseline vs. Optimized with TSP		16%	-8%	-2%	0%	13%	-10%	
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Nov. 2015	4.15	4.04	4.48	5.43	5.14	7.00	
		Optimized w/out TSP	March 2016	3.12	3.60	3.78	4.75	2.91	5.37	
		Optimized with TSP	June 2016	3.98	3.90	6.17	5.76	3.61	8.17	
		% Change – Baseline vs. Optimized w/o TSP		-33%	-12%	-18%	-14%	-77%	-30%	
		Optimized w/o TSP vs. with TSP		22%	8%	39%	18%	19%	34%	
		Baseline vs. Optimized with TSP		-4%	-4%	27%	6%	-42%	14%	
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline*	Nov. 2015	10.40	9.78	10.12	10.92	11.73	14.18	
		Optimized w/out TSP	March 2016	15.48	12.62	13.85	15.87	14.88	17.17	
		Optimized with TSP	June 2016	16.32	14.00	14.67	18.65	14.43	21.40	
		% Change – Baseline vs. Optimized w/o TSP		33%	22%	27%	31%	21%	17%	
		Optimized w/o TSP vs. with TSP		5%	10%	6%	15%	-3%	20%	
		Baseline vs. Optimized with TSP		36%	30%	31%	41%	19%	34%	
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline*	Nov. 2015	17	17	19	19	18	22	
		Optimized w/out TSP	March 2016	21	22	22	25	21	22	
		Optimized with TSP	June 2016	22	21	19	22	19	24	
		% Change – Baseline vs. Optimized w/o TSP		19%	23%	14%	24%	14%	0%	
		Optimized w/o TSP vs. with TSP		5%	-5%	-16%	-14%	-11%	8%	
		Baseline vs. Optimized with TSP		23%	19%	0%	14%	5%	8%	
2: General Vehicle Travel Times (in minutes)	Floating Car (2015-2016) / HERE Data (2016-2019)	Baseline	Nov. 2015	29.27	27.93	30.30	28.12	29.15	31.47	
		Optimized w/out TSP	March 2016	27.93	27.55	27.53	26.25	28.15	30.73	
		Optimized w/out TSP**	April 2016	25.14	25.01	24.71	26.63	24.66	28.20	
		Optimized with TSP	July 2016	29.42	29.55	29.81	32.16	29.32	33.92	
		% Change – Baseline vs. Optimized w/o TSP		-5%	-1%	-10%	-7%	-4%	-2%	
		Optimized w/o TSP vs. with TSP		15%	15%	17%	17%	16%	17%	
		Baseline vs. Optimized with TSP								

*Baseline values are from field data collected by EJM as opposed to the TSP PMAT that analyzed CTA second-by-second AVL data in other phases. Percent changes are not calculated for data sets that were obtained with different methodologies.

** HERE data collected in April 2016 and July 2016 as two points of comparison (before and after TSP deployment on the corridor).

Table 7 – CTA South Ashland Avenue Route X9 Performance Measures Summary

South Ashland Avenue for CTA Route X9 (Cermak Rd. to 95th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	46.62	39.68	49.70	47.88	42.58	37.53
		Optimized with TSP	June 2016	50.40	39.30	43.23	40.73	41.40	47.23
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		8%	-1%	-15%	-18%	-3%	21%
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	3.64	3.38	NA	NA	5.29	3.06
		Optimized with TSP	June 2016	4.74	4.37	2.58	5.03	4.63	5.07
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		23%	22%	-	-	-14%	40%
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	
		Optimized w/out TSP	March 2016	13.70	12.03	17.45	17.82	12.35	10.13
		Optimized with TSP	June 2016	17.47	11.27	11.57	12.23	11.52	16.55
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		22%	-7%	-51%	-46%	-7%	39%
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	19	22	22	25	18	21
		Optimized with TSP	June 2016	21	19	16	20	17	21
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		10%	-16%	-38%	-25%	-6%	0%
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Floating Car (2015-2016) / HERE Data (2016-2019)	Baseline	Nov. 2015	29.27	27.93	30.30	28.12	29.15	31.47
		Optimized w/out TSP	March 2016	27.93	27.55	27.53	26.25	28.15	30.73
		Optimized w/out TSP**	April 2016	25.14	25.01	24.71	26.63	24.66	28.2
		Optimized with TSP	Sept. 2019	29.42	29.55	29.81	32.16	29.32	33.92
		% Change – Baseline vs. Optimized w/o TSP		-5%	-1%	-10%	-7%	-4%	-2%
		Optimized w/o TSP vs. with TSP		15%	15%	17%	17%	16%	17%
		Baseline vs. Optimized with TSP							

** HERE data collected in April 2016 and July 2016 as two points of comparison (before and after TSP deployment on the corridor).

Table 8 – CTA Western Avenue (Route 49) Performance Measures Summary

Western Avenue for CTA Route 49 (Berwyn to 79th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	96.57	91.28	97.34	102.01	104.31	107.40
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	96.88	92.02	100.86	100.17	106.08	112.54
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		0%	1%	3%	-2%	2%	5%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	13.98	9.03	8.48	8.57	12.53	15.60
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	11.73	11.21	8.88	8.83	12.54	16.15
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-19%	19%	5%	3%	0%	3%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	43.93	38.72	36.73	39.45	50.20	56.72
		Baseline	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	49	51	49	51	54	58
		Baseline	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route 49 (Berwyn to 79th)					
		Baseline	Sept. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		Optimized with TSP	Sept. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		0%	-35%	-3%	1%	-2%	-4%

Table 9 – CTA Western Avenue (Route X49) Performance Measures Summary

Western Avenue for CTA Route X49 (Berwyn to 79th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	99.67	89.23	--	--	101.79	112.59
		Optimized w/out TSP				--	--		
		Optimized with TSP	Fall 2019	96.39	83.90	--	--	96.55	103.35
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		-3%	-6%	--	--	-5%	-9%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	10.02	8.75	--	--	9.58	10.89
		Optimized w/out TSP				--	--		
		Optimized with TSP	Fall 2019	8.02	5.83	--	--	8.38	7.64
		% Change – Baseline vs. Optimized w/o TSP				-	-		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		-25%	-50%	--	--	-14%	-42%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	38.70	48.88	--	--	35.33	57.68
		Baseline	Fall 2018			--	--		
		Optimized with TSP	Fall 2019			--	--		
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP				--	--		
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	42	47	--	--	47	53
		Baseline	Fall 2018			--	--		
		Optimized with TSP	Fall 2019			--	--		
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP				--	--		
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route X49 (Berwyn to 79th)					
		Baseline	Sept. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		Optimized with TSP	Sept. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		0%	-35%	-3%	1%	-2%	-4%

Table 10 – CTA Western Avenue (Route 49B) Performance Measures Summary

Western Avenue for CTA Routes 49B (Howard to Brown Line Station)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	22.10	24.53	22.64	23.19	25.43	25.80
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	21.55	26.88	22.49	25.84	24.70	27.58
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-3%	9%	-1%	10%	-3%	6%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	3.57	3.98	3.23	3.07	3.87	3.58
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	3.37	4.62	3.43	3.77	3.63	4.10
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-6%	14%	6%	19%	-7%	13%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	8.43	9.67	6.77	8.13	10.42	11.62
		Baseline	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	11	13	11	13	13	13
		Baseline	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route 49B (Howard to Leland)					
		Baseline	Sept. 2018	19.56	17.80	15.22	14.66	18.64	18.84
		Optimized with TSP	Sept. 2019	21.11	17.76	17.42	14.41	20.00	18.48
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		7%	0%	13%	-2%	7%	-2%

4.2. Pace Results

The results from traffic signal optimization along Pace TSP corridors are included in Tables 11 through 19 below. Baseline data is compared against optimized signal data "without TSP" because TSP technology has not been fully deployed along these corridors to collect "with-TSP" performance measure data. Once this information is available, the tables below will be revised to include TSP data.

Below is a summary of the Pace AVL data collection periods for baseline conditions (before signal optimization) and optimized without TSP operations along all of Pace's TSP corridors. Future AVL data will need to be gathered after TSP deployment to compare the effects of TSP operations on the performance measures presented in this section.

Data Collection Periods	95th Street (Route 381)	Cicero Ave. (Route 383)	159th St. (Route 364)	Milwaukee Ave. (Route 270)	Dempster St. (Route 250)
Baseline	May 2012	Nov. 2012	Jan. 2013	Dec. 2010	Feb. 2012
Optimized w/out TSP	Oct. 2012	July 2013	April 2013	April 2011	May 2012
Optimized w/out TSP	Summer 2019	Summer 2019	Summer 2019	Summer 2019	Summer 2019
Optimized with TSP					

Data Collection Periods	147th Street (Route 350)	Roosevelt Rd. (Route 301)	Grand Ave. (Route 565)	Cermak Rd. (Route 322)
Baseline	Nov. 2015	April 2012	Dec. 2014	July-Sept. 2012
Optimized w/out TSP	Dec. 2015	July 2012	Apr. 2015	Oct. 2012 – Apr. 2013
Optimized w/out TSP	Summer 2019	Summer 2019	Summer 2019	Summer 2019
Optimized with TSP				

4.2.1. Average Bus Travel Time

This performance measure showed benefit gained from signal optimization in both directions at all times of the day for the 95th Street corridor (Route 381), the 159th Street Corridor (Route 364), and the Milwaukee Avenue corridor (Route 270). Other TSP corridors, such as the Cicero Avenue corridor (Route 383) and the Roosevelt Road corridor (Route 301) showed either no changes or very small increases in transit travel times before and after signal timing optimization.

4.2.2. Bus Travel Time Variability

This performance measure showed benefit gained from signal optimization in both directions at all times of the day for the 95th Street corridor (Route 381) and the Milwaukee Avenue corridor (Route 270).

4.2.3. Traffic Signal Delay

Traffic signal delay could not be calculated from Pace buses given that their AVL system does not yet record second-by-second data for analysis. Pace is working to gather this data for future analyses on the effect of TSP on traffic signal delay.

Once second-by-second location data becomes available from the Pace AVL system, the data can be provided for use as an input into the TSP PMAT developed for the program. One of the data outputs from this algorithm will provide an estimate the amount of traffic signal delay experienced by Pace buses on specific TSP corridors.

4.2.4. Number of Stops at Red Signals

The number of stops at red signals could not be calculated from Pace buses given that their AVL system does not yet record second-by-second data for analysis. Pace is working to gather this data for future analyses on the effect of TSP on the number of stops at red signals.
Once second-by-second location data becomes available from the Pace AVL system, the data can be provided for use as an input into the TSP PMAT developed for the program. One of the data outputs from this algorithm will provide an estimate of the number of stops made by Pace buses at red traffic signals on specific TSP corridors.

4.2.5. General Vehicle Travel Time

This performance measure showed benefit gained from signal optimization in both directions at all times of the day for all corridors. Results presented in Tables 11 through 19 are drawn from previous signal timing optimization efforts conducted from 2012 through 2015 along Pace TSP corridors by an IDOT District One approved Signal Coordination and Timing (SCAT) consultant.

Additional performance measure data will be gathered by CMAP in subsequent years to assess the before and after effect of TSP deployment on general vehicle travel times along those corridors. Data from September 2019 has been gathered through a web-based database (available at ritis.org) by CMAP along the noted Pace TSP corridors . A similar round of data collection is planned to be performed by CMAP after Pace has completed TSP deployment along these corridors for comparison with the September 2019 data. This comparison will help to illustrate any potential impacts that TSP deployment may have on general vehicle travel times.

A template for presenting this performance measure is provided in Tables 20 and 21 below. Table 20 illustrates the near-term limits of the Pace TSP corridors that are planned for deployment in 2020. Upon completion of TSP deployment, data can be gathered and compared against the September 2019 data to assess the difference in general vehicle travel times.

Table 21 presents the full length of the Pace TSP Corridors planned for the program, portions of which will not receive a full deployment of TSP operations until after the initial deployment of TSP operations is completed by Pace. Upon completion of deployment along the full corridor, data could be gathered and compared against the September 2019 data to assess the difference in general vehicle travel times. The September 2019 data gathered by CMAP has been provided to RTA for reference and is provided in Appendix G for reference.

Appendix H to this Evalaution Report also contains a summary of performance measures that have been evaluated along the full corridor limits that Pace has planned for TSP operations. The layout of these tables is similar to what is presented in Tables 11 through 19 below.

Table 11 – Pace Cermak Road Performance Measures Summary

Cermak Road for Pace Route 322 (IL Route 56 (Butterfield Rd.) to 54th Avenue)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	July-Sept. 2012	54.55	61.77	56.81	61.73	63.77	65.48
		Optimized w/out TSP	Oct. 2012 – Apr. 2013	57.82	61.79	58.73	61.58	63.95	63.95
		Optimized w/out TSP	Summer 2019	54.51	57.58	60.24	60.33	66.49	60.81
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**		6%	0%	3%	0%	0%	-2%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	July-Sept. 2012	3.09	3.76	4.01	2.90	6.76	4.57
		Optimized w/out TSP	Oct. 2012 – Apr. 2013	5.04	4.81	5.59	3.62	5.51	4.77
		Optimized w/out TSP	Summer 2019	3.82	6.49	7.25	4.22	10.18	5.53
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**		39%	22%	28%	20%	-23%	4%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP					-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-13) ; HERE Data (2019)	Baseline	July-Sept. 2012	26.04	27.54	27.33	27.49	35.55	27.21
		Optimized w/out TSP**	Oct. 2012 – Apr. 2013	22.95	22.9	23.37	24.16	25.57	25.7
		Optimized w/out TSP***	Sept. 2019	36.52	40.37	38.14	39.45	46.08	42.59
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**		-12%	-17%	-14%	-12%	-28%	-6%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant along multiple signal systems of Cermak Road between July 2012 and April 2013 between IL Route 56 (Butterfield Rd.) to 54th Avenue.

*** HERE Data collected between IL Route 56 (Butterfield Rd.) to 54th Avenue.

Table 12 – Pace Cicero Avenue Performance Measures Summary

Cicero Avenue for Pace Route 383 (87th Street to US Route 6 (159th Street))									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Nov. 2012	11.82	10.29	10.76	10.43	11.18	11.03
		Optimized w/out TSP	July 2013	12.05	9.80	11.39	10.46	11.18	10.92
		Optimized w/out TSP	Summer 2019	39.44	38.39	41.91	40.42	41.23	41.42
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**		2%	-5%	6%	0%	0%	-1%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Nov. 2012	1.83	1.81	2.29	1.98	2.08	2.11
		Optimized w/out TSP	July 2013	2.01	1.61	2.22	1.93	2.43	1.85
		Optimized w/out TSP	Summer 2019	3.07	4.20	3.87	5.13	4.06	3.84
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**		10%	-11%	-3%	-3%	17%	-12%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times	Speed / Delay Studies (2012-15); HERE Data (2019)	Baseline	Nov. 2012 and Mar. 2015	21.87	22.4	22.44	22.54	25.21	28.49
		Optimized w/out TSP**	July 2013 and June 2015	19.65	19.39	22.03	20.61	22.85	23.7
		Optimized w/out TSP***	Sept. 2019	27.51	25.29	24.25	25.89	27.56	29.06
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-15)**		-10%	-13%	-2%	-9%	-9%	-17%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between 87th Street to 115th Street in 2012 / 2013 and separately between 115^{th} and 159^{th} Street in 2015.

*** HERE Data collected between 87th Street and US Route 6 (159th Street).

Table 13 – Pace Dempster Street Performance Measures Summary

Dempster Street for Pace Route 250 (Mannheim Road to Dodge Avenue)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Feb. 2012	16.43	15.61	15.73	15.56	17.94	18.44
		Optimized w/out TSP	May 2012	16.36	15.77	18.17	16.27	20.22	20.21
		Optimized w/out TSP	Summer 2019	51.92	52.34	53.52	54.07	57.93	57.67
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)**		0%	1%	16%	5%	13%	10%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Feb. 2012	3.80	4.18	3.68	4.23	3.71	5.99
		Optimized w/out TSP	May 2012	3.84	4.79	3.56	4.65	3.68	6.55
		Optimized w/out TSP	Summer 2019	4.79	6.34	5.12	5.90	5.23	7.48
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)**		1%	15%	-3%	10%	-1%	9%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012); HERE Data (2019)	Baseline	Feb. 2012	15.28	16.65	14.53	14.98	19.36	18.20
		Optimized w/out TSP**	May 2012	13.68	13.91	11.31	12.71	16.56	19.23
		Optimized w/out TSP***	Sept. 2019	48.65	42.40	45.24	44.76	45.26	51.10
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)		-10%	-16%	-22%	-15%	-14%	6%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant from Potter Road to Cumberland Avenue and from Harlem Avenue to Skokie Boulevard.

*** HERE Data collected between Mannheim Road in city of Des Plaines and Dodge Avenue in city of Evanston.

Table 14 – Pace Grand Avenue (Lake County) Performance Measures Summary

Grand Avenue (Lake County) for Pace Route 565 from Dilleys Road to Sheridan Road									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Dec. 2014	19.31	19.14	24.96	21.25	22.61	28.40
		Optimized w/out TSP	Apr. 2015	18.74	21.48	21.50	21.11	30.33	24.62
		Optimized w/out TSP	Summer 2019	18.25	27.49	20.39	28.13	24.15	30.16
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-3%	11%	-16%	-1%	25%	-15%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Dec. 2014	7.21	1.18	4.91	1.20	1.45	4.69
		Optimized w/out TSP	Apr. 2015	1.12	1.78	3.30	1.35	NA	4.73
		Optimized w/out TSP	Summer 2019	2.55	2.58	3.02	4.45	3.18	4.55
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-545%	34%	-49%	11%	--	1%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2014-15); HERE Data (2019)	Baseline	Dec. 2014	2.23	2.23	2.61	2.17	2.3	2.31
		Optimized w/out TSP**	Apr. 2015	1.93	1.94	2.28	2.14	2.12	2.22
		Optimized w/out TSP***	Sept. 2019	15.21	14.22	16.04	15.05	17.26	16.07
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-13%	-13%	-13%	-1%	-8%	-4%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant from Jackson Street to Sheridan Road in Dec. 2014 / April 2015.

*** HERE Data collected between Dilleys Road and Sheridan Road.

Table 15 – Pace Milwaukee Avenue Performance Measures Summary

Milwaukee Avenue for Pace Route 270 (Golf Mill Mall and Jefferson Park CTA Station)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Dec. 2010	20.81	22.52	21.49	23.62	22.31	26.87
		Optimized w/out TSP	April 2011	20.47	21.91	21.93	23.23	21.31	26.37
		Optimized w/out TSP	Summer 2019	25.89	26.19	26.67	27.06	26.29	31.38
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-2%	-3%	2%	-2%	-4%	-2%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Dec. 2010	6.60	9.79	6.70	7.17	8.08	6.70
		Optimized w/out TSP	April 2011	6.22	7.56	6.31	6.78	9.11	6.56
		Optimized w/out TSP	Summer 2019	2.74	2.38	2.78	2.88	2.81	5.18
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-6%	-22%	-6%	-5%	13%	-2%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2010-11); HERE Data (2019)	Baseline	Dec. 2010	19.38	17.25	18.58	17.63	20.65	23.86
		Optimized w/out TSP**	April 2011	16.6	15.62	15.65	15.46	17.59	20.17
		Optimized w/out TSP***	Sept. 2019	23.41	21.14	20.36	21.05	21.08	30.86
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-14%	-9%	-16%	-12%	-15%	-15%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Golf Road and Gale Street.

*** HERE Data collected between Golf Mill Mall to Jefferson Park CTA Station.

Table 16 – Pace Roosevelt Road Performance Measures Summary

Roosevelt Road for Pace Route 301 from Warrenville Rd. / West Street to IL Route 43 (Harlem Ave)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	April 2012	15.81	20.63	15.79	20.96	17.07	25.19
		Optimized w/out TSP	July 2012	16.45	19.94	17.75	22.73	16.66	24.84
		Optimized w/out TSP	Summer 2019	69.86	70.81	74.51	76.80	87.56	83.92
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)		4%	-3%	12%	8%	-2%	-1%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	April 2012						
		Optimized w/out TSP	July 2012						
		Optimized w/out TSP	Summer 2019	3.12	4.94	3.95	6.36	7.87	7.21
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP					-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-15); HERE Data (2019)	Baseline	April 2012 and Nov. 2014	30.18	27.76	26.8	25.74	36.02	30.16
		Optimized w/out TSP**	July 2012 and Dec. 2015	18.28	16.68	17.49	16.07	20.85	17.38
		Optimized w/out TSP***	Sept. 2019	44.07	32.77	36.33	30.11	47.45	37.97
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-39%	-40%	-35%	-38%	-42%	-42%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant from Carleton to I-355 in April 2012 / July 2012 and from Hamilton Ave. / Harrison St. to IL 43 (Harlem Ave.) in Nov. 2014 / Dec. 2015.

*** HERE Data collected between Warrenville Rd. / West Street to IL Route 43 (Harlem Ave).

Table 17 – Pace 95th Street Performance Measures Summary

<table>
<tr><th colspan="10">95th Street for Pace Route 381 (Roberts Road to Western Avenue)</th></tr>
<tr><th rowspan="2">Performance Measure</th><th rowspan="2">Data Source</th><th rowspan="2"></th><th>Period</th><th colspan="2">AM Peak</th><th colspan="2">Midday</th><th colspan="2">PM Peak</th></tr>
<tr><th>Direction</th><th>East-bound</th><th>West-bound</th><th>East-bound</th><th>West-bound</th><th>East-bound</th><th>West-bound</th></tr>
<tr><td rowspan="7">1-A Average Bus Travel Time (in minutes)</td><td rowspan="7">Timepoint Data</td><td>Baseline</td><td>May 2012</td><td>21.42</td><td>22.35</td><td>23.42</td><td>22.53</td><td>26.13</td><td>23.70</td></tr>
<tr><td>Optimized w/out TSP</td><td>Oct. 2012</td><td>21.28</td><td>21.08</td><td>22.67</td><td>21.03</td><td>25.19</td><td>22.67</td></tr>
<tr><td>Optimized w/out TSP</td><td>Summer 2019</td><td>26.50</td><td>28.08</td><td>31.39</td><td>29.49</td><td>33.31</td><td>29.24</td></tr>
<tr><td>Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Change – Baseline vs. Optimized w/o TSP (2012)**</td><td>-1%</td><td>-1%</td><td>-6%</td><td>-3%</td><td>-7%</td><td>-4%</td></tr>
<tr><td colspan="2">Optimized w/o TSP vs. with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Baseline vs. Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="7">1-B Bus Travel Time Variability (in minutes)</td><td rowspan="7">Timepoint Data</td><td>Baseline</td><td>May 2012</td><td>5.98</td><td>4.79</td><td>5.56</td><td>4.74</td><td>6.45</td><td>4.51</td></tr>
<tr><td>Optimized w/out TSP</td><td>Oct. 2012</td><td>4.61</td><td>4.46</td><td>5.24</td><td>5.38</td><td>6.42</td><td>4.86</td></tr>
<tr><td>Optimized w/out TSP</td><td>Summer 2019</td><td>2.72</td><td>2.99</td><td>4.18</td><td>3.19</td><td>4.85</td><td>3.78</td></tr>
<tr><td>Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Change – Baseline vs. Optimized w/o TSP (2012)**</td><td>-23%</td><td>-7%</td><td>-6%</td><td>14%</td><td>-1%</td><td>8%</td></tr>
<tr><td colspan="2">Optimized w/o TSP vs. with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Baseline vs. Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">1-C Traffic Signal Delay (in minutes)</td><td rowspan="6">Second-by-Second AVL Data*</td><td>Baseline</td><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Optimized w/out TSP</td><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Change – Baseline vs. Optimized w/o TSP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Optimized w/o TSP vs. with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Baseline vs. Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">1-D Number of Stops at Red Signals</td><td rowspan="6">Second-by-Second AVL Data*</td><td>Baseline</td><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Optimized w/out TSP</td><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Change – Baseline vs. Optimized w/o TSP</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Optimized w/o TSP vs. with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Baseline vs. Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="7">2: General Vehicle Travel Times (in minutes)</td><td rowspan="7">Speed / Delay Studies (2012-14); HERE Data (2019)</td><td>Baseline</td><td>May 2012 and Oct. 2014</td><td>17.70</td><td>19.51</td><td>20.82</td><td>22.69</td><td>24.94</td><td>25.81</td></tr>
<tr><td>Optimized w/out TSP**</td><td>Oct. 2012 and Dec. 2014</td><td>14.39</td><td>17.25</td><td>17.94</td><td>18.56</td><td>18.43</td><td>18.53</td></tr>
<tr><td>Optimized w/out TSP***</td><td>Sept. 2019</td><td>20.79</td><td>23.37</td><td>22.11</td><td>23.94</td><td>25.57</td><td>25.47</td></tr>
<tr><td>Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Change – Baseline vs. Optimized w/o TSP (2012-14)**</td><td>-19%</td><td>-12%</td><td>-14%</td><td>-18%</td><td>-26%</td><td>-28%</td></tr>
<tr><td colspan="2">Optimized w/o TSP vs. with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Baseline vs. Optimized with TSP</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Oak Park Avenue to Western Avenue and from Roberts Road to I-294.

*** HERE Data collected between Roberts Road in the city of Hickory Hills to Western Avenue in the village of Evergreen Park.

Table 18 – Pace 147th Street Performance Measures Summary

147th Street / Sibley Boulevard for Pace Route 350 (IL Route 1 (Halsted St.) to IL Route 83 (Torrence Avenue))									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Nov. 2015						
		Optimized w/out TSP	Dec. 2015						
		Optimized w/out TSP	Summer 2019	12.06	13.90	14.17	14.93	15.80	14.02
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Nov. 2015						
		Optimized w/out TSP	Dec. 2015						
		Optimized w/out TSP	Summer 2019	1.43	1.31	2.59	2.31	2.43	1.85
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2015) ; HERE Data (2019)	Baseline	Nov. 2015	28.53	28.6	28.66	29.7	32.1	35.38
		Optimized w/out TSP**	Dec. 2015	21.53	23.21	22.47	23.72	25	28.18
		Optimized w/out TSP***	Sept. 2019	11.69	12.95	11.41	13.15	12.99	15.09
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-25%	-19%	-22%	-20%	-22%	-20%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant from Homan Ave. to Michigan City Rd. and from Torrence Avenue to Madison Avenue in Nov. 2015 and Dec. 2015.

*** HERE Data collected between Warrenville Rd. / West Street to IL Route 43 (Harlem Ave).

Table 19 – Pace 159th Street Performance Measures Summary

159th Street for Pace Route 364 (Park Center Drive to IL 83 (Torrence Avenue))									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Jan. 2013	17.34	16.66	16.47	17.78	17.21	17.28
		Optimized w/out TSP	April 2013	16.78	16.98	16.18	16.97	17.04	18.12
		Optimized w/out TSP	Summer 2019	57.52	60.59	60.23	61.96	62.13	60.73
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		-3%	2%	-2%	-5%	-1%	5%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Jan. 2013	2.88	2.70	4.13	3.09	3.40	3.93
		Optimized w/out TSP	April 2013	3.19	3.42	4.36	3.61	3.81	4.68
		Optimized w/out TSP	Summer 2019	3.40	3.97	5.19	4.59	5.30	4.06
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		10%	27%	6%	17%	12%	19%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-				-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2013); HERE Data (2019)	Baseline	Jan. 2013	7.41	7.68	7.84	8.32	8.41	8.75
		Optimized w/out TSP**	April 2013	7.36	7.72	7.35	7.42	7.27	7.56
		Optimized w/out TSP***	Sept. 2019	29.05	28.70	30.24	29.37	32.93	31.79
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		-1%	1%	-6%	-11%	-14%	-14%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Crawford Avenue and Park Avenue.

*** HERE Data collected between Park Center Drive to IL 83 (Torrence Avenue).

Table 20 – General Vehicle Travel Times (in minutes) on Pace TSP Corridors (Near Term Segments)								
Pace TSP Corridor		Near Term Segments of TSP Deployment by Pace		Data Collection Period (Month / Year)	Direction	AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)
		From	To					
1	Cermak Road / 22nd Street	IL Route 56 (Butterfield Rd.) and Fairfield Ave (village of Lombard)	54th Avenue in the town of Cicero	Optimized w/out TSP (Sept. 2019)	WB	40.37	39.45	42.59
					EB	36.52	38.14	46.08
				Optimized with TSP	WB			
					EB			
2	IL Route 50 (Cicero Avenue)	87th Street in the village of Oak Lawn	US Route 6 (159th Street) in the city of Oak Forest	Optimized w/out TSP (Sept. 2019)	NB	27.51	24.25	27.56
					SB	25.29	25.89	29.06
				Optimized with TSP	NB			
					SB			
3	IL Route 58 (Dempster St.)	Mannheim Road in city of Des Plaines	Dodge Avenue in city of Evanston	Optimized w/out TSP (Sept. 2019)	WB	42.40	44.76	51.10
					EB	48.65	45.24	45.26
				Optimized with TSP	WB			
					EB			
4	Grand Avenue (Lake County)	Dilleys Road in the village of Gurnee	Sheridan Road in city of Waukegan	Optimized w/out TSP (Sept. 2019)	WB	14.22	15.05	16.07
					EB	15.21	16.04	17.26
				Optimized with TSP	WB			
					EB			
5	Milwaukee Avenue	Golf Mill	Jefferson Park CTA Station	Optimized w/out TSP (Sept. 2019)	NB	23.41	20.36	21.08
					SB	21.14	21.05	30.86
				Optimized with TSP	NB			
					SB			

Table 20 – General Vehicle Travel Times (in minutes) on Pace TSP Corridors (Near Term Segments)								
Pace TSP Corridor		Near Term Segments of TSP Deployment by Pace		Data Collection Period (Month / Year)	Direction	AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)
		From	To					
6	IL Route 38 (Roosevelt Rd.)	Warrenville Rd. / West Street in the city of Wheaton	IL Route 43 (Harlem Ave) in village of Forest Park	Optimized w/out TSP (Sept. 2019)	WB	32.77	30.11	37.97
					EB	44.07	36.33	47.45
				Optimized with TSP	WB			
					EB			
7	95th Street	Roberts Road in the city of Hickory Hills	Western Avenue in the village of Evergreen Park	Optimized w/out TSP (Sept. 2019)	WB	23.37	23.94	25.47
					EB	20.79	22.11	25.57
				Optimized with TSP	WB			
					EB			
8	IL Route 83 (147th St. / Sibley Blvd.)	IL Route 1 (Halsted St.) in the city of Harvey	IL Route 83 (Torrence Avenue) in Calumet City	Optimized w/out TSP (Sept. 2019)	WB	12.95	13.15	15.09
					EB	11.69	11.41	12.99
				Optimized with TSP	WB			
					EB			
9	US Route 6 (159th Street)	Park Center Drive in the village of Orland Park	IL Route 83 (Torrence Avenue) in Calumet City	Optimized w/out TSP (Sept. 2019)	WB	28.70	29.37	31.79
					EB	29.05	30.24	32.93
				Optimized with TSP	WB			
					EB			

Table 21 – General Vehicle Travel Times (in minutes) on Pace TSP Corridors (Full Corridor Limits)								
Pace TSP Corridor		Full Corridor Limits of TSP Deployment by Pace		Data Collection Period (Month / Year)	Direction	AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)
		From	To					
1	Cermak Road / 22nd Street	Butterfield Road/Lambert Road	Cicero Avenue	Optimized w/out TSP (Sept. 2019)	WB	51.90	50.99	57.63
					EB	51.18	49.30	58.14
				Optimized with TSP	WB			
					EB			
2	IL Route 50 (Cicero Avenue)	59th Street	167th Street	Optimized w/out TSP (Sept. 2019)	NB	43.89	38.23	42.63
					SB	38.17	38.82	46.59
				Optimized with TSP	NB			
					SB			
3	IL Route 58 (Dempster St.)	Elmhurst Road	Ridge Avenue	Optimized w/out TSP (Sept. 2019)	WB	46.21	48.85	56.56
					EB	53.72	49.50	50.28
				Optimized with TSP	WB			
					EB			
4	Grand Avenue (Lake County)	U.S. 45	Sheridan Road	Optimized w/out TSP (Sept. 2019)	WB	21.43	23.30	23.34
					EB	23.94	26.39	26.54
				Optimized with TSP	WB			
					EB			
5	Halsted Street and Harvey TSP System Upgrade	95th Street	Chicago Heights Terminal	Optimized w/out TSP (Sept. 2019)	NB	35.44	35.89	35.71
					SB	34.91	36.96	37.58
				Optimized with TSP	NB			
					SB			
6	Milwaukee Avenue	Golf Mill	Jefferson Park CTA Station	Optimized w/out TSP (Sept. 2019)	NB	23.41	20.36	21.08
					SB	21.14	21.05	30.86
				Optimized with TSP	NB			
					SB			
7	IL Route 38 (Roosevelt Rd.)	Carlton Avenue	Laramie Avenue	Optimized w/out TSP (Sept. 2019)	WB	46.66	41.77	54.72
					EB	53.71	43.58	56.68
				Optimized with TSP	WB			
					EB			

Table 21 – General Vehicle Travel Times (in minutes) on Pace TSP Corridors (Full Corridor Limits)								
Pace TSP Corridor		Full Corridor Limits of TSP Deployment by Pace		Data Collection Period (Month / Year)	Direction	AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)
		From	To					
8	95th Street	88th Avenue	Stony Island Avenue	Optimized w/out TSP (Sept. 2019)	WB	42.24	43.29	45.36
					EB	41.77	42.37	47.07
				Optimized with TSP	WB			
					EB			
9	IL Route 83 (147th St. / Sibley Blvd.)	Cicero Avenue	State Line Road	Optimized w/out TSP (Sept. 2019)	WB	28.68	28.77	31.46
					EB	28.59	28.65	31.40
				Optimized with TSP	WB			
					EB			
10	US Route 6 (159th Street)	94th Avenue	Torrance Avenue	Optimized w/out TSP (Sept. 2019)	WB	31.59	33.26	35.27
					EB	33.02	35.21	37.71
				Optimized with TSP	WB			
					EB			

5. PROGRAM NEXT STEPS / RECOMMENDATIONS

This section presents a summary of next steps for the Regional TSP Implementation Program and offers recommendations for advancing the program in the coming years.

5.1. Pace / CTA Next Steps

5.1.1. Pace Near-Term Corridor Plans for TSP Deployment

In the coming years, Pace will work with an installation contractor to deploy TSP and communications equipment along nine regional corridors as shown in Table 22 below. Traffic signals at which TSP will be deployed will include a regional PRS device that will receive requests for TSP from Pace buses and communicate the requests with existing signal controllers. At some locations, new ATC model signal controllers manufactured from Econolite (Cobalt ATC) and Siemens (M60 ATC) will be installed to enable TSP operations.

Table 22 – Pace Near-Term Corridor Plans for TSP Deployment

TSP Corridor	Corridor Lengths (approx. miles)	Total Number of Signals on Corridor	Total Number of Signals Planned for TSP with an External PRS	Total Number of Controllers to be Replaced with ATC Model Controllers
Cermak Road	15	68	55	43
Cicero Avenue	12.5	47	33	24
Dempster Street	17	82	55	23
Grand Avenue	6	10	10	2
Rand Road	4	11	9	5
Roosevelt Road	12	38	31	26
95th Street	7	29	23	18
147th Street / Sibley Avenue	4	14	14	12
159th Street	12	43	38	29
Total	89.5	342	268	182

5.1.2. Pace Development / Testing of Internal PRS

New ATC model signal controllers that will be installed on Pace TSP corridors will have the capability to host an internal PRS, which would remove the need to continue operating an external PRS at the intersection. The installation of the internal PRS on these ATC model controllers will require bench testing and field testing to be conducted by Pace and IDOT prior to formal approval for operation in the field.

As of October 2019, IDOT is in the process of bench testing and field testing the Cobalt ATC controller with eOS firmware to verify that it will be safe for traffic signal operations. Following successful completion of this testing, Pace plans to field test the operation of the Regional PRS on an Econolite Cobalt ATC model controller at an intersection along the Grand Avenue corridor in Lake County, prior to implementing the Econolite Regional PRS at additional intersections.

Further development of a regional on the Siemens M60 ATC model controller will be needed, as well as bench testing and field testing by IDOT, prior to deployment on a Pace corridor.

5.1.3. Pace / CTA Collection of Second-by-Second AVL Data

Two of the performance measures to assess the effectiveness of TSP operations selected for the program are traffic signal delay (1-C) and the number of stops at red signals (1-D). These measures were evaluated for the CTA Ashland Avenue corridor using second-by-second AVL data on vehicle location and other vehicle-based information from the CTA AVL system. Using this data as a base, a TSP Performance Measures Analytics Tool (PMAT) has been developed for the program that can be used in future years to review the AVL data and produce an output of the two performance measures 1-C and 1-D for the program.

In future years, the CTA will continue to collect second-by-second AVL data from its AVL system that could also be used within the TSP PMAT to produce the two performance measures of traffic signal delay and stops at red signals.

As of October 2019, Pace is working with its AVL system provider to update the vehicle AVL system to enable it to record the necessary second-by-second AVL data that could be used within the data algorithm to produce the two performance measures of traffic signal delay and stops at red signals.

5.1.4. CTA Plans for Future TSP Deployment

The CTA will continue to monitor TSP operations along Ashland and Western Avenues where it has been deployed under the program. Future deployment of TSP along Ashland Avenue is planned for the segment between Irving Park Road and Cermak Road, which will require upgrades to signal controllers and communications infrastructure prior to TSP operations.

The CTA is also currently reviewing updates to be made to the Sierra MP70 routers to enable them to communicate TSP requests through a WLAN or VLAN that connects the intersection-based communications equipment. The presence of WLAN along CTA TSP corridors will enable Pace buses to also communicate TSP requests to the same intersection-based communications equipment and fully enable regional TSP interoperability on Pace and CTA corridors. The CTA plans to observe how the Pace deployment of a WLAN along the Milwaukee Avenue corridor enables TSP communications between buses and intersections, and will determine next steps for upgrades to its communications equipment in the coming years.

5.1.5. Collection of HERE Data along Pace / CTA Corridors

The RTA will continue working with CMAP to collect probe traffic data from HERE through a regional database available to CMAP as the Chicago Metropolitan Planning Organization (MPO). This data has been collected for the month of September 2019 and can be used as a baseline to compare the before and after impacts of TSP operations on general vehicle travel times as performance measure number 2 for the program. This data can be used along both the Pace and CTA TSP corridors described within this evaluation report.

5.2. Program Recommendations

The RTA will continue to coordinate with Pace and CTA as they proceed with the next steps outlined above.

5.2.1. Usage of TSP PMAT

The TSP Performance Measures and Analytics Tool (PMAT) developed for the program will allow Pace and CTA to understand the effectiveness of TSP operations selected in terms of the impacts of TSP on traffic signal delay and the number of stops at red signals.

A user guide has been developed for Pace and CTA to guide agency staff through the process of entering detailed second-by-second AVL into the TSP PMAT that will provide performance measures on Pace and CTA TSP corridors at various data collection periods.

5.2.2. Follow-up Report on the Impact of TSP on Performance Measures

To date, insufficient data is available to support any conclusions regarding the overall effectiveness of TSP on bus and general vehicle performance. Pending additional data collection and evaluation, to be completed in 2020 by the CTA and Pace, the RTA will publish a follow-up report on the impact of TSP implementation on the selected performance measures that have been detailed in this Evaluation Report.

5.2.3. Continued Quarterly Meetings with Agencies

Progress made by Pace and CTA in the coming years of the program can be discussed and presented at quarterly meetings with RTA and other stakeholders that have participated in the TSP Working Group since 2013.

Reference List

[1] AECOM, “Regional TSP System Interoperability Test Plan for the Regional Transit Signal Priority Implementation Program (RTSPIP)”, Version 2.2, June 2018.

[2] AECOM, “Concept of Operations for the Regional Transit Signal Priority Implementation Program (RTSPIP)”, Version 1.3, April 2013.

[3] AECOM, “Technical System Requirements for the Regional Transit Signal Priority Implementation Program (RTSPIP)”, Version 2.3, June 2013.

[4] AECOM, “Regional Transit Signal Priority Standards and Implementation Guidelines for the RTSPIP”, Version 1.8, Updated February 2017.

[5] AECOM, “Regional TSP System Verification Plan for the Regional Transit Signal Priority Implementation Program (RTSPIP)”, Version 1.3, November 2014.

Appendix A

Pace Central Software Acceptance Test - Jim Curry Notes

TSP Central Software Basic Functions

Test Location: Lab for bench testing
Verification Method: Demonstration

Objective:
The objective of this testing is to verify the basic functions of the TSP Central Software as dictated by the associated requirements listed below.

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Requirement ID	Requirement Description	Verification Record	Criteria
2.5.1.	The PRS (central software) shall be designed to prevent unauthorized access and to facilitate only authorized access.	Demonstration of software. List of multiple system users and associated access levels.	Pass: Access is possible only by user authentication ok
2.5.2.	System administrators shall be capable of assigning and changing access privileges to the PRS for the defined users and user groups.	Demonstration of software	Pass: User configuration controls are enabled for administrator account ok
2.5.3.	A user login feature shall be provided in the PRS central software. The PRS access privileges shall include, but not be limited to:	Demonstration of software. List of multiple system users and associated access levels. (see 2.5.1.)	Pass: Access is possible only by user authentication (same as 2.5.1.)
2.5.3.1.	Monitoring and event logs reporting only	Demonstration of software. List of multiple system users and associated access levels. (see 2.5.1.)	Pass: User profile that corresponds to these privileges various permissions
2.5.3.2.	System configuration	Demonstration of software. List of multiple system users and associated access levels. (see 2.5.1.)	Pass: User profile that corresponds to these privileges
2.5.3.3.	System administration	Demonstration of software. List of multiple system users and associated access levels. (see 2.5.1.)	Pass: User profile that corresponds to these privileges ok
2.5.4.	The user access history to the PRS through the PRS central software shall be logged.	Log of user access history	Pass: Log shows user access history ok/report
2.5.6.	The PRS central software shall have a help feature with user manual information.	Demonstration of software NOT DONE	Pass: Help menu with sample user manual information (provided later prior to final software delivery)
2.5.7.	The PRS central software shall provide features to maintain data integrity, including error checking.	Error message NEED TESTS	Pass: Manually-created data discrepancy results in error message

NTCIP message table (Tariq)

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Requirement ID	Requirement Description	Verification Record	Criteria
4.2.6.	The Contractor shall provide a data backup system for data archiving and recovery	Demonstration of software see 4.2.5	Pass: Backup data is retrieved
4.2.7.	Tools to enable scheduling of data archiving and batch processing shall be provided	Demonstration of software ok	Pass: Backup scheduling controls

Special Notes:

Witnessed by:

Signature: ______

Printed Name: ______

Date: ______

Organization: ______

Signature: ______

Printed Name: ______

Date: ______

Organization: ______

Requirement ID	Requirement Description	Verification Record	Criteria
2.5.8.	In the PRS central software, verification features shall be provided to confirm that there have been no losses of data at any point in the system, and no unauthorized changes to the data.	Warning message NO DATA TO VERIFY	Pass: Manually-removed data results in warning message. Manually-edited data results in warning message. Showing NoComm error log
2.5.9.	All system measurements shall be displayed in US units.	Demonstration of software	Pass: Measurements are in US units ok
2.5.10.	The time clock of the PRS central software shall be sync with the Pace's IT network time	Demonstration of software ok-by design	Pass: Time reverts to being same for both after PRS central software time is manually changed . Use lab network time to represent Pace's IT network.
2.5.11.	The PRS central software date and time shall be adjusted automatically for daylight savings, Central Standard Time and holidays.	Demonstration of software ok-by design	Pass: Same date and time is maintained for both after network date and time traverses event threshold. Use lab network date and time to represent Pace's IT network.
2.5.12.	The PRS central software shall ensure that all created files are uniquely identified, and that no files shall be lost or missed during data transfer.	Unique file IDs ok-by design	Pass: Unique ID for ten sample test files.
2.5.18.	All map icons, row and column titles displayed on the PRS central software shall be configurable.	Demonstration of software Not user configurable Tobe Discussed	Pass: Map icons are selectable by user. Table headings are editable by user.
4.2.1.	All software shall be written in a common and well-known, modern, high-level, highly structured language .	Software documentation Java + some C-sharp ok	Pass: Documentation of software language
4.2.2.	All software shall be the current version in production at the time of installation.	Verification letter LATER	Pass: Verification statement in letter
4.2.3.	All software shall contain version control numbers.	Software documentation Build + version 9.0.37	Pass: Software documentation showing version
4.2.4.	Adjustable and configurable parameters shall not be hard-coded onto the source-code. They shall be user-modifiable.	Demonstration of software ok/subject to revision if needed	Pass: Enterable fields in user interface
4.2.5.	The Contractor shall prepare a comprehensive data backup and recovery plan, which shall adhere to Pace's IT standards.	Plan documentation PREMATURE Parsons in house plan	Pass: Pace approval of data backup and recovery plan documentation

TSP Central Software Application Functions

Test Location: Lab for bench testing
Verification Method: Demonstration

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Objective:
The objective of this testing is to verify the application functions of the TSP Central Software as dictated by the associated requirements listed below.

Requirement ID	Requirement Description	Verification Record	Criteria
2.5.5.	In the PRS central software, a web-based Graphical User Interface (GUI), both map and tabular, shall be designed to view, configure and modify functions, setting and parameters of Regional PRS.	Demonstration of software ok - demo'd	Pass: Map GUI and tabular GUI. Viewing near real-time bus location on map based on Trapeze AVL data interface. Viewing near real-time TSP Transaction Summary and Fault Message Set from the Regional PRS in table when user requests. Viewing and modifications of Regional PRS configuration parameters through GUI.
2.5.13a.	PRS shall push Transaction Summary and Fault Message Set data to the Central Software thereby enabling near real-time monitoring of corresponding information. The Regional PRS includes the following pushed information:	Log of data transmissions ok - not using transaction summary	Pass: Transaction Summary and Fault Message Set are received from PRS (see below)
2.5.13.1.	Transaction Summary, including date/time of TSP request start, date/time of TSP request end, TSP request duration, vehicle ID, intersection ID, TSP phase required, response to TSP request, and TSP request ID	Log of data transmissions	Pass: Transaction Summary is viewable in tabular format.
2.5.13.2.	Fault Message Set, including date/time stamp, intersection ID, and fault event ID	Log of data transmissions	Pass: Fault Message Set is viewable
2.5.15.	The PRS central software shall store event logs from the PRS and its database shall allow for data query via standard SQL for report generations.	Event log and visual inspection of software ok	Pass: Regional PRS event logs, message logs, and fault logs are stored and accessible through software. SQL data query on database generates reports. SNMP diagnostic logs are retrieved through separate networking monitoring application.

Requirement ID	Requirement Description	Verification Record	Criteria
2.5.16a.	The PRS central software shall allow the users to export the event logs to Microsoft Excel and Adobe Acrobat.	Exported files and visual inspection of software ok - demo'd	Pass: All TSP event logs in accordance with Novax Regional PRS Design Plan (1.0i) are exported to each file format.
2.5.17.	The PRS central software shall archive event log files. The log file archive period in the PRS central software shall be configurable.	File archive and visual inspection of software Archive Period Config DEFERRED	Pass: Archive shows past Regional PRS event logs, message logs, fault logs, and bus logs for user-selected period.
SOFT-1a.	SOFT shall perform remote monitoring and configuration of the Regional PRS:	Demonstration of software ok	Pass: Remote monitoring and configuration functions can be performed (see below). Configuration changes made in the field are reconciled by CENT SW.
SOFT-1.1a	Version	Demonstration of software	Pass: Version is viewable and configurable
SOFT-1.2a	Intersection ID	Demonstration of software	Pass: Intersection ID is viewable and configurable
SOFT-1.3a	PRS ID	Demonstration of software	Pass: PRS ID is viewable and configurable
SOFT-1.4a	IP Address	Demonstration of software	Pass: IP Address is viewable and configurable
SOFT-1.5a	PRS Network Mask	Demonstration of software	Pass: PRS Network Mask is viewable and configurable
SOFT-1.6a	PRS Gateway	Demonstration of software	Pass: PRS Gateway is viewable and configurable
SOFT-1.7a	Central Server IP Address	Demonstration of software	Pass: Central Server IP Address is viewable and configurable
SOFT-1.8a	NTP Server IP Address	Demonstration of software	Pass: NTP Server IP Address is viewable and configurable
SOFT-1.9a	PRG Communications Timeout	Demonstration of software	Pass: PRG Communications Timeout is viewable and configurable
SOFT-1.10a	PRS Signal Output Type	Demonstration of software	Pass: PRS Signal Output Type is viewable and configurable
SOFT-1.11a	Reservice Time	Demonstration of software	Pass: Reservice Time is viewable and configurable
SOFT-1.12a	Phase/PRS Output Mapping	Demonstration of software	Pass: Phase/PRS Output Mapping is viewable and configurable
SOFT-1.13a	PRS/Pin Output Mapping	Demonstration of software	Pass: PRS/Pin Output Mapping is viewable and configurable
SOFT-1.14a	PRS Inputs	Demonstration of software	Pass: PRS Inputs is viewable and configurable
SOFT-1.15a	Time of Day Table	Demonstration of software	Pass: Time of Day Table is viewable and configurable

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Requirement ID	Requirement Description	Verification Record	Criteria
SOFT-2a.	SOFT shall perform near real-time remote monitoring of pushed data from the Regional PRS, Econolite Cobalt (ASC/3) traffic signal controller, Econolite Cobalt (EOS), and Peek ATC-1000 traffic signal controller.	Demonstration of software Demo for PRS w/ ASC only	Pass: Near real-time monitoring is operational
SOFT-3a.	SOFT shall receive the TSP Transaction Summary and Fault Message Set from the Regional PRS that are transmitted in near real-time, and shall pull the TSP event logs and PRG/PRS communication messages when requested by user.	Log of data transmissions ok - w/o transaction file (not used)	Pass: TSP Transaction Summary and Fault Message Set are pushed by the Regional PRS and received in near real-time. TSP event logs and PRG/PRS communication messages are pulled from the Regional PRS. Diagnostic logs are pulled with separate networking monitoring application. Bus position data is accepted in near real-time and bus log data is retrievable daily.
SOFT-4.	SOFT shall utilize a web-based interface for retrieving TSP message sets and log data transmitted from the PRG	Demonstration of software ok - by design No DATA	Pass: Corresponding interface and data file transfer is shown
SOFT-5a.	SOFT shall utilize SNMP V1 for COM device health monitoring and configuration purposes	Demonstration of software ok - by design	Pass: Receive the pushed PRS Fault Message Set code 2, which indicate communications failure with vehicle PRG. Separate network monitoring application shows communications health status of network devices. No configuration.
SOFT-6a.	SOFT shall utilize SNMP V1 for COM device health monitoring and configuration purposes	Demonstration of software ok - by design	Pass: Receive the pushed PRS Fault Message Set code 2, which indicate communications failure with vehicle PRG. Separate network monitoring application shows communications health status of network devices. No configuration.
~~SOFT-7.~~	~~SOFT shall permit different levels of access for multiple user roles, agencies, or jurisdictions~~	~~Demonstration of software~~	~~Pass: Record of multiple users and access levels~~
(SOFT-8 to SOFT-18)	SOFT shall allow users to retrieve TSP data logs and view TSP data by selecting a combination of any of the following characteristics:	Demonstration of software	Pass: Output report showing user-selected items (see below)
SOFT-8.	a) Within a specified date range field	Demonstration of software	Pass: Output report showing user-selected items

Requirement ID	Requirement Description	Verification Record	Criteria
SOFT-9.	b) time of day	Demonstration of software	Pass: Output report showing user-selected items
SOFT-10.	c) Day of week	Demonstration of software	Pass: Output report showing user-selected items
SOFT-11.	d) Agency ID field	Demonstration of software	Pass: Output report showing user-selected items
SOFT-12.	e) One or multiple Route IDs	Demonstration of software	Pass: Output report showing user-selected items
SOFT-13.	f) One or multiple intersection IDs	Demonstration of software BEING	Pass: Output report showing user-selected items
SOFT-14.	g) One or multiple vehicle IDs	Demonstration of software WORKED	Pass: Output report showing user-selected items
SOFT-15.	h) Direction of Travel	Demonstration of software ON	Pass: Output report showing user-selected items
SOFT-16.	i) One or multiple request ID fields	Demonstration of software (2 WEEKS)	Pass: Output report showing user-selected items
SOFT-17.	j) Number TSP requests granted and denied by signal controller	Demonstration of software TS File N/A	Pass: Output report showing user-selected items
SOFT-18.	k) Reason for TSP denial by signal controller	Demonstration of software	Pass: Output report showing user-selected items
SOFT-19.	SOFT shall present TSP data logs in a table format with each data field in a separate column identified with a header row	Data log ok	Pass: PRG/PRS communication message log and TSP event log are shown
SOFT-20a.	SOFT shall provide reporting functions of the data that is readily exportable to Microsoft Excel and Adobe Acrobat	Exported files and visual inspection of software ok	Pass: Reports are converted to each file format
SOFT-21.	SOFT shall query TSP system daily activity files	Demonstration of software ok	Pass: Results shown from data query on bus position data, bus log, Regional PRS event logs, message logs, and fault logs for selected day
SOFT-22.	SOFT shall archive TSP system daily activity files	Demonstration of software ARCHIVE TBD	Pass: Archive of bus position data, bus log, Regional PRS event logs, message logs, and fault logs is shown
SOFT-23.	SOFT shall aggregate intersection ID fields to present TSP sys log data by TSP corridor	Demonstration of software KPI REPORT shown BY ROUTE OK DEFER TO KPI	Pass: Corresponding aggregated data from bus position data, bus log, Regional PRS event logs, message logs, and fault logs is shown for user-selected IDs and TSP corridors. SNMP diagnostic logs to be retrieved by separate network monitoring application.
SOFT-24.	SOFT shall present vehicle travel times on TSP corridors by route ID for performance measurement purposes (will add filter by route)	Demonstration of software Defer to KPI	Pass: Travel time data is shown to be calculated from and consistent with raw bus data for user-selected intersection-to-intersection pairs along TSP corridors by direction

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Requirement ID	Requirement Description	Verification Record	Criteria
SOFT-25a.	SOFT shall report communication failures at message level as reported by the on-board bus systems and from event logs of field devices, and discrepancies between bus and intersection data.	Demonstration of software Need Trapeze data	Pass: Receive the pushed PRS Fault Message Set code 2, which indicate communications failure with vehicle PRG.
SOFT-26a.	SOFT shall provide a graphical user interface to all functions, settings, and technical parameters of PRS.	Demonstration of software ok - config tool	Pass: Corresponding user controls are shown for near real-time monitoring, reports, and separate network monitoring application.
SOFT-27.	SOFT shall permit individual system users or groups of system users to log on with authorized user names and passwords, log off, print reports, view system status information, and configure TSP System operations	Demonstration of software ok	Pass: Record of multiple users and corresponding controls
SOFT-28.	SOFT shall allow a System Administrator to assign multiple levels of system configuration access privileges to individual System Users and groups of System Users	Demonstration of software ok	Pass: User configuration controls are enabled for administrator account
SOFT-29.	SOFT shall display PRG, PRS, and COM components against a graphical representation of their respective geographic locations	Demonstration of software ok - discussed how comm displayed ok	Pass: Static PRS location viewable at corresponding intersection location on map. PRG equipment location represented by corresponding near real-time bus location on map. COM equipment locations implicitly represented by bus and intersection locations.
SOFT-30.	SOFT shall display PRG, PRS, and COM components with icons that are automatically updated based on the current state of those components	Demonstration of software Layer - bus Layer - PRS	Pass: Icons with status indicators are viewable on map and updated in near real-time for pushed data in accordance with Novax Regional PRS Design Plan (1.0i).
SOFT-31.	SOFT shall include tools for System Users / Administrators to modify and add functioning icons for new PRG, PRS and COM components	Demonstration of software Icon issue	Pass: Corresponding software features are shown

Special Notes:

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Requirement ID	Requirement Description	Verification Record	Criteria

Witnessed by:

Signature: ____________________
Printed Name: ____________________
Date: ____________________
Organization: ____________________

Signature: ____________________
Printed Name: ____________________
Date: ____________________
Organization: ____________________

TSP Central Software Scenario Testing: One Transit Vehicle, One Intersection

Test Location: Lab for bench testing
Verification Method: Demonstration

Objective:
The objective of this testing is to verify the functions of the TSP Central Software in coordination with the Regional PRS requirements associated with this scenario.

Requirement ID	Requirement Description	Verification Record	Criteria
2.1.1 2.1.2 2.1.3	Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. PRS logs the message and does not generate a priority request signal to the traffic controller.	Log of data transmissions	Pass: The "log only" request is viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.1.8 2.2.4.1	Bus approaching intersection at normal operating speed, running late, and requests priority. The PRS generates a priority request which the traffic controller accepts. Controller may provide either Green Extension or Early Green.	Log of data transmissions	Pass: The request and controller response received by PRS is viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.1.8 2.2.4.2	Bus approaching intersection at normal operating speed, running late, and requests priority. Controller denies request. Reason not known.	Log of data transmissions	Pass: The request and controller response received by PRS is viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
	Bus approaching intersection at normal operating speed, running late, and requests priority. Intersection ID does not match PRS Intersection ID (configuration). PRS denies priority request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.2.1	Bus approaching intersection at normal operating speed, running late, and requests priority. Request is during a disallowed period. PRS denies request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.

Requirement ID	Requirement Description	Verification Record	Criteria
2.2.1	Bus approaching intersection at normal operating speed, running late, and requests priority. Requested Phase is not defined by configuration. PRS denies request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.1.12 2.2.4.6	Bus approaching intersection at normal operating speed, running late, and requests priority. Intersection is in Flash . PRS denies request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.1.12 2.2.4.5	Bus approaching intersection at normal operating speed, running late, and requests priority. Intersection is in Re-Service Mode. PRS denies request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
2.1.12 2.2.4.4 PRS-2	Bus approaching intersection at normal operating speed, running late, and requests priority. Intersection is in Priority Mode. PRS denies request.	Log of data transmissions	Pass: The request denial and reason received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
PRS-2	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a preemption call before the priority request is cancelled and cleared.	Log of data transmissions	Pass: The request and controller response received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers . Bus closes doors after passengers board, and requests priority again. Controller may provide either Green Extension or Early Green.	Log of data transmissions	Pass: The request and controller response received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.

Requirement ID	Requirement Description	Verification Record	Criteria
	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	Log of data transmissions	Pass: The request and granted response record, no clear record, and time-out record received by PRS are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
	Bus approaches intersection at normal operating speed, running late, and requests priority. Priority message is received but not acknowledged . Bus repeats priority request with same Request ID. Priority request is received and acknowledged, and bus proceeds through the intersection.	Log of data transmissions	Pass: The second request with acknowledgement received by PRS is viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log. Bus log shows initial and second request.

Special Notes:

Witnessed by:

Signature: __________
Printed Name: __________
Date: __________
Organization: __________

Signature: __________
Printed Name: __________
Date: __________
Organization: __________

TSP Central Software Scenario Testing: Two Transit Vehicles, One Intersection

Test Location: Lab for bench testing
Verification Method: Demonstration

Objective:
The objective of this testing is to verify the functions of the TSP Central Software in coordination with the Regional PRS requirements associated with this scenario.

Requirement ID	Requirement Description	Verification Record	Criteria
2.4.1	First Bus approaches the intersection at normal operating speed, running late, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection shortly after the First Bus has cleared the intersection, without changing speed, but PRS denies request due to re-service lockout time. (Same phase requested – Re-Service on Controller disabled.).	Log of data transmissions	Pass: The request and granted response for First Bus ID and request denial with reason for Second Bus ID are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
PRS-1	First Bus (Class 2; Level 1) approaches the intersection at normal operating speed, running late in the EB direction and requests priority. The Second Bus (Class 1, Level 1), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and requests priority. Only the Second Bus receives priority treatment since it has a higher Class designation. Both buses continue through the intersection.	Log of data transmissions	Pass: The two requests and granted response for Second Bus ID and denial with reason for First Bus ID are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.

Requirement ID	Requirement Description	Verification Record	Criteria
PRS-1	First Bus (Class 1; Level 1) approaches the intersection at normal operating speed, running late in the EB direction, and requests priority. The Second Bus (Class 1; Level 2), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and requests priority. Only the First Bus receives priority treatment since it has a higher Level. Both buses continue through the intersection.	Log of data transmissions	Pass: The two requests and granted response for First Bus ID and denial with reason for Second Bus ID are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.
PRS-13	First Bus (Class 1; Level 1; Lateness 45) approaches the intersection at normal operating speed, running late in the EB direction, and requests priority. The Second Bus (Class 1; Level 1; Lateness 25), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and requests priority. Only the First Bus receives priority treatment since it is running later than the 2nd bus. Both buses continue through the intersection.	Log of data transmissions	Pass: The two requests and granted response for First Bus ID and denial with reason for Second Bus ID are viewable on screen in pushed Transaction Summary in near real-time and in pulled bus log, PRG/PRS communication message log, and TSP event log.

Special Notes:

Witnessed by:

Signature:	Signature:
Printed Name:	Printed Name:
Date:	Date:
Organization:	Organization:

TSP Central Software Scenario Testing: PRS Fault Testing

Test Location: Lab for bench testing
Verification Method: Demonstration

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Objective:
The objective of this testing is to verify the functions of the TSP Central Software in coordination with the Regional PRS requirements associated with faults.

Requirement ID	Requirement Description	Verification Record	Criteria
2.4.6	Test as outlined in 11-2A is performed. Power is removed after Priority Request is granted. Power is then re-applied after 30s to ensure a complete power down. This checks log file integrity and power fail detection operation. Appropriate log event messages should be generated.	Log file ok - demo'd	Pass: Fault Message Set and System Log show corresponding content.
	Test as outlined in 11-2A is performed but TSP request signal to controller is not connected. This should result in a log message showing "I/O problem". After reconnection of signal to the controller an "I/O Fault cleared" message should be seen in the log file.	Log file	Pass: PRS Output Log Entry and PRS Input Log Entry show corresponding content.
2.4.7.2	During testing it is expected that the PRG communications will not occur for periods longer than the set "PRG Communications Failure Timeout" period. Check log to verify "PRG Communications Fault" and "PRG Communications Fault Cleared" messages are generated.	Log file ok - demo'd	Pass: Fault Message Set shows corresponding content.

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Requirement ID	Requirement Description	Verification Record	Criteria
2.4.7.3	Input assigned to UPS backup power will be activated for 10 seconds. Message log should include messages for "On Backup Power" and "Off Backup Power".	Log file Tested N/A	Pass: Fault Message Set shows corresponding content.

Special Notes:

Witnessed by:

Signature:
Printed Name:
Date:
Organization:

Signature:
Printed Name:
Date:
Organization:

Appendix B

Pace TSP Integrated Systems Bench Test Plan

Pace Transit Signal Priority Program

Pace Suburban Bus

TSP Integrated Systems
Bench Test Plan

Document No. C9X24800-XX|0

Document history and status

Revision	Date	Description	By	Review	Approved
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	04/18/18	Revised Draft	JPC		
	04/30/18	Revised Draft	JPC		

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments

TSP Integrated Systems
Bench Test Plan

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Project Manager:	Chad Hammerl
Author:	Jim Curry
File name:	N/A

Jacobs Engineering Group Inc.

525 West Monroe, Suite 1600
Chicago, Illinois 60661
United States
T +1.312.251.3000
F +1.312.251.3015
www.jacobs.com

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Table of Contents

1. Introduction

1.1 Background

Pace Suburban Bus (Pace) and the Chicago Transit Authority (CTA) are deploying Transit Signal Priority (TSP) systems to provide additional green time at traffic signals to buses that are behind schedule. The Regional TSP IP (RTSPIP) committee headed by RTA in partnership with Pace and CTA created a standard message set, referred to as the Regional TSP Interoperable Message Set, for bus-to-intersection communications. The Regional TSP Message Set defines the dialog between the on-bus Priority Request Generator (PRG) software and intersection-based Priority Request Server (PRS) software implemented on the intersection traffic controller or on a standalone Regional PRS device that interfaces with the intersection traffic controller.

1.2 Purpose

The scope of this document is to define the bench test plan for the TSP systems to be deployed initially on the Milwaukee Avenue corridor and, following the Milwaukee Avenue deployment, on other corridors in the Pace service area. The tests will verify that the TSP systems including the on-bus systems, on-bus and intersection communications equipment, traffic controller equipment, and Central Monitoring and Reporting software are fully functional and ready to be deployed for bus operations in the Milwaukee Avenue corridor.

1.3 Reference Documents

1. Pace Comprehensive TSP Communications System Design Document, Jacobs, Rev E (July 2016)
2. Technical System Requirements for the RTSPIP, version 2.4 (05/08/14)
3. Regional TSP Standards and Implementation Guidelines, version 1.5 (05/08/14)
4. Regional TSP Central Software Acceptance Test Plan, Parsons, Rev 1.3 (01/31/18)
5. PRS Acceptance Test Plan, Novax, Rev 1.0e (10/31/17)

1.4 Acronyms

AP – Access Point
ATC – Advanced Traffic (Signal) Controller
BIAB – Bus-In-A-Box Test Equipment
CTA – Chicago Transit Authority
EB - Eastbound
I2I – Intersection to Intersection (Communications)
I2C – Intersection to Center (Communications)
IP – Internet Protocol
NB – Northbound
NEMA – National Electrical Manufactures Association
NTCIP – National Transportation Communications for ITS Protocol
Pace – Pace Suburban Bus
PRG – Priority Request Generator
PRS – Priority Request Server
RTA – Regional Transportation Authority
RTSPIP - Regional Transit Signal Priority Implementation Program
SB - Southbound

SNMP – Simple Network Management Protocol
TSP – Transit Signal Priority
VLU – Vehicle Logic Unit
VTT – Virtual Testing Tool
WB - Westbound

2. Project Test Plan

Testing and acceptance of the Pace Transit Signal Priority Systems to be deployed on ten corridors in the Pace service area will be determined through a series of 13 test events that are summarized in Table 1. Table 1 describes each of the test events according to the following categories.

- Reference (column header “Ref”): reference number starting at 1.
- TSP Integrated Systems Bench Test (column header “INT”): test event is part of TSP Systems Integrated Bench Test (tests described in this document).
- Test Event: name of test event.
- Test Event Prerequisites: development or test activities that must be successfully completed before the test event can be done.
- Test Event Equipment: equipment required to conduct the test event.
- Test Event Output: data to be used to evaluate if test has demonstrated required functionality and has been successfully completed.
- Responsibility: Lead – responsible for conducting test event; Support – responsible to provide technical support to lead for conducting test event; Witness – responsible for witnessing test and contributing to evaluation of test results; Approval – responsible for final approval that tests have been completed successfully.

Table 1 describing the test events is included on the following pages.

The test events in **Table 1** have been shaded as follows to indicate the current status. Test events labelled “INT” identify test events that are described in this report (TSP integrated systems bench tests).

Shading	Status
Light Blue	Completed
Light Orange	On-Going
White	Not Started

2.1 Test Event Prerequisites

Table 1 lists the prerequisites for each of the test events, that is, development or test activities that must be successfully completed before a test event can be done. This approach is required to avoid re-testing when changes or modifications are made in equipment or software being used for the test event after the test event has been completed.

Figure 1 shows the interdependence of the planned test events, illustrating how test events are dependent on the completion of other test events and establishing the order in which test events must be completed.

Test events shown in **Figure 1** in “bold letters” identify test events that are described in this report (TSP integrated systems bench tests).

Table 1. Summary of Project Acceptance Test Events (Page 1 of 5)

Ref	INT	Test Event	Test Event Prerequisites	Test Event Equipment	Test Event Outputs	Responsibility
1		Trapeze PRG Software Acceptance Test	Trapeze PRG Software Ready For Testing	Bus-In-A-Box loaded with PRG Software PRS Virtual Testing Tool (VTT) Loaded On Laptop Bus-To-Intersection Communications Test Equipment	TSP Factory Acceptance Test (FTA) Results TSP Factory Acceptance Test (FTA) Results Summary	Lead: Trapeze Witness: Pace, Jacobs/Iteris Approval: Pace
2		Trapeze PRG Software Bench Re-Test	Modified Trapeze PRG Software Ready For Testing Trapeze PRG Software Acceptance Test Completed	Bus-In-A-Box Loaded with Modified PRG Software PRS Virtual Testing Tool (VTT) Loaded On Laptop Bus-To-Intersection Communications Test Equipment	TSP Factory Acceptance Test Results	Lead: Trapeze Approval: Pace
3		Econolite Cobalt Controller EOS-Based PRS Software Acceptance Test	Econolite Cobalt Controller EOS-Based PRS Software Ready For Testing	Econolite Cobalt Controller Loaded with PRG Software PRG Virtual Testing Tool (VTT) Loaded On Laptop Bus-To-Intersection Communications Test Equipment	Acceptance Test Results	Lead: Econolite Witness: Pace, Jacobs/Iteris Approval: Pace
4		Econolite Cobalt Controller EOS-Based Intersection Control Software Bench Testing (TCC)	Econolite Cobalt Controller EOS-Based PRS Software Acceptance Test Completed	Econolite Cobalt Controller Loaded with EOS Intersection Control Software	Test Observations	Lead: TCC Approval: IDOT
5		Econolite Cobalt Controller with EOS-Based Intersection Control Software Bench Testing (IDOT)	Econolite Cobalt Controller EOS-Based Intersection Control Software Bench Testing By TCC Completed	Econolite Cobalt Controller Loaded with EOS Intersection Control Software	Test Observations	Lead: IDOT Support: TCC Approval: IDOT
6		Econolite Cobalt Controller EOS-Based Intersection Control Software Field Operational Test	Econolite Cobalt Controller EOS-Based Intersection Control Software Bench Testing By IDOT Completed	Econolite Cobalt Controller Loaded with EOS Intersection Control Software Installed at One Intersection in Lake County	Test Observations	Lead: IDOT, Lake County Support: TCC Approval: IDOT, Lake County

Table 1. Summary of Project Acceptance Test Events (Page 2 of 5)

Ref	INT	Test Event	Test Event Prerequisites	Test Event Equipment	Test Event Outputs	Responsibility
7		Novax Regional PRS Device Development Testing	Novax Regional PRS Device Ready For Testing	Novax Regional PRS Device Ready For Testing Econolite ASC/3 Controller with ASC/3 Intersection Control Software Econolite Cobalt Controller with ASC/3 Intersection Control Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software RTA PRG Virtual Testing Tool Loaded on Laptop Computer Laptop Computer Configured to Configure Regional PRS Device and Retrieve TSP Log Data	Test Observations PRS TSP Data Logs RTA PRG Virtual Testing Tool Data Logs RTA PRG Virtual Testing Tool Screen Shots Test Controller Front Panel Display Shots	Lead: Novax
8		Novax Regional PRS Device Laboratory Acceptance Test	Novax Regional PRS Device Ready For Acceptance Testing Novax Regional PRS Development Testing Completed Final PRS Acceptance Test Plan	Novax Regional PRS Device(s) Ready For Testing Econolite ASC/3 Controller with ASC/3 Intersection Control Software Econolite Cobalt Controller Loaded with ASC/3 Intersection Control Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software RTA PRG Virtual Testing Tool Loaded on Laptop Computer Laptop Computer Configured to Configure Regional PRS Device and to Retrieve TSP Log Data	Test Observations PRS TSP Data Logs RTA PRG Virtual Testing Tool Data Logs RTA PRG Virtual Testing Tool Screen Shots Test Controller Front Panel Display Shots Test Results Final Report	Lead: Novax Witness: Pace, Jacobs/Iteris Approval: Pace

Table 1. Summary of Project Acceptance Test Events (Page 3 of 5)

Ref	INT	Test Event	Test Event Prerequisites	Test Event Equipment	Test Event Outputs	Responsibility
9		TSP Reporting Software Acceptance Test	TSP Reporting Software Ready For Acceptance Testing Novax Regional PRS Device Acceptance Test Completed Peek ATC PRS Software Acceptance Test Completed Econolite Cobalt EOS-Based PRS Software Acceptance Test Completed	TSP Reporting Software Installed on Laptop Computer RTA PRG Virtual Testing Tool Loaded on Laptop Computer Novax Regional PRS Device(s) Econolite Cobalt Controller Loaded with ASC/3 Intersection Control Software Econolite ASC/3 Controller Loaded with ASC/3 Intersection Control Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software Peek ATC Controller Loaded with PRS Software Econolite Cobalt Controller Loaded with EOS-Based PRS Software	Test Observations TSP Reporting Software Reports Regional PRS and Controller TSP Data Logs RTA PRG Virtual Testing Tool Data Logs RTA PRG Virtual Testing Tool Screen Shots Test Controller Front Panel Display Shots Test Results Final Report	Lead: Parsons Witness: Pace, Jacob/Iteris Approval: Pace
10	X	Econolite Cobalt Controller EOS 1.0 PRS Software Verification Test (Trapeze PRG Software with Econolite Cobalt Controller EOS-Based PRS Software)	Trapeze PRG Software Bench Re-Test Completed Econolite Cobalt Controller EOS-Based PRS Software Acceptance Test Completed TSP Reporting Software Operational For Retrieving Controller TSP Data Logs	Trapeze Bus-In-A-Box Loaded with PRG Software RTA PRG Virtual Testing Tool Loaded on Laptop Computer Econolite Cobalt Controller Loaded with EOS-Based PRS Software Bus-To-Intersection Communications Test Equipment TSP Reporting Software Operational for Retrieving Controller TSP Data Logs	Test Observations Controller TSP Data Logs Trapeze BIAB TSP Data Logs Trapeze BIAB Front Panel Display Shots Test Controller Front Panel Display Shots Test Results Technical Memorandum Report	Lead: Iteris Support: Jacobs, Trapeze, Meade, Parsons Witness: Pace Approval: Pace
11	X	Gale Street TSP Systems Interoperability Verification Test (Trapeze PRG Software with Peek ATC Controller PRS Software)	Trapeze PRG Software Bench Re-Test Completed Peek ATC Controller PRS Software Acceptance Test Completed TSP Reporting Software Operational For Retrieving Controller TSP Data Logs	Trapeze Bus-In-A-Box Loaded with PRG Software RTA PRG Virtual Testing Tool Loaded on Laptop Computer Peek ATC Controller Loaded with PRS Software Bus-To-Intersection Communications Test Equipment (CTA) Bus-To-Intersection Communications Test Equipment (Pace) TSP Reporting Software Operational for Retrieving Controller TSP Data Logs	Test Observations Controller TSP Data Logs Trapeze BIAB TSP Data Logs Trapeze BIAB Front Panel Display Shots Test Controller Front Panel Display Shots Test Results Technical Memorandum Report	Lead: Iteris Support: Jacobs, Trapeze, Meade, Parsons Witness: CTA, Pace Approval: Pace, CTA

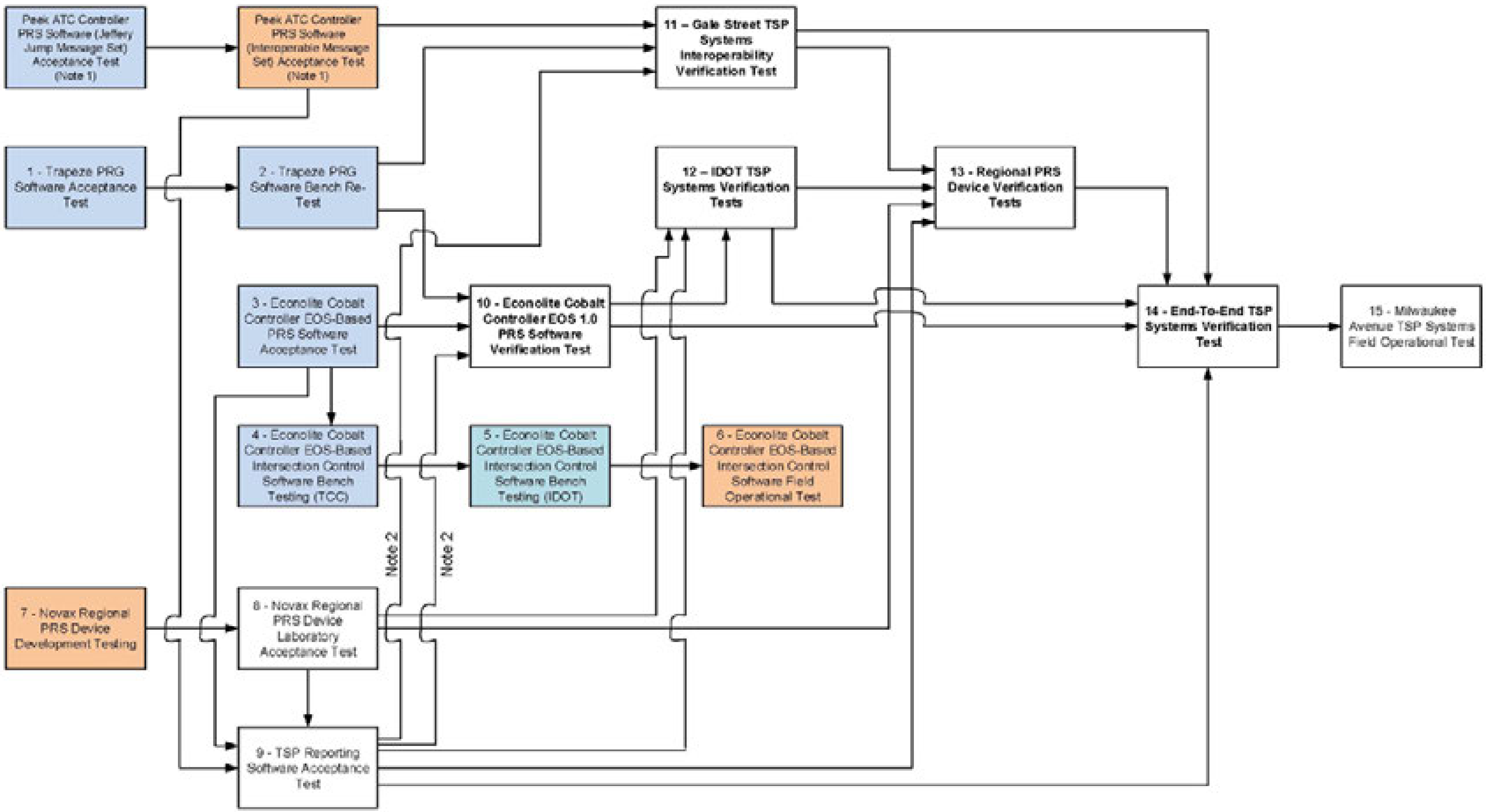
Table 1. Summary of Project Acceptance Test Events (Page 4 of 5)

Ref	INT	Test Event	Test Event Prerequisites	Test Event Equipment	Test Event Outputs	Responsibility
12	X	IDOT TSP Systems Verification Tests	TSP Reporting Software Acceptance Test Completed Novax Regional PRS Device Acceptance Test Completed Econolite Cobalt Controller EOS-Based PRS Software Verification Test Completed	TSP Reporting Software Installed and Operational RTA PRG Virtual Testing Tool Loaded on Laptop Computer Novax Regional PRS Device Econolite ASC/3 Controller loaded with ASC/3 Intersection Control Software Econolite Cobalt Controller Loaded with ASC/3 Intersection Control Software Econolite Cobalt Controller Loaded with EOS-Based PRS Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software Bus-To-Intersection Communications Test Equipment (Pace) Fully Wired NEMA TS2 Traffic Cabinet(s)	Test Observations TSP Reporting Software Reports Regional PRS and Controller TSP Data Logs RTA PRG Virtual Testing Tool Data Logs RTA PRG Virtual Testing Tool Screen Shots Test Controller Front Panel Display Shots	Lead: IDOT Support: Jacobs/Iteris, Trapeze, Novax/Parsons, Controller Equipment Suppliers Approval: IDOT
13	X	Regional PRS Device Verification Tests	Gale Street TSP Systems Interoperability Test Completed TSP Reporting Software Acceptance Test Completed Novax Regional PRS Device Acceptance Test Completed IDOT TSP Systems Verification Tests Completed	TSP Reporting Software Installed and Operational Trapeze Bus-In-A-Box Loaded with PRG Software Novax Regional PRS Device Econolite ASC/3 Controller loaded with ASC/3 Intersection Control Software Econolite Cobalt Controller Loaded with ASC/3 Intersection Control Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software Bus-To-Intersection Communications Test Equipment (Pace) Fully Wired NEMA TS2 Traffic Cabinet(s)	Test Observations TSP Reporting Software Reports Regional PRS and Controller TSP Data Logs Trapeze BIAB TSP Data Logs Trapeze BIAB Front Panel Display Shots Test Controller Front Panel Display Shots Test Results Technical Memorandum Report	Lead: Iteris Support: Jacobs, Trapeze, Novax/Parsons, Controller Equipment Suppliers, Meade Witness: Pace Approval: Pace

Table 1. Summary of Project Acceptance Test Events (Page 5 of 5)

Ref	INT	Test Event	Test Event Prerequisites	Test Event Equipment	Test Event Outputs	Responsibility
14	X	End-To End TSP Systems Verification Test	Gale Street TSP Systems Interoperability Test Completed TSP Reporting Software Acceptance Test Completed Regional PRS Device Verification Test Completed Econolite Cobalt Controller EOS 1.0 PRS Software Verification Test IDOT TSP Systems Verification Tests	TSP Reporting Software Installed and Operational Trapeze Bus-In-A-Box Loaded with PRG Software Novax Regional PRS Device(s) Econolite ASC/3 Controller loaded with ASC/3 Intersection Control Software Econolite Cobalt Controller Loaded with ASC/3 Intersection Control Software Eagle M50 Controller Loaded with TSP-Enabled Intersection Control Software Eagle M60 Controller Loaded with TSP-Enabled Intersection Control Software Peek ATC Controller Loaded with PRS Software Bus-To-Intersection Communications Test Equipment (CTA) Bus-To-Intersection Communications Test Equipment (Pace)	Test Observations TSP Reporting Software Reports Regional PRS and Controller TSP Data Logs Trapeze BIAB TSP Data Logs Trapeze BIAB Front Panel Display Shots Test Controller Front Panel Display Shots Test Results Technical Memorandum Report	Lead: Iteris Support: Jacobs, Trapeze, Novax/Parsons, Controller Equipment Suppliers, Meade Witness: Pace, CTA, RTA, CDOT, IDOT Approval: Pace
15		Milwaukee Avenue TSP Systems Field Operational Test	End-To-End TSP Systems Verification Test Completed	Updated Controller Equipment Including Signal Timing Installed at Milwaukee Avenue IDOT and CDOT Intersections Bus-To-Intersection and Intersection-To-Central Communications Installed and Operational Bus-To-Intersection and Intersection-To-Central Communications Installed and Operational TSP Reporting Software Installed and Operational on TSP Data Server Test Pace Vehicle(s) Equipped with Trapeze PRG Software Test CTA Vehicle(s) Equipped with Clever Devices PRG Software	Test Observations TSP Reporting Software Reports CTA TSP Reporting Software Reports Regional PRS and Controller TSP Data Logs Test Vehicle(s) TSP Data Logs Test Results Technical Memorandum Report	Lead: Iteris Support: Meade, Trapeze, Novax/Parsons, Meade, Traffic Controller Equipment Suppliers, On-bus Router Equipment Supplier Witness: Pace, CTA, RTA, CDOT, IDOT Approval: Pace

Figure 1. Project Acceptance Test Events



Note 1. Acceptance tests conducted by CTA.
Note 2. Operational For TSP Data Log Retrieval and Reporting

3. Integrated Systems Bench Test Plan

Testing of the TSP integrated systems functionality will be determined through a series of bench tests conducted at the Meade Electric facilities, 9550 West 55th Street in McCook, Illinois (about 26 miles from the Pace headquarters building).

The TSP integrated systems bench tests will include five groups of tests as follows.

1. Econolite Cobalt EOS 1.0 PRS Software Verification Test (Test Event 10)
   Purpose: To verify the PRS functionality of the Cobalt EOS 1.0 PRS software with the Trapeze PRG software.

2. Gale Street TSP Systems Interoperability Verification Tests (Test Event 11)
   Purpose #1: To verify the PRS functionality of the Peek ATC 1000 GreenWave software (version 3.24.4055 or later) with the Trapeze PRG software.
   Purpose #2: To verify the PRS functionality of the Peek ATC 1000 GreenWave software (version 3.24.4055 or later) in responding to request for priority messages initiated simultaneously by a CTA TSP-equipped bus and a Pace TSP-equipped bus.

3. IDOT TSP Software Verification Tests (Test Event 12)
   Tests to be conducted independently by IDOT.
   Purpose: To verify the TSP functionality of the TSP software running on the following controller types (combination of controller hardware and intersection control software):

   a. Econolite ASC/3 Controller running ASC/3 32.66.10 software
   b. Econolite Cobalt Controller running ASC/3 32.66.10 software
   c. Econolite Cobalt Controller running EOS 1.0 software
   c. Siemens Eagle M50 Controller running EPAC 3.57c software
   d. Siemens Eagle M60 Controller running EPAC 3.57c software

   Under the following conditions:

   a. TSP for left turn phases
   b. TSP with actuated pedestrian signals
   c. TSP override for railroad preemption
   d. TSP override for emergency vehicle preemption

4. Regional PRS Device Verification Tests (Test Event 13)
   Purpose: To verify the PRS functionality of the Regional PRS Device in conjunction with the following controller types (combination of controller hardware and intersection control software, tested one controller type at a time):

   a. Econolite ASC/3 Controller running ASC/3 32.10.66 software
   b. Econolite Cobalt Controller running ASC/3 32.10.66 software
   c. Siemens Eagle M50 Controller running EPAC 3.57c software
   d. Siemens Eagle M60 Controller running EPAC 3.57c software

   This series of tests will also verify the TSP Reporting Software, in particular its interfaces with the Regional PRS device.

5. End-To-End TSP Systems Verification Test (Test Event 14)
   Purpose: To verify the TSP functionality of different intersection controller types (combination of controller hardware and intersection control software) to be deployed by under the Pace TSP

program. The tests will be conducted by simulating Pace and CTA buses operating through five "test intersections', each equipped with a different controller type.

Econolite ASC/3 Controller running ASC/3 32.66.10 software (*)
Econolite Cobalt Controller running ASC/3 32.66.10 software (*)
Siemens Eagle M50 Controller running EPAC 3.57c software (*)
Siemens Eagle M60 Controller running EPAC 3.57c software
Peek ATC 1000 Controller running GreenWave 3.24.4055 software with PRS functionality (*)

(*) To be deployed at intersections on Milwaukee Avenue.

The End-To-End TSP Systems Verification Test will also verify the TSP Reporting Software including its interfaces with the various intersection controller types.

Each of the five groups of tests are described in more detail in the following sections of this report.

3.1 Test Procedure Pass/Fail

Test procedures will be developed and applied for each of the TSP integrated systems tests. When a test procedure is successfully completed, it will be assigned a "pass" designation. If the test criteria are not fully met, it will be designated as a "fail" result. Where a test procedure is failed, modifications to the equipment or software being tested may be required. In this case, previously tested functions will be subject to regression testing when testing is re-done as agreed upon by the witnessing representatives.

It is expected that some test procedures will not be successfully completed on the first attempt and will require re-testing. The test plan is intended to include one round of re-testing for selected functions where equipment or software modifications are required. The test plan does not include complete re-testing for updated versions of equipment or software released by the equipment or software suppliers.

Test results will be documented as shown in **Table 1**. Reports generated by the TSP Reporting Software from TSP log data produced by the Trapeze PRG software and from controller TSP action taken log data produced by the Regional PRS device and intersection controller PRS software will be used to document test results. Additionally, test results will be documented by recording screen or front panel data displayed during the test procedure by the BIAB, VTT laptop, and traffic controllers.

3.2 Communications Equipment Verification

The TSP integrated systems bench tests are intended to verify the functionality of the TSP systems equipment and software, already developed and tested independently, as an overall working system prior to these systems being deployed on Milwaukee Avenue and other corridors in the Pace service area.

The TSP integrated systems tests will utilize the same bus-to-intersection communications equipment that will be deployed on the street. However, the tests should not be considered as verification of the bus-to-intersection communications network design and proposed operation. The verification of the bus-to-intersection communications network to support wireless communications between moving vehicles and intersection traffic control equipment can only be determined with certainty when communications equipment has been deployed on Milwaukee Avenue and operated for a period of time under varying field conditions.

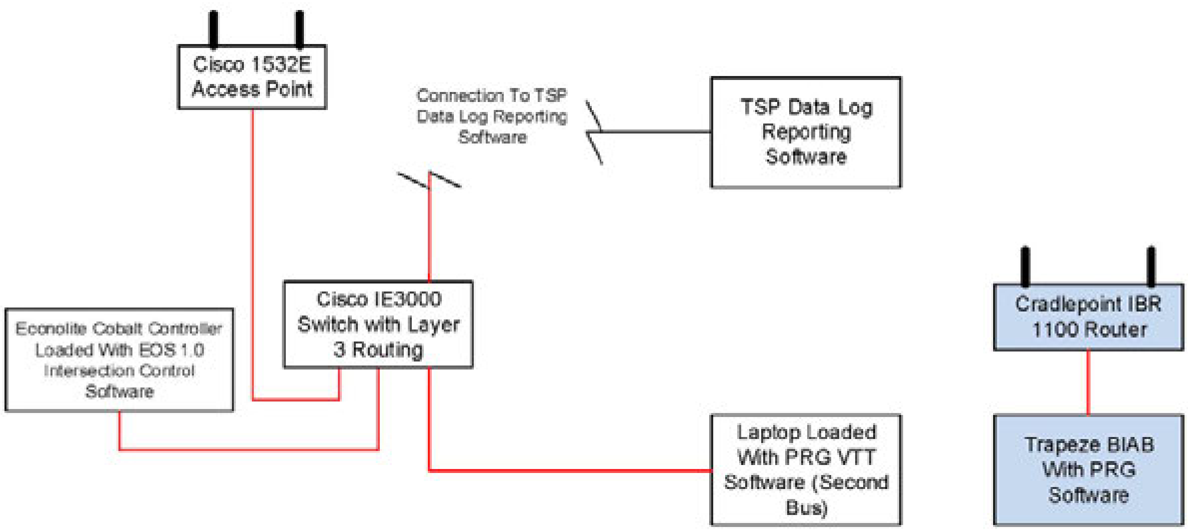
In the same way, the TSP integrated systems tests will utilize the TSP Reporting Software for the collection of bus and traffic controller log data that will be reviewed to verify that the tests were successfully completed with the desired results. However, the tests will not serve to verify the intersection-to-central communications design and proposed operation that will serve to transport log files from both buses and intersections to a central data server for processing and analysis by the TSP Reporting Software.

3.3 Econolite Cobalt EOS 1.0 PRS Software Verification Test (Test Event 10)

The Econolite Cobalt EOS 1.0 verification tests will be conducted using the test equipment setup depicted in **Figure 2**. The Trapeze Bus-In-A-Box (BIAB) including the PRG software will be used to simulate the operation of a single bus approaching the test intersection equipped with an Econolite Cobalt controller loaded with the EOS 1.0 intersection control software including PRS functionality. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and Cisco 1532E IEEE 802.11n-compliant access point (intersection equipment) will be used for the tests.

Intersection controller log data will be uploaded to the TSP Reporting Software for each of the tests for review and reporting. The details of making the connection to the TSP Reporting Software remains to be finalized, depending on where the TSP Reporting Software is implemented.

Figure 2. Econolite Cobalt EOS 1.0 PRS Verification Bench Test Equipment



Two sets of verification tests for the Econolite Cobalt EOS 1.0 PRS Software will be conducted as follows.

- One Bus, One Intersection
- Two Buses, One Intersection

The verification tests will include the same tests already conducted for the acceptance of the Econolite Cobalt Controller (EOS 1.0) PRS functionality using the RTA PRG VTT, except for certain tests that are not feasible using the Trapeze PRG software running on the BIAB.

3.3.1 Econolite Cobalt EOS 1.0 PRS Software Verification Tests – One Bus, One Intersection

The Econolite Cobalt EOS 1.0 PRS Software verification bench tests with and one bus and one intersection will consist of the tests described below in **Table 2.**

Table 2. Econolite Cobalt EOS 1.0 PRS Software Verification Tests – One Bus, One Intersection

Ref	Test Description
EOS-11-1	Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.
EOS-11-2	Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.
EOS-11-3	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.
EOS-11-4	Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority for left turn phase. Bus continues through the intersection on the left turn phase with no action taken by the controller.
EOS-11-5	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase with a green time extension.
EOS-11-6	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase green signal without adjustment.
EOS-11-7	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus is stopped in the left turn lane for a red signal. Bus continues through the intersection on the left turn phase with an early green on the left turn signal.
EOS-11-8	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.
EOS-11-9	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).
EOS-11-10	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a EVP preemption call before the priority request is cancelled and cleared.
EOS-11-11	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to railroad preemption lockout (already in progress).
EOS-11-12	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a railroad preemption call before the priority request is cancelled and cleared.
EOS-11-13	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.

EOS-11-14	Bus approaches intersection at normal operating speed, running late, and requests priority. Priority message is received but intersection ID does not match controller ID. Priority is not initiated and bus continues through intersection.
EOS-11-15	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through intersection on green extension.
EOS-11-16	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.
EOS-11-17	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.
EOS-11-18	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.
EOS-11-19	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus is slowed and stopped for red signal. Pedestrian receives full walk time for crossing street. Bus continues through the intersection on early or normal green.
EOS-11-20	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus continues through the intersection on normal green. Pedestrian receives full walk time for crossing street.
EOS-11-21	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus continues through the intersection on green extension time. Pedestrian receives full walk time for crossing street.

3.3.2 Econolite Cobalt EOS 1.0 PRS Software Verification Tests – Two Buses, One Intersection

The Econolite Cobalt EOS 1.0 PRS Software verification bench tests with and two buses and one intersection will consist of the tests described below in **Table 3.**

Table 3. Regional PRS Verification Tests – Two Buses, One Intersection

Ref	Test Description
EOS-21-1	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.

EOS-21-2	First Bus approaches the intersection at normal operating speed, running on-time in the SB direction, and requests "log only" priority. The First Bus continues through the intersection. The Second Bus approaches the intersection from the NB direction shortly after the First Bus clears the intersection, running late, and requests priority. The controller provides a green extension or early green signal for the Second Bus.
EOS-21-3	First Bus approaches the intersection in the SB direction at normal operating speed, running late, and requests priority. The Second Bus approaches the intersection in the NB direction at normal operating speeds, running late, and requests priority with estimated arrival time earlier than the First Bus. Both buses continue through the intersection.
EOS-21-4	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the EB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.
EOS-21-5	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority on the left turn phase. The controller takes no action for the Second Bus due to re-service lockout time.
EOS-21-6	First Bus approaches the intersection at normal operating speed, running late in the SB direction, and requests priority on the left turn phase. The First Bus continues through the intersection without changing speed with green extension or after stopping on an early green. The Second Bus approaches the intersection from the NB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.
EOS-21-7	First Bus (Type =2; Level=1) approaches the intersection at slow operating speed, running late in the SB direction, and requests priority. The Second Bus (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and the Second Bus requests priority. Only the Second Bus receives priority treatment since it has a higher Type designation. Both buses continue through the intersection.
EOS-21-8	First Bus (Type =1; Level=2) approaches the intersection at normal operating speed, running late in the SB direction, and requests priority. The Second Bus (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and the Second Bus requests priority. Only the First Bus receives priority treatment since a higher Level does not override a lower Level. Both buses continue through the intersection.

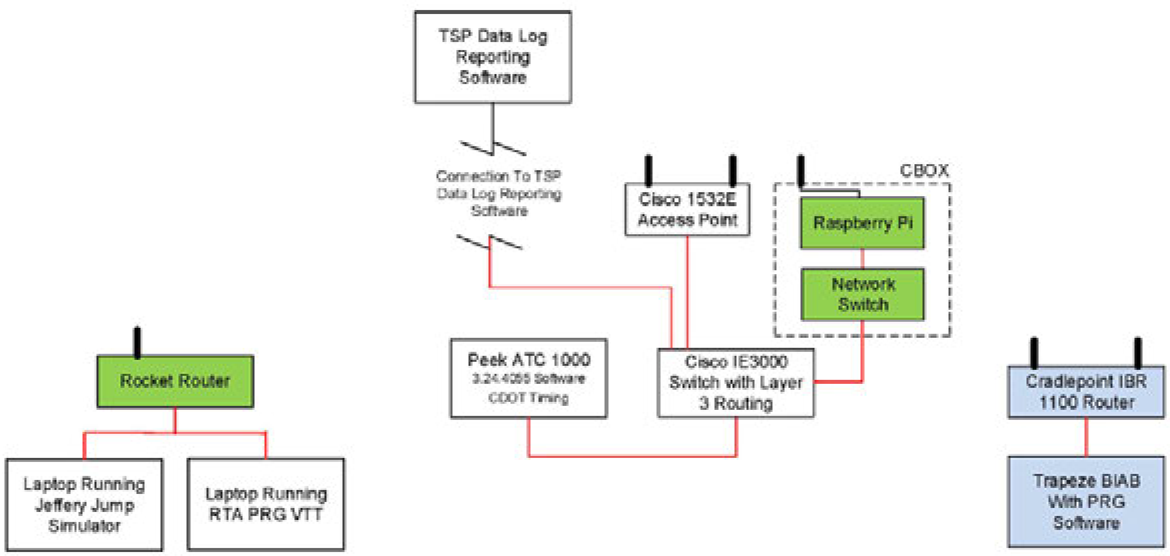
3.4 Gale Street TSP Systems Interoperability Verification Tests (Test Event 11)

The TSP systems interoperability verification tests will be conducted using the test equipment setup depicted in **Figure 3**. The Trapeze BIAB including the PRG software will be used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Gale Street intersection (test intersection).

Both the RTA PRG VTT and the CTA Jeffery Jump Message Set Simulator will be used to simulate the operation of a CTA bus equipped with Rocket Router communications equipment approaching the test intersection. The test intersection equipped with a Peek ATC 1000 traffic controller will be configured to support bus-to-intersection communications using the Cisco 1532E IEEE 802.11n-compliant access point and the CTA UANET-based protocol implemented on the Rocket Router (bus) and Raspberry Pi (intersection) communications equipment.

Intersection controller log data will be uploaded to the TSP Reporting Software for each of the tests for review and reporting.

Figure 3. TSP Systems Interoperability Verification Bench Test Equipment



Two sets of TSP systems interoperability verification tests will be conducted as follows.

- One CDOT Intersection (Gale Street), One Pace Bus
- One CDOT Intersection (Gale Street), Two Buses (One Pace Bus, One CTA Bus)

3.4.1 TSP Systems Interoperability Verification Tests – One Pace Bus, One CDOT Intersection

The TSP systems interoperability verification tests with one Pace bus and one CDOT intersection will consist of the following tests described below in Table 4.

Table 4. TSP Systems Interoperability Verification Tests – One Pace Bus, One CDOT Intersection

Ref	Test Description
INT-11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.

INT-11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.
INT-11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.
INT-11-4	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority for left turn phase. Bus continues through the intersection on the left turn phase with no action being taken by the controller.
INT-11-5	Pace Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase with a green time extension.
INT-11-6	Pace Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase green signal without adjustment.
INT-11-7	Pace Bus approaching intersection at normal operating speed, running late, and requests priority for the turn phase. Bus is stopped in the left turn lane for a red signal. Bus continues through the intersection on the left turn phase with an early green on the left turn signal.
INT-11-8	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.
INT-11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).
INT-11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a EVP preemption call before the priority request is cancelled and cleared.
INT-11-11	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to railroad preemption lockout (already in progress).
INT-11-12	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a railroad preemption call before the priority request is cancelled and cleared.
INT-11-13	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.
INT-11-14	Pace Bus approaches intersection at normal operating speed, running late, and requests priority. Priority message is received but intersection ID does not match controller ID. Priority is not initiated and bus continues through intersection.
INT-11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through intersection on green extension.

INT-11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.
INT-11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.
INT-11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.

3.4.2 TSP Systems Interoperability Verification Tests – Two Buses, One CDOT Intersection

The TSP systems interoperability verification tests with two buses, one Pace bus and one CTA bus, and one CDOT intersection will consist of the tests shown below in **Table 5**. Note that the CTA vehicle operation will be simulated using the RTA PRG Virtual Testing Tool (VTT) or CTA Jeffery Jump Message Set Simulator using a wired ethernet connection to the intersection control equipment for these tests. The Pace vehicle operation will be simulated using the Trapeze BIAB with PRG functionality.

Table 5. TSP Systems Interoperability Verification Tests – Two Buses, One CDOT Intersection

Ref	Test Description
INT-21-1	CTA Bus equipped with CTA Rocket Router communications equipment approaching Milwaukee Avenue/Gale Street test intersection, running late, requests priority using the RTA PRG VTT. Bus proceeds though the intersection on green extension or early green.
INT-21-2	CTA Bus equipped with CTA Rocket Router communications equipment approaching Milwaukee Avenue/Gale Street test intersection, running late, requests priority using the CTA Jeffery Jump simulator. Bus proceeds though the intersection on green extension or early green.
INT-21-4	CTA Bus (First Bus) approaches the intersection from SB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The CTA Bus (First Bus) continues through the intersection with green extension or early green. Pace Bus (Second Bus) approaches the intersection in the NB direction shortly after the CTA Bus (First Bus) has cleared the intersection, running late, and requests priority. The controller takes no action for the Pace Bus (Second Bus) due to re-service lockout time.
INT-21-5	CTA Bus (First Bus) approaches the intersection from SB direction at normal operating speed, running on-time, and requests priority using the Regional Interoperable Message Set. No action is taken by the controller. Pace Bus (Second Bus) approaches the intersection in the NB direction shortly after the CTA Bus (First Bus) has cleared the intersection, running late, and requests priority. The Pace Bus (Second Bus) continues through the intersection with green extension or early green. CTA Bus (Third Bus) approaches the intersection from SB direction, running late, and requests priority using the Jeffery Jump Message Set. The controller takes no action for the CTA bus (Third Bus) due to re-service lockout timer.

INT-21-6	CTA Bus (First Bus) approaches the intersection from SB direction at normal operating speed, running on-time, and requests priority using the Regional Interoperable Message Set. No action is taken by the controller. Pace Bus (Second Bus) approaches the intersection in the NB direction while the CTA Bus (First Bus) is approaching the intersection, running late, and requests priority. The Pace Bus (Second Bus) continues through the intersection with green extension or early green. CTA Bus (Third Bus) approaches the intersection from SB direction while the Pace Bus (Second Bus) is approaching the intersection, running late, and requests priority using the Jeffery Jump Message Set. The controller takes no action for the CTA bus (Third Bus) due to re-service lockout timer.
INT-21-6	CTA Bus (First Bus) approaches the intersection in the NB direction at normal operating speed, running late, and requests priority. The Pace Bus (Second Bus) approaches the intersection in the SB direction at normal operating speed, running late, and requests priority with estimated arrival time earlier than the CTA Bus (First Bus). Both buses continue through the intersection.
INT-21-7	Pace Bus (First Bus) (Type =2; Level=1) approaches the intersection at normal operating speed, running late in the SB direction, and requests priority. The CTA Bus (Second Bus) (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the Pace Bus (First Bus) requests priority and requests priority using the Regional Interoperable Message Set. Both buses continue through the intersection.
INT-21-8	Pace Bus (First Bus) (Type =1; Level=2) approaches the intersection at normal operating speed, running late in the SB direction, and requests priority. The CTA Bus (Second Bus) (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the Pace Bus (First Bus) requests priority and requests priority using the Regional Interoperable Message Set. Both buses continue through the intersection.

3.5 IDOT TSP Software Verification Tests (Test Event 12)

This set of tests will be conducted independently by IDOT using test equipment at the Pace headquarters facility. IDOT requires verification of the certain TSP functionality with the following controller types (combination of controller hardware and intersection control software) being used for this project.

a. Econolite ASC/3 Controller running ASC/3 32.66.10 software
b. Econolite Cobalt Controller running ASC/3 32.66.10 software
c. Econolite Cobalt Controller running EOS 1.0 software
c. Siemens Eagle M50 Controller running EPAC 3.57c software
d. Siemens Eagle M60 Controller running EPAC 3.57c software

The TSP functionality to be tested by IDOT is as follows:

a. Railroad preemption with TSP (Cobalt controller running ASC.3 software only)
b. Emergency vehicle preemption with TSP
c. Pedestrian actuation with TSP
d. TSP calls on a left turn phase

The test plans for the Econolite Cobalt EOS 1.0 PRS Software Verification Test (Test Event 10) and Regional PRS Device Verification Tests (Test Event 13) include tests to verify the TSP functionality for the four cases identified by IDOT.

It is expected that IDOT will be able to utilize the test equipment being assembled for the TSP integrated systems bench test to conduct the desired independent tests.

3.6 Regional PRS Device Verification Tests (Test Event 13)

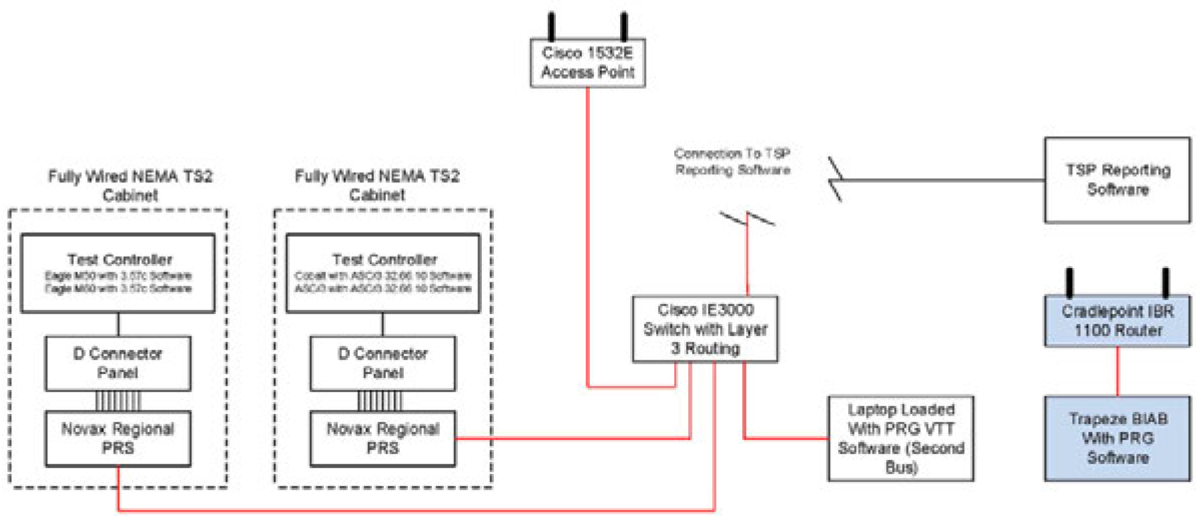
The Regional PRS Device Verification Tests will be conducted using the test equipment setup depicted in **Figure 4**. Note that the Trapeze BIAB including the PRG software will be used to simulate the operation of a single bus approaching a test intersection equipped with the Regional PRS device connected to one of the four intersection controller types installed in a fully-wired NEMA TS2 cabinet. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and IEEE 802.11n access point (intersection equipment) will be used.

For each of the four intersection controller types, two sets of verification tests will be conducted as follows.

- One Bus, One Intersection
- Two Buses, One Intersection

For consistency, the verification tests include the same tests (except for certain tests that are not feasible using the Trapeze PRG software running on the BIAB) to be conducted by the Novax team for the Regional PRS Device as described in PRS Acceptance Test Plan (prepared by Novax, dated 10/31/17) and for the TSP Reporting Software as described in the Regional TSP Central Software Acceptance Test Plan (prepared by Parsons, dated 01/31/18) using the RTA PRG VTT to provide PRG functionality.

Figure 4. Regional PRS Device Verification Bench Test Equipment



3.6.1 Regional PRS Device Verification Tests – One Bus, One Intersection

The Regional PRS Device verification bench tests with one transit vehicle and one intersection, to be conducted separately for each controller type, will consist of the following tests described below in **Table 6.**

Table 6. Regional PRS Device Verification Tests – One Bus, One Intersection

Ref	Test Description
PRS-11-1	Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.
PRS-11-2	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.
PRS-11-3	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.
PRS-11-4	Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority for left turn phase. Bus continues through the intersection on the left turn phase with no action taken by the controller.
PRS-11-5	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase with a green time extension.
PRS-11-6	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus continues through the intersection on the left turn phase green signal without adjustment.
PRS-11-7	Bus approaching intersection at normal operating speed, running late, and requests priority for left turn phase. Bus is stopped in the left turn lane for a red signal. Bus continues through the intersection on the left turn phase with an early green on the left turn signal.
PRS-11-8	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.
PRS-11-9	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).
PRS-11-10	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a EVP preemption call before the priority request is cancelled and cleared.
PRS-11-11	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to railroad preemption lockout (already in progress).
PRS-11-12	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a railroad preemption call before the priority request is cancelled and cleared.
PRS-11-13	Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.

PRS-11-14	Bus approaches intersection at normal operating speed, running late, and requests priority. Priority message is received but intersection ID does not match controller ID. Priority is not initiated and bus continues through intersection.
PRS-11-15	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through intersection on green extension.
PRS-11-16	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.
PRS-11-17	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.
PRS-11-18	Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.
PRS-11-19	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus is slowed and stopped for a red signal. Pedestrian receives full walk time for crossing street. Bus continues through the intersection on early or normal green.
PRS-11-20	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus continues through the intersection on normal green. Pedestrian receives full walk time for crossing street.
PRS-11-21	Bus approaching intersection at normal operating speed, running late, and requests priority. Pedestrian requests walk for crossing street. Bus continues through the intersection on green extension time. Pedestrian receives full walk time for crossing street.

3.6.2 Regional PRS Device Verification Tests – Two Buses, One Intersection

The Regional PRS verification bench testing with two buses and one intersection will consist of the tests shown below in **Table 7**. Note that the second vehicle operation will be simulated using the RTA PRG Virtual Testing Tool (VTT) with a wired ethernet connection to the intersection control equipment for these tests.

Table 7. Regional PRS Device Verification Tests – Two Buses, One Intersection

Ref	Test Description
PRS-21-1	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.
PRS-21-2	First Bus approaches the intersection at normal operating speed, running on-time in the SB direction, and requests "log only" priority. The First Bus continues through the intersection. The Second Bus approaches the intersection from the NB direction shortly after the First Bus clears the intersection, running late, and requests priority. The controller provides a green extension or early green signal for the Second Bus.
PRS-21-3	First Bus approaches the intersection in the SB direction at normal operating speed, running late, and requests priority. The Second Bus approaches the intersection in the NB direction at normal operating speeds, running late, and requests priority with estimated arrival time earlier than the First Bus. Both buses continue through the intersection.
PRS-21-4	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the EB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.
PRS-21-5	First Bus approaches the intersection at normal operating speed, running late in the NB direction, and requests priority. The First Bus continues through the intersection without changing speed with green extension or early green. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority on the left turn phase. The controller takes no action for the Second Bus due to re-service lockout time.
PRS-21-6	First Bus approaches the intersection at normal operating speed, running late in the SB direction, and requests priority on the left turn phase. The First Bus continues through the intersection without changing speed with green extension or after stopping on an early green. The Second Bus approaches the intersection from the NB direction shortly after the First Bus has cleared the intersection, running late, and requests priority. The controller takes no action for the Second Bus due to re-service lockout time.
PRS-21-7	First Bus (Type =2; Level=1) approaches the intersection at slow operating speed, running late in the SB direction, and requests priority. The Second Bus (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and requests priority. Only the Second Bus receives priority treatment since it has a higher Type designation. Both buses continue through the intersection.

PRS-21-8	First Bus (Type =1; Level=2) approaches the intersection at normal operating speed, running late in the SB direction, and requests priority. The Second Bus (Type 1; Level 1), also running late, approaches the intersection in the NB direction shortly after the First Bus requests priority and requests priority. Only the First Bus receives priority treatment since a higher Level does not override a lower Level. Both buses continue through the intersection.

3.7 End-To-End TSP Systems Verification Tests (Test Event 14)

The end-to-end TSP systems verification tests will be conducted using the test equipment setup depicted in **Figure 5**. The Trapeze BIAB including the PRG software will be used to simulate a single Pace bus as it operates over Route 270 along Milwaukee Avenue from the Milwaukee Avenue/Maryland Avenue/ Church Street intersection to the Milwaukee Avenue/Gale Street intersection through the following five test intersections (from north to south), each equipped with a different controller type as follows.

- Milwaukee Avenue/Maryland Avenue/Church Street – Econolite Cobalt controller loaded with ASC/3 32.66.10 intersection control software including TSP functionality and IDOT signal timing for Maryland Avenue.

  Note that NB Route 270 buses travel straight through the intersection on Milwaukee Avenue, and SB Route 270 buses make a right turn from EB Maryland Avenue to SB Milwaukee Avenue through the intersection.

- Milwaukee Avenue/Main Street – Siemens Eagle controller loaded with EPAC 3.57c intersection control software including TSP functionality and IDOT signal timing for Main Street.

- Milwaukee Avenue/Oak Mill Mall Entrance – Siemens Eagle controller loaded with EPAC 3.57c intersection control software including TSP functionality and IDOT signal timing for Oak Mill Mall Entrance.

- Milwaukee Avenue/Harts Road – Econolite ACS/3 controller loaded with ASC/3 32.66.10 intersection control software including TSP functionality and IDOT signal timing for Harts Road.

- Milwaukee Avenue/Gale Street – Peek ATC 1000 controller loaded with GreenWave 3.24.4055 (or later) intersection control software including PRS functionality and CDOT signal timing for Gale Street.

Note that the test equipment setup includes only four access points, each corresponding with a physical segment on Milwaukee Avenue. It will be necessary to connect and disconnect the access points by hand as the BIAB vehicle travels on the test route to simulate the on-the-street performance of the access points where buses will associate and then dis-associate with access points as they travel on the route. In fact, the test could be done with only a single access point connected through a network router to each of the five test intersections. It is not possible to fully verify the communications network by bench testing.

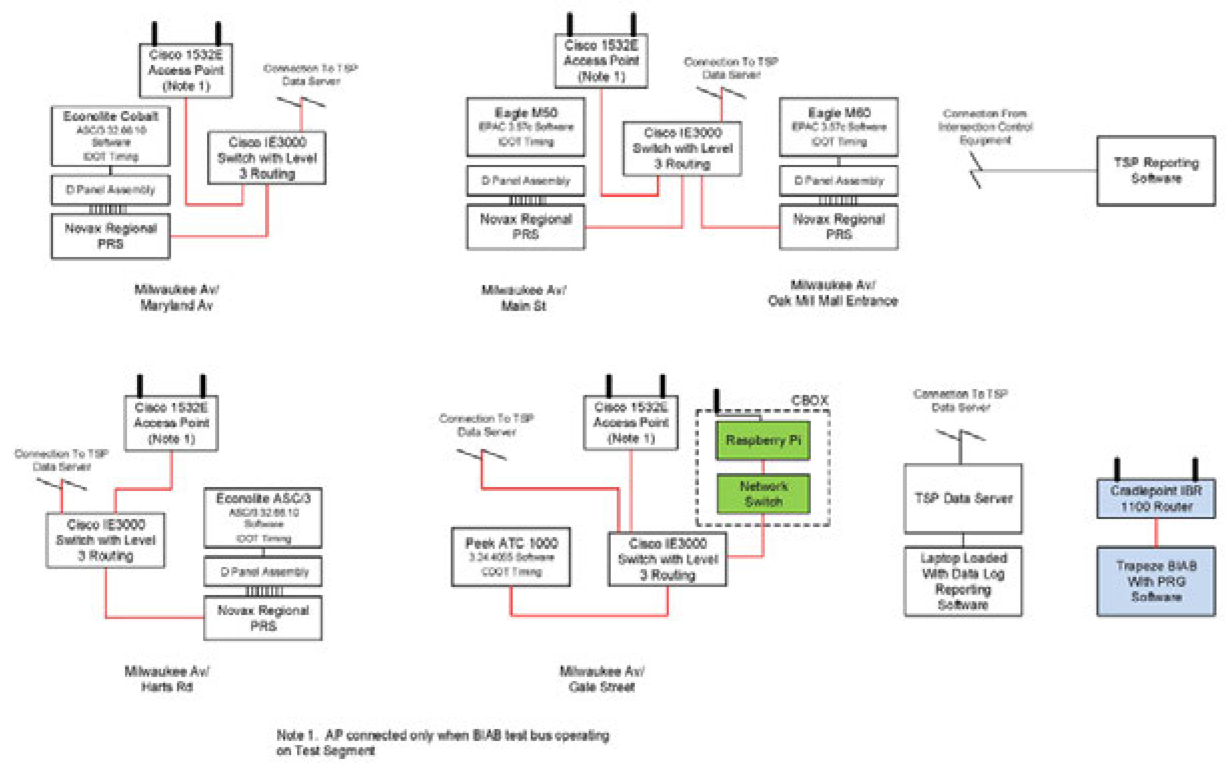
The end-to-end TSP systems verification tests will include TSP operations at both near side and far side bus stops as indicated in **Table 8**.

Table 8. Near and Far Side Bus Stops

Intersection	Southbound	Northbound
Milwaukee/Maryland	Near	Near
Milwaukee/Main	Near	Near
Milwaukee/Oak Mill Mall Entrance	Far	Near
Milwaukee/Harts	Far	Far
Milwaukee/Gale	Near	None

The end-to-end test will be repeated four times for each direction (NB and SB). Intersection log data will be uploaded to the TSP Reporting Software for each of the test bus runs for review and reporting.

Figure 5. End-To-End TSP Systems Verification Bench Test Equipment



The end-to-end TSP systems bench test will consist of the following tests described below in **Table 9.**

Table 9. End-To-End TSP Systems Verification Tests

Ref	Test Description
EE-1	Bus running from Milwaukee Avenue/Maryland Avenue to Milwaukee Avenue/Gale Street through five (5)test intersections in SB direction. AP radios are disabled to simulate “out of range” as bus passes from route segment to route segment. Stop for at least one near side bus stop per trip.

EE-2 through EE-4	Repeat EE-1 (SB direction). Stop for at least one trip at near side bus stop at Gale Street.
EE-5	Bus running from Milwaukee Avenue/Maryland Avenue to Milwaukee Avenue/Gale Street through five (5) test intersections in NB direction. AP radios are disabled to simulate "out of range" as bus passes from route segment to route segment. Stop for at least one near side bus stop per trip.
EE-6 through EE-8	Repeat EE-5 (SB direction).

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Appendix C

Pace TSP Integrated Systems Bench Test Data 11-30-18

JACOBS

Pace Transit Signal Priority Program

Pace Suburban Bus

TSP Integrated Systems Bench Test Data

Document No. C9X24800-XX|0

Document history and status

Revision	Date	Description	By	Review	Approved
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TSP Integrated Systems
Bench Test Data

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Jacobs Engineering Group Inc.

525 West Monroe, Suite 1600
Chicago, Illinois 60661
United States
T +1.312.251.3000
F +1.312.251.3015
www.jacobs.com

Table of Contents

1. Introduction

1.1 Background

Pace Suburban Bus (Pace) and the Chicago Transit Authority (CTA) are deploying Transit Signal Priority (TSP) systems to provide additional green time at traffic signals to buses that are behind schedule. The Regional TSP IP (RTSPIP) committee headed by RTA in partnership with Pace and CTA created a standard message set, referred to as the Regional TSP Interoperable Message Set, for bus-to-intersection communications. The Regional TSP Message Set defines the dialog between the on-bus Priority Request Generator (PRG) software and intersection-based Priority Request Server (PRS) software implemented on the intersection traffic controller or on a standalone Regional PRS device that interfaces with the intersection traffic controller.

1.2 Purpose

The scope of this document is to present the results of the TSP integrated systems bench tests conducted at Meade Electric facilities, 9550 West 55th Street in McCook, Illinois (about 26 miles from the Pace headquarters building) on 11/13/18 through 11/16/18. The tests were conducted to verify that the TSP systems including the on-bus systems, on-bus and intersection communications equipment, traffic controller equipment, and Central Monitoring and Reporting software are functional and ready to be deployed for the Field Operational Test in the Milwaukee Avenue corridor.

The TSP integrated systems bench tests included the following sets of tests.

A. Gale Street TSP Systems Interoperability Verification Tests
Purpose: To verify the PRS functionality of the Peek ATC 1000 GreenWave software (version 3.24.4055) with the Trapeze PRG software.

B. Regional PRS Device Verification Tests: Econolite ASC/3 Controller Running ASC/3 32.10.66 Software
Purpose: To verify the PRS functionality of the Regional PRS Device in conjunction with the Econolite ASC/3 Controller running ASC/3 32.10.66 Software.

C. Regional PRS Device Verification Tests: Econolite Cobalt Controller Running ASC/3 32.10.66 Software
Purpose: To verify the PRS functionality of the Regional PRS Device in conjunction with the Econolite Cobalt Controller running ASC/3 32.10.66 Software.

D. Regional PRS Device Verification Tests: Siemens Eagle CM50 Controller Running EPAC 3.57c Software
Purpose: To verify the PRS functionality of the Regional PRS Device in conjunction with the Siemens Eagle M50 Controller running EPAC 3.57c Software.

E. Regional PRS Device Verification Tests: Siemens Eagle CM60 Controller Running EPAC 3.57c Software
Purpose: To verify the PRS functionality of the Regional PRS Device in conjunction with the Siemens Eagle M60 Controller running EPAC 3.57c Software.

F. End-To-End TSP Systems Verification Test
Purpose: To verify the TSP functionality of different intersection controller types (combination of controller hardware and intersection control software) to be deployed under the Pace TSP program. The End-To-End TSP Systems Verification Test was conducted by simulating a Pace bus operating

through five “test intersections’ on Milwaukee Avenue, each equipped with a different controller type as follows.

Econolite ASC/3 Controller running ASC/3 32.66.10 software (Harts Road)
Econolite Cobalt Controller running ASC/3 32.66.10 software (Maryland Street)
Siemens Eagle M50 Controller running EPAC 3.57c software (Main Street)
Siemens Eagle M60 Controller running EPAC 3.57c software (Oak Mill Mall Entrance)
Peek ATC 1000 Controller running GreenWave 3.24.4055 software with PRS functionality (Gale Street)

Test data and results for each of the six sets of tests are described in more detail in the following sections of this report.

1.3 Test Data and Results

The test data and results foreach of the six sets of tests have been organized as follows.

- Test Summary
  - Test Equipment Summary
  - Test Data Collection
  - Test Results (Passed/Failed)
  - Test Results Anomalies
- Test Description Table
- Annotated Regional PRS Log Reports
- Annotated TSP Reporting Software Reports

The test data and results for the six sets of tests are presented in the following sections, labelled Section A through Section F.

1.4 Reference Documents

1. Draft TSP Integrated Systems Bench Test Plan, Jacobs, Rev C (04/30/18)
2. Pace Comprehensive TSP Communications System Design Document, Jacobs, Rev E (July 2016)
3. Technical System Requirements for the RTSPIP, version 2.4 (05/08/14)
4. Regional TSP Standards and Implementation Guidelines, version 1.5 (05/08/14)
5. Regional TSP Central Software Acceptance Test Plan, Parsons, Rev 1.3 (01/31/18)
6. PRS Acceptance Test Plan, Novax, Rev 1.0e (10/31/17)

1.5 Acronyms

AP – Access Point
ATC – Advanced Traffic (Signal) Controller
BIAB – Bus-In-A-Box Test Equipment
CTA – Chicago Transit Authority
EB - Eastbound
I2I – Intersection to Intersection (Communications)
I2C – Intersection to Center (Communications)
IP – Internet Protocol
NB – Northbound
NEMA – National Electrical Manufactures Association

NTCIP – National Transportation Communications for ITS Protocol
Pace – Pace Suburban Bus
PRG – Priority Request Generator
PRS – Priority Request Server
RTA – Regional Transportation Authority
RTSPIP - Regional Transit Signal Priority Implementation Program
SB - Southbound
SNMP – Simple Network Management Protocol
TSP – Transit Signal Priority
VLU – Vehicle Logic Unit
VTT – Virtual Testing Tool
WB - Westbound

A - Gale Street TSP Systems Interoperability Verification Test

Test Summary

For this set of tests, the Trapeze BIAB including the PRG software was used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Gale Street intersection (test intersection) in the NB direction. Current signal timing including TSP parameters were installed on the intersection traffic controller (Peek ATC 1000 running GreenWave 3.24.4055). For three tests, the RTA PRG VTT was used to simulate CTA buses approaching the test intersection at the same time as Pace buses. No Rocket Router or Raspberry Pi communications equipment was available for the test so the PRG VTT was directly connected to the intersection network router. The test intersection equipped with a Peek ATC 1000 traffic controller was configured to support bus-to-intersection communications between a Cradlepoint IBR1100 router (bus end of communications) and Cisco 1532E IEEE 802.11n-compliant access point (test intersection end of communications).

Observations of the controller front panel display were made and recorded during the testing. Additionally, intersection controller TSP log data was uploaded to the TSP Reporting Software by cellular communications for each of the tests for review and reporting. Note that the controller TSP log data report was not available until the following day since TSP log data from the Peek PRS software can only be uploaded once per day for reporting.

The TSP systems interoperability verification tests with the Milwaukee Avenue/Gale Street intersection consisted of ten tests as summarized in the Test Description Table starting on the next page. The ten tests were successfully completed ("Passed"). The ten tests verified bus-to-intersection communications between the Trapeze PRG software and Peek ATC 1000 PRS software (GreenWave 3.24.4055).

Attached following the Test Description Table are the Test Data Sheets (two pages) marked up as the tests were conducted and the Peek ATC TSP log data reported by the TSP Reporting Software (one page). The Peek ATC TSP log data report has been annotated.

Four anomalies were observed during the testing and/or from the TSP log data reports.

1. Selected tests (INT 11-17, INT 21-3, INT 21-5, and INT 21-6) were expected to generate a re-service override response for the second (or third) of back-to-back requests for priority but re-service overrides were not observed or reported for any of the tests. For tests INT 21-3, INT 21-5, and INT 21-6, it is possible that the Peek controller logic was able to provide priority for the second (or third) request for priority at the same time as taking action for the first (or second) request for priority. If so, no re-service override action taken would be generated.

2. The TSP Reporting Software did not report correctly for tests INT 21-3; INT 21-5; and INT 21-6. Only one TSP event is reported for each of the tests, each of which included two or three TSP events from back-to-back requests for priority from more than one bus.

3. The TSP Reporting Software reported two TSP events with re-service override action taken that did not match with observations or other test data. Both TSP events were reported with "blank" Route ID and Run Number values.

4. The tests were done using the Peek GreenWave 3.24.4055 intersection control software. This software has known bugs in the TSP log data reporting that have been corrected in a later version of the software. The TSP Reporting Software does not support the corrected log file content.

Gale Street TSP Systems Interoperability Verification Tests

Ref	Test Description	Date/Time	Pass/Fail	Observations
INT 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	11/13/18 2:56PM	Pass	
INT 11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	11/13/18 1:51PM	Pass	Green extension observed
INT 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	11/13/18 1:54PM	Pass	No adjustment required observed
INT 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).		N/A	No EVP at CDOT signals. Test not supported by Peek software.
INT 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by a EVP preemption call before the priority request is cancelled and cleared.		N/A	No EVP at CDOT signals. Test not supported by Peek software.
INT 11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through intersection on green extension.	11/13/18 2:01PM	Pass	
INT 11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.	11/13/18 2:14PM	Pass	
INT 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.	11/13/18 2:17PM	Pass	No re-service override observed for second call

Ref	Test Description	Date/Time	Pass/Fail	Observations
INT 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	11/13/18 2:20PM	Pass	
INT 21-3	Pace Bus (First Bus) approaches the intersection from NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The Pace Bus (First Bus) continues through the intersection with green extension or early green or no action required. CTA Bus (Second Bus) approaches the intersection in the SB direction shortly after the Pace Bus (First Bus) has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the CTA Bus (Second Bus) due to re-service lockout time.	11/13/18 2:36PM	Pass	No re-service override observed for second call
INT 21-4	CTA Bus (First Bus) approaches the intersection from SB direction at normal operating speed, running on-time, and requests priority using the RTA PRG VTT. No action is taken by the controller. Pace Bus (Second Bus) approaches the intersection in the NB direction shortly after the CTA Bus (First Bus) has cleared the intersection, running late, and requests priority using the Regional Interoperable Message Set. The Pace Bus (Second Bus) continues through the intersection with green extension, early green, or no action required. CTA Bus (Third Bus) approaches the intersection from SB direction while the Pace Bus (Second Bus) is approaching the intersection, running late, and requests priority using the RTA PG VTT. The controller takes no action for the CTA bus (Third Bus) due to re-service lockout timer.	11/13/18 2:41PM	Pass	No re-service override observed for third call
INT 21-6	Pace Bus (First Bus) approaches the intersection in the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The CTA Bus (Second Bus) approaches the intersection in the SB direction at normal operating speed, running late, and requests priority using the RTA PRG VTT with estimated arrival time earlier than the Pace Bus (First Bus). Both buses continue through the intersection.	11/13/18 2:52PM	Pass	Green extension observed for second bus

11-13-18

PEEK

GALE STREET INTEGRATED SYSTEMS TEST

Ref	Test	Test Description	Expected PRS Status	Expected Action Taken	Test Start Time	Test End Time	Test Notes	Witness
1	INT 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	TSP event rejected by PRS and not set up by Controller. No PRS status available.	0 LoggedOnly	~~1~~ 2:56		Log only	
2	INT 11-2	Pace Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	4 activeProcessing; 13 closedCompleted	3 Normal Green No Action Taken	1:51		Green extension 2+6 called (NB)	
3	INT 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	4 activeProcessing; 13 closedCompleted	7 Extension Only	1:54		No Extend/thru on green	
4	INT 11-8	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.	12 reserved (closedStrategyError) OR 13 closedCompleted					
5	INT 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to preemption lockout (already in progress).	3 activeProcessing; 13 closedComplete	5 Override Emergency Vehicle	1:54		No EVP setup	
6	INT 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by preemption call before the priority request is cancelled and cleared.	4 activeProcessing; 13 closedCompleted	5 Override Emergency Vehicle				
7	INT 11-13	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.	12 closedStrategyError				Not able to conduct	
8	INT 11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through the intersection on green extension.	4 activeProcessing; 13 closedCompleted	7 Extension Only	2:01		2+6 called/poss ext	
9	INT 11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.	4 activeProcessing; 13 closedCompleted	6 Reduction Only	~~2:04~~ ~~2:12~~ 2:14		Restarted CP 2+6/extended/TSP call dropped/timeout?	
10	INT 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers. Bus closes doors after passengers board, requests priority, and then proceeds through the intersection on green signal.	First Request: 4 activeProcessing; 13 closedCancelled. Second Request: 9 reserviceError		2:17		First request ok 2nd request ok	
11	INT 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	4 activeProcessing; 13 closedCompleted	6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken	2:20		TSP call on 2/6 Dropped	
12	INT 21-1	CTA Bus equipped with Rocket Router communications equipment approaches the Gale Street intersection at normal operating speed, running late, and requests priority using the RTA PRG VTT. Bus proceeds through the intersection on green extension, early green, or no action required.	4 activeProcessing; 13 closedCompleted	6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken				
13	INT 21-2	CTA Bus equipped with Rocket Router communications equipment approaches the Gale Street intersection at normal operating speed, running late, and requests priority using the Jeffery Jump simulator. Bus proceeds through the intersection on green extension,early green, or no action required.	No Status Messages	6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken				
14	INT 21-3	Pace Bus (First Bus) approaches the intersection from the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The Pace Bus (First Bus) continues through the intersection on a green extension, early green, or no action required. CTA Bus (Second Bus) approaches the intersection from the SB direction shortly after the Pace Bus (First Bus) has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the CTA Bus (Second Bus) due to re-service lockout.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 9 re-service error	First Bus: 6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken. Second Bus: 2 Re-Service No Action Taken	~~2:24~~ 2:26 Rerunning 2:33 Rerunning 2:36		#1 TSP call 2/6 Checked out #2 Waited for red No re-service	

0003 Section 3 ALICJA 0 2 60 14 420 0 0

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11-13-18

15	INT 21-4	CTA Bus (First Bus) approaches the intersection from the SB direction at normal operating speed, running on-time, and requests priority using the RTA PRG VTT. No action is taken by the controller. Pace Bus (Second Bus) approaches the intersection from the NB direction shortly after the CTA Bus (First Bus) has cleared the intersection, running late, and requests priority using the Regional Interoperable Message Set. The Pace Bus (Second Bus) continues through the intersection with green extension, early green,or no action required. CTA Bus (Third Bus) approaches the intersection from SB direction after the Pace Bus (Second Bus) has cleared the intersection, running late, and requests priority using the Jeffery Jump Message Set. The controller takes no action for the CTA Bus (Third Bus) due to re-service lockout timer.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 13 closedCompleted. Third Bus: No Status Messages	First Bus: 0 Log Only. Second Bus: 6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken. Third Bus: 2 Re-Service No Action Taken	2:41		#1 2+6 call log only #2 2+6 call TSP call #3 2+6 call no re-service timeout	Occupied Dirty
16	INT 21-5	CTA Bus (First Bus) approaches the intersection from the SB direction at normal operating speed, running on-time, and requests priority using the RTA PRG VTT. No action is taken by the controller. Pace Bus (Second Bus) approaches the intersection from the SB direction while the CTA Bus (First Bus) is approaching the intersection, running late, and requests priority using the Regional Interoperable Message Set. The Pace Bus (Second Bus) continues through the intersection with green extension, early green,or no action required. CTA Bus (Third Bus) approaches the intersection from NB direction while the Pace Bus (Second Bus) is approaching the intersection, running late, and requests priority using the Jeffery Jump Message Set. The controller takes no action for the CTA Bus (Third Bus) due to re-service lockout timer.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 13 closedCompleted. Third Bus: No Status Messages	First Bus: 0 Log Only. Second Bus: 6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken. Third Bus: 2 Re-Service No Action Taken				212
17	INT 21-6	Pace Bus (First Bus) approaches the intersection in the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. CTA Bus (Second Bus) approaches the intersection in the SB direction at normal operating speed, running late, and requests priority using the RTA PRG VTT with estimated arrival time earlier than the First Bus (Pace Bus). Both buses continue through the intersection.	First Bus: 4 activeProcessing; 3 readyOverridden; 13 closedCompleted. Second Bus: 4 activeProcessing; 13 closedCompleted	First Bus: 6 Reduction Only OR 7 Extension Only OR Normal Green No Action Taken. Second Bus: 6 Reduction Only OR 7 Extension Only OR 3 Normal Green No Action Taken	2:52		#1 ok #2 extension	

TSP REPORTING SOFTWARE GALE STREET 11/13/18

Alarm | Administ

...us	Check-in	Phasesin	Time to Activate	MaxAc	Vehicle ID	Route ID	Run Config	Action Taken	Cycles Service ID	Extension	Reduction		CheckOut	Vehicle Occupancy	Forced	Run Number
cing /	2018-11-13 13:48:03	2,5	0	0	PRS	150	2	NORMAL	0	0	0		2018-11-13 13:48:06	2,6	false	14
cing /	2018-11-13 14:27:34	4	0	0	PRS	150	3	NORMAL	0	0	0		2018-11-13 14:27:57	2,5	false	14
cing /	2018-11-13 14:34:20	2,6	0	0	PRS	150	2	NORMAL	0	0	0		2018-11-13 14:34:53	4	false	14
cing /	2018-11-13 14:37:25	4	0	0	PRS	150	2	NORMAL	0	0	0		2018-11-13 14:37:55	2,5	false	14
cing /	2018-11-13 14:42:13	2,6	0	0	PRS	150	2	NORMAL	0	0	0		2018-11-13 14:42:27	2,6	false	14
cing /	2018-11-13 14:45:27	2,6	0	0	PRS	150	2	NORMAL	0	0	0		2018-11-13 14:45:41	2,6	false	14
cing /	2018-11-13 13:51:45	2,6	0	0	V8 BIA	6663	2	EXTEND	0	84	0	11-2	2018-11-13 13:51:59	2,6	false	349
cing /	2018-11-13 13:55:28	2,6	0	0	V8 BIA	6541	2	NORMAL	0	0	0	11-3	2018-11-13 13:55:38	2,6	false	350
cing /	2018-11-13 14:01:11	2,6	0	0	V8 BIA	6541	2	EXTEND	1	200	0	11-15	2018-11-13 14:02:11	4	true	350
cing /	2018-11-13 14:02:13	4	0	0	V8 BIA		2	RESRVC	0	0	0	?	2018-11-13 14:02:15	4	false	
cing /	2018-11-13 14:14:14	2,6	0	0	V8 BIA	6521	2	REDEXT	1	200	80	11-16	2018-11-13 14:15:14	2,5	true	361
cing /	2018-11-13 14:15:15	2,5	0	0	V8 BIA		2	RESRVC	0	0	0	?	2018-11-13 14:15:17	2,5	false	
cing /	2018-11-13 14:18:22	2,6	0	0	V8 BIA	6521	2	NORMAL	0	0	0	11-17	2018-11-13 14:18:34	2,6	false	361
cing /	2018-11-13 14:18:50	2,6	0	0	V8 BIA	6521	2	NORMAL	0	0	0		2018-11-13 14:19:07	4	false	361
cing /	2018-11-13 14:21:08	2,6	0	0	V8 BIA	6521	2	REDEXT	1	200	80	11-18	2018-11-13 14:22:08	4	true	361
cing /	2018-11-13 14:26:48	2,6	0	0	V8 BIA	6521	2	NORMAL	0	0	0	21-3	2018-11-13 14:27:09	2,6	false	361
cing /	2018-11-13 14:33:54	2,6	0	0	V8 BIA	6450	2	NORMAL	0	0	0		2018-11-13 14:34:11	2,6	false	356
cing /	2018-11-13 14:36:51	2,6	0	0	V8 BIA	6450	2	NORMAL	0	0	0		2018-11-13 14:37:06	2,6	false	356
cing /	2018-11-13 14:43:46	2,6	0	0	V8 BIA	6450	2	NORMAL	0	0	0	21-5	2018-11-13 14:44:00	2,6	false	356
cing /	2018-11-13 14:52:17	2,6	0	0	V8 BIA	6663	2	EXTEND	1	200	0	21-6	2018-11-13 14:53:04	4	false	349
cing /	2018-11-13 14:55:27	2,6	0	0	V8 BIA	6547	0	LOGONLY	0	0	0	11-1	2018-11-13 14:55:27	2,6	false	348

No Second Bus TSP Event

Re-run

B - Regional PRS Device Verification Test: ASC/3 Controller Running ASC/3 Software

Test Summary

The Trapeze BIAB including the PRG software was used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Harts Road intersection equipped with the Regional PRS device connected to an Econolite ASC/3 controller running the ASC/3 32.10.66 intersection control software. Current signal timing for the Harts Road intersection was installed on the intersection traffic controller. A blue TSP datakey required to enable TSP functionality was inserted in the ASC/3 controller datakey port for the tests. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and IEEE 802.11n access point (intersection equipment) was used.

Observations of the controller front panel display were made and recorded during the testing. Additionally, the Regional PRS log files were downloaded after the completion of the tests for reporting and review. The Regional PRS log files for each of the tests were also uploaded in near real time by a cellular VPN link to the TSP Data Server at the Parsons offices but were not available for reporting and review in the preparation of this report.

The Regional PRS Device verification tests for the Milwaukee Avenue/Harts Road intersection consisted of six tests as summarized in the Test Description Table starting on the next page. Three planned tests were not completed due to time constraints. The three planned tests were not done since the planned tests duplicated tests run for the ASC/3 software running on the Econolite Cobalt traffic controller. The six tests were successfully completed ("Passed"). The six tests verified bus-to-intersection communications between the Trapeze PRG software and Regional PRS Device connected with an ASC/3 traffic controller running ASC/3 32.10.66 intersection control software.

Attached following the Test Description Table are the Test Data Sheets (two pages) marked up as the tests were conducted and the Regional PRS log data in an Excel spreadsheet format (nine pages). The Regional PRS log data report has been annotated.

One anomaly was observed during the testing and recorded in the Regional PRS data log reports.

1. A second pair of CANCEL and CLEAR messages was reported in the Regional PRS log file reports for tests 11-9 and 11-18.

Regional PRS Device Verification Tests: ASC/3 Controller Running ASC/3 Software

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.		N/A	Not done.
PRS 11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	11/14/18 3:02PM	Pass	Test repeated. Observed unexpected second TSP call after completion of first call
PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	11/14/18 3:22PM	Pass	Test repeated. Observed unexpected second TSP call after completion of first call
PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).	11/14/18 3:29PM	Pass	
PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by an EVP preemption call before the priority request is cancelled and cleared.	11/14/18 3:32PM	Pass	
PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.	11/14/18 3:34PM	Pass	Locked out first call for re-service override
PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	11/14/18 3:40PM	Pass	

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 21-1	First Bus approaches the intersection from NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection with green extension or early green or no action required. The Second Bus approaches the intersection in the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the CTA Bus (Second Bus) due to re-service override.		N/A	Not done
PRS 21-2	First Bus approaches the intersection in the SB direction at normal operating speed, running on-time, and requests priority using the RTA PRG VTT. The Second Bus approaches the intersection in the NB direction shortly after the first bus has cleared the intersection at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The controller provides a green extension, early green, or no adjustment required for the Second Bus.		N/A	Not done

ASC/3

11-14-18

REGIONAL PRS DEVICE VERIFICATION TESTS - ASC/3 CONTROLLER WITH ASC/3 FIRMWARE

Harts Road

Ref	Test	Test Description	Expected PRS Status	Expected Action Taken	Test Start Time	Test End Time	Test Notes
1	PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	TSP event rejected by PRS and not set up by Controller. No PRS status available.	11 Log Only Request			
2	PRS 11-2	Pace Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	2:37 Rerun #1 Rerun #2		SB 3:02 TSP Call Rerun #3 2:45
3	PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	3:05		SB Stopped for red signal
4	PRS 11-8	Pace Bus approaching ~~intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.~~	12 reserved (closedStrategyError) OR 13 closedCompleted	04 Time Of Day Override	Reservice 1 cycle		
5	PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to preemption lockout (already in progress).	3 activeProcessing; 13 closedComplete	03 Preemption Override	3:29	second check-in	Not w/ simulator Second short check-in w/ AP
6	PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by preemption call before the priority request is cancelled and cleared.	4 activeProcessing; 13 closedCompleted	03 Preemption Override	3:32	ok	Inhibiting priority w/ transition
7	PRS 11-13	Pace Bus approaching ~~intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested.~~ Bus continues through intersection.	12 closedStrategyError	01 Invalid ID Override			
8	PRS 11-15	Pace Bus approaching ~~intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through the intersection on~~ green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			
9	PRS 11-16	Pace Bus approaching ~~intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on~~ early green.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			
10	PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers. Bus closes doors after passengers board, requests priority, and then proceeds through the intersection on green signal.	First Request: 4 activeProcessing; 13 closedCancelled. Second Request: 9 reserviceError	First Request: 0 Priority Action Taken. Second Request: 09 Reservice Override	3:34	ok	locked out first call for re-service
11	PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	~~3:34~~ 3:40	ok	
12	PRS 21-1	First Bus approaches the intersection from the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection on a green extension, early green, or no action required. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 9 re-service error	First Bus: 0 Priority Action Taken. Second Bus: 09 Re-service Override			

Rerun #3 3:22

TSP Call ok
Second TSP call/not expected

REGIONAL PRS LOGS ECONOLITE ASC/3 CONTROLLER WITH ASC/3 SOFTWARE (HARTS ROAD) 11/14/2018

01,02,111418141730,495445524953,02,04,06,014d,01bc,01,0000029a,00000309,4d494c48415254,31353020202020,31342020202020202020,012c,0a			
111418141730, 01,01,1	**VTT**	2:17:30	**PRE-TEST**
02,02,111418141739,495445524953,02,04,06,014d,01bc,01,0000029a,00000309,012c			
03,02,111418141740,495445524953,02,04,06,04			STATUS ActiveProcessing
03,02,111418141742,495445524953,02,04,06,04			
05,02,111418141745,495445524953,02,04,06			CANCEL
111418141745, 01,01,0			
03,02,111418141746,495445524953,02,04,06,08			STATUS ClosedCancelled
06,02,111418141749,495445524953,02,04,06			CLEAR
07,111418141730,111418141749,0013,495445524953,4d494c48415254,01,00,02			DURATION 19 SECS; PHASE 1;TSP ENABLED; REQUEST 2
03,02,111418141750,495445524953,02,04,06,01			
01,0a,111418141906,563820424941,02,01,03,0014,0014,02,6b340a19,a9deaacb,4d494c48415254,36363633202020,33343920202020202020,063f,ff			
111418141906, 02,02,1	**BIAB**	2:19:06	**PRE-TEST**
03,0a,111418141906,563820424941,02,01,03,04			
02,0a,111418141911,563820424941,02,01,03,0010,0010,02,8e2a0a19,4fe8aacb,0640			
03,0a,111418141911,563820424941,02,01,03,04			
02,0a,111418141916,563820424941,02,01,03,000a,000a,02,b31e0a19,e6f3aacb,063f			
03,0a,111418141916,563820424941,02,01,03,04			STATUS ActiveProcessing
02,0a,111418141921,563820424941,02,01,03,0006,0006,02,d5140a19,8bfdaacb,0640			
03,0a,111418141921,563820424941,02,01,03,04			
02,0a,111418141926,563820424941,02,01,03,0001,0001,02,0e0b0a19,1b07abcb,0641			
03,0a,111418141927,563820424941,02,01,03,04			
02,0a,111418141932,563820424941,02,01,03,0001,0001,02,31010a19,c010abcb,0642			
03,0a,111418141932,563820424941,02,01,03,04			
02,0a,111418141937,563820424941,02,01,03,0001,0001,02,69f70919,501aabcb,0643			
03,0a,111418141937,563820424941,02,01,03,04			
05,0a,111418141940,563820424941,02,01,03			CANCEL
111418141940, 02,02,0			
06,0a,111418141940,563820424941,02,01,03			CLEAR
07,111418141906,111418141940,0022,563820424941,4d494c48415254,02,00,0a			DURATION 34 SECS; PHASE 2; TSP ENABLED; REQUEST 10
01,0b,111418141951,563820424941,02,01,03,0012,0012,02,03df0919,d133abcb,4d494c48415254,36363633202020,33343920202020202020,0645,ff			
111418141951, 02,02,1	**BIAB**	2:19:51	**PRE-TEST**
03,0b,111418141951,563820424941,02,01,03,04			
02,0b,111418141956,563820424941,02,01,03,0011,0011,02,40e30919,f637abcb,0648			

03,0b,111418141956,563820424941,02,01,03,04			STATUS ActiveProcessing
02,0b,111418142002,563820424941,02,01,03,0011,0011,02,40e30919,f637abcb,064e			
03,0b,111418142002,563820424941,02,01,03,04			
02,0b,111418142007,563820424941,02,01,03,0011,0011,02,d6020a19,d856abcb,0645			
03,0b,111418142007,563820424941,02,01,03,04			
05,0b,111418142010,563820424941,02,01,03			CANCEL
111418142010, 02,02,0			
06,0b,111418142010,563820424941,02,01,03			CLEAR
07,111418141951,111418142010,0013,563820424941,4d494c48415254,02,00,0b			DURATION 19 SECS; PHASE 2; TSP ENABLED; REQUEST 11
01,01,111418142446,464941542020,01,04,06,014d,01bc,02,0000029a,00000309,4d494c48415254,31353020202020,313420202020202020,012c,0a			
111418142446, 02,02,1	**VTT**	2:24:46	**PRE-TEST**
03,01,111418142454,464941542020,01,04,06,04			
02,01,111418142458,464941542020,01,04,06,014d,01bc,02,0000029a,00000309,012c			
03,01,111418142503,464941542020,01,04,06,04			
05,01,111418142507,464941542020,01,04,06			CANCEL
111418142507, 02,02,0			
06,01,111418142509,464941542020,01,04,06			CLEAR
07,111418142446,111418142509,0017,464941542020,4d494c48415254,02,00,01			DURATION 23 SECS; PHASE 2; TSP ENABLED; REQUEST 1
111418142921, SYS, Novax PRS Program Started!			
111418143010, 01,01			
07,111418143010,111418143010,0000,313131342020,4d494c4d415259,02,01,01			
01,01,111418143010,313131342020,02,04,06,001e,0032,02,000001bd,00000315,4d494c4d415259,31353020202020,313420202020202020,0028,0a			
111418143050, 01,01		2:30:10	**PRE-TEST**
111418143059, 01,01			
111418143522, SYS, Novax PRS Program Started!			
01,01,111418143705,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,4d494c48415254,31353020202020,313420202020202020,012c,0a			
111418143705, 02,01,1	**VTT**	2:37:05	**PRE-TEST**
02,01,111418143714,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
03,01,111418143716,495445524953,02,04,06,04			STATUS ActiveProcessing
05,01,111418143720,495445524953,02,04,06			CANCEL
111418143720, 02,01,0			
06,01,111418143724,495445524953,02,04,06			CLEAR
07,111418143705,111418143724,0013,495445524953,4d494c48415254,02,00,01			DURATION 19 SECS; PHASE 2; TSP ENABLED; REQUEST 1
01,0e,111418143833,563820424941,02,01,03,0014,0014,02,06350a19,12deaacb,4d494c48415254,36353431202020,333530202020202020,0168,ff			
111418143833, 02,01,1		2:38:33	**PRS 11-2 #1**
03,0e,111418143833,563820424941,02,01,03,04			
02,0e,111418143838,563820424941,02,01,03,0010,0010,02,8b2c0a19,5ce6aacb,016a			
03,0e,111418143838,563820424941,02,01,03,04			

02,0e,111418143843,563820424941,02,01,03,000d,000d,02,10240a19,a7eeaacb,016b
03,0e,111418143843,563820424941,02,01,03,04
02,0e,111418143848,563820424941,02,01,03,0009,0009,02,ac1b0a19,dcf6aacb,016c
03,0e,111418143848,563820424941,02,01,03,04 STATUS ActiveProcessing
02,0e,111418143854,563820424941,02,01,03,0005,0005,02,5d130a19,fcfeaacb,0175
03,0e,111418143854,563820424941,02,01,03,04
02,0e,111418143859,563820424941,02,01,03,0001,0001,02,0e0b0a19,1b07abcb,0176
03,0e,111418143859,563820424941,02,01,03,04
02,0e,111418143904,563820424941,02,01,03,0001,0001,02,a9020a19,500fabcb,0178
03,0e,111418143904,563820424941,02,01,03,04
02,0e,111418143909,563820424941,02,01,03,0001,0001,02,89f80919,3619abcb,0179
03,0e,111418143909,563820424941,02,01,03,04
05,0e,111418143913,563820424941,02,01,03 CANCEL
111418143913, 02,01,0
06,0e,111418143913,563820424941,02,01,03 CLEAR
07,111418143833,111418143913,0028,563820424941,4d494c48415254,02,00,0e DURATION 40 SECS; PHASE 2; TSP ENABLED; REQUEST 14
01,0f,111418143924,563820424941,02,01,03,0011,0011,02,54e50919,fe39abcb,4d494c48415254,36353431202020,3335302020202020,0177,ff
111418143924, 02,01,1 2:39:24 **PRS 11-2#2**
03,0f,111418143924,563820424941,02,01,03,04
02,0f,111418143929,563820424941,02,01,03,0011,0011,02,531b0a19,ca6eabcb,0165
03,0f,111418143929,563820424941,02,01,03,04 STATUS ActiveProcessing
05,0f,111418143931,563820424941,02,01,03 CANCEL
111418143931, 02,01,0
06,0f,111418143931,563820424941,02,01,03 CLEAR
07,111418143924,111418143931,0007,563820424941,4d494c48415254,02,00,0f DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 15
01,11,111418144350,563820424941,02,01,03,0014,0014,02,c4340a19,53deaacb,4d494c48415254,36353431202020,3335302020202020,02ab,ff
111418144350, 02,01,1 2:43:50 **PRS 11-2 #3**
03,11,111418144350,563820424941,02,01,03,04
02,11,111418144355,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02af
03,11,111418144355,563820424941,02,01,03,04 STATUS ActiveProcessing
02,11,111418144400,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02b4
03,11,111418144400,563820424941,02,01,03,04
02,11,111418144405,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02b9
03,11,111418144405,563820424941,02,01,03,04
02,11,111418144410,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02be
03,11,111418144410,563820424941,02,01,03,04
02,11,111418144416,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02c3
03,11,111418144416,563820424941,02,01,03,04

02,11,111418144421,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02c8			
03,11,111418144421,563820424941,02,01,03,04			
02,11,111418144426,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02ce			
03,11,111418144426,563820424941,02,01,03,04			
02,11,111418144431,563820424941,02,01,03,0012,0012,02,a92f0a19,51e3aacb,02d3			
03,11,111418144431,563820424941,02,01,03,04			
02,11,111418144436,563820424941,02,01,03,000e,000e,02,df270a19,eeeaaacb,02d5			
03,11,111418144436,563820424941,02,01,03,04			
02,11,111418144441,563820424941,02,01,03,0009,0009,02,731c0a19,19f6aacb,02d4			
03,11,111418144442,563820424941,02,01,03,04			
02,11,111418144447,563820424941,02,01,03,0005,0005,02,d8120a19,7dffaacb,02d5			
03,11,111418144447,563820424941,02,01,03,04			
02,11,111418144452,563820424941,02,01,03,0001,0001,02,53090a19,cc08abcb,02d7			
03,11,111418144452,563820424941,02,01,03,04			
02,11,111418144457,563820424941,02,01,03,0001,0001,02,dbfe0919,0913abcb,02d7			
03,11,111418144457,563820424941,02,01,03,04			
02,11,111418144502,563820424941,02,01,03,0001,0001,02,22f20919,791fabcb,02d7			
03,11,111418144502,563820424941,02,01,03,04			
05,11,111418144503,563820424941,02,01,03			CANCEL
111418144503, 02,01,0			PRIORITY OFF
06,11,111418144503,563820424941,02,01,03			CLEAR
07,111418144350,111418144503,0049,563820424941,4d494c48415254,02,00,11			DURATION 73 SECS; PHASE 2; TSP ENABLED; REQUEST 17
01,12,111418144511,563820424941,02,01,03,0011,0011,02,9edf0919,6834abcb,4d494c48415254,36353431202020,33353020202020202020,02d4,ff			
111418144511, 02,01,1		2:45:11	**PRS 11-3**
03,12,111418144511,563820424941,02,01,03,04			
02,12,111418144516,563820424941,02,01,03,0011,0011,02,09fd0919,2d51abcb,02cd			
03,12,111418144516,563820424941,02,01,03,04			STATUS ActiveProcessing
05,12,111418144519,563820424941,02,01,03			CANCEL
111418144519, 02,01,0			
06,12,111418144519,563820424941,02,01,03			CLEAR
07,111418144511,111418144519,0008,563820424941,4d494c48415254,02,00,12			DURATION 8 SECS; PHASE 2: TSP ENABLED; REQUEST 18
111418144621, PREEMPT,1			PREEMPT ON
111418144621, PIN: 1			
111418144624, PREEMPT,0			PREEMPT OFF
01,02,111418145045,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,4d494c48415254,31353020202020,31342020202020202020,012c,0a			
111418145045, 02,01,1	**VTT**	2:50:45	
02,02,111418145054,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
02,02,111418145058,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			

02,02,111418145101,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
02,02,111418145103,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
03,02,111418145105,495445524953,02,04,06,04			STATUS ActiveProcessing
02,02,111418145107,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
03,02,111418145116,495445524953,02,04,06,04			
02,02,111418145118,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
02,02,111418145121,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
02,02,111418145124,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
02,02,111418145128,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
03,02,111418145137,495445524953,02,04,06,04			
02,02,111418145143,495445524953,02,04,06,014d,01bc,02,0000029a,00000309,012c			
05,02,111418145152,495445524953,02,04,06			CANCEL
111418145152, 02,01,0			
03,02,111418145156,495445524953,02,04,06,08			STATUS ClosedCancelled
06,02,111418145158,495445524953,02,04,06			CLEAR
07,111418145045,111418145158,0049,495445524953,4d494c48415254,02,00,02			DURATION 73 SECS; PHASE 2; TSP ENABLED;REQUEST 2
03,02,111418145159,495445524953,02,04,06,01			STATUS IdleNotValid
01,15,111418145807,563820424941,02,01,03,0014,0014,02,6b340a19,a9deaacb,4d494c48415254,36353431202020,33353020202020202020,0605,ff			
111418145807, 02,01,1	**BIAB**	2:58:07	
03,15,111418145807,563820424941,02,01,03,04			
02,15,111418145812,563820424941,02,01,03,0010,0010,02,062c0a19,dee6aacb,0606			
03,15,111418145812,563820424941,02,01,03,04			STATUS ActiveProcessing
02,15,111418145817,563820424941,02,01,03,000d,000d,02,3d240a19,7ceeaacb,0608			
03,15,111418145817,563820424941,02,01,03,04			
02,15,111418145823,563820424941,02,01,03,0009,0009,02,731c0a19,19f6aacb,0609			
03,15,111418145823,563820424941,02,01,03,04			
02,15,111418145828,563820424941,02,01,03,0006,0006,02,a9140a19,b7fdaacb,060b			
03,15,111418145828,563820424941,02,01,03,04			
02,15,111418145833,563820424941,02,01,03,0002,0002,02,c90c0a19,6a05abcb,060d			
03,15,111418145833,563820424941,02,01,03,04			
02,15,111418145838,563820424941,02,01,03,0000,0000,02,16050a19,f10cabcb,060f			
03,15,111418145838,563820424941,02,01,03,04			
02,15,111418145843,563820424941,02,01,03,0004,0004,02,36fd0919,a414abcb,0611			
03,15,111418145843,563820424941,02,01,03,04			
02,15,111418145848,563820424941,02,01,03,0004,0004,02,6cf50919,421cabcb,0612			
03,15,111418145849,563820424941,02,01,03,04			
05,15,111418145850,563820424941,02,01,03			CANCEL
111418145850, 02,01,0			

06,15,111418145850,563820424941,02,01,03		CLOSE
07,111418145807,111418145850,002b,563820424941,4d494c48415254,02,00,15		DURATION 43 SECS;PHASE 2; TSP ENABLED; REQUEST 21
01,16,111418145904,563820424941,02,01,03,0012,0012,02,f8dd0919,2f33abcb,4d494c48415254,36353431202020,3335302020202020 20,0617,ff		
111418145904, 02,01,1	2:59:04	
03,16,111418145904,563820424941,02,01,03,04		
02,16,111418145909,563820424941,02,01,03,0011,0011,02,47e60919,ec3aabcb,0618		
03,16,111418145909,563820424941,02,01,03,04		STATUS ActiveProcessing
02,16,111418145914,563820424941,02,01,03,0011,0011,02,11ee0919,8a42abcb,061a		
03,16,111418145914,563820424941,02,01,03,04		
02,16,111418145919,563820424941,02,01,03,0011,0011,02,dbf50919,274aabcb,061b		
03,16,111418145919,563820424941,02,01,03,04		
02,16,111418145924,563820424941,02,01,03,0011,0011,02,a4fd0919,c551abcb,061d		
03,16,111418145924,563820424941,02,01,03,04		
02,16,111418145930,563820424941,02,01,03,0011,0011,02,84050a19,7859abcb,061e		
03,16,111418145930,563820424941,02,01,03,04		
02,16,111418145935,563820424941,02,01,03,0011,0011,02,380d0a19,ff60abcb,0620		
03,16,111418145935,563820424941,02,01,03,04		
02,16,111418145940,563820424941,02,01,03,0011,0011,02,18150a19,b368abcb,0622		
03,16,111418145940,563820424941,02,01,03,04		
02,16,111418145945,563820424941,02,01,03,0011,0011,02,e11c0a19,5070abcb,0624		
03,16,111418145945,563820424941,02,01,03,04		
05,16,111418145950,563820424941,02,01,03		CANCEL
111418145950, 02,01,0		INPUT OFF
06,16,111418145950,563820424941,02,01,03		CLEAR
07,111418145904,111418145950,002e,563820424941,4d494c48415254,02,00,16		DURATION 46 SECS; PHASE 2; TSP ENABLED; REQUEST 22
111418150514, PREEMPT,1		PREEMPT ON
111418150514, PIN: 1		
111418150522, 19,03		
07,111418150522,111418150522,0000,563820424941,4d494c48415254,02,03,19		
01,19,111418150522,563820424941,02,01,03,0014,0014,02,ae340a19,68deaacb,4d494c48415254,36363530202020,3335362020202020 20,0430,ff		
	3:05:22	**PRS11-9 PREEMPT ON**
03,19,111418150522,563820424941,02,01,03,03		STATUS ReadyOverridden
05,19,111418150522,563820424941,02,01,03		CANCEL
06,19,111418150523,563820424941,02,01,03		CLEAR
111418150543, 19,03		
03,1a,111418150543,563820424941,02,01,03,01		STATUS ReadyOverridden
05,1a,111418150543,563820424941,02,01,03		CANCEL
06,1a,111418150543,563820424941,02,01,03		CLEAR

111418150612, PREEMPT,0			PREEMPT OFF
01,1d,111418150743,563820424941,02,01,03,0015,0015,02,3c360a19,e2dcaacb,4d494c48415254,36363530202020,333536202020202020,04c2,ff			
111418150743, 02,01,1		3:07:43	**PRS 11-10 PREEMPT INTERRUPT**
03,1d,111418150743,563820424941,02,01,03,04			
111418150748, PREEMPT,1			Preempt On
111418150748, PIN: 1			
111418150748, 02,01,0			
111418150748, 1d,03			
07,111418150743,111418150748,0005,563820424941,4d494c48415254,02,03,1d			DURATION 5 SECS;PHASE 2; Preempt Override; REQUEST 13
111418150749, 1d,03			
03,1d,111418150749,563820424941,02,01,03,06			STATUS ActiveOverride
05,1d,111418150749,563820424941,02,01,03			CANCEL
06,1d,111418150749,563820424941,02,01,03			CLEAR
111418150759, PREEMPT,0			PREEMPT OFF
01,1e,111418150814,563820424941,02,01,03,0011,0011,02,aae70919,473cabcb,4d494c48415254,36363530202020,333536202020202020,04b4,ff			
111418150814, 02,01,1	**BIAB**	3:08:14	**PRE-TEST**
03,1e,111418150814,563820424941,02,01,03,04			STATUS Active Processing
02,1e,111418150819,563820424941,02,01,03,0011,0011,02,a91d0a19,1371abcb,04a1			
03,1e,111418150819,563820424941,02,01,03,04			
05,1e,111418150821,563820424941,02,01,03			CLEAR
111418150821, 02,01,0			
06,1e,111418150821,563820424941,02,01,03			CANCEL
07,111418150814,111418150821,0007,563820424941,4d494c48415254,02,00,1e			DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 30
01,21,111418151006,563820424941,02,01,03,0014,0014,02,06350a19,12deaacb,4d494c48415254,36363530202020,333536202020202020,0550,ff			
111418151006, 02,01,1		3:10:06	**PRS 11-17 NEAR SIDE STOP #1**
03,21,111418151006,563820424941,02,01,03,04			
02,21,111418151012,563820424941,02,01,03,0010,0010,02,1d2c0a19,c9e6aacb,0551			
03,21,111418151012,563820424941,02,01,03,04			STATUS ActiveProcessing
02,21,111418151017,563820424941,02,01,03,000c,000c,02,49230a19,6aefaacb,0554			
03,21,111418151017,563820424941,02,01,03,04			
02,21,111418151022,563820424941,02,01,03,0009,0009,02,731c0a19,19f6aacb,0555			
03,21,111418151022,563820424941,02,01,03,04			
05,21,111418151023,563820424941,02,01,03			CANCEL
111418151023, 02,01,0			PRIORITY OFF
06,21,111418151023,563820424941,02,01,03			CLEAR
07,111418151006,111418151023,0011,563820424941,4d494c48415254,02,00,21			DURATION 17 SECS; PHASE 2; TSP ENABLED; REQUEST 33
01,21,111418151042,563820424941,02,01,03,0009,0009,02,731c0a19,19f6aacb,4d494c48415254,36363530202020,333536202020202020,0568,ff			
111418151042, 02,01,1		3:10:42	**PRS 11-17 NEAR SIDE BUS STOP #2**

03,21,111418151042,563820424941,02,01,03,04			
02,21,111418151047,563820424941,02,01,03,0007,0007,02,bd160a19,affbaacb,056c			
03,21,111418151047,563820424941,02,01,03,04			STATUS ActiveProcessing
02,21,111418151052,563820424941,02,01,03,0003,0003,02,e90d0a19,5004abcb,056d			
03,21,111418151052,563820424941,02,01,03,04			
02,21,111418151057,563820424941,02,01,03,0000,0000,02,00050a19,070dabcb,056e			
03,21,111418151057,563820424941,02,01,03,04			
02,21,111418151103,563820424941,02,01,03,0005,0005,02,45fa0919,8517abcb,056e			
03,21,111418151103,563820424941,02,01,03,04			
05,21,111418151107,563820424941,02,01,03			CANCEL
111418151107, 02,01,0			
06,21,111418151108,563820424941,02,01,03			CLEAR
07,111418151042,111418151108,001a,563820424941,4d494c48415254,02,00,21			DURATION 26 SECS; PHASE 2; TSP ENABLED; REQUEST 33
01,22,111418151121,563820424941,02,01,03,0012,0012,02,94de0919,6433abcb,4d494c48415254,36363530202020,333536202020202020,0574,ff			
111418151121, 02,01,1		3:11:21	**PRE-TEST**
03,22,111418151121,563820424941,02,01,03,04			
02,22,111418151126,563820424941,02,01,03,0011,0011,02,39e90919,cd3dabcb,0574			
03,22,111418151126,563820424941,02,01,03,04			
02,22,111418151131,563820424941,02,01,03,0011,0011,02,0cf20919,6e46abcb,0575			
03,22,111418151131,563820424941,02,01,03,04			STATUS ActiveProcessing
02,22,111418151136,563820424941,02,01,03,0011,0011,02,acf70919,ee4babcb,0578			
03,22,111418151136,563820424941,02,01,03,04			
02,22,111418151142,563820424941,02,01,03,0011,0011,02,acf70919,ee4babcb,057d			
03,22,111418151142,563820424941,02,01,03,04			
02,22,111418151147,563820424941,02,01,03,0011,0011,02,3c240a19,8177abcb,056e			
03,22,111418151147,563820424941,02,01,03,04			
05,22,111418151147,563820424941,02,01,03			CANCEL
111418151147, 02,01,0			
06,22,111418151147,563820424941,02,01,03			CLEAR
07,111418151121,111418151147,001a,563820424941,4d494c48415254,02,00,22			DURATION 26 SECS; PHASE 2; TSP ENABLED; REQUEST 34
01,25,111418151556,563820424941,02,01,03,0015,0015,02,3c360a19,e2dcaacb,4d494c48415254,36363530202020,333536202020202020,06af,ff			
111418151556, 02,01,1	BIAB	3:15:56	**PRS 11-18 COMM DROPPED**
03,25,111418151556,563820424941,02,01,03,04			No Comm for 41 Secs
03,26,111418151637,563820424941,02,01,03,04			STATUS ActiveProcessing
05,25,111418151639,563820424941,02,01,03			CANCEL
111418151639, 02,01,0			
06,25,111418151639,563820424941,02,01,03			CLEAR
07,111418151556,111418151639,002b,563820424941,4d494c48415254,02,00,25			DURATION 43 SECS; PHASE 2; TSP ENABLED; REQUEST 37

03,26,111418151642,563820424941,02,01,03,01	STATUS IdleNotValid	
05,26,111418151642,563820424941,02,01,03	CANCEL	Second Cancel and Clear
06,26,111418151642,563820424941,02,01,03	CLEAR	

C - Regional PRS Device Verification Test: Cobalt Controller Running ASC/3 Software

Test Summary

The Trapeze BIAB including the PRG software was used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Maryland Avenue intersection equipped with the Regional PRS device connected to an Econolite Cobalt controller running the ASC/3 32.10.66 intersection control software. Current signal timing for the Maryland Avenue intersection was installed on the intersection traffic controller. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and IEEE 802.11n access point (intersection equipment) was used.

Observations of the controller front panel display were made and recorded during the testing. Additionally, the Regional PRS log files were downloaded after the completion of the tests for reporting and review. The Regional PRS log files for each of the tests were also uploaded in near real time by a cellular VPN link to the TSP Data Server at the Parsons offices but were not available for reporting and review in the preparation of this report.

The Regional PRS Device verification tests for the Milwaukee Avenue/Maryland Avenue intersection consisted of eight tests as summarized in the Test Description Table starting on the next page. The eight tests were successfully completed (“Passed”). The eight tests verified bus-to-intersection communications between the Trapeze PRG software and Regional PRS Device connected with a Siemens Eagle M50 traffic controller running ASC/3 32.10.66 intersection control software.

Attached following the Test Description Table is the Test Data Sheet (one page) marked up as the tests were conducted and the Regional PRS log data in an Excel spreadsheet format (five pages). The Regional PRS log data report has been annotated.

One anomaly was observed during the testing and confirmed in the Regional PRS log file reports.

1. Test PRS 21-1 was expected to generate a re-service override response to the second of back-to-back requests for priority. No re-service override was observed or reported for the test. It is not known if the re-service override timer was set to greater than zero cycles or seconds for the test.

Regional PRS Device Verification Tests: Cobalt Controller Running ASC/3 Software

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	11/14/18 1:17PM	Pass	No TSP call initiated at controller
PRS 11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	11/14/18 12:47PM	Pass	
PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	11/14/18 12:49PM	Pass	
PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).	11/14/18 1:15PM	Pass	
PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by EVP preemption call before the priority request is cancelled and cleared.	11/14/18 1:36PM	Pass	
PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.	11/14/18 1:37PM	Pass	
PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	11/14/18 1:40PM	Pass	

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 21-1	First Bus approaches the intersection from NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection with green extension, early green, or no action required. The Second Bus approaches the intersection in the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	11/14/18 1:41PM	Pass	No re-service lockout observed

11-14-18

REGIONAL PRS DEVICE VERIFICATION TESTS - COBALT CONTROLLER WITH ASC/3 FIRMWARE

Ref	Test	Test Description	Expected PRS Status	Expected Action Taken	Test Start Time	Test End Time	Test Notes
1	PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	TSP event rejected by PRS and not set up by Controller. No PRS status available.	11 Log Only Request	1:17		~~SB~~ No TSP call
2	PRS 11-2	Pace Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	12:47		NB TSP call ok Possible early grn
3	PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	12:49		NB TSP call
4	PRS 11-8	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.	12 reserved (closedStrategyError) OR 13 closedCompleted	04 Time Of Day Override	/		PREL enabled @ tester
5	PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to preemption lockout (already in progress).	3 activeProcessing; 13 closedComplete	03 Preemption Override	1:15		No TSP G, short G, A? Preempt LED on
6	PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by preemption call before the priority request is cancelled and cleared.	4 activeProcessing; 13 closedCompleted	03 Preemption Override	1:36		Override
7	PRS 11-13	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.	12 closedStrategyError	01 Invalid ID Override	/		
8	PRS 11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through the intersection on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	/		Duplicate
9	PRS 11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	/		Duplicate
10	PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers. Bus closes doors after passengers board, requests priority, and then proceeds through the intersection on green signal.	First Request: 4 activeProcessing; 13 closedCancelled. Second Request: 9 reserviceError	First Request: 0 Priority Action Taken. Second Request: 09 Reservice Override	1:37		TSP Call #1 TSP Call #2
11	PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	1:40		No Comm A stayed on
12	PRS 21-1	First Bus approaches the intersection from the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection on a green extension, early green, or no action required. The Second Bus approaches the intersection from the EB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 9 re-service error	First Bus: 0 Priority Action Taken. Second Bus: 09 Re-service Override	1:41		#1 TSP Call #2 TSP Call

13	PRS 21-2	First Bus approaches the intersection from the EB direction at normal operating speed, running on-time, and requests "log only" priority using the RTA PRG VTT. The controller takes no action for the First Bus. The First Bus continues through the intersection. The Second Bus approaches the intersection from the NB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the Regional Interoperable Message Set. The controller provides a green extension, early green, or no action required for the Second Bus.	First Bus: No Status Messages. Second Bus: 4 activeProcessing; 13 closedCompleted.	First Bus: 11 Log Only Request. Second Bus: 0 Priority Action Taken			

REGIONAL PRS LOGS COBALT CONTROLLER WITH ASC/3 SOFTWARE (MARYLAND STREET)
11/14/2018

01,01,111418123057,313131342020,02,04,06,001e,0032,02,000001bd,00000315,4d494c4d415259,31353020202020,3134202020202020202020,0028,0a			
	VTT	12:30:57	**PRE-TEST**
03,01,111418123230,313131342020,02,04,06,01			STATUS IdleNotValid
111418123955, 01,01			
07,111418123955,111418123955,0000,563820424941,4d494c4d415259,02,01,01			DURATION 0 SECS; PHASE 2; INVALID ID; REQUEST 1
01,01,111418123955,563820424941,02,01,03,001c,001c,02,c2d60f19,82efa5cb,4d494c4d415259,36343434202020,3335352020202020202020,036e,ff			
	BIAB	12:39:55	**PRE-TEST**
03,01,111418123955,563820424941,02,01,03,01			STATUS IdleNotValid
05,01,111418123955,563820424941,02,01,03			CANCEL
06,01,111418123956,563820424941,02,01,03			CLEAR
111418124342, SYS, Novax PRS Program Started!			RE-STARTED
01,02,111418124440,313131342020,02,04,06,001e,0032,02,000001bd,00000315,4d494c4d415259,31353020202020,3134202020202020202020,0028,0a			
111418124440, 02,01,1	**VTT**		**PRE-TEST**
01,02,111418124442,563820424941,02,01,03,0011,0011,02,03eb0f19,788ea5cb,4d494c4d415259,36343434202020,3335352020202020202020,0314,ff			
03,02,111418124442,563820424941,02,01,03,04	**BIAB**	12:44:42	**PRE-TEST**
02,02,111418124447,563820424941,02,01,03,0011,0011,02,52b70f19,40a8a5cb,0303			
03,02,111418124447,563820424941,02,01,03,04			STATUS ActiveProcessing
05,02,111418124447,563820424941,02,01,03			CANCEL
06,02,111418124448,563820424941,02,01,03			CLEAR
07,111418124442,111418124448,0006,563820424941,4d494c4d415259,02,00,02			DURATION 6 SECS; PHASE 2; TSP ENABLED; REQUEST 2
	VTT	12:44:51	
02,02,111418124451,313131342020,02,04,06,001e,0032,02,000001bd,00000315,0028			
03,02,111418124452,313131342020,02,04,06,04			STATUS ActiveProcessing
03,02,111418124456,313131342020,02,04,06,04			
05,02,111418124508,313131342020,02,04,06			CANCEL
111418124508, 02,01,0			
06,02,111418124510,313131342020,02,04,06			CLEAR
07,111418124440,111418124510,001e,313131342020,4d494c4d415259,02,00,02			DURATION 30 SECS; PHASE2; TSP ENABLED; REQUEST 2
01,03,111418124618,563820424941,02,01,03,001c,001c,02,aad60f19,94efa5cb,4d494c4d415259,36343434202020,3335352020202020202020,04ed,ff			
111418124618, 02,01,1	**BIAB**	12:46:18	**PRS 11-2 NORMAL OPERATION**
03,03,111418124618,563820424941,02,01,03,04			
02,03,111418124623,563820424941,02,01,03,0010,0010,02,46ec0f19,72dfa5cb,04e7			
03,03,111418124623,563820424941,02,01,03,04			STATUS ActiveProcessing
02,03,111418124628,563820424941,02,01,03,0004,0004,02,b2011019,74cfa5cb,04e0			

03,03,111418124628,563820424941,02,01,03,04			
02,03,111418124633,563820424941,02,01,03,0004,0004,02,d0171019,aec0a5cb,04d9			
03,03,111418124633,563820424941,02,01,03,04			
05,03,111418124635,563820424941,02,01,03			CANCEL
111418124635, 02,01,0			
06,03,111418124635,563820424941,02,01,03			CLEAR
07,111418124618,111418124635,0011,563820424941,4d494c4d415259,02,00,03			DURATION 17 SECS; PHASE 2; TSP ENABLED; REQUEST 3
01,04,111418124736,563820424941,02,01,03,0010,0010,02,1ceb0f19,1a96a5cb,4d494c4d415259,36343434202020,333535202020202020,03c0,ff			
111418124736, 02,01,1	**BIAB**	12:47:36	**PRS 11-2 NORMAL OPERATION**
03,04,111418124736,563820424941,02,01,03,04			STATUS ActiveProcessing
02,04,111418124741,563820424941,02,01,03,0010,0010,02,76b20f19,95aba5cb,03af			
03,04,111418124741,563820424941,02,01,03,04			
05,04,111418124743,563820424941,02,01,03			CANCEL
111418124743, 02,01,0			
06,04,111418124743,563820424941,02,01,03			CLEAR
07,111418124736,111418124743,0007,563820424941,4d494c4d415259,02,00,04			DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 4
01,05,111418124903,563820424941,02,01,03,001b,001b,02,11d80f19,88eea5cb,4d494c4d415259,36343434202020,333535202020202020,0592,ff			
111418124903, 02,01,1	**BIAB**	12:49:03	**PRS 11-3 NORMAL OPERATION BUS SLOWING**
03,05,111418124903,563820424941,02,01,03,04			
02,05,111418124909,563820424941,02,01,03,0012,0012,02,17e90f19,d2e1a5cb,058e			
03,05,111418124909,563820424941,02,01,03,04			
02,05,111418124914,563820424941,02,01,03,0008,0008,02,eef90f19,40d5a5cb,0589			
03,05,111418124914,563820424941,02,01,03,04			STATUS ActiveProcessing
02,05,111418124920,563820424941,02,01,03,0000,0000,02,8e0b1019,d4c9a5cb,0585			
03,05,111418124920,563820424941,02,01,03,04			
02,05,111418124925,563820424941,02,01,03,000a,000a,02,ad1c1019,0cbda5cb,0581			
03,05,111418124925,563820424941,02,01,03,04			
05,05,111418124925,563820424941,02,01,03			CANCEL
111418124925, 02,01,0			
06,05,111418124926,563820424941,02,01,03			CLEAR
07,111418124903,111418124926,0017,563820424941,4d494c4d415259,02,00,05			DURATION 23 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,06,111418125055,563820424941,02,01,03,0012,0012,02,f8ea0f19,4d8ba5cb,4d494c4d415259,36343434202020,333535202020202020,0488,ff			
111418125055, 02,01,1		12:50:55	**PRS 11-9 PREEMPT OVERRIDE**
03,06,111418125055,563820424941,02,01,03,04			
02,06,111418125100,563820424941,02,01,03,0010,0010,02,c7e10f19,5ca1a5cb,0486			
03,06,111418125100,563820424941,02,01,03,04			STATUS ActiveProcessing
111418125134, PREEMPT,1			PREEMPT ON
111418125134, PIN: 1			

111418125134, 02,01,0			PRIORITY OFF
111418125134, 06,03			
07,111418125055,111418125134,0027,563820424941,4d494c4d415259,02,03,06			DURATION 39 SECS; PHASE 2; Preempt Override; REQUEST 6
111418125135, PREEMPT,0			
111418125135, PREEMPT,1			
111418125135, PIN: 1			
111418125141, PREEMPT,0			
111418125303, SYS, PRG Communications Failure Timeout			
111418125303, 06,0a			
ff,0b0e120c3503,4d494c4d415259,02,563820424941			
111418131112, PREEMPT,1			
111418131112, PIN: 1			
111418131230, PREEMPT,0			
01,0f,111418133531,563820424941,02,01,03,001b,001b,02,e1d70f19,aceea5cb,4d494c4d415259,36343437202020,333438202020202020,0266,ff			
111418133531, 02,01,1	**BIAB**	1:35:31	**PRS 11-10 PREEMPT INTERRUPT**
03,0f,111418133531,563820424941,02,01,03,04			STATUS ActiveProcessing
111418133535, PREEMPT,1			PREEMPT ON
111418133535, PIN: 1			
111418133535, 02,01,0			
111418133535, 0f,03			
07,111418133531,111418133535,0004,563820424941,4d494c4d415259,02,03,0f			DURATION 4 SECS; PHASE 2; PREEMPT OVERRIDE;REQUEST 15
111418133536, PREEMPT,0			PREEMPT OFF
111418133536, PREEMPT,1			PREEMPT ON
111418133536, PIN: 1			
111418133536, 0f,03			
03,0f,111418133536,563820424941,02,01,03,06			STATUS ActiveOverride
05,0f,111418133537,563820424941,02,01,03			CANCEL
06,0f,111418133537,563820424941,02,01,03			CLEAR
111418133558, PREEMPT,0			PREEMPT OFF
01,10,111418133642,563820424941,02,01,03,0011,0011,02,05eb0f19,308fa5cb,4d494c4d415259,36343437202020,333438202020202020,0133,ff			
111418133642, 02,01,1		1:36:42	**PRE-TEST**
03,10,111418133642,563820424941,02,01,03,04			STATUS ActiveProcessing
02,10,111418133647,563820424941,02,01,03,0011,0011,02,21b70f19,61a8a5cb,0122			
03,10,111418133647,563820424941,02,01,03,04			
05,10,111418133650,563820424941,02,01,03			CANCEL
111418133650, 02,01,0			
06,10,111418133650,563820424941,02,01,03			CLEAR
07,111418133642,111418133650,0008,563820424941,4d494c4d415259,02,00,10			DURATION 8 SECS; PHASE 2; TSP ENABLED; REQUEST 16

01,11,111418133837,563820424941,02,01,03,001c,001c,02,69d70f19,05efa5cb,4d494c4d415259,36343437202020,3334382020202020,031e,ff			
111418133837, 02,01,1	**BIAB**	1:39:01	**PRS 11-17 NEAR SIDE BUS STOP #1**
03,11,111418133837,563820424941,02,01,03,04			
02,11,111418133842,563820424941,02,01,03,0015,0015,02,7be30f19,03e6a5cb,031e			
03,11,111418133842,563820424941,02,01,03,04			STATUS ActiveProcessing
02,11,111418133847,563820424941,02,01,03,000e,000e,02,74ef0f19,13dda5cb,031c			
03,11,111418133847,563820424941,02,01,03,04			
02,11,111418133852,563820424941,02,01,03,000c,000c,02,eaf20f19,7ddaa5cb,031f			
03,11,111418133852,563820424941,02,01,03,04			
05,11,111418133852,563820424941,02,01,03			CANCEL
111418133852, 02,01,0			
06,11,111418133852,563820424941,02,01,03			CLEAR
07,111418133837,111418133852,000f,563820424941,4d494c4d415259,02,00,11			DURATION 15 SECS; PHASE 2; TSP ENABLED; REQUEST 17
01,11,111418133901,563820424941,02,01,03,000c,000c,02,eaf20f19,7ddaa5cb,4d494c4d415259,36343437202020,3334382020202020,0328,ff			
111418133901, 02,01,1	**BIAB**	1:39:01	**PRS 11-17 NEAR SIDE BUS STOP #2**
03,11,111418133901,563820424941,02,01,03,04			
02,11,111418133906,563820424941,02,01,03,000c,000c,02,eaf20f19,7ddaa5cb,032d			
03,11,111418133906,563820424941,02,01,03,04			
02,11,111418133911,563820424941,02,01,03,0006,0006,02,0cfe0f19,2ed2a5cb,032c			
03,11,111418133911,563820424941,02,01,03,04			
02,11,111418133916,563820424941,02,01,03,0000,0000,02,9f0a1019,86caa5cb,032a			
03,11,111418133917,563820424941,02,01,03,04			
02,11,111418133922,563820424941,02,01,03,0008,0008,02,07191019,c5bfa5cb,0327			
03,11,111418133922,563820424941,02,01,03,04			STATUS ActiveProcessing
05,11,111418133926,563820424941,02,01,03			CANCEL
111418133926, 02,01,0			
06,11,111418133926,563820424941,02,01,03			CLEAR
07,111418133901,111418133926,0019,563820424941,4d494c4d415259,02,00,11			DURATION 25 SECS; PHASE 2: TSP ENABLED; REQUEST 17
01,12,111418134013,563820424941,02,01,03,0011,0011,02,02eb0f19,538ea5cb,4d494c4d415259,36343437202020,3334382020202020,0206,ff			
111418134013, 02,01,1		1:40:13	**PRS 11-18 NO COMM**
03,12,111418134014,563820424941,02,01,03,04			
02,12,111418134019,563820424941,02,01,03,0011,0011,02,e5b70f19,dba7a5cb,01f6			
03,12,111418134019,563820424941,02,01,03,04			STATUS ActiveProcessing
05,12,111418134021,563820424941,02,01,03			CANCEL
111418134021, 02,01,0			
06,12,111418134021,563820424941,02,01,03			CLEAR
07,111418134013,111418134021,0008,563820424941,4d494c4d415259,02,00,12			DURATION 8 SECS; PHASE 2; TSP ENABLED; REQUEST 18
111418134223, SYS, PRG Communications Fault Cleared			COMM RE-ESTABLISHED

01,13,111418134223,563820424941,02,01,03,001c,001c,02,aad60f19,94efa5cb,4d494c4d415259,36343437202020,33343820202020202020,0402,ff
111418134223, 02,01,1 **BIAB** 1:42:23 **PRS 21-1 TWO BUSES BUS #1**
03,13,111418134223,563820424941,02,01,03,04
02,13,111418134228,563820424941,02,01,03,0018,0018,02,b5de0f19,93e9a5cb,0402
03,13,111418134229,563820424941,02,01,03,04 STATUS ActiveProcessing
02,13,111418134234,563820424941,02,01,03,0013,0013,02,c1e60f19,91e3a5cb,0403
03,13,111418134234,563820424941,02,01,03,04
02,13,111418134239,563820424941,02,01,03,000f,000f,02,ccee0f19,90dda5cb,0404
03,13,111418134239,563820424941,02,01,03,04
02,13,111418134244,563820424941,02,01,03,000a,000a,02,a8f60f19,b2d7a5cb,0405
03,13,111418134244,563820424941,02,01,03,04
02,13,111418134249,563820424941,02,01,03,0006,0006,02,cbfe0f19,9fd1a5cb,0406
03,13,111418134249,563820424941,02,01,03,04
02,13,111418134254,563820424941,02,01,03,0001,0001,02,ef061019,8bcba5cb,0406
03,13,111418134255,563820424941,02,01,03,04
02,13,111418134300,563820424941,02,01,03,0001,0001,02,2b111019,a3c5a5cb,0406
03,13,111418134300,563820424941,02,01,03,04
02,13,111418134305,563820424941,02,01,03,0001,0001,02,1f191019,b3bfa5cb,0407
03,13,111418134305,563820424941,02,01,03,04
05,13,111418134308,563820424941,02,01,03 CANCEL
111418134308, 02,01,0
06,13,111418134308,563820424941,02,01,03 CLEAR
07,111418134223,111418134308,002d,563820424941,4d494c4d415259,02,00,13 DURATION 45 SECS; PHASE 2; TSP ENABLED; REQUEST 19
01,01,111418134316,495445524953,02,04,06,001e,0032,02,000001bd,00000315,4d494c4d415259,31353020202020,31342020202020202020,0028,0a
111418134316, 02,01,1 **VTT** 1:43:16 **PRS 21-1 TWO BUSES BUS #2**
02,01,111418134322,495445524953,02,04,06,001e,0032,02,000001bd,00000315,0028
03,01,111418134324,495445524953,02,04,06,04 STATUS ActiveProcessing
03,01,111418134326,495445524953,02,04,06,04
03,01,111418134328,495445524953,02,04,06,04
05,01,111418134334,495445524953,02,04,06 CANCEL
111418134334, 02,01,0
06,01,111418134338,495445524953,02,04,06 CLEAR
07,111418134316,111418134338,0016,495445524953,4d494c4d415259,02,00,01 DURATION 22 SECS; PHASE 2; TSP ENABLED; REQUEST 1
NO RE-SERVICE ERROR OUTPUT FROM CONTROLLER

D - Regional PRS Device Verification Test: Eagle M50 Controller Running EPAC Software

Test Summary

The Trapeze BIAB including the PRG software was used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Main Street intersection equipped with the Regional PRS device connected to a Siemens Eagle M50 controller running the EPAC 3.57c intersection control software. Current signal timing for the Main Street intersection was installed on the intersection traffic controller. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and IEEE 802.11n access point (intersection equipment) was used.

Observations of the controller front panel inputs display were made and recorded during the testing. Additionally, the Regional PRS log files were downloaded after the completion of the tests for reporting and review. The Regional PRS log files for each of the tests were also uploaded in near real time by a cellular VPN link to the TSP Data Server at the Parsons offices but were not available for reporting and review in the preparation of this report.

The Regional PRS Device verification tests for the Milwaukee Avenue/Main Street intersection consisted of eight tests as summarized in the Test Description Table starting on the next page. The eight tests were successfully completed ("Passed"). The eight tests verified bus-to-intersection communications between the Trapeze PRG software and Regional PRS Device connected with a Siemens Eagle M60 controller running EPAC 3.57c intersection control software.

Attached following the Test Description Table is the Test Data Sheet (one page) marked up as the tests were conducted and the Regional PRS log data in an Excel spreadsheet format (nine pages). The Regional PRS log data report has been annotated.

Five anomalies were observed during the testing and confirmed from the Regional PRS log file reports.

1. Test PRS 21-1 was expected to generate a re-service override response to the second of back-to-back requests for priority. No re-service override was observed or reported for the test. It is not known if the re-service override timer was set to greater than zero cycles or seconds for the test.

2. The Eagle M50 appeared to be locked in flash or preemption mode. Attempts were made to re-boot the traffic controller without any success. As a result, the response of the traffic controller to the TSP calls received could not be determined. The inputs to the traffic controller from the Regional PRS Device were monitored and were determined to be fully operational.

3. Tests PRS 11-9 and PRS 11-10 were expected to generate preemption overrides to the requests for priority from the Pace buses. No preemption overrides were observed or reported for the tests.

4. An unexpected request for priority was initiated five seconds after the completion of test 11-10. The request for priority message set was recorded in the Regional PRS log file report.

5. No "request for priority" message (record type 01) was recorded in the Regional PRS log file report for test 11-1. Otherwise, the test was completed as expected.

Regional PRS Device Verification Tests: Eagle M50 Controller Running EPAC Software

Ref	Test Description	Date/Time	Pass/Fail	Comments
PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	11/15/18 11:51AM	Pass	
PRS 11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	11/15/18 11:24AM	Pass	
PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	11/15/18 11:25AM	Pass	
PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).	11/15/18 11:28AM	Pass	
PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by EVP preemption call before the priority request is cancelled and cleared.	11/15/18 11:31AM	Pass	
PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.	11/15/18 11:32AM	Pass	
PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	11/15/18 11:37AM	Pass	TSP call held at PRS after communications disconnected

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 21-1	First Bus approaches the intersection from NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection with green extension, early green, or no action required. The Second Bus approaches the intersection in the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	11/15/18 11:40AM	Pass	No re-service lockout observed.

11-15-18

M50

REGIONAL PRS DEVICE VERIFICATION TESTS - EAGLE M50 CONTROLLER WITH EPAC FIRMWARE

Ref	Test	Test Description	Expected PRS Status	Expected Action Taken	Test Start Time	Test End Time	Test Notes
1	PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	TSP event rejected by PRS and not set up by Controller. No PRS status available.	11 Log Only Request	1151		SB Log only/no PRS flash
2	PRS 11-2	Pace Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	1124		SB TSP ok Controller @ Flash
3	PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	1125		SB TSP ok
4	PRS 11-8	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.	12 reserved (closedStrategyError) OR 13 closedCompleted	04 Time Of Day Override			
5	PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to preemption lockout (already in progress).	3 activeProcessing; 13 closedComplete	03 Preemption Override	1128		SB PRS flashing
6	PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by preemption call before the priority request is cancelled and cleared.	4 activeProcessing; 13 closedCompleted	03 Preemption Override	1131		SB PRS flashing
7	PRS 11-13	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.	12 closedStrategyError	01 Invalid ID Override			
8	PRS 11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through the intersection on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			
9	PRS 11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			
10	PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers. Bus closes doors after passengers board, requests priority, and then proceeds through the intersection on green signal.	First Request: 4 activeProcessing; 13 closedCancelled. Second Request: 9 reserviceError	First Request: 0 Priority Action Taken. Second Request: 09 Reservice Override	1132		SB TSP #1 ok/ TSP #2 ok
11	PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	1137		SB TSP Call held after comm lost
12	PRS 21-1	First Bus approaches the intersection from the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection on a green extension, early green, or no action required. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 9 re-service error	First Bus: 0 Priority Action Taken. Second Bus: 09 Re-service Override	1140		SB TSP Call #1 ok #2 ok

13	PRS 21-2	First Bus approaches the intersection from the SB direction at normal operating speed, running on-time, and requests "log only" priority using the RTA PRG VTT. The controller takes no action for the First Bus. The First Bus continues through the intersection. The Second Bus approaches the intersection from the NB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the Regional Interoperable Message Set. The controller provides a green extension, early green, or no action required for the Second Bus.	First Bus: No Status Messages. Second Bus: 4 activeProcessing; 13 closedCompleted.	First Bus: 11 Log Only Request. Second Bus: 0 Priority Action Taken			[illegible]

REGIONAL PRS LOG FOR EAGLE M50 CONTROLLER WITH EPAC SOFTWARE (MAIN STREET)

01,05,111518110531,563820424941,02,01,03,000e,000e,02,5b910d19,ecd5a7cb,4d494c4d41494e,36343532202020,333537202020202020,00fe,ff
111518110532, 02,01,1 **BIAB** 11:05:31 **PRE-TEST**
03,05,111518110532,563820424941,02,01,03,04
02,05,111518110537,563820424941,02,01,03,000e,000e,02,5b910d19,ecd5a7cb,0103
03,05,111518110537,563820424941,02,01,03,04
02,05,111518110542,563820424941,02,01,03,000e,000e,02,5b910d19,ecd5a7cb,0108
03,05,111518110542,563820424941,02,01,03,04
02,05,111518110547,563820424941,02,01,03,000e,000e,02,5b910d19,ecd5a7cb,010d
03,05,111518110547,563820424941,02,01,03,04
02,05,111518110552,563820424941,02,01,03,0003,0003,02,22b70d19,0eb4a7cb,0107
03,05,111518110552,563820424941,02,01,03,04
05,05,111518110557,563820424941,02,01,03
111518110557, 02,01,0
06,05,111518110557,563820424941,02,01,03
07,111518110531,111518110557,001a,563820424941,4d494c4d41494e,02,00,05 DURATION 26 SECS; PHASE 2; TSP ENABLED; REQUEST 5
111518110735, SYS, PRG Communications Fault Cleared
01,01,111518112337,563820424941,02,01,03,0014,0014,02,19f20d19,6185a7cb,4d494c4d41494e,36353231202020,333631202020202020,0379,ff
111518112337, 02,01,1 **BIAB** 11:23:37 **PRS 11-2 NORMAL OPERATION**
03,01,111518112337,563820424941,02,01,03,04
02,01,111518112342,563820424941,02,01,03,000f,000f,02,cee50d19,2090a7cb,0379
03,01,111518112342,563820424941,02,01,03,04
02,01,111518112347,563820424941,02,01,03,000a,000a,02,6dd90d19,f29aa7cb,0378
03,01,111518112347,563820424941,02,01,03,04
02,01,111518112352,563820424941,02,01,03,0004,0004,02,6bcc0d19,51a6a7cb,0377
03,01,111518112353,563820424941,02,01,03,04 STATUS Active Processing
02,01,111518112358,563820424941,02,01,03,0002,0002,02,e2bd0d19,05b3a7cb,0376
03,01,111518112358,563820424941,02,01,03,04
05,01,111518112401,563820424941,02,01,03 CANCEL
111518112401, 02,01,0
06,01,111518112402,563820424941,02,01,03 CLEAR
07,111518112337,111518112402,0019,563820424941,4d494c4d41494e,02,00,01 DURATION 25 SECS; PHASE 2; TSP ENABLED; REQUEST 1
01,02,111518112404,563820424941,02,01,03,0013,0013,02,70970d19,aed6a7cb,4d494c4d41494e,36353231202020,333631202020202020,036b,ff
111518112404, 02,01,1 **BIAB** 11:24:04 **PRS 11-2 NORMAL OPERATION**
03,02,111518112404,563820424941,02,01,03,04

02,02,111518112409,563820424941,02,01,03,0013,0013,02,78a70d19,e521a8cb,0358
03,02,111518112409,563820424941,02,01,03,04 STATUS Active Processing
05,02,111518112411,563820424941,02,01,03 CANCEL
111518112411, 02,01,0
06,02,111518112411,563820424941,02,01,03 CLEAR
07,111518112404,111518112411,0007,563820424941,4d494c4d41494e,02,00,02 DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 2
01,03,111518112534,563820424941,02,01,03,0013,0013,02,c3ef0d19,6b87a7cb,4d494c4d41494e,36353231202020,333631202020202020,03ed,ff
111518112534, 02,01,1 **BIAB** 11:25:34 **PRS 11-3 NORMAL OPERATION BUS SLOWING**
03,03,111518112534,563820424941,02,01,03,04
02,03,111518112539,563820424941,02,01,03,0009,0009,02,46d70d19,d49ca7cb,03e7
03,03,111518112539,563820424941,02,01,03,04
02,03,111518112544,563820424941,02,01,03,0009,0009,02,46d70d19,d49ca7cb,03ec
03,03,111518112544,563820424941,02,01,03,04
02,03,111518112550,563820424941,02,01,03,0004,0004,02,3acd0d19,9ca5a7cb,03ed
03,03,111518112550,563820424941,02,01,03,04
02,03,111518112555,563820424941,02,01,03,0004,0004,02,3dcc0d19,79a6a7cb,03f2
03,03,111518112555,563820424941,02,01,03,04 STATUS ActiveProcessing
02,03,111518112600,563820424941,02,01,03,0002,0002,02,f2c60d19,1aaba7cb,03f5
03,03,111518112600,563820424941,02,01,03,04
02,03,111518112605,563820424941,02,01,03,0002,0002,02,04bb0d19,88b5a7cb,03f5
03,03,111518112605,563820424941,02,01,03,04
05,03,111518112610,563820424941,02,01,03 CANCEL
111518112610, 02,01,0
06,03,111518112610,563820424941,02,01,03 CLEAR
07,111518112534,111518112610,0024,563820424941,4d494c4d41494e,02,00,03 DURATION 36 SECS; PHASE 2; TSP ENABLED; REQUEST 3
01,04,111518112623,563820424941,02,01,03,0013,0013,02,c2980d19,20d9a7cb,4d494c4d41494e,36353231202020,333631202020202020,03f5,ff
111518112623, 02,01,1 **BIAB** 11:26:23
03,04,111518112623,563820424941,02,01,03,04
02,04,111518112628,563820424941,02,01,03,0013,0013,02,65a90d19,da21a8cb,03e2
03,04,111518112628,563820424941,02,01,03,04 STATUS Active Processing
05,04,111518112630,563820424941,02,01,03 CANCEL
111518112630, 02,01,0
06,04,111518112630,563820424941,02,01,03 CLEAR
07,111518112623,111518112630,0007,563820424941,4d494c4d41494e,02,00,04 DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 4
01,05,111518112819,563820424941,02,01,03,0014,0014,02,ebf10d19,8985a7cb,4d494c4d41494e,36353231202020,333631202020202020,0493,ff
111518112819, 02,01,1 **BIAB** 11:28:19

03,05,111518112819,563820424941,02,01,03,04
02,05,111518112824,563820424941,02,01,03,0003,0003,02,d9b90d19,8db6a7cb,047f
03,05,111518112824,563820424941,02,01,03,04 STATUS ActiveProcessing
05,05,111518112826,563820424941,02,01,03 CANCEL
111518112826, 02,01,0
06,05,111518112826,563820424941,02,01,03 CLEAR
07,111518112819,111518112826,0007,563820424941,4d494c4d41494e,02,00,05 DURATION 7 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,06,111518112828,563820424941,02,01,03,0013,0013,02,279c0d19,6bdfa7cb,4d494c4d41494e,36353231202020,33363120202020202020,0470,ff
111518112828, 02,01,1 **BIAB** 11:28:28 **PRS 11-09 PREEMPT #1**
No Preempt Reported
03,06,111518112828,563820424941,02,01,03,04
02,06,111518112833,563820424941,02,01,03,0013,0013,02,08a00d19,de03a8cb,046a
03,06,111518112833,563820424941,02,01,03,04
02,06,111518112838,563820424941,02,01,03,0013,0013,02,63a00d19,8a11a8cb,046c
03,06,111518112838,563820424941,02,01,03,04
02,06,111518112844,563820424941,02,01,03,0013,0013,02,42a40d19,f921a8cb,046b
03,06,111518112844,563820424941,02,01,03,04
02,06,111518112849,563820424941,02,01,03,0013,0013,02,fbb30d19,9a21a8cb,046b
03,06,111518112849,563820424941,02,01,03,04 STATUS Active Processing
05,06,111518112853,563820424941,02,01,03 CANCEL
111518112853, 02,01,0
06,06,111518112853,563820424941,02,01,03 CLEAR
07,111518112828,111518112853,0019,563820424941,4d494c4d41494e,02,00,06 DURATION 25 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,07,111518113019,563820424941,02,01,03,0015,0015,02,71f30d19,3484a7cb,4d494c4d41494e,36353231202020,33363120202020202020,050b,ff
111518113019, 02,01,1 **BIAB** 11:30:19 **PRS 11-10 PREEMPT #2**
No Preempt Reported
03,07,111518113019,563820424941,02,01,03,04
02,07,111518113024,563820424941,02,01,03,0013,0013,02,daef0d19,5787a7cb,050f
03,07,111518113024,563820424941,02,01,03,04
02,07,111518113029,563820424941,02,01,03,0013,0013,02,daef0d19,5787a7cb,0514
03,07,111518113029,563820424941,02,01,03,04
02,07,111518113034,563820424941,02,01,03,0013,0013,02,daef0d19,5787a7cb,0519
03,07,111518113034,563820424941,02,01,03,04 STATUS Active Processing
02,07,111518113040,563820424941,02,01,03,0013,0013,02,daef0d19,5787a7cb,051e
03,07,111518113040,563820424941,02,01,03,04
02,07,111518113045,563820424941,02,01,03,000f,000f,02,2de50d19,ac90a7cb,051f

03,07,111518113045,563820424941,02,01,03,04			
02,07,111518113050,563820424941,02,01,03,0008,0008,02,60d60d19,9d9da7cb,051e			
03,07,111518113050,563820424941,02,01,03,04			
02,07,111518113055,563820424941,02,01,03,0001,0001,02,b4c40d19,10ada7cb,051b			
03,07,111518113055,563820424941,02,01,03,04			
02,07,111518113100,563820424941,02,01,03,0001,0001,02,5dae0d19,96c0a7cb,0516			
03,07,111518113100,563820424941,02,01,03,04			
05,07,111518113100,563820424941,02,01,03			CANCEL
111518113100, 02,01,0			
06,07,111518113101,563820424941,02,01,03			CLEAR
07,111518113019,111518113101,002a,563820424941,4d494c4d41494e,02,00,07			DURATION 42 SECS; PHASE 2; TSP ENABLED; REQUEST 7
01,08,111518113106,563820424941,02,01,03,0013,0013,02,cf960d19,84d5a7cb,4d494c4d41494e,36353231202020,33363120202020202020,0510,ff			
111518113106, 02,01,1	**BIAB**	11:31:06	**Five Seconds After CLEAR**
03,08,111518113106,563820424941,02,01,03,04			STATUS Active Processing
02,08,111518113111,563820424941,02,01,03,0013,0013,02,42a00d19,a50ca8cb,0506			UPDATE 5 SECS AFTER CALL
03,08,111518113111,563820424941,02,01,03,04			STATUS Active Processing
05,08,111518113114,563820424941,02,01,03			CANCEL
111518113114, 02,01,0			PRIORITY OFF
06,08,111518113114,563820424941,02,01,03			CLEAR
07,111518113106,111518113114,0008,563820424941,4d494c4d41494e,02,00,08			DURATION 8 SECS; PHASE 2; TSP ENABLED; REQUEST 8
01,09,111518113254,563820424941,02,01,03,0015,0015,02,a2f20d19,e984a7cb,4d494c4d41494e,36353231202020,33363120202020202020,05a6,ff			
111518113254, 02,01,1	**BIAB**	11:32:54	**PRS 11-17 NEAR SIDE BUS STOP #1**
03,09,111518113254,563820424941,02,01,03,04			
02,09,111518113259,563820424941,02,01,03,000e,000e,02,aae20d19,de92a7cb,05a4			
03,09,111518113300,563820424941,02,01,03,04			
02,09,111518113305,563820424941,02,01,03,0006,0006,02,2cd10d19,29a2a7cb,05a2			
03,09,111518113305,563820424941,02,01,03,04			
02,09,111518113310,563820424941,02,01,03,0003,0003,02,29cb0d19,6aa7a7cb,05a5			
03,09,111518113310,563820424941,02,01,03,04			STATUS Active Processing
02,09,111518113315,563820424941,02,01,03,0003,0003,02,29cb0d19,6aa7a7cb,05aa			
03,09,111518113315,563820424941,02,01,03,04			
02,09,111518113320,563820424941,02,01,03,0003,0003,02,29cb0d19,6aa7a7cb,05af			
03,09,111518113320,563820424941,02,01,03,04			
05,09,111518113321,563820424941,02,01,03			CANCEL
111518113321, 02,01,0			
06,09,111518113321,563820424941,02,01,03			CLEAR

07,111518113254,111518113321,001b,563820424941,4d494c4d41494e,02,00,09			DURATION 27 SECS; PHASE 2; TSP ENABLED; REQUEST 9
01,09,111518113328,563820424941,02,01,03,0003,0003,02,29cb0d19,6aa7a7cb,4d494c4d41494e,36353231202020,33363120202020202020,05b7,ff			
111518113328, 02,01,1	**BIAB**	11:33:28	**PRS 11-17 NEAR SIDE BUS STOP #2**
03,09,111518113328,563820424941,02,01,03,04			
02,09,111518113333,563820424941,02,01,03,0002,0002,02,06c80d19,29aaa7cb,05bb			
03,09,111518113333,563820424941,02,01,03,04			STATUS ActiveProcessing
02,09,111518113338,563820424941,02,01,03,0002,0002,02,c5b80d19,7eb7a7cb,05b9			
03,09,111518113338,563820424941,02,01,03,04			
05,09,111518113340,563820424941,02,01,03			CANCEL
111518113340, 02,01,0			
06,09,111518113340,563820424941,02,01,03			CLEAR
07,111518113328,111518113340,000c,563820424941,4d494c4d41494e,02,00,09			DURATION 12 SECS; PHASE 2; TSP ENABLED; REQUEST 9
01,0a,111518113343,563820424941,02,01,03,0013,0013,02,c69b0d19,b8dea7cb,4d494c4d41494e,36353231202020,33363120202020202020,05ab,ff			
111518113343, 02,01,1	**BIAB**	11:33:43	
03,0a,111518113343,563820424941,02,01,03,04			STATUS Active Processing
02,0a,111518113348,563820424941,02,01,03,0013,0013,02,49bd0d19,6221a8cb,0592			UPDATE
03,0a,111518113348,563820424941,02,01,03,04			STATUS Active Processing
05,0a,111518113350,563820424941,02,01,03			CANCEL
111518113350, 02,01,0			PRIORITY OFF
06,0a,111518113350,563820424941,02,01,03			CLEAR
07,111518113343,111518113350,0007,563820424941,4d494c4d41494e,02,00,0a			DURATION 7 SECS;PHASE 2; TSP ENABLED; REQUEST 10
01,0b,111518113616,563820424941,02,01,03,000d,000d,02,ada40d19,0ec9a7cb,4d494c4d41494e,36343434202020,33353520202020202020,01b9,ff			
111518113616, 02,01,1	**BIAB**	11:36:16	
03,0b,111518113616,563820424941,02,01,03,04			
03,0c,111518113618,563820424941,02,01,03,04			STATUS Active Processing
02,0b,111518113621,563820424941,02,01,03,000d,000d,02,69a00d19,6712a8cb,01a7			
03,0b,111518113621,563820424941,02,01,03,04			
05,0b,111518113622,563820424941,02,01,03			CANCEL
111518113622, 02,01,0			
06,0b,111518113622,563820424941,02,01,03			CLEAR
07,111518113616,111518113622,0006,563820424941,4d494c4d41494e,02,00,0b			DURATION 6 SECS; PHASE 2; TSP ENABLED; REQUEST 11
03,0c,111518113623,563820424941,02,01,03,01			STATUS IdleNotValid
05,0c,111518113623,563820424941,02,01,03			CANCEL One Second Later; Possible No SNMP ACK
06,0c,111518113623,563820424941,02,01,03			CLEAR One Second Later
			Second Cancel and Clear
01,0d,111518113804,563820424941,02,01,03,0015,0015,02,5af30d19,4884a7cb,4d494c4d41494e,36343434202020,33353520202020202020,022c,ff			

111518113804, 02,01,1	**BIAB**	11:38:04	**PRS 11-18 NO COMM**	
03,0d,111518113805,563820424941,02,01,03,04			STATUS ActiveProcessing 11:38:05	
02,0d,111518113810,563820424941,02,01,03,0011,0011,02,02eb0d19,938ba7cb,022e				
03,0d,111518113810,563820424941,02,01,03,04			STATUS Active Processing 11:38:10	
05,0d,111518113932,563820424941,02,01,03			CANCEL 11:39:32	L247I218M224:M245L
111518113932, 02,01,0				
06,0d,111518113932,563820424941,02,01,03			CLEAR	
07,111518113804,111518113932,0058,563820424941,4d494c4d41494e,02,00,0d			DURATION 88 SECS; PHASE 2; TSP ENABLED; REQUEST 14	
01,0f,111518114112,563820424941,02,01,03,0015,0015,02,cdf30d19,e483a7cb,4d494c4d41494e,36343434202020,333535202020202020,02e9,ff				
111518114112, 02,01,1	**BIAB**	11:41:12		
03,0f,111518114113,563820424941,02,01,03,04				
02,0f,111518114118,563820424941,02,01,03,0012,0012,02,a0ec0d19,2a8aa7cb,02eb				
03,0f,111518114118,563820424941,02,01,03,04				
02,0f,111518114123,563820424941,02,01,03,000e,000e,02,06e30d19,8e92a7cb,02ec				
03,0f,111518114123,563820424941,02,01,03,04			STATUS Active Processing	
02,0f,111518114128,563820424941,02,01,03,0009,0009,02,59d80d19,e39ba7cb,02ed				
03,0f,111518114128,563820424941,02,01,03,04				
02,0f,111518114133,563820424941,02,01,03,0004,0004,02,b3cb0d19,f2a6a7cb,02ec				
03,0f,111518114133,563820424941,02,01,03,04				
02,0f,111518114138,563820424941,02,01,03,0000,0000,02,06c10d19,47b0a7cb,02ec				
03,0f,111518114138,563820424941,02,01,03,04				
02,0f,111518114144,563820424941,02,01,03,0005,0005,02,70b60d19,88b9a7cb,02ed				
03,0f,111518114144,563820424941,02,01,03,04				
05,0f,111518114147,563820424941,02,01,03			CANCEL	
111518114147, 02,01,0				
06,0f,111518114147,563820424941,02,01,03			CLEAR	
07,111518114112,111518114147,0023,563820424941,4d494c4d41494e,02,00,0f			DURATION 35 SECS; PHASE 2; TSP ENABLED; REQUEST 16	
01,02,111518114154,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,313420202020202020,00c8,0a				
111518114154, 02,01,1	**VTT**	11:41:54	**PRS 21-1 TWO BUSES AT SAME TIME #1**	
01,10,111518114157,563820424941,02,01,03,0013,0013,02,9e960d19,2ad5a7cb,4d494c4d41494e,36343434202020,333535202020202020,02ec,ff				
03,10,111518114157,563820424941,02,01,03,04	**BIAB**	11:41:57	**PRS 21-1 TWO BUSES AT SAME TIME #2**	
02,10,111518114202,563820424941,02,01,03,0013,0013,02,4f9f0d19,f2e7a7cb,02eb				
03,10,111518114203,563820424941,02,01,03,04			STATUS BIAB ActiveProcessing	
05,01,111518114207,495445524953,02,04,06			CANCEL VTT	
02,10,111518114208,563820424941,02,01,03,0013,0013,02,e39f0d19,41fea7cb,02ea			UPDATE BIAB	
03,10,111518114208,563820424941,02,01,03,04			STATUS BIAB ActiveProcessing	

02,10,111518114213,563820424941,02,01,03,0013,0013,02,93a00d19,bc18a8cb,02e8			
03,10,111518114213,563820424941,02,01,03,04			
06,01,111518114215,495445524953,02,04,06			CLEAR VTT
07,111518114154,111518114215,0015,495445524953,4d494c4d41494e,02,00,01			VTT DURATION 21 SECS; PHASE 2; TSP ENABLED; REQUEST 1
02,10,111518114218,563820424941,02,01,03,0013,0013,02,09aa0d19,d621a8cb,02e7			UPDATE
03,10,111518114218,563820424941,02,01,03,04			Status ActiveProcessing
05,10,111518114221,563820424941,02,01,03			CANCEL BIAB
111518114221, 02,01,0			PRIORITY OFF
06,10,111518114221,563820424941,02,01,03			CLEAR BIAB
07,111518114157,111518114221,0018,563820424941,4d494c4d41494e,02,00,10			BIAB DURATION 24 SECS; PHASE 2; TSP ENABLED; REQUEST 16
			STARTS AT 01 RECORD; ENDS AT 11:42:21 CANCEL
			PRS 11-1 LOG ONLY
111518115146, 12,0b			SNMP Log Record Log Only
07,111518115146,111518115146,0000,563820424941,4d494c4d41494e,00,0b,12			DURATION 0 SECS; PHASE 0; LOG ONLY; REQUEST 18
			STARTS AT 11:51:46
			NO INITIAL REQUEST RECORD FOR LOG IN ONLY
01,12,111518115146,563820424941,02,01,03,0015,0015,00,e7f20d19,ac84a7cb,4d494c4d41494e,36343530202020,333536202020202020,0000,ff			
03,12,111518115146,563820424941,02,01,03,01	**BIAB**	11:51:46	
05,12,111518115147,563820424941,02,01,03			CANCEL
06,12,111518115147,563820424941,02,01,03			CLEAR
111518115214, 12,0b			
03,13,111518115214,563820424941,02,01,03,01			STATUS IdleNotValid 30 Seconds After Clear
05,13,111518115214,563820424941,02,01,03			CANCEL
06,13,111518115214,563820424941,02,01,03			CLEAR
			SECOND SET OF CANCEL AND CLEAR MESSAGES
			NO 7 RECORD
01,01,111518115857,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,313420202020202020,00c8,0a			
111518115857, 02,01,1	**VTT**	11:58:57	
05,01,111518115932,495445524953,02,04,06			CANCEL 35 SECS AFTER CALL
111518115932, 02,01,0			PRIORITY OFF
111518120105, SYS, PRG Communications Failure Timeout			93 SECS AFTER CANCEL
111518120105, 01,0a			
07,111518115857,111518120105,0080,495445524953,4d494c4d41494e,02,0a,01			DURATION 128 SEC; PHASE 2: TIME TO LIVE EXCEEDED; REQUEST 1
ff,0b0f120c0105,4d494c4d41494e,02,495445524953			
01,03,111518125657,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,313420202020202020,00c8,0a			
111518125657, 02,01,1	**VTT**	12:56:57	**END TO END PRE-TEST**

05,03,111518125731,495445524953,02,04,06

111518125731, 02,01,0

06,03,111518125736,495445524953,02,04,06

07,111518125657,111518125736,0027,495445524953,4d494c4d41494e,02,00,03 DURATION 39 SECS; PHASE 2; TSP ENABLED; REQUEST 3

111518125905, SYS, PRG Communications Fault Cleared

01,04,111518130532,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,3134202020202020,00c8,0a

111518130532, 02,01,1 **VTT** 1:05:32

111518130735, SYS, PRG Communications Failure Timeout

111518130735, 04,0a

07,111518130532,111518130735,007b,495445524953,4d494c4d41494e,02,0a,04 DURATION 123 SECS; PHASE 2; TIME TO LIVE EXCEEDED; REQUEST 4

ff,0b0f120d0723,4d494c4d41494e,02,495445524953

111518130735, 02,01,0

01,01,111518140437,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,3134202020202020,00c8,0a

111518140437, 02,01,1 **VTT** 2:04:37

05,01,111518140537,495445524953,02,04,06

111518140537, 02,01,0

111518140646, 01,0a

07,111518140437,111518140646,0081,495445524953,4d494c4d41494e,02,0a,01 DURATION 131 SECS; PHASE 2; TIME TO LIVE EXCEEDED; REQUEST 1

ff,0b0f120e062e,4d494c4d41494e,02,495445524953

01,01,111518140936,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,3134202020202020,00c8,0a

111518140936, 02,01,1 **VTT** 2:09:36

03,01,111518141015,495445524953,02,04,06,04 STATUS Active Processing

05,01,111518141018,495445524953,02,04,06 CANCEL

111518141018, 02,01,0

111518141146, 01,0a

07,111518140936,111518141146,0082,495445524953,4d494c4d41494e,02,0a,01 DURATION 140 SECS; PHASE 2; TIME TO LIVE EXCEEDED; REQUEST 1

ff,0b0f120e0b2e,4d494c4d41494e,02,495445524953

01,05,111518142412,563820424941,02,01,03,000e,000e,02,89910d19,c5d5a7cb,4d494c4d41494e,36353231202020,3336312020202020,00b0,ff

111518142412, 02,01,1 **BIAB** 2:24:12

03,05,111518142413,563820424941,02,01,03,04

02,05,111518142418,563820424941,02,01,03,000b,000b,02,179c0d19,9ecca7cb,00b2

03,05,111518142418,563820424941,02,01,03,04

02,05,111518142423,563820424941,02,01,03,0008,0008,02,60a60d19,46c3a7cb,00b4

03,05,111518142423,563820424941,02,01,03,04

02,05,111518142428,563820424941,02,01,03,0004,0004,02,25b30d19,aeb7a7cb,00b6

03,05,111518142428,563820424941,02,01,03,04

02,05,111518142433,563820424941,02,01,03,0000,0000,02,c3be0d19,21ada7cb,00b7
03,05,111518142433,563820424941,02,01,03,04
02,05,111518142438,563820424941,02,01,03,0004,0004,02,26cf0d19,a7a0a7cb,00b7
03,05,111518142438,563820424941,02,01,03,04
05,05,111518142441,563820424941,02,01,03
111518142441, 02,01,0
06,05,111518142441,563820424941,02,01,03
07,111518142412,111518142441,001d,563820424941,4d494c4d41494e,02,00,05 DURATION 29 SECS; PHASE 2; TSP ENABLED; REQUEST 5
111518142616, SYS, PRG Communications Fault Cleared
01,05,111518150416,563820424941,02,01,03,000e,000e,02,fe900d19,3ad6a7cb,4d494c4d41494e,36363633202020,333439202020202020,00b3,ff
111518150416, 02,01,1 **BIAB** 3:04:16
03,05,111518150416,563820424941,02,01,03,04
02,05,111518150421,563820424941,02,01,03,000b,000b,02,bc9b0d19,f0cca7cb,00b5
03,05,111518150421,563820424941,02,01,03,04 STATUS Active Processing
02,05,111518150426,563820424941,02,01,03,0008,0008,02,49a60d19,5bc3a7cb,00b7
03,05,111518150426,563820424941,02,01,03,04
02,05,111518150431,563820424941,02,01,03,0005,0005,02,d7b00d19,c6b9a7cb,00b9
03,05,111518150432,563820424941,02,01,03,04
02,05,111518150437,563820424941,02,01,03,0001,0001,02,6ebd0d19,56aea7cb,00bb
03,05,111518150437,563820424941,02,01,03,04
02,05,111518150442,563820424941,02,01,03,0001,0001,02,a3c80d19,eba5a7cb,00bc
03,05,111518150442,563820424941,02,01,03,04
02,05,111518150447,563820424941,02,01,03,0001,0001,02,8dd30d19,179da7cb,00be
03,05,111518150447,563820424941,02,01,03,04
05,05,111518150448,563820424941,02,01,03 CANCEL
111518150448, 02,01,0
06,05,111518150448,563820424941,02,01,03 CLEAR
07,111518150416,111518150448,0020,563820424941,4d494c4d41494e,02,00,05 DURATION 32 SECS; PHASE 2; TSP ENABLED; REQUEST 5

E - Regional PRS Device Verification Test: Eagle M60 Controller Running EPAC Software

Test Summary

The Trapeze BIAB including the PRG software was used to simulate the operation of a Pace bus approaching the Milwaukee Avenue/Oak Mill Mall intersection equipped with the Regional PRS device connected to a Siemens Eagle M60 controller running the EPAC 3.57c intersection control software. Current signal timing for the Oak Mill Mall intersection was installed on the intersection traffic controller. Wireless bus-to-intersection communications using a Cradlepoint IBR 1100 mobile router (on-bus equipment) and IEEE 802.11n access point (intersection equipment) was used.

Observations of the controller front panel inputs display were made and recorded during the testing. Additionally, the Regional PRS log files were downloaded after the completion of the tests for reporting and review. The Regional PRS log files for each of the tests were also uploaded in near real time by a cellular VPN link to the TSP Data Server at the Parsons offices but were not available for reporting and review in the preparation of this report.

The Regional PRS Device verification tests for the Milwaukee Avenue/Oak Mill Mall intersection consisted of eight tests as summarized in the Test Description Table starting on the next page. The eight tests were successfully completed ("Passed"). The eight tests verified bus-to-intersection communications between the Trapeze PRG software and Regional PRS Device connected with a Siemens Eagle M60 controller running EPAC 3.57c intersection control software.

Attached following Test Description Table is the Test Data Sheet (one page) marked up as the tests were conducted and the Regional PRS log data in an Excel spreadsheet format (four pages). The Regional PRS log data report has been annotated. Also attached is a TSP log data report (two pages) generated by the TSP Reporting Software from the PRS log data files.

Three anomalies were observed during the testing or noted from the Regional PRS log file reports.

1. Test PRS 21-1 was expected to generate a re-service override response to the second of back-to-back requests for priority. No re-service override was observed or reported for the test. It is not known if the re-service override timer was set to greater than zero cycles or seconds for the test.

2. A second pair of CLEAR and CANCEL messages were reported in Regional PRS Device log files immediately after completion of the initial request for priority for tests PRS 11-1.

3. Tests PRS 11-9 and PRS 11-10 were expected to generate preemption overrides to the requests for priority from the Pace buses. No preemption overrides were observed or reported for the tests. It is not known if preemption timing was properly configured or operational for the tests.

Regional PRS Device Verification Tests: Eagle M60 Controller Running EPAC Software

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates “log only” request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	11/16/18 7:34AM	Pass	
PRS 11-2	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	11/16/18 7:13AM	Pass	
PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	11/16/18 7:14AM	Pass	
PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to EVP preemption lockout (already in progress).	11/16/18 7:16AM	Pass	
PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by EVP preemption call before the priority request is cancelled and cleared.	11/16/18 7:18AM	Pass	
PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop and opens doors to pick up passengers. Bus closes doors after passenger boarding, requests priority, and then proceeds through the intersection on green signal.	11/16/18 7:20AM	Pass	
PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	11/16/18 7:22AM	Pass	TSP call held at PRS after communications disconnected

Ref	Test Description	Date/Time	Pass/Fail	Observations
PRS 21-1	First Bus approaches the intersection from SB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection with green extension, early green, or no action required. The Second Bus approaches the intersection in the NB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	11/16/18 7:24AM	Pass	No re-service lockout observed.

11-16-18

M60

OAK MILL

REGIONAL PRS DEVICE VERIFICATION TESTS - EAGLE M60 CONTROLLER WITH EPAC FIRMWARE

Ref	Test	Test Description	Expected PRS Status	Expected Action Taken	Test Start Time	Test End Time	Test Notes
1	PRS 11-1	Pace Bus approaching intersection at normal operating speed, running on-time, and initiates "log only" request for priority message set. Bus continues through the intersection without changing speed on the green signal without adjustment.	TSP event rejected by PRS and not set up by Controller. No PRS status available.	11 Log Only Request	7:34		Checked in/no PRS flash
2	PRS 11-2	Pace Bus approaching intersection at normal operating speed; running late, and requests priority. Bus continues through the intersection without changing speed on green signal without adjustment.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	7:13		SB TSP call ok
3	PRS 11-3	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without changing speed on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	7:14		Bus slowing TSP Call ok
4	PRS 11-8	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to time of day lockout and bus continues through intersection.	12 reserved (closedStrategyError) OR 13 closedCompleted	04 Time Of Day Override			
5	PRS 11-9	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is denied due to preemption lockout (already in progress).	3 activeProcessing; 13 closedComplete	03 Preemption Override	7:16		Preempt on Locked out
6	PRS 11-10	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is initiated by the controller but interrupted by preemption call before the priority request is cancelled and cleared.	4 activeProcessing; 13 closedCompleted	03 Preemption Override	7:18		Preempt kicked in after TSP call
7	PRS 11-13	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Priority is not initiated since timing not set up for input (phase) number being requested. Bus continues through intersection.	12 closedStrategyError	01 Invalid ID Override			
8	PRS 11-15	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed as it approaches intersection but continues through the intersection on green extension.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			#3
9	PRS 11-16	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus is slowed and stopped for a red signal, then continues through the intersection on early green.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken			
10	PRS 11-17	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus slows and stops for a near side bus stop, and opens doors to pick up passengers. Bus closes doors after passengers board, requests priority, and then proceeds through the intersection on green signal.	First Request: 4 activeProcessing; 13 closedCancelled. Second Request: 9 reserviceError	First Request: 0 Priority Action Taken. Second Request: 09 Reservice Override	7:20		Call #1 ok Call #2 ok
11	PRS 11-18	Pace Bus approaching intersection at normal operating speed, running late, and requests priority. Bus continues through the intersection without slowing down. Cancel and Clear messages are not received at intersection and request for priority is cleared automatically based on user-specified time to live parameter.	4 activeProcessing; 13 closedCompleted	0 Priority Action Taken	7:22		Holds call after no comm
12	PRS 21-1	First Bus approaches the intersection from the NB direction at normal operating speed, running late, and requests priority using the Regional Interoperable Message Set. The First Bus continues through the intersection on a green extension, early green, or no action required. The Second Bus approaches the intersection from the SB direction shortly after the First Bus has cleared the intersection, running late, and requests priority using the RTA PRG VTT. The controller takes no action for the Second Bus due to re-service lockout.	First Bus: 4 activeProcessing; 13 closedCompleted. Second Bus: 4 activeProcessing; 9 re-service error	First Bus: 0 Priority Action Taken. Second Bus: 09 Re-service Override	7:24		TSP Call #1 ok TSP Call #2 ok

REGIONAL PRS LOGS EAGLE M60 RUNNING EPAC SOFTWARE (OAK MILL MALL ENTRANCE) 11/16/2018

01,01,111618071257,563820424941,02,01,03,0010,0010,02,869e0c19,a8b2a8cb,4d494c4f414b4d,36363633202020,333539202020202020,0195,ff	
111618071257, 02,01,1	**M60 PRS 11-2**
03,01,111618071257,563820424941,02,01,03,04	
02,01,111618071303,563820424941,02,01,03,0007,0007,02,e08d0c19,59c2a8cb,0191	
03,01,111618071303,563820424941,02,01,03,04	
02,01,111618071308,563820424941,02,01,03,0001,0001,02,ab7d0c19,a0d1a8cb,018d	
03,01,111618071308,563820424941,02,01,03,04	
02,01,111618071313,563820424941,02,01,03,0001,0001,02,0a6a0c19,20e4a8cb,0188	
03,01,111618071313,563820424941,02,01,03,04	STATUS ActiveProcessing
05,01,111618071314,563820424941,02,01,03	CANCEL
111618071314, 02,01,0	
06,01,111618071314,563820424941,02,01,03	CLEAR
07,111618071257,111618071314,0011,563820424941,4d494c4f414b4d,02,00,01	17 SECS DURATION; PHASE 2; TSP ENABLED
111618071412, SYS, PRG Communications Failure Timeout	
111618071412, 01,0a	
07,111618071207,111618071412,007d,495445524953,4d494c4f414b4d,02,0a,01	
ff,0b1012070e0c,4d494c4f414b4d,02,495445524953	
111618071502, SYS, PRG Communications Fault Cleared	
01,02,111618071505,563820424941,02,01,03,0010,0010,02,a69d0c19,7cb3a8cb,4d494c4f414b4d,36363633202020,333539202020202020,0214,ff	
111618071505, 02,01,1	**M60 PRS 11-3**
03,02,111618071505,563820424941,02,01,03,04	
02,02,111618071510,563820424941,02,01,03,000c,000c,02,1d960c19,96baa8cb,0215	
03,02,111618071510,563820424941,02,01,03,04	
02,02,111618071515,563820424941,02,01,03,000b,000b,02,b6940c19,e8bba8cb,021a	
03,02,111618071516,563820424941,02,01,03,04	
02,02,111618071521,563820424941,02,01,03,0009,0009,02,db900c19,8abfa8cb,021d	
03,02,111618071521,563820424941,02,01,03,04	
02,02,111618071526,563820424941,02,01,03,0005,0005,02,e2880c19,0ec7a8cb,021d	
03,02,111618071526,563820424941,02,01,03,04	
02,02,111618071531,563820424941,02,01,03,0005,0005,02,39710c19,5adda8cb,0217	
03,02,111618071531,563820424941,02,01,03,04	STATUS ActiveProcessing
05,02,111618071532,563820424941,02,01,03	CANCEL
111618071532, 02,01,0	
06,02,111618071532,563820424941,02,01,03	CLEAR

07,111618071505,111618071532,001b,563820424941,4d494c4f414b4d,02,00,02	27 SECS DURATION; PHASE 2; TSP ENABLED; REQUEST 2
01,03,111618071650,563820424941,02,01,03,000f,000f,02,cf9b0c19,38b5a8cb,4d494c4f414b4d,36363633202020,333539202020202020,027c,ff	
111618071650, 02,01,1	**M60 PRS 11-9 Preemption Already In Progress**
03,03,111618071650,563820424941,02,01,03,04	STATUS ActiveProcessing
02,03,111618071655,563820424941,02,01,03,000d,000d,02,46660c19,ade7a8cb,0265	
03,03,111618071655,563820424941,02,01,03,04	
05,03,111618071656,563820424941,02,01,03	CANCEL
111618071656, 02,01,0	
06,03,111618071656,563820424941,02,01,03	CLEAR
07,111618071650,111618071656,0006,563820424941,4d494c4f414b4d,02,00,03	DURATION 6 SECS; PHASE 2; TSP ENABLED; REQUEST 3
01,04,111618071812,563820424941,02,01,03,000f,000f,02,b89b0c19,4db5a8cb,4d494c4f414b4d,36363633202020,333539202020202020,02ce,ff	
111618071812, 02,01,1	**M60 PRS 11-10 Preemption After TSP Call**
03,04,111618071812,563820424941,02,01,03,04	
02,04,111618071817,563820424941,02,01,03,0007,0007,02,708d0c19,c3c2a8cb,02cc	
03,04,111618071817,563820424941,02,01,03,04	STATUS ActiveProcessing
02,04,111618071822,563820424941,02,01,03,0007,0007,02,708d0c19,c3c2a8cb,02d1	
03,04,111618071822,563820424941,02,01,03,04	
02,04,111618071827,563820424941,02,01,03,0007,0007,02,708d0c19,c3c2a8cb,02d6	
03,04,111618071827,563820424941,02,01,03,04	
02,04,111618071833,563820424941,02,01,03,0007,0007,02,708d0c19,c3c2a8cb,02db	
03,04,111618071833,563820424941,02,01,03,04	
02,04,111618071838,563820424941,02,01,03,0007,0007,02,dc6e0c19,95dfa8cb,02cf	
03,04,111618071838,563820424941,02,01,03,04	
05,04,111618071839,563820424941,02,01,03	CANCEL
111618071839, 02,01,0	
06,04,111618071839,563820424941,02,01,03	CLEAR
07,111618071812,111618071839,001b,563820424941,4d494c4f414b4d,02,00,04	DURATION 27 SECS; PHASE 2; TSP ENABLED; REQUEST 4
01,05,111618072003,563820424941,02,01,03,000f,000f,02,4c9d0c19,d0b3a8cb,4d494c4f414b4d,36363633202020,333539202020202020,033d,ff	
111618072003, 02,01,1	**M60 PRS 11-17 NEAR SIDE STOP**
03,05,111618072003,563820424941,02,01,03,04	STATUS ActiveProcessing
02,05,111618072008,563820424941,02,01,03,0006,0006,02,dc8b0c19,3fc4a8cb,0339	
03,05,111618072008,563820424941,02,01,03,04	
02,05,111618072013,563820424941,02,01,03,0003,0003,02,77850c19,47caa8cb,033a	
03,05,111618072013,563820424941,02,01,03,04	
05,05,111618072014,563820424941,02,01,03	CANCEL
111618072014, 02,01,0	
06,05,111618072014,563820424941,02,01,03	CLEAR
07,111618072003,111618072014,000b,563820424941,4d494c4f414b4d,02,00,05	DURATION 11 SECS; PHASE 2; TSP ENABLED; REQUEST 5

01,05,111618072020,563820424941,02,01,03,0003,0003,02,77850c19,47caa8cb,4d494c4f414b4d,36363633202020,333539202020202020,0342,ff	
111618072020, 02,01,1	**M60 PRS 11-17 NEAR SIDE STOP**
03,05,111618072020,563820424941,02,01,03,04	
02,05,111618072025,563820424941,02,01,03,0003,0003,02,77850c19,47caa8cb,0347	
03,05,111618072025,563820424941,02,01,03,04	
02,05,111618072031,563820424941,02,01,03,0003,0003,02,9b750c19,39d9a8cb,0344	
03,05,111618072031,563820424941,02,01,03,04	
05,05,111618072034,563820424941,02,01,03	CANCEL
111618072034, 02,01,0	
06,05,111618072034,563820424941,02,01,03	CLEAR
07,111618072020,111618072034,000e,563820424941,4d494c4f414b4d,02,00,05	DURATION 14 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,06,111618072151,563820424941,02,01,03,0010,0010,02,599e0c19,d3b2a8cb,4d494c4f414b4d,36363633202020,333539202020202020,03aa,ff	
111618072151, 02,01,1	**PRS 11-18 NO CLEAR AND CANCEL**
03,06,111618072151,563820424941,02,01,03,04	
02,06,111618072156,563820424941,02,01,03,000c,000c,02,1d960c19,96baa8cb,03ac	
03,06,111618072156,563820424941,02,01,03,04	
02,06,111618072201,563820424941,02,01,03,000c,000c,02,1d960c19,96baa8cb,03b1	NO COMM
03,06,111618072202,563820424941,02,01,03,04	
05,06,111618072249,563820424941,02,01,03	CANCEL
111618072249, 02,01,0	
05,06,111618072251,563820424941,02,01,03	CANCEL AT 60 SECS
06,06,111618072251,563820424941,02,01,03	CLEAR
07,111618072151,111618072251,003c,563820424941,4d494c4f414b4d,02,00,06	DURATION 60 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,07,111618072354,563820424941,02,01,03,000e,000e,02,d89a0c19,20b6a8cb,4d494c4f414b4d,36363633202020,333539202020202020,042d,ff	
111618072354, 02,01,1	**PRS 21-1 BUS #1**
03,07,111618072354,563820424941,02,01,03,04	
02,07,111618072359,563820424941,02,01,03,0007,0007,02,638c0c19,c1c3a8cb,042a	
03,07,111618072359,563820424941,02,01,03,04	
02,07,111618072404,563820424941,02,01,03,0001,0001,02,c9810c19,bfcda8cb,0429	
03,07,111618072404,563820424941,02,01,03,04	
02,07,111618072409,563820424941,02,01,03,0001,0001,02,a0720c19,08dca8cb,041d	
03,07,111618072409,563820424941,02,01,03,04	STATUS ActiveProcessing
05,07,111618072414,563820424941,02,01,03	CANCEL
111618072414, 02,01,0	
06,07,111618072414,563820424941,02,01,03	CLEAR
07,111618072354,111618072414,0014,563820424941,4d494c4f414b4d,02,00,07	DURATION 20 SECS; PHASE 2; TSP ENABLED; REQUEST 7
01,01,111618072420,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4f414b4d,31353020202020,313420202020202020,00c8,0a	
111618072420, 02,01,1	**PRS 21-1 BUS #2**

05,01,111618072435,495445524953,02,04,06	CANCEL
111618072435, 02,01,0	
111618072602, 07,0b	
03,08,111618072602,563820424941,02,01,03,01	STATUS IdleNotValid
05,08,111618072602,563820424941,02,01,03	CANCEL
06,08,111618072602,563820424941,02,01,03	CLEAR
111618072622, SYS, PRG Communications Failure Timeout	TIMED OUT AFTER 122 SECS
111618072622, 01,0a	
07,111618072420,111618072622,007a,495445524953,4d494c4f414b4d,02,0a,01	DURATION 122 SECS; PHASE 2; TIME TO LIVE EXCEEDED; REQUEST
ff,0b1012071a16,4d494c4f414b4d,02,495445524953	
111618072823, 09,0b	
07,111618072823,111618072823,0000,563820424941,4d494c4f414b4d,00,0b,09	DURATION 0 SECS; PHASE 0; LOG ONLY REQUEST;REQUEST 9
01,09,111618072823,563820424941,02,01,03,000f,000f,00,629d0c19,bbb3a8cb,4d494c4f414b4d,36363330202020,333534202020202020,0000,ff	
03,09,111618072823,563820424941,02,01,03,01	
05,09,111618072823,563820424941,02,01,03	
06,09,111618072823,563820424941,02,01,03	
111618073032, SYS, PRG Communications Fault Cleared	
111618073357, 01,0b	
07,111618073357,111618073357,0000,563820424941,4d494c4f414b4d,00,0b,01	
01,01,111618073357,563820424941,02,01,03,0010,0010,00,799d0c19,a6b3a8cb,4d494c4f414b4d,36363330202020,333534202020202020,0000,ff	
03,01,111618073357,563820424941,02,01,03,01	**PRS 11-1 LOG ONLY**
05,01,111618073358,563820424941,02,01,03	CANCEL
06,01,111618073358,563820424941,02,01,03	CLEAR
01,04,111618080014,563820424941,02,01,03,001e,001e,02,a24f0c19,66f8a8cb,4d494c4f414b4d,36363633202020,333539202020202020,02d5,ff	

Message Log Report

Device id	Day	Timestamp	Test ID	Command	Request id	Vehicle id	Time of service	Estimate time of departure	Intersection	Phase	Route id	Run number	Scheduled lateness
		PRS 11-2 NORMAL OPERATION											
36	Friday	11/16/2018 7:12:57 AM	901	0	1	V8BIA	16	16	MILOAKM	2	6663	359	405
36	Friday	11/16/2018 7:13:03 AM	901	1	1	V8BIA	7	7		2			401
36	Friday	11/16/2018 7:13:08 AM	901	1	1	V8BIA	1	1		2			397
36	Friday	11/16/2018 7:13:13 AM	901	1	1	V8BIA	1	1		2			392
36	Friday	11/16/2018 7:13:14 AM	901	4	1	V8BIA							
		PRS 11-3 NORMAL OPERATION SLOWING DOWN											
36	Friday	11/16/2018 7:15:05 AM	902	0	2	V8BIA	16	16	MILOAKM	2	6663	359	532
36	Friday	11/16/2018 7:15:10 AM	902	1	2	V8BIA	12	12		2			533
36	Friday	11/16/2018 7:15:15 AM	902	1	2	V8BIA	11	11		2			538
36	Friday	11/16/2018 7:15:21 AM	902	1	2	V8BIA	9	9		2			541
36	Friday	11/16/2018 7:15:26 AM	902	1	2	V8BIA	5	5		2			541
36	Friday	11/16/2018 7:15:31 AM	902	1	2	V8BIA	5	5		2			535
36	Friday	11/16/2018 7:15:32 AM	902	4	2	V8BIA							
		PRS 11-09 PREEMPT											
36	Friday	11/16/2018 7:16:50 AM	903	0	3	V8BIA	15	15	MILOAKM	2	6663	359	636
36	Friday	11/16/2018 7:16:55 AM	903	1	3	V8BIA	13	13		2			613
36	Friday	11/16/2018 7:16:56 AM	903	4	3	V8BIA							
		PRS 11-10 PREEMPT INTERRUPT											
36	Friday	11/16/2018 7:18:12 AM	904	0	4	V8BIA	15	15	MILOAKM	2	6663	359	718
36	Friday	11/16/2018 7:18:17 AM	904	1	4	V8BIA	7	7		2			716
36	Friday	11/16/2018 7:18:22 AM	904	1	4	V8BIA	7	7		2			721
36	Friday	11/16/2018 7:18:27 AM	904	1	4	V8BIA	7	7		2			726
36	Friday	11/16/2018 7:18:33 AM	904	1	4	V8BIA	7	7		2			731
36	Friday	11/16/2018 7:18:38 AM	904	1	4	V8BIA	7	7		2			719
36	Friday	11/16/2018 7:18:39 AM	904	4	4	V8BIA							
		PRS 11-17 NEAR SIDE BUS STOP											
36	Friday	11/16/2018 7:20:03 AM	905	0	5	V8BIA	15	15	MILOAKM	2	6663	359	829
36	Friday	11/16/2018 7:20:08 AM	905	1	5	V8BIA	6	6		2			825
36	Friday	11/16/2018 7:20:13 AM	905	1	5	V8BIA	3	3		2			826
36	Friday	11/16/2018 7:20:14 AM	905	4	5	V8BIA							
36	Friday	11/16/2018 7:20:20 AM	906	0	5	V8BIA	3	3	MILOAKM	2	6663	359	834
36	Friday	11/16/2018 7:20:25 AM	906	1	5	V8BIA	3	3		2			839
36	Friday	11/16/2018 7:20:31 AM	906	1	5	V8BIA	3	3		2			836
36	Friday	11/16/2018 7:20:34 AM	906	4	5	V8BIA							
		PRS 11-18 NO COMM											
36	Friday	11/16/2018 7:21:51 AM	907	0	6	V8BIA	16	16	MILOAKM	2	6663	359	938
36	Friday	11/16/2018 7:21:56 AM	907	1	6	V8BIA	12	12		2			940
36	Friday	11/16/2018 7:22:01 AM	907	1	6	V8BIA	12	12		2			945
36	Friday	11/16/2018 7:22:49 AM	907	4	6	V8BIA	NO COMM FOR 48 SECS						
36	Friday	11/16/2018 7:22:51 AM	907	4	6	V8BIA							
		PRS 21-1 TWO BUSES AT SAME TIME											
36	Friday	11/16/2018 7:23:54 AM	908	0	7	V8BIA	14	14	MILOAKM	2	6663	359	1069
36	Friday	11/16/2018 7:23:59 AM	908	1	7	V8BIA	7	7		2			1066
36	Friday	11/16/2018 7:24:04 AM	908	1	7	V8BIA	1	1		2			1065
36	Friday	11/16/2018 7:24:09 AM	908	1	7	V8BIA	1	1		2			1053
36	Friday	11/16/2018 7:24:14 AM	908	4	7	V8BIA							
36	Friday	11/16/2018 7:24:20 AM	909	0	1	ITERIS	200	200	MILOAKM	2	150	14	200
36	Friday	11/16/2018 7:24:35 AM	909	4	1	ITERIS	NO INDICATION OF RE-SERVICE ERROR ON THIS REPORT						

		PRS 11-1 LOG ONLY											
36	Friday	11/16/2018 7:33:57 AM	911	0	1	V8BIA	16	16	MILOAKM	0	6630	354	0
36	Friday	11/16/2018 7:33:58 AM	911	4	1	V8BIA	BUS ON-TIME						
		PRE-TEST DATA											
36	Friday	11/16/2018 7:10:51 AM	0	0	1	ITERIS	200	200	MILOAKL	2	150	14	200
36	Friday	11/16/2018 7:12:07 AM	0	0	1	ITERIS	200	200	MILOAKM	2	150	14	200
36	Friday	11/16/2018 7:12:16 AM	0	4	1	ITERIS							
36	Friday	11/16/2018 7:28:23 AM	910	0	9	V8BIA	15	15	MILOAKM	0	6630	354	0
34	Friday	11/16/2018 7:50:16 AM	0	0	1	FINAL	20	20	STOP123	2	MILMAIN	RUN123456	200
34	Friday	11/16/2018 7:52:49 AM	0	0	1	ITERIS	200	200	MILMAIN	2	150	14	200
34	Friday	11/16/2018 7:53:17 AM	0	4	1	ITERIS							
34	Friday	11/16/2018 7:53:23 AM	0	4	1	ITERIS							
34	Friday	11/16/2018 8:51:18 AM	0	0	1	ITERIS	200	200	MILMAIN	2	150	14	200
34	Friday	11/16/2018 8:51:39 AM	0	4	1	ITERIS							
34	Friday	11/16/2018 8:55:54 AM	0	0	1	ITERIS	200	200	MILMAIN	2	150	14	200
34	Friday	11/16/2018 8:56:09 AM	0	4	1	ITERIS							
34	Friday	11/16/2018 8:56:12 AM	0	5	1	ITERIS							
9	Friday	11/16/2018 8:59:54 AM	0	0	1	VEH001	60	60	1234567	2	9	14	60

F - End-To-End TSP Systems Verification Test

Test Summary

The end-to-end TSP systems verification tests were conducted using the Trapeze BIAB including the PRG software to simulate a Pace bus operating on Route 270 along Milwaukee Avenue in the NB direction from the Milwaukee Avenue/Gale Street intersection to the Milwaukee Avenue/Maryland Avenue intersection. The Pace bus operated through five test intersections (from south to north), each equipped with a different controller type as follows.

- Milwaukee Avenue/Gale Street – Peek ATC 1000 controller loaded with GreenWave 3.24.4055 intersection control software including PRS functionality and proposed CDOT signal timing for Gale Street.
- Milwaukee Avenue/Harts Road – Econolite ACS/3 controller loaded with ASC/3 32.66.10 intersection control software including TSP functionality and current IDOT signal timing for Harts Road.
- Milwaukee Avenue/Oak Mill Mall Entrance – Siemens Eagle M60 controller loaded with EPAC 3.57c intersection control software including TSP functionality and current IDOT signal timing for Oak Mill Mall Entrance.
- Milwaukee Avenue/Main Street – Siemens Eagle M50 controller loaded with EPAC 3.57c intersection control software including TSP functionality and current IDOT signal timing for Main Street. The Pace bus simulated stopping at a near side bus stop to serve passengers at the Milwaukee Avenue/Main Street intersection.
- Milwaukee Avenue/Maryland Avenue – Econolite Cobalt controller loaded with ASC/3 32.66.10 intersection control software including TSP functionality and current IDOT signal timing for Maryland Avenue. The Pace bus simulated stopping at a near side bus stop to serve passengers at the Milwaukee Avenue/Maryland Avenue intersection.

Wireless bus-to-intersection communications was implemented for the test between a Cradlepoint IBR 1100 mobile router (on-bus equipment) and one IEEE 802.11n-compliant access point (intersection equipment). Note that only one access point connected to a network router to each of the five test intersections was used for the test. As noted previously, it is not possible to fully verify the bus-to-intersection communications network by bench testing.

The end-to-end TSP systems test was repeated four times for NB direction, three times as pre-test runs on 11/15/18 and 11/16/18 and one time when observed by a large number of project stakeholders on 11/16/18. One of the pre-tests was video recorded showing the test intersection control equipment responding to requests for priority initiated by the simulated Pace bus. Additionally, the TSP log files for the four test intersections equipped with Regional PRS devices were uploaded as the tests were conducted for near real time display during the tests and for reporting and review. The TSP log files created by the Peek ATC traffic controller at Gale Street were also uploaded to the TSP Data Server at the Parsons offices for reporting and review.

The end-to-end TSP Systems tests were successfully completed and documented. Attached are the Regional PRS log data reports for each of the test intersections equipped with Regional PRS devices (10 pages). Also attached is the report generated by TSP Reporting Software for four intersections equipped with Regional PRS devices (three pages). No data was available from the TSP Reporting Software for the Gale Street intersection. The TSP log data reports have been annotated.

One anomaly was observed for the end-to-end TSP Systems pre-tests and demonstration.

1. The TSP Reporting Software did not report the action taken by the intersection PRS device and traffic controller for the four intersections equipped with Regional PRS devices. The action taken data is included in the TSP log files uploaded to the TSP Data Server.

REGIONAL PRS LOGS ECONOLITE ASC/3 CONTROLLER WITH ASC/3 SOFTWARE (HARTS ROAD)
END-TO-END DEMO 11/16/18

01,02,111618073417,563820424941,02,01,03,0012,0012,02,a6d90919,6c34abcb,4d494c48415254,36363633202020,3335392020202020,03e0,ff	
111618073417, 02,01,1	**TEST**
03,02,111618073417,563820424941,02,01,03,04	
02,02,111618073422,563820424941,02,01,03,0007,0007,02,05f40919,921babcb,03da	
03,02,111618073422,563820424941,02,01,03,04	
02,02,111618073427,563820424941,02,01,03,0006,0006,02,79f60919,4219abcb,03de	
03,02,111618073427,563820424941,02,01,03,04	STATUS ActiveProcessing
02,02,111618073433,563820424941,02,01,03,0006,0006,02,79f60919,4219abcb,03e3	
03,02,111618073433,563820424941,02,01,03,04	
02,02,111618073438,563820424941,02,01,03,0006,0006,02,79f60919,4219abcb,03e9	
03,02,111618073438,563820424941,02,01,03,04	
02,02,111618073443,563820424941,02,01,03,0003,0003,02,c8fc0919,5013abcb,03eb	
03,02,111618073443,563820424941,02,01,03,04	
02,02,111618073448,563820424941,02,01,03,0003,0003,02,6a130a19,16feaacb,03e7	
03,02,111618073448,563820424941,02,01,03,04	
05,02,111618073452,563820424941,02,01,03	CANCEL
111618073452, 02,01,0	
06,02,111618073452,563820424941,02,01,03	CLEAR
07,111618073417,111618073452,0023,563820424941,4d494c48415254,02,00,02	DURATION 35 SECS; PHASE 2; TSP ENABLED
01,02,111618083840,563820424941,02,01,03,0013,0013,02,a2d70919,5236abcb,4d494c48415254,36343237202020,3338392020202020,03bb,ff	
111618083840, 02,01,1	**END-TO-END TEST RUN**
03,02,111618083840,563820424941,02,01,03,04	
02,02,111618083845,563820424941,02,01,03,000f,000f,02,d5e00919,a72dabcb,03bc	
03,02,111618083845,563820424941,02,01,03,04	STATUS ActiveProcessing
02,02,111618083850,563820424941,02,01,03,000b,000b,02,8fea0919,7c24abcb,03bd	
03,02,111618083850,563820424941,02,01,03,04	
02,02,111618083855,563820424941,02,01,03,0006,0006,02,59f70919,6e18abcb,03be	
03,02,111618083855,563820424941,02,01,03,04	
02,02,111618083901,563820424941,02,01,03,0001,0001,02,0a020a19,5c0eabcb,03be	
03,02,111618083901,563820424941,02,01,03,04	
02,02,111618083906,563820424941,02,01,03,0001,0001,02,820e0a19,b602abcb,03be	
03,02,111618083906,563820424941,02,01,03,04	

05,02,111618083910,563820424941,02,01,03	CANCEL
111618083910, 02,01,0	
06,02,111618083910,563820424941,02,01,03	CLEAR
07,111618083840,111618083910,001e,563820424941,4d494c48415254,02,00,02	DURATION 30 SECS; PHASE 2; TSP ENABLED
01,02,111618092149,563820424941,02,01,03,0013,0013,02,eed60919,fb36abcb,4d494c48415254,36343532202020,3335372020202020,0311,ff	
111618092149, 02,01,1	**END-TO-END DEMO**
03,02,111618092149,563820424941,02,01,03,04	STATUS ActiveProcessing
02,02,111618092154,563820424941,02,01,03,000f,000f,02,9fe10919,e82cabcb,0312	
03,02,111618092154,563820424941,02,01,03,04	
02,02,111618092159,563820424941,02,01,03,000a,000a,02,0cec0919,1523abcb,0312	
03,02,111618092159,563820424941,02,01,03,04	
02,02,111618092204,563820424941,02,01,03,0005,0005,02,50f80919,8617abcb,0312	
03,02,111618092204,563820424941,02,01,03,04	
02,02,111618092209,563820424941,02,01,03,0001,0001,02,90020a19,dd0dabcb,0314	
03,02,111618092210,563820424941,02,01,03,04	
02,02,111618092215,563820424941,02,01,03,0001,0001,02,ee0c0a19,3204abcb,0315	
03,02,111618092215,563820424941,02,01,03,04	
02,02,111618092220,563820424941,02,01,03,0001,0001,02,2f170a19,89faaacb,0316	
03,02,111618092220,563820424941,02,01,03,04	
05,02,111618092221,563820424941,02,01,03	CANCEL
111618092221, 02,01,0	
06,02,111618092221,563820424941,02,01,03	CLEAR
07,111618092149,111618092221,0020,563820424941,4d494c48415254,02,00,02	DURATION 32 SECS; PHASE 2: TSP ENABLED

REGIONAL PRS LOGS EAGLE M60 RUNNING EPAC SOFTWARE (OAK MILL MALL ENTRANCE)
END-TO-END DEMO 11/16/2018

111618080014, 02,01,1 **END-TO-END TEST RUN WITH NEAR SIDE BUS STOP**
03,04,111618080014,563820424941,02,01,03,04
02,04,111618080019,563820424941,02,01,03,0014,0014,02,875e0c19,dfeaa8cb,02d2
03,04,111618080019,563820424941,02,01,03,04
02,04,111618080025,563820424941,02,01,03,000c,000c,02,b36c0c19,11e3a8cb,02cf
03,04,111618080025,563820424941,02,01,03,04
02,04,111618080030,563820424941,02,01,03,0004,0004,02,d7790c19,aed6a8cb,02cb
03,04,111618080030,563820424941,02,01,03,04
02,04,111618080035,563820424941,02,01,03,0004,0004,02,00890c19,64c8a8cb,02c6
03,04,111618080035,563820424941,02,01,03,04
05,04,111618080038,563820424941,02,01,03
111618080038, 02,01,0
06,04,111618080038,563820424941,02,01,03
07,111618080014,111618080038,0018,563820424941,4d494c4f414b4d,02,00,04 DURATION 24 SECS; PHASE2; TSP ENABLED; REQUEST 4
01,04,111618090437,563820424941,02,01,03,001f,001f,02,6a4d0c19,69faa8cb,4d494c4f414b4d,36343237202020,333839202020202020,02b1,ff
111618090437, 02,01,1
03,04,111618090437,563820424941,02,01,03,04
02,04,111618090442,563820424941,02,01,03,0019,0019,02,ba560c19,f5f1a8cb,02b1
03,04,111618090442,563820424941,02,01,03,04
02,04,111618090447,563820424941,02,01,03,0013,0013,02,c2600c19,40eaa8cb,02b0
03,04,111618090447,563820424941,02,01,03,04
02,04,111618090453,563820424941,02,01,03,000b,000b,02,546f0c19,97e0a8cb,02ac
03,04,111618090453,563820424941,02,01,03,04
02,04,111618090458,563820424941,02,01,03,0002,0002,02,da800c19,12d0a8cb,02a5
03,04,111618090458,563820424941,02,01,03,04
02,04,111618090503,563820424941,02,01,03,0002,0002,02,928f0c19,32c2a8cb,02a1
03,04,111618090503,563820424941,02,01,03,04
05,04,111618090505,563820424941,02,01,03
111618090505, 02,01,0
06,04,111618090505,563820424941,02,01,03
07,111618090437,111618090505,001c,563820424941,4d494c4f414b4d,02,00,04 DURATION 28 SECS; PHASE 2; TSP ENABLED; REQUEST 4
01,04,111618094852,563820424941,02,01,03,001e,001e,02,304f0c19,cdf8a8cb,4d494c4f414b4d,36343532202020,333537202020202020,0248,ff
111618094852, 02,01,1 **END-TO-END DEMO**
03,04,111618094852,563820424941,02,01,03,04

02,04,111618094857,563820424941,02,01,03,0016,0016,02,de5b0c19,49eda8cb,0245	
03,04,111618094857,563820424941,02,01,03,04	STATUS ActiveProcessing
02,04,111618094902,563820424941,02,01,03,000e,000e,02,cf690c19,cbe5a8cb,0242	
03,04,111618094903,563820424941,02,01,03,04	
02,04,111618094908,563820424941,02,01,03,0007,0007,02,3c740c19,f7dba8cb,0241	
03,04,111618094908,563820424941,02,01,03,04	
02,04,111618094913,563820424941,02,01,03,0002,0002,02,467f0c19,8fd1a8cb,023e	
03,04,111618094913,563820424941,02,01,03,04	
02,04,111618094918,563820424941,02,01,03,0002,0002,02,618d0c19,43c4a8cb,023a	
03,04,111618094918,563820424941,02,01,03,04	
05,04,111618094920,563820424941,02,01,03	CANCEL
111618094920, 02,01,0	
06,04,111618094921,563820424941,02,01,03	CLEAR
07,111618094852,111618094921,001d,563820424941,4d494c4f414b4d,02,00,04	DURATION 29 SECS; PHASE 2; TSP ENABLED

REGIONAL PRS LOG EAGLE M50 WITH EPAC SOFTWARE (MAIN STREET)
END-TO-END DEMO 11/16/18

01,05,111618080119,563820424941,02,01,03,000f,000f,02,cf900d19,61d6a7cb,4d494c4d41494e,36363633202020,3335392020202020,0296,ff			
111618080119, 02,01,1	**BIAB**	**8:01:46**	**END-TO-END PRE-TEST NEAR SIDE BUS STOP #1**
03,05,111618080119,563820424941,02,01,03,04			STATUS Active Processing
02,05,111618080124,563820424941,02,01,03,0007,0007,02,9ea70d19,26c2a7cb,0295			
03,05,111618080124,563820424941,02,01,03,04			
02,05,111618080129,563820424941,02,01,03,0005,0005,02,92b00d19,04baa7cb,0298			
03,05,111618080129,563820424941,02,01,03,04			
02,05,111618080134,563820424941,02,01,03,0004,0004,02,6fb20d19,53b8a7cb,029c			
03,05,111618080135,563820424941,02,01,03,04			
05,05,111618080135,563820424941,02,01,03			CANCEL
111618080135, 02,01,0			
06,05,111618080135,563820424941,02,01,03			CLEAR AT 08:01:35
07,111618080119,111618080135,0010,563820424941,4d494c4d41494e,02,00,05			DURATION 15 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,05,111618080146,563820424941,02,01,03,0004,0004,02,6fb20d19,53b8a7cb,4d494c4d41494e,36363633202020,3335392020202020,02a7,ff			
111618080146, 02,01,1	**BIAB**	**8:01:46**	**END-TO-END PRE-TEST NEAR SIDE BUS STOP #2**
03,05,111618080146,563820424941,02,01,03,04			STATUS Active Processing
02,05,111618080151,563820424941,02,01,03,0004,0004,02,6fb20d19,53b8a7cb,02ac			
03,05,111618080151,563820424941,02,01,03,04			
02,05,111618080156,563820424941,02,01,03,0002,0002,02,e8b80d19,72b2a7cb,02af			
03,05,111618080156,563820424941,02,01,03,04			
02,05,111618080201,563820424941,02,01,03,0000,0000,02,50c20d19,09aba7cb,02b2			
03,05,111618080201,563820424941,02,01,03,04			
02,05,111618080206,563820424941,02,01,03,0003,0003,02,08cc0d19,2ca3a7cb,02b4			
03,05,111618080206,563820424941,02,01,03,04			
05,05,111618080210,563820424941,02,01,03			CANCEL
111618080210, 02,01,0			
06,05,111618080210,563820424941,02,01,03			CLEAR
07,111618080146,111618080210,0018,563820424941,4d494c4d41494e,02,00,05			DURATION 24 SECS; PHASE 2: TSP ENABLED; REQUEST 5
111618080350, SYS, PRG Communications Fault Cleared			
01,01,111618085118,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,3134202020202020,00c8,0a			
111618085118, 02,01,1	**VTT**	**8:51:18**	**PRE-TEST**
05,01,111618085139,495445524953,02,04,06			CANCEL

111618085139, 02,01,0
111618085320, SYS, PRG Communications Failure Timeout
111618085320, 01,0a
07,111618085118,111618085320,007a,495445524953,4d494c4d41494e,02,0a,01 DURATION 122 SECS; PHASE 2; TIMEOUT; REQUEST 1
ff,0b1012083514,4d494c4d41494e,02,495445524953
01,01,111618085554,495445524953,02,04,06,00c8,00c8,02,000001bd,00000315,4d494c4d41494e,31353020202020,313420202020202020,00c8,0a
111618085554, 02,01,1 **VTT** **8:55:54** **PRE-TEST**
05,01,111618085609,495445524953,02,04,06 CANCEL
111618085609, 02,01,0
06,01,111618085612,495445524953,02,04,06 CLEAR
07,111618085554,111618085612,0012,495445524953,4d494c4d41494e,02,00,01 DURATION 18 SECS; PHASE 2; TSP ENABLED; REQUEST 1
111618085800, SYS, PRG Communications Fault Cleared
01,05,111618090551,563820424941,02,01,03,000e,000e,02,2c920d19,3cd5a7cb,4d494c4d41494e,36343237202020,333839202020202020,027a,ff
111618090551, 02,01,1 **BIAB** **9:05:51** **END-TO-END PRE-TEST NEAR SIDE BUS STOP**
03,05,111618090551,563820424941,02,01,03,04 STATUS ActiveProcessing
02,05,111618090556,563820424941,02,01,03,000a,000a,02,42a00d19,d5c8a7cb,027b
03,05,111618090557,563820424941,02,01,03,04
02,05,111618090602,563820424941,02,01,03,0004,0004,02,04b10d19,9db9a7cb,027a
03,05,111618090602,563820424941,02,01,03,04
02,05,111618090607,563820424941,02,01,03,0003,0003,02,f5b60d19,37b4a7cb,027e
03,05,111618090607,563820424941,02,01,03,04
02,05,111618090612,563820424941,02,01,03,0003,0003,02,f5b60d19,37b4a7cb,0283
03,05,111618090612,563820424941,02,01,03,04
05,05,111618090615,563820424941,02,01,03 CANCEL
111618090615, 02,01,0
06,05,111618090616,563820424941,02,01,03 CLEAR
07,111618090551,111618090616,0019,563820424941,4d494c4d41494e,02,00,05 DURATION 25 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,05,111618090627,563820424941,02,01,03,0003,0003,02,f5b60d19,37b4a7cb,4d494c4d41494e,36343237202020,333839202020202020,0292,ff
111618090627, 02,01,1 **BIAB** **9:06:16** **END-TO-END PRE-TEST NEAR SIDE BUS STOP**
03,05,111618090627,563820424941,02,01,03,04 STATUS ActiveProcessing
02,05,111618090632,563820424941,02,01,03,0003,0003,02,f5b60d19,37b4a7cb,0297
03,05,111618090632,563820424941,02,01,03,04
02,05,111618090637,563820424941,02,01,03,0002,0002,02,e8c70d19,83a6a7cb,0297
03,05,111618090637,563820424941,02,01,03,04
05,05,111618090642,563820424941,02,01,03 CANCEL
111618090642, 02,01,0

06,05,111618090642,563820424941,02,01,03 CLEAR
07,111618090627,111618090642,000f,563820424941,4d494c4d41494e,02,00,05 DURATION 15 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,05,111618095011,563820424941,02,01,03,000e,000e,02,e7900d19,4dd6a7cb,4d494c4d41494e,36343532202020,333537202020202020,0216,ff
111618095011, 02,01,1 **BIAB** **9:50:11** **END-TO END DEMO NEAR SIDE BUS STOP #2**
03,05,111618095011,563820424941,02,01,03,04 STATUS Active Processing
02,05,111618095016,563820424941,02,01,03,000b,000b,02,cc9c0d19,f9cba7cb,0219
03,05,111618095016,563820424941,02,01,03,04
02,05,111618095022,563820424941,02,01,03,0006,0006,02,68ac0d19,cdbda7cb,0219
03,05,111618095022,563820424941,02,01,03,04
02,05,111618095027,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,021b
03,05,111618095027,563820424941,02,01,03,04
02,05,111618095032,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0220
03,05,111618095032,563820424941,02,01,03,04
02,05,111618095037,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0225
03,05,111618095037,563820424941,02,01,03,04
02,05,111618095042,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,022a
03,05,111618095042,563820424941,02,01,03,04
05,05,111618095044,563820424941,02,01,03 CANCEL
111618095044, 02,01,0
06,05,111618095044,563820424941,02,01,03 CLEAR AT 09:50:44
07,111618095011,111618095044,0021,563820424941,4d494c4d41494e,02,00,05 DURATION 33 SECS; PHASE 2; TSP ENABLED; REQUEST 5
01,05,111618095123,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,4d494c4d41494e,36343532202020,333537202020202020,0253,ff
111618095123, 02,01,1 **BIAB** **9:51:23** **END-TO END DEMO NEAR SIDE BUS STOP #2**
03,05,111618095123,563820424941,02,01,03,04 STATUS ActiveProcessing
02,05,111618095128,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0258 UPDATE
03,05,111618095128,563820424941,02,01,03,04 STATUS ActiveProcessing
02,05,111618095133,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,025d
03,05,111618095133,563820424941,02,01,03,04
02,05,111618095138,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0262
03,05,111618095138,563820424941,02,01,03,04
02,05,111618095143,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0267
03,05,111618095143,563820424941,02,01,03,04
02,05,111618095148,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,026d
03,05,111618095148,563820424941,02,01,03,04
02,05,111618095154,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0272
03,05,111618095154,563820424941,02,01,03,04

02,05,111618095159,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0277	
03,05,111618095159,563820424941,02,01,03,04	
02,05,111618095204,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,027c	
03,05,111618095204,563820424941,02,01,03,04	
02,05,111618095209,563820424941,02,01,03,0003,0003,02,6db60d19,b3b4a7cb,0281	
03,05,111618095209,563820424941,02,01,03,04	
02,05,111618095214,563820424941,02,01,03,0002,0002,02,b5b90d19,b8b1a7cb,0286	
03,05,111618095214,563820424941,02,01,03,04	
05,05,111618095219,563820424941,02,01,03	CANCEL
111618095219, 02,01,0	
06,05,111618095219,563820424941,02,01,03	CLEAR
07,111618095123,111618095219,0038,563820424941,4d494c4d41494e,02,00,05	DURATION 56 SECS; PHASE 2; TSP ENABLED; REQUEST 5

REGIONAL PRS LOGS COBALT CONTROLLER RUNNING ASC/3 SOFTWARE (MARYLAND STREET)
END-TO-END DEMO 11/16/18

01,06,111618080315,563820424941,02,01,03,001b,001b,02,10d80f19,cdeea5cb,4d494c4d415259,36363633202020,33353920202020202020,0218,ff		
111618080315, 02,01,1	8:03:15	**PRE-TEST NEAR SIDE BUS STOP**
03,06,111618080315,563820424941,02,01,03,04		
02,06,111618080320,563820424941,02,01,03,0016,0016,02,41e20f19,e1e6a5cb,0217		
03,06,111618080320,563820424941,02,01,03,04		STATUS Active Processing
02,06,111618080325,563820424941,02,01,03,000e,000e,02,09ef0f19,f1dca5cb,0216		
03,06,111618080325,563820424941,02,01,03,04		
02,06,111618080330,563820424941,02,01,03,0009,0009,02,22f90f19,17d5a5cb,0216		
03,06,111618080331,563820424941,02,01,03,04		
02,06,111618080336,563820424941,02,01,03,0009,0009,02,22f90f19,17d5a5cb,021b		
03,06,111618080336,563820424941,02,01,03,04		
05,06,111618080338,563820424941,02,01,03		CANCEL
111618080338, 02,01,0		
06,06,111618080338,563820424941,02,01,03		CLEAR
07,111618080315,111618080338,0017,563820424941,4d494c4d415259,02,00,06		DURATION 23 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,06,111618080348,563820424941,02,01,03,0009,0009,02,22f90f19,17d5a5cb,4d494c4d415259,36363633202020,33353920202020202020,0227,ff		
111618080348, 02,01,1	8:03:48	**PRE-TEST NEAR SIDE BUS STOP**
03,06,111618080348,563820424941,02,01,03,04		
02,06,111618080353,563820424941,02,01,03,0005,0005,02,57ff0f19,44d0a5cb,0228		
03,06,111618080353,563820424941,02,01,03,04		STATUS Active Processing
02,06,111618080358,563820424941,02,01,03,0002,0002,02,58061019,e4c5a5cb,0226		
03,06,111618080358,563820424941,02,01,03,04		
02,06,111618080403,563820424941,02,01,03,0002,0002,02,e9fe0f19,8db4a5cb,0225		
03,06,111618080403,563820424941,02,01,03,04		
05,06,111618080406,563820424941,02,01,03		CANCEL
111618080406, 02,01,0		
06,06,111618080406,563820424941,02,01,03		CLEAR
07,111618080348,111618080406,0012,563820424941,4d494c4d415259,02,00,06		DURATION 18 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,06,111618090744,563820424941,02,01,03,001b,001b,02,6fd80f19,84eea5cb,4d494c4d415259,36343237202020,33383920202020202020,01f8,ff		
111618090744, 02,01,1	9:07:44	**PRE-TEST NEAR SIDE BUS STOP**
03,06,111618090744,563820424941,02,01,03,04		
02,06,111618090749,563820424941,02,01,03,0013,0013,02,b8e70f19,a1e2a5cb,01f5		

03,06,111618090749,563820424941,02,01,03,04		STATUS Active Processing
02,06,111618090754,563820424941,02,01,03,000b,000b,02,80f40f19,b1d8a5cb,01f3		
03,06,111618090754,563820424941,02,01,03,04		
02,06,111618090759,563820424941,02,01,03,0005,0005,02,57ff0f19,44d0a5cb,01f2		
03,06,111618090800,563820424941,02,01,03,04		
02,06,111618090805,563820424941,02,01,03,0005,0005,02,57ff0f19,44d0a5cb,01f7		
03,06,111618090805,563820424941,02,01,03,04		
05,06,111618090805,563820424941,02,01,03		CANCEL
111618090805, 02,01,0		
06,06,111618090805,563820424941,02,01,03		CLEAR
07,111618090744,111618090805,0015,563820424941,4d494c4d415259,02,00,06		DURATION 21 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,06,111618090814,563820424941,02,01,03,0005,0005,02,57ff0f19,44d0a5cb,4d494c4d415259,36343237202020,3338392020202020,0201,ff		
111618090814, 02,01,1	9:08:14	**PRE-TEST NEAR SIDE BUS STOP**
03,06,111618090814,563820424941,02,01,03,04		
02,06,111618090820,563820424941,02,01,03,0005,0005,02,57ff0f19,44d0a5cb,0206		
03,06,111618090820,563820424941,02,01,03,04		STATUS Active Processing
02,06,111618090825,563820424941,02,01,03,0002,0002,02,73061019,23c6a5cb,0204		
03,06,111618090825,563820424941,02,01,03,04		
02,06,111618090830,563820424941,02,01,03,0002,0002,02,12ff0f19,edb4a5cb,0202		
03,06,111618090830,563820424941,02,01,03,04		
05,06,111618090833,563820424941,02,01,03		CANCEL
111618090833, 02,01,0		
06,06,111618090833,563820424941,02,01,03		CLEAR
07,111618090814,111618090833,0013,563820424941,4d494c4d415259,02,00,06		DURATION 19 SECS; PHASE 2;TSP ENABLED; REQUEST 6
01,06,111618095315,563820424941,02,01,03,001b,001b,02,2dd90f19,f0eda5cb,4d494c4d415259,36343532202020,3335372020202020,01dc,ff		
111618095315, 02,01,1	9:53:15	**END-TO-END DEMO NEAR SIDE BUS STOP**
03,06,111618095315,563820424941,02,01,03,04		
02,06,111618095320,563820424941,02,01,03,000f,000f,02,63ee0f19,72dda5cb,01d5		
03,06,111618095320,563820424941,02,01,03,04		STATUS ActiveProcessing
02,06,111618095325,563820424941,02,01,03,0005,0005,02,9eff0f19,0dd0a5cb,01d0		
03,06,111618095325,563820424941,02,01,03,04		
05,06,111618095330,563820424941,02,01,03		CANCEL
111618095330, 02,01,0		
06,06,111618095330,563820424941,02,01,03		CLEAR
07,111618095315,111618095330,000f,563820424941,4d494c4d415259,02,00,06		DURATION 15 SECS; PHASE 2; TSP ENABLED; REQUEST 6
01,06,111618095338,563820424941,02,01,03,0005,0005,02,44001019,8ccfa5cb,4d494c4d415259,36343532202020,3335372020202020,01dc,ff		

111618095338, 02,01,1 9:53:38 **END-TO_END DEMO NEAR SIDE BUS STOP**
03,06,111618095338,563820424941,02,01,03,04
02,06,111618095343,563820424941,02,01,03,0005,0005,02,44001019,8ccfa5cb,01e2
03,06,111618095343,563820424941,02,01,03,04 STATUS Active Processing
02,06,111618095348,563820424941,02,01,03,0001,0001,02,d8061019,6ecaa5cb,01e3
03,06,111618095348,563820424941,02,01,03,04
02,06,111618095353,563820424941,02,01,03,0001,0001,02,de021019,c8bda5cb,01e1
03,06,111618095353,563820424941,02,01,03,04
02,06,111618095358,563820424941,02,01,03,0001,0001,02,57fc0f19,90aea5cb,01e1
03,06,111618095359,563820424941,02,01,03,04
05,06,111618095359,563820424941,02,01,03 CANCEL
111618095359, 02,01,0
06,06,111618095400,563820424941,02,01,03 CLOSE
07,111618095338,111618095400,0016,563820424941,4d494c4d415259,02,00,06 DURATION 22 SECS; PHASE 2: TSP ENABLED; REQUEST 6

Message Log Report

Device id	Day	Timestamp	Test ID	Command	Request id	Vehicle id	Time of service	Estimate time of departure	Intersection	Phase	Route id	Run number	Scheduled lateness
		START OF END-TO-END PRE-TEST #1											
35	Friday	11/16/2018 7:34:17 AM	11	0	2	V8BIA	18	18	MILHART	2	6663	359	992
35	Friday	11/16/2018 7:34:22 AM	11	1	2	V8BIA	7	7		2			986
35	Friday	11/16/2018 7:34:27 AM	11	1	2	V8BIA	6	6		2			990
35	Friday	11/16/2018 7:34:33 AM	11	1	2	V8BIA	6	6		2			995
35	Friday	11/16/2018 7:34:38 AM	11	1	2	V8BIA	6	6		2			1001
35	Friday	11/16/2018 7:34:43 AM	11	1	2	V8BIA	3	3		2			1003
35	Friday	11/16/2018 7:34:48 AM	11	1	2	V8BIA	3	3		2			999
35	Friday	11/16/2018 7:34:52 AM	11	4	2	V8BIA							
36	Friday	11/16/2018 8:00:14 AM	12	0	4	V8BIA	30	30	MILOAKM	2	6663	359	725
36	Friday	11/16/2018 8:00:19 AM	12	1	4	V8BIA	20	20		2			722
36	Friday	11/16/2018 8:00:25 AM	12	1	4	V8BIA	12	12		2			719
36	Friday	11/16/2018 8:00:30 AM	12	1	4	V8BIA	4	4		2			715
36	Friday	11/16/2018 8:00:35 AM	12	1	4	V8BIA	4	4		2			710
36	Friday	11/16/2018 8:00:38 AM	12	4	4	V8BIA							
34	Friday	11/16/2018 8:01:19 AM	13	0	5	V8BIA	15	15	MILMAIN	2	6663	359	662
34	Friday	11/16/2018 8:01:24 AM	13	1	5	V8BIA	7	7		2			661
34	Friday	11/16/2018 8:01:29 AM	13	1	5	V8BIA	5	5		2			664
34	Friday	11/16/2018 8:01:34 AM	13	1	5	V8BIA	4	4		2			668
34	Friday	11/16/2018 8:01:35 AM	13	4	5	V8BIA							
34	Friday	11/16/2018 8:01:46 AM	14	0	5	V8BIA	4	4	MILMAIN	2	6663	359	679
34	Friday	11/16/2018 8:01:51 AM	14	1	5	V8BIA	4	4		2			684
34	Friday	11/16/2018 8:01:56 AM	14	1	5	V8BIA	2	2		2			687
34	Friday	11/16/2018 8:02:01 AM	14	1	5	V8BIA	0	0		2			690
34	Friday	11/16/2018 8:02:06 AM	14	1	5	V8BIA	3	3		2			692
34	Friday	11/16/2018 8:02:10 AM	14	4	5	V8BIA							
33	Friday	11/16/2018 8:03:15 AM	15	0	6	V8BIA	27	27	MILMARY	2	6663	359	536
33	Friday	11/16/2018 8:03:20 AM	15	1	6	V8BIA	22	22		2			535
33	Friday	11/16/2018 8:03:25 AM	15	1	6	V8BIA	14	14		2			534
33	Friday	11/16/2018 8:03:30 AM	15	1	6	V8BIA	9	9		2			534
33	Friday	11/16/2018 8:03:36 AM	15	1	6	V8BIA	9	9		2			539
33	Friday	11/16/2018 8:03:38 AM	15	4	6	V8BIA							
33	Friday	11/16/2018 8:03:48 AM	16	0	6	V8BIA	9	9	MILMARY	2	6663	359	551
33	Friday	11/16/2018 8:03:53 AM	16	1	6	V8BIA	5	5		2			552
33	Friday	11/16/2018 8:03:58 AM	16	1	6	V8BIA	2	2		2			550
33	Friday	11/16/2018 8:04:03 AM	16	1	6	V8BIA	2	2		2			549
33	Friday	11/16/2018 8:04:06 AM	16	4	6	V8BIA							
		END OF END-TO-END PRE-TEST #1											
		START OF END-TO-END PRE-TEST #2											
35	Friday	11/16/2018 8:38:40 AM	21	0	2	V8BIA	19	19	MILHART	2	6427	389	955
35	Friday	11/16/2018 8:38:45 AM	21	1	2	V8BIA	15	15		2			956
35	Friday	11/16/2018 8:38:50 AM	21	1	2	V8BIA	11	11		2			957
35	Friday	11/16/2018 8:38:55 AM	21	1	2	V8BIA	6	6		2			958
35	Friday	11/16/2018 8:39:01 AM	21	1	2	V8BIA	1	1		2			958
35	Friday	11/16/2018 8:39:06 AM	21	1	2	V8BIA	1	1		2			958
35	Friday	11/16/2018 8:39:10 AM	21	4	2	V8BIA							
36	Friday	11/16/2018 9:04:37 AM	22	0	4	V8BIA	31	31	MILOAKM	2	6427	389	689
36	Friday	11/16/2018 9:04:42 AM	22	1	4	V8BIA	25	25		2			689
36	Friday	11/16/2018 9:04:47 AM	22	1	4	V8BIA	19	19		2			688

36	Friday	11/16/2018 9:04:53 AM	22	1	4	V8BIA	11	11		2			684
36	Friday	11/16/2018 9:04:58 AM	22	1	4	V8BIA	2	2		2			677
36	Friday	11/16/2018 9:05:03 AM	22	1	4	V8BIA	2	2		2			673
36	Friday	11/16/2018 9:05:05 AM	22	4	4	V8BIA							
34	Friday	11/16/2018 9:05:51 AM	23	0	5	V8BIA	14	14	MILMAIN	2	6427	389	634
34	Friday	11/16/2018 9:05:56 AM	23	1	5	V8BIA	10	10		2			635
34	Friday	11/16/2018 9:06:02 AM	23	1	5	V8BIA	4	4		2			634
34	Friday	11/16/2018 9:06:07 AM	23	1	5	V8BIA	3	3		2			638
34	Friday	11/16/2018 9:06:12 AM	23	1	5	V8BIA	3	3		2			643
34	Friday	11/16/2018 9:06:15 AM	23	4	5	V8BIA							
34	Friday	11/16/2018 9:06:16 AM	23	5	5	V8BIA							
34	Friday	11/16/2018 9:06:27 AM	24	0	5	V8BIA	3	3	MILMAIN	2	6427	389	658
34	Friday	11/16/2018 9:06:32 AM	24	1	5	V8BIA	3	3		2			663
34	Friday	11/16/2018 9:06:37 AM	24	1	5	V8BIA	2	2		2			663
34	Friday	11/16/2018 9:06:42 AM	24	4	5	V8BIA							
33	Friday	11/16/2018 9:07:44 AM	25	0	6	V8BIA	27	27	MILMARY	2	6427	389	504
33	Friday	11/16/2018 9:07:49 AM	25	1	6	V8BIA	19	19		2			501
33	Friday	11/16/2018 9:07:54 AM	25	1	6	V8BIA	11	11		2			499
33	Friday	11/16/2018 9:07:59 AM	25	1	6	V8BIA	5	5		2			498
33	Friday	11/16/2018 9:08:05 AM	25	1	6	V8BIA	5	5		2			503
33	Friday	11/16/2018 9:08:14 AM	26	0	6	V8BIA	5	5	MILMARY	2	6427	389	513
33	Friday	11/16/2018 9:08:20 AM	26	1	6	V8BIA	5	5		2			518
33	Friday	11/16/2018 9:08:25 AM	26	1	6	V8BIA	2	2		2			516
33	Friday	11/16/2018 9:08:30 AM	26	1	6	V8BIA	2	2		2			514
33	Friday	11/16/2018 9:08:33 AM	26	4	6	V8BIA							
		END OF END-TO-END PRE-TEST #2											
		START OF END-TO-END DEMO											
35	Friday	11/16/2018 9:21:49 AM	31	0	2	V8BIA	19	19	MILHART	2	6452	357	785
35	Friday	11/16/2018 9:21:54 AM	31	1	2	V8BIA	15	15		2			786
35	Friday	11/16/2018 9:21:59 AM	31	1	2	V8BIA	10	10		2			786
35	Friday	11/16/2018 9:22:04 AM	31	1	2	V8BIA	5	5		2			786
35	Friday	11/16/2018 9:22:09 AM	31	1	2	V8BIA	1	1		2			788
35	Friday	11/16/2018 9:22:15 AM	31	1	2	V8BIA	1	1		2			789
35	Friday	11/16/2018 9:22:20 AM	31	1	2	V8BIA	1	1		2			790
35	Friday	11/16/2018 9:22:21 AM	31	4	2	V8BIA							
36	Friday	11/16/2018 9:48:52 AM	32	0	4	V8BIA	30	30	MILOAKM	2	6452	357	584
36	Friday	11/16/2018 9:48:57 AM	32	1	4	V8BIA	22	22		2			581
36	Friday	11/16/2018 9:49:02 AM	32	1	4	V8BIA	14	14		2			578
36	Friday	11/16/2018 9:49:08 AM	32	1	4	V8BIA	7	7		2			577
36	Friday	11/16/2018 9:49:13 AM	32	1	4	V8BIA	2	2		2			574
36	Friday	11/16/2018 9:49:18 AM	32	1	4	V8BIA	2	2		2			570
36	Friday	11/16/2018 9:49:20 AM	32	4	4	V8BIA							
36	Friday	11/16/2018 9:49:21 AM	32	5	4	V8BIA							
34	Friday	11/16/2018 9:50:11 AM	33	0	5	V8BIA	14	14	MILMAIN	2	6452	357	534
34	Friday	11/16/2018 9:50:16 AM	33	1	5	V8BIA	11	11		2			537
34	Friday	11/16/2018 9:50:22 AM	33	1	5	V8BIA	6	6		2			537
34	Friday	11/16/2018 9:50:27 AM	33	1	5	V8BIA	3	3		2			539
34	Friday	11/16/2018 9:50:32 AM	33	1	5	V8BIA	3	3		2			544
34	Friday	11/16/2018 9:50:37 AM	33	1	5	V8BIA	3	3		2			549
34	Friday	11/16/2018 9:50:42 AM	33	1	5	V8BIA	3	3		2			554
34	Friday	11/16/2018 9:50:44 AM	33	4	5	V8BIA							
34	Friday	11/16/2018 9:51:23 AM	34	0	5	V8BIA	3	3	MILMAIN	2	6452	357	595
34	Friday	11/16/2018 9:51:28 AM	34	1	5	V8BIA	3	3		2			600

34	Friday	11/16/2018 9:51:33 AM	34	1	5	V8BIA	3	3		2			605
34	Friday	11/16/2018 9:51:38 AM	34	1	5	V8BIA	3	3		2			610
34	Friday	11/16/2018 9:51:43 AM	34	1	5	V8BIA	3	3		2			615
34	Friday	11/16/2018 9:51:48 AM	34	1	5	V8BIA	3	3		2			621
34	Friday	11/16/2018 9:51:54 AM	34	1	5	V8BIA	3	3		2			626
34	Friday	11/16/2018 9:51:59 AM	34	1	5	V8BIA	3	3		2			631
34	Friday	11/16/2018 9:52:04 AM	34	1	5	V8BIA	3	3		2			636
34	Friday	11/16/2018 9:52:09 AM	34	1	5	V8BIA	3	3		2			641
34	Friday	11/16/2018 9:52:14 AM	34	1	5	V8BIA	2	2		2			646
34	Friday	11/16/2018 9:52:19 AM	34	4	5	V8BIA							
33	Friday	11/16/2018 9:53:15 AM	35	0	6	V8BIA	27	27	MILMARY	2	6452	357	476
33	Friday	11/16/2018 9:53:20 AM	35	1	6	V8BIA	15	15		2			469
33	Friday	11/16/2018 9:53:25 AM	35	1	6	V8BIA	5	5		2			464
33	Friday	11/16/2018 9:53:30 AM	35	4	6	V8BIA							
33	Friday	11/16/2018 9:53:38 AM	36	0	6	V8BIA	5	5	MILMARY	2	6452	357	476
33	Friday	11/16/2018 9:53:43 AM	36	1	6	V8BIA	5	5		2			482
33	Friday	11/16/2018 9:53:48 AM	36	1	6	V8BIA	1	1		2			483
33	Friday	11/16/2018 9:53:53 AM	36	1	6	V8BIA	1	1		2			481
33	Friday	11/16/2018 9:53:58 AM	36	1	6	V8BIA	1	1		2			481
33	Friday	11/16/2018 9:53:59 AM	36	4	6	V8BIA							
33	Friday	11/16/2018 9:54:00 AM	36	5	6	V8BIA							
		END OF END-TO-END DEMO											

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Appendix D

Interoperability Testing and RTSPIP Technical System Requirements Traceability

Appendix D -- Interoperability Testing and RTSPIP Technical System Requirements Traceability

Interoperability Testing Plan		Program System Requirements			Verification / Testing Dates and Notes					
ITC Numbers	**ITC Test Name**	**Sys. Req. ID**	**Requirement**	**Importance**	**Pace Testing Date**	**CTA Testing Date**	**Pace Notes**	**Pace Results Documentation**	**CTA Notes**	**CTA Results Documentation**
ITC_01, 02, 03	Virtual and Bench Testing	PRO-1	The TSP request shall be a secure priority request that utilizes NTCIP 1211 protocols for signal priority	V	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Bench testing with Novax Regional PRS occurred at Meade Electric during week of Nov. 12th.	Reference test results from Sections B, C, D, and E of Jacobs Bench Test Data Report containing TSP Message Set logs on Regional PRS Device	Bench testing with Peek Regional PRS occurred at Meade Electric during week of Nov. 12th; log data has been requested	Reference test results from Section A of Jacobs Bench Test Data Report containing TSP Software Reporting logs of communication with Peek Controller
ITC_01, 02, 03	Virtual and Bench Testing		The message shall include, at a minimum, the following critical items in the stated formats:	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -2	a) Vehicle ID (alphanumeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -3	b) Intersection ID (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -4	c) Direction of TSP Required (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -5	d) Unique ID for PRS (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing		The message shall include the following additional items in the stated formats:	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -6	e) Route ID (alphanumeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -7	f) Run number (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -8	g) Request ID (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -9	h) Agency ID (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -10	i) TSP Request: initiate TSP request (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -11	j) TSP Clear: clear TSP request (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -12	k) TSP Cancel: cancel TSP request (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -13	l) Route type (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -14	m) Vehicle Approach (alphabetic value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -15	n) GPS Timestamp of TSP call (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -16	o) Time to hold call prior to TSP Clear (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -17	p) Schedule lateness at time of request (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -18	q) Bus occupancy at time of request (numeric value)	O						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -19	r) Vehicle Location in Longitude, Latitude (numeric values)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -20	s) Time of Service Desired (numeric value)	M						
ITC_01, 02, 03	Virtual and Bench Testing	PRO -21	t) Estimated Departure Time (numeric value)	M						
ITC_04	PRG Interoperability Corridor Test	PRG-1	The PRG shall generate priority requests based on schedule adherence conditions measured by the AVL System	M	11/13/18, & 11/16/18		TSP requests while behind schedule were simulated with bus-in-a-box in bench testing during week of Nov. 12th			

Appendix D -- Interoperability Testing and RTSPIP Technical System Requirements Traceability

ITC Numbers	ITC Test Name	Sys. Req. ID	Requirement	Importance	Pace Testing Date	CTA Testing Date	Pace Notes	Pace Results Documentation	CTA Notes	CTA Results Documentation
ITC_04	PRG Interoperability Corridor Test	PRG -2	The PRG shall generate priority requests based on vehicle location (need to reference a level of accuracy within space and time)	M	11/13/18, & 11/16/18		TSP requests were simulated with bus-in-a-box in bench testing during week of Nov. 12th			
ITC_04	PRG Interoperability Corridor Test	PRG -3	The vehicle location shall be provided by the AVL system	V	11/13/18, & 11/16/18		Pace AVL System was simulated with bus-in-a-box in bench testing during week of Nov. 12th			
ITC_04	PRG Interoperability Corridor Test		The PRG shall generate priority requests based on conditions in addition to schedule adherence measured by the AVL System, including:	O						
ITC_04	PRG Interoperability Corridor Test	PRG -4	a) Passenger occupancy	O						
ITC_04	PRG Interoperability Corridor Test	PRG -5	b) Time-of-day	V						
ITC_04	PRG Interoperability Corridor Test	PRG -6	c) Type of route (BRT, express, local, etc…)	V						
ITC_04	PRG Interoperability Corridor Test	PRG -7	d) Presence of exclusive transit phase	V						
ITC_04	PRG Interoperability Corridor Test	PRG -11	The PRG shall require no action from the bus driver to initiate operations of the TSP System, and thus cause no interference to the bus driver	M	11/13/18, & 11/16/18		TSP requests were simulated with bus-in-a-box in bench testing during week of Nov. 12th			
ITC_04	PRG Interoperability Corridor Test	PRG -12	The PRG shall log priority requests made through messages sent to the PRS: a) Each bus should log each time it traverses a TSP intersection regardless of whether it is requesting TSP ; b) Each log should include whether or not the bus met the schedule adherence (lateness) threshold	M	11/13/18, & 11/16/18		Receipt of logs from bench testing during week of Nov. 12th pending			

Appendix D -- Interoperability Testing and RTSPIP Technical System Requirements Traceability

ITC Numbers	ITC Test Name	Sys. Req. ID	Requirement	Importance	Pace Testing Date	CTA Testing Date	Pace Notes	Pace Results Documentation	CTA Notes	CTA Results Documentation
ITC_01, 04	PRG Interoperability Corridor Test	PRG -20	PRG equipment that is not part of the AVL System shall be compatible with installed communication systems of existing Priority Request Servers in the region	V	N/A	N/A	Not applicable since PRG is part of the Trapeze AVL System		Not applicable since PRG is part of the Clever Devices AVL System	
ITC_04	PRG Interoperability Corridor Test	PRG -21	PRG equipment not part of the AVL System shall interface (via the AVL) with bus door open / close sensors to allow the ability to disable requests for TSP when bus doors are opened. This should be configurable by intersection, route, etc. This has to be addressed at the PRS, communication system, logs (i.e. incorporated into the message set).	O	N/A	N/A	Not applicable since PRG is part of the Trapeze AVL System		Not applicable since PRG is part of the Clever Devices AVL System	
ITC_04	PRG Interoperability Corridor Test	PRG -22	PRG equipment not part of the AVL System shall interface (via the AVL) with next stop pull cords to allow the ability to disable requests for TSP when pull cords are activated to request a stop at a near-side bus stop. This should be configurable by intersection, route, etc. This has to be addressed at the PRS, communication system, logs. (i.e. incorporated into the message set).	O	N/A	N/A	Not applicable since PRG is part of the Trapeze AVL System		Not applicable since PRG is part of the Clever Devices AVL System	
ITC_04	PRG Interoperability Corridor Test	PRG -24	PRG equipment not part of the AVL System shall utilize Simple Network Management Protocol (SNMP) version 2 for alerting staff about: a) devices not receiving communications from AVL Systems, b) devices not communicating to signal controllers, c) devices not reporting to central software.	V	N/A	N/A	Not applicable since PRG is part of the Trapeze AVL System		Not applicable since PRG is part of the Clever Devices AVL System	
ITC_05	PRS Interoperability Corridor Test	PRS-1	The PRS shall process priority requests from eligible buses according to the VehicleClassType and VehicleClassLevel	V						
ITC_05	PRS Interoperability Corridor Test	PRS -2	The PRS shall differentiate between a preemption and a priority request such that preemption requests are granted higher priority over priority requests from buses	V						
ITC_05	PRS Interoperability Corridor Test	PRS -13	The PRS shall process priority requests from eligible buses based on the schedule lateness of the vehicle requesting TSP	O						
ITC_05	PRS Interoperability Corridor Test		The PRS shall inhibit TSP requests made to the signal controller by the following:	V						
ITC_05	PRS Interoperability Corridor Test	PRS -14	a) Time-of-day	V						
ITC_05	PRS Interoperability Corridor Test	PRS -15	b) Day-of-week	V						
ITC_05	PRS Interoperability Corridor Test	PRS -16	c) Direction of TSP request (i.e. north or south, east or west)	V						
ITC_02, 05	PRS Interoperability Corridor Test	PRS -18	PRS equipment that is not part of the existing traffic signal controller shall be compatible with existing PRG components in the region	V		N/A			Not applicable since PRS is part of the Peek ATC-1000 Controllers	
ITC_06	PRG Interoperability Log Test	PRG -8	The PRG shall generate a TSP corridor check-in message at the first TSP intersection encountered on the corridor, regardless of schedule adherence or other conditions measured by the AVL system, for the purposes of travel time analysis and TSP performance reporting	V	11/13/18, & 11/16/18		Receipt of logs from bench testing during week of Nov. 12th pending			
ITC_06	PRG Interoperability Log Test	PRG -9	The PRG shall generate a TSP corridor check-out message at the last TSP intersection encountered on the corridor, regardless of schedule adherence or other conditions measured by the AVL system, for the purposes of travel time analysis and TSP performance reporting	V	11/13/18, & 11/16/18		Receipt of logs from bench testing during week of Nov. 12th pending			
ITC_06	PRG Interoperability Log Test		The PRS shall send the following information to the PRG regarding TSP events:							
ITC_06	PRG Interoperability Log Test	PRS -10	a) Indication of whether or not TSP was granted or denied by the signal controller	V	11/13/18, & 11/16/18		Receipt of Trapeze logs from bench testing during week of Nov. 12th pending			
ITC_06	PRG Interoperability Log Test	PRS -11	b) Reason for TSP denial by signal controller	V	11/13/18, & 11/16/18		Receipt of Trapeze logs from bench testing during week of Nov. 12th pending			

Appendix D -- Interoperability Testing and RTSPIP Technical System Requirements Traceability

ITC Numbers	ITC Test Name	Sys. Req. ID	Requirement	Importance	Pace Testing Date	CTA Testing Date	Pace Notes	Pace Results Documentation	CTA Notes	CTA Results Documentation
ITC_06	PRG Interoperability Log Test	COM -12	COM equipment on the buses shall transmit log data from the PRG on the buses to a SQL database for processing by TSP Central Software, which shall include the following data elements previously defined in this document:	M						
ITC_06	PRG Interoperability Log Test	COM -13	a) PRO-2 through PRO-21	M						
ITC_06	PRG Interoperability Log Test	COM -14	b) PRS-10 and PRS-11	M						
ITC_07	PRS Interoperability Log Test	COM -18	Backhaul of COM equipment data shall utilize wired connections between intersections and central offices where possible.	V						
ITC_07	PRS Interoperability Log Test		The PRS shall log the following information regarding TSP events:	M						
ITC_07	PRS Interoperability Log Test	PRS -3	a) Date and time that TSP request begins	M	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -4	b) Date and time that TSP request ends	V	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -5	c) Duration of the TSP request	V	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -6	d) Indication of whether or not TSP was granted or denied by the signal controller	V	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -7	e) Directional heading of the vehicle	V	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -8	f) Vehicle ID number	M	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_07	PRS Interoperability Log Test	PRS -9	g) Intersection ID number	M	11/13/18, & 11/16/18	11/13/18, & 11/16/18	Receipt of logs from Novax PRS in bench testing during week of Nov. 12th pending		Receipt of logs from Peek Regional PRS during week of Nov. 12th is pending	
ITC_03	Bench Testing		The PRS shall log all information transmitted from the vehicle to the intersection as reflected in the following requirements		11/13/18, & 11/16/18	11/13/18, & 11/16/18				
ITC_03	Bench Testing	PRS -12	a) PRO-2 through PRO-21	M	8/1/18; 11/13/18, & 11/16/18	11/13/18, & 11/16/18	Bench testing with Novax Regional PRS occurred at Meade Electric during week of Nov. 12th.	Reference test results from Sections B, C, D, and E of Jacobs Bench Test Data Report containing TSP Message Set logs on Regional PRS Device	Bench testing with Peek Regional PRS occurred at Meade Electric during week of Nov. 12th; log data has been requested	Reference test results from Section A of Jacobs Bench Test Data Report containing TSP Software Reporting logs of communication with Peek Controller

Appendix E

TSP Performance Measures Analytics Tool Details

Final Report

Transit Signal Priority (TSP) Performance Measures Analytics Tool

Prepared for AECOM
by IBI Group
December 12, 2019

Document Control Page

CLIENT:	AECOM
PROJECT NAME:	Regional Transit Signal Priority Implementation Program (RTSPIP)
REPORT TITLE:	Transit Signal Priority (TSP) Performance Measures Analytics Tool
IBI REFERENCE:	36192
VERSION:	V2.0
DIGITAL MASTER:	J:\34031_RTATSPProjec\5.0 Design (Work) Phase\GPS Data Analysis\RTA Final Deliverable\Manual\TTW_HowToManual_2019-12-12.docx
ORIGINATOR:	Graham Devitt, Maria Demitiry
REVIEWER:	Andrew Wong, Mackenzie de Carle, Marc Tan
AUTHORIZATION:	Mike Corby
CIRCULATION LIST:	RTA, CTA, and PACE Stakeholders
HISTORY:	V1.0 (Draft) – Submitted on December 4, 2019

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Acronyms and Definitions

ACRONYM	DEFINITION
APC	Automatic Passenger Count
AVL	Automatic Vehicle Location
CTA	Chicago Transit Authority
POI	Point of Interest
RT	Runtime
RTA	Regional Transportation Authority
RTSPIP	Regional Transit Signal Priority Implementation Program
TSP	Transit Signal Priority
UTM	Universal Transverse Mercator

1 Overview

A regionally interoperable Transit Signal Priority (TSP) system for both the Chicago Transit Authority (CTA) and the Pace Suburban Bus Company (Pace) is to be implemented under the Regional Transit Signal Priority Implementation Program (RTSPIP) by the Regional Transportation Authority (RTA). This document outlines the TSP performance measures analytics tool used in the RTSPIP to determine four (4) bus performance measurements which are instrumental in the study's performance analysis. These performance measures are:

- Performance Measure 1A: Average Bus Travel Time (Corridor Level);
- Performance Measure 1B: Bus Travel Time Variability (Standard Deviation);
- Performance Measure 1C: Traffic Signal Delay; and
- Performance Measure 1D: Number of Stops at Red Signals.

1.1 Purpose

A data processing tool was developed using Microsoft Access, based on GPS data provided by CTA in 2016. The tool's outputs can be used to evaluate the effectiveness of the TSP system. An overview of the tool is as follows:

- **Inputs:** Includes Automatic Vehicle Location (AVL) data, Automatic Passenger Count (APC) data, and timepoint-based files. The layout of these tables are based on the transit data files developed by CTA. Further details are presented in **Section 2**;
- **Process:** Includes running several modules in Access which process the data using tables. Troubleshooting details are also outlined. Further details are presented in **Section 3**; and
- **Outputs:** Excel files which include performance measurements including as average travel time, standard deviation of travel time, average signal delay, and number of stops at each red signal. Further details are presented in **Section 4**.

This document will provide direction on how to obtain these performance measurements given the appropriate inputs.

1.2 Software Requirements

The following software are required to set-up and run the performance measures analytics tool:

- Microsoft Access;
- Microsoft Excel; and
- Google Earth.

2 Inputs

This section summarizes the inputs required for the data processing tool, as well as the steps to set up these inputs correctly. Users are required to set up the Access database tables prescribed by this section, including column name, data format, and data type.

2.1 Input Files

Three (3) transit data files are required for this process. These include:

- A second-to-second Automatic Vehicle Location (AVL) table containing all runs of a corridor for a given day;
- An Automatic Passenger Count (APC) table with recorded dwell time (See CTA's AVAS file); and
- A timepoint-to-timepoint table including arrival and departure times from each timepoint as well as route pattern IDs (See CTA's Runtime file).

Details of which data to include from each of these tables are outlined in **Section 2.2**. This section will also highlight the details for the Points of Interest (POI) table to be generated, which includes geographic information for all signalized intersections and bus stops along the corridor.

2.2 Surveys

Surveys are the basis for identifying potential trip matches between tables in the database, reducing the processing time significantly. A survey denotes a trip's date, bus ID, and route number. As **Section 2.3** will describe, many of the tables require the set-up of a survey. The format of a survey is:

YYMMDD_RouteName_SurveyType_BusID_Route#

If a trip spans two dates, the start date of the trip is used. The "RouteName" must match the "Route" column of the **TPtoTP** table (see **Exhibit 2-6** in **Section 2.3.3**) and that of CTA's Runtime file. "Route#" includes any branches along the route and must be at least two digits (**if a route is single-digit, add a leading 0**). "SurveyType" is a three-letter code which refers to the type of bus route studied. **Exhibit 2-1** shows the possible survey types. **Please ensure the three-letter code matches that in Exhibit 2-1**.

Exhibit 2-1: Survey Types and their Descriptions

SURVEY TYPE	SURVEY TYPE DESCRIPTION
art	Arterials
exp	Expressways
hwy	Highways
loc	Local Roads
mix	Mixed

An example of a Survey for bus 8038 serving Route X9 S Ashland Ave on December 8th, 2015 would be "151208_S Ashland Ave_art_8038_X9".

2.3 Database Tables

This section will detail what data to include in each input table along with screenshots of how each table appears. **It is very important that the columns are named as they appear in this section**. Note that screenshots of some tables may show an "ID" field on the far left side. This is a column automatically generated by Access when inputting tables, and therefore does not need to be included at this stage. More detail about these columns are found in **Section 3.2.1.**

General Note:

Please ensure all values in a column are the same format. For example, if a "Route ID" column has a mix of "9" and "X9" values, please ensure the "9" values are stored as **text** and not as a **number**.

2.3.1 AVL GPS Data Files

AVL GPS data should include coordinates, timestamps, dates, and bus IDs. The input data should contain **all trips** of **all branches** from **all buses** for a given route and specified period of time (typically one day).

- For CTA, this data originates from the AVL BWLOG files.
- If the data collected is on a millisecond-to-millisecond basis, please filter it to a second-to-second basis before beginning the data processing.

This stage will require the conversion of Latitudes and Longitudes to Universal Transverse Mercator (UTM) coordinates (Northing and Easting). This is required as the tool is configured to calculate distances based on UTM. Refer to the "UTMConversions" Excel spreadsheet included (Dutch, 2005) for batch conversions.

Notes:

- It is recommended that the conversion formulas from the "UTMConversions" Excel file be copied into the AVL BWLOG files, and the conversions take place in the AVL BWLOG files.
- Chicago IL is in UTM Zone 16.

This data will be inputted in the **RawData** table in the Access database. **Exhibit 2-2** describes the columns required to set up the table and **Exhibit 2-3** shows a sample image of the table in Access.

Exhibit 2-2: Description of the Columns in the RawData Table

COLUMN NAME	DESCRIPTION	DATA TYPE
ID	Index of the record. **Note**: This does not need to be included in the input as Access is able to index tables upon importing. See **Section 3.2.1** for more details.	Number (Integer)

COLUMN NAME	DESCRIPTION	DATA TYPE
Survey	Name of the survey. This must be manually created (See **Section 2.2** for details). Note that routes may serving different branches trip-to-trip may not be reflected in the AVL data. This tool corrects for the branch in the AVL data by matching AVL trips to recorded trips from the timepoint and APC files. Because of this, when creating a survey for this table, only the primary route number is needed (e.g. “09” can be used for all 09 and X9 trips).	Text
DATETIME	Date and time of the GPS point. Note, from the CTA’s AVL data, this the sum of the separate Date and Time columns.	Date/Time (yyyy-mm-dd hh:mm:ss)
DIR1_RUN	This column **must be populated by zeroes**, which will be replaced by the tool. It denotes the trip number of a built run in direction 1.	Number (Integer) – populate column with 0
DIR1_MATCH	This column **must be populated by zeroes**, which will be replaced by the tool. It denotes a match between the GPS point and a POI in direction 1.	Number (Integer) – populate column with 0
DIR2_RUN	This column **must be populated by zeroes**, which will be replaced by the tool. It denotes the trip number of a built run in direction 2.	Number (Integer) – populate column with 0
DIR2_MATCH	This column **must be populated by zeroes**, which will be replaced by the tool. It denotes a match between the GPS point and a POI in direction 2.	Number (Integer) – populate column with 0
NORTHING	Includes UTM-converted latitudes.	Number (Decimal)
EASTING	Includes UTM-converted longitudes.	Number (Decimal)
SPEED_MPH	Includes the speed (in miles per hour) between each GPS point and subsequent point. **Note:** The Pythagorean difference between two sets of UTM coordinates equals the distance in metres. To convert metres to miles, divide by 1609. Refer to the equation below for converting to miles per hour (the time difference between timestamps t_1 and t_2 must be in seconds). $v = \frac{3600 * \sqrt{(Northing_2 - Northing_1)^2 + (Easting_2 - Easting_1)^2}}{1609 * (t_2 - t_1)}$	Number (Decimal)
Delay	Blank column which will be populated by the tool. It is the signal delay at GPS points matched to points of interest.	Blank
Dwell_Time	Blank column which will be populated by the tool. It is the dwell time at GPS points matched to points of interest.	Blank

Notes:

Please ensure that the table is sorted by:

- “Survey”; then by
- “DATETIME”.

Exhibit 2-3: Sample Screenshot of the **RawData** Table

RawData

ID	DATETIME	Survey	DIR1_RUN	DIR1_MATCI	DIR2_RUN	DIR2_MATCI	NORTHING	EASTING	SPEED_MPH	Delay	Dwell_Time
1	2015-12-08 1:05:52	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
2	2015-12-08 1:05:53	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
3	2015-12-08 1:05:54	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
4	2015-12-08 1:05:55	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
5	2015-12-08 1:05:56	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
6	2015-12-08 1:05:57	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
7	2015-12-08 1:05:58	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
8	2015-12-08 1:05:59	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
9	2015-12-08 1:06:00	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
10	2015-12-08 1:06:01	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
11	2015-12-08 1:06:02	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
12	2015-12-08 1:06:03	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
13	2015-12-08 1:06:04	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
14	2015-12-08 1:06:05	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
15	2015-12-08 1:06:06	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
16	2015-12-08 1:06:08	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
17	2015-12-08 1:06:09	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
18	2015-12-08 1:06:10	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
19	2015-12-08 1:06:11	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
20	2015-12-08 1:06:12	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
21	2015-12-08 1:06:13	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
22	2015-12-08 1:06:14	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	0		
23	2015-12-08 1:06:15	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623182.31450	444499.204122	14.3348684371		
24	2015-12-08 1:06:16	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623187.27902	444503.316294	18.2867276874		
25	2015-12-08 1:06:17	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623193.90310	444508.189557	0		
26	2015-12-08 1:06:18	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623193.90310	444508.189557	6.98470713498		
27	2015-12-08 1:06:19	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623196.44249	444510.038242	6.03218957181		
28	2015-12-08 1:06:21	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623201.19657	444512.652329	5.90275403829		
29	2015-12-08 1:06:23	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623206.06555	444514.768491	5.27255852169		
30	2015-12-08 1:06:24	151208_S Ashland Ave_art_8033_09	0	0	0	0	4623208.2796	444515.617022	5.10460909025		

2.3.2 Dwell Time and APC Data

Each entry of the **DwellTimeData** table is an event, such as timepoints, unserviced stops, serviced stops, and unknown stops. This table includes APC data, or the number of passengers boarding or alighting at the front and rear doors. This table also includes recorded dwell time data at each event.

- For CTA, this data originates from the AVAS file (e.g. TSP_AVAS_ROUTE9_2016_03.txt).

Exhibit 2-4 describes the columns required to set up the **DwellTimeData** table in the Access database and **Exhibit 2-5** shows a sample image of the table in Access.

Exhibit 2-4: Description of the Columns in the DwellTimeData Table

COLUMN NAME	DESCRIPTION	DATA TYPE
ID	Index of the record. **Note**: This does not need to be included in the input as Access is able to index tables upon importing. See **Section 3.2.1** for more details.	Number (Integer)
Event	Type of event captured by the survey. Please ensure this column labels timepoint events as **"Timepoint".**	Text
Route_ID	Number of the route including route branch (e.g. 49B, X9 etc.).	Text
Stop_ID	Number of the stop. If the event is a **timepoint**, this entry should be blank.	Number (Integer)
DateTime	Date and time of the event.	Date/Time (yyyy-mm-dd hh:mm:ss)
DwellTime	Recorded dwell time at each event.	Number (Integer)
ValidatedDwell	Blank column which will be populated by the tool. Represents the validated dwell time.	Blank
DepartureTime	Departure time from the event.	Date/Time (yyyy-mm-dd hh:mm:ss)
FrontOFF	Number of passengers offloading at the front of the bus.	Number (Integer)
FrontON	Number of passengers loading at the front of the bus.	Number (Integer)
RearOFF	Number of passengers offloading at the back of the bus.	Number (Integer)
Wheelchair	Number of wheelchair users boarding the bus.	Number (Integer)
Survey	Name of the survey record. This must be manually created (See **Section 2.2** for details). Unlike for **RawData**, please ensure the proper route branch is used for these surveys.	Text

Exhibit 2-5: Sample Screenshot of the **DwellTimeData** Table

DwellTimeData

ID	Event	Route_ID	Stop_ID	DateTime	DwellTime	ValidatedDwell	DepartureTime	FrontOFF	FrontON	RearOFF	Wheelchair	Survey
1	Timepoint	9		2015-12-10 3:24	0		2015-12-10 3:25:03 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
2	UnServiced Stc	9	6109	2015-12-10 3:24	0		2015-12-10 3:24:52 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
3	UnServiced Stc	9	15913	2015-12-10 3:25	0		2015-12-10 3:25:11 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
4	UnServiced Stc	9	6111	2015-12-10 3:25	0		2015-12-10 3:25:23 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
5	UnServiced Stc	9	6112	2015-12-10 3:25	0		2015-12-10 3:25:38 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
6	UnServiced Stc	9	6113	2015-12-10 3:25	0		2015-12-10 3:25:51 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
7	Timepoint	9		2015-12-10 3:26	0		2015-12-10 3:26:50 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
8	UnServiced Stc	9	6114	2015-12-10 3:26	0		2015-12-10 3:26:21 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
9	UnServiced Stc	9	6115	2015-12-10 3:26	0		2015-12-10 3:26:54 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
10	Serviced Stop	9	6116	2015-12-10 3:27	5		2015-12-10 3:27:20 AM	0	1	0	0	151210_S Ashland Ave_art_8031_09
11	UnServiced Stc	9	6117	2015-12-10 3:27	0		2015-12-10 3:27:56 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
12	Serviced Stop	9	6118	2015-12-10 3:28	17		2015-12-10 3:28:37 AM	0	1	0	0	151210_S Ashland Ave_art_8031_09
13	UnServiced Stc	9	6119	2015-12-10 3:29	0		2015-12-10 3:29:21 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
14	UnServiced Stc	9	6120	2015-12-10 3:29	0		2015-12-10 3:29:50 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
15	UnServiced Stc	9	6121	2015-12-10 3:30	0		2015-12-10 3:30:21 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
16	UnServiced Stc	9	15249	2015-12-10 3:31	0		2015-12-10 3:31:00 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
17	UnServiced Stc	9	6123	2015-12-10 3:31	0		2015-12-10 3:31:13 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
18	UnServiced Stc	9	6124	2015-12-10 3:31	0		2015-12-10 3:31:30 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
19	UnServiced Stc	9	6125	2015-12-10 3:31	0		2015-12-10 3:31:50 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
20	UnServiced Stc	9	6126	2015-12-10 3:32	0		2015-12-10 3:32:05 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
21	UnServiced Stc	9	6127	2015-12-10 3:32	0		2015-12-10 3:32:19 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
22	UnServiced Stc	9	6128	2015-12-10 3:32	0		2015-12-10 3:32:33 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
23	UnServiced Stc	9	6129	2015-12-10 3:32	0		2015-12-10 3:32:47 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
24	Timepoint	9		2015-12-10 3:33	0		2015-12-10 3:33:21 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
25	Serviced Stop	9	15211	2015-12-10 3:33	0		2015-12-10 3:33:15 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
26	Serviced Stop	9	3497	2015-12-10 3:33	11		2015-12-10 3:33:43 AM	1	0	0	0	151210_S Ashland Ave_art_8031_09
27	UnServiced Stc	9	3498	2015-12-10 3:33	0		2015-12-10 3:33:59 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
28	UnServiced Stc	9	15027	2015-12-10 3:34	0		2015-12-10 3:34:40 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
29	UnServiced Stc	9	3500	2015-12-10 3:34	0		2015-12-10 3:34:51 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
30	UnServiced Stc	9	3501	2015-12-10 3:35	0		2015-12-10 3:35:05 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
31	UnServiced Stc	9	3502	2015-12-10 3:35	0		2015-12-10 3:35:29 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
32	UnServiced Stc	9	3503	2015-12-10 3:36	0		2015-12-10 3:36:08 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
33	UnServiced Stc	9	3504	2015-12-10 3:36	0		2015-12-10 3:36:23 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09
34	UnServiced Stc	9	15026	2015-12-10 3:37	0		2015-12-10 3:37:08 AM	0	0	0	0	151210_S Ashland Ave_art_8031_09

2.3.3 Timepoint to Timepoint Data

The AVL data will be processed on a timepoint-to-timepoint basis and used to create trips. To accomplish this, the **TPtoTP** table in the Access database is used.

- For CTA, this data originates from the Runtime (RT) file (e.g. TSP_RUNTIME_ROUTE9.txt).

Exhibit 2-6 describes the columns required to set up the table and **Exhibit 2-7** shows a sample image of the table in Access.

Exhibit 2-6: Description of the Columns in the TPtoTP Table

COLUMN NAME	DESCRIPTION	DATA TYPE
ID	Index of the record. **Note**: This does not need to be included in the input as Access is able to index tables upon importing. See **Section 3.2.1** for more details.	Number (Integer)
Survey	Blank column which will be populated by the tool.	Blank
Route	Name of the route. **Note**: Please ensure there is no underscore "_" in the name.	Text
Route_ID	Number of the route.	Text
Bus_ID	ID of the bus.	Number (Integer)
Run_ID	ID of the run. **Note**: Please ensure in the input file this column is stored as a text, not as a number.	Text
Operator_ID	ID of the operator.	Number (Integer)
From_TP	Starting timepoint of the entry, formatted as two three-character IDs, as appearing in the CTA Runtime files.	Text
To_TP	Ending timepoint of the entry, formatted as two three-character IDs, as appearing in the CTA Runtime files.	Text
Segment	Blank column which will be populated by the tool.	Blank
TripStart_DateString	Date of the trip.	Date (yyyy-mm-dd)
TripStart_TimeString	Starting time of the trip.	Time (hh:mm:ss)
From_Arrival_DateTime	Date and time of arrival at the starting timepoint.	Date/Time (yyyy-mm-dd hh:mm:ss)
From_Depart_DateTime	Date and time of departure from the starting timepoint.	Date/Time (yyyy-mm-dd hh:mm:ss)

COLUMN NAME	DESCRIPTION	DATA TYPE
To_Arrival_DateTime	Date and time of arrival at the ending timepoint.	Date/Time (yyyy-mm-dd hh:mm:ss)
To_Depart_DateTime	Date and time of departure from the ending timepoint.	Date/Time (yyyy-mm-dd hh:mm:ss)
Trip_ID	ID of the trip.	Number (Long)
Block_ID	ID of the block.	Number (Long)
Pattern_ID	ID of the pattern.	Number (Integer)
Direction	Direction of the run. “1” represents northbound/eastbound and “2” represents southbound/westbound.	Number (Integer)

Exhibit 2-7: Sample Screenshot of the **TPtoTP** Table

TPtoTP

ID	Survey	Route	Route_ID	Bus_ID	Run_ID	Operator_ID	From_TP	To_TP	Segment	TripStart_DateString	TripStart_TimeString	From_Arrival_DateTime	From_Depart_DateTime
1		S Ashland Ave	9	8038	6002	20305	74 Ash	79 Ash		2015-12-08	3:22:11 AM	2015-12-08 3:24:25 AM	2015-12-08 3:24:57 AM
2		S Ashland Ave	9	8038	6002	20305	79 Ash	95 Ash		2015-12-08	3:22:11 AM	2015-12-08 3:26:00 AM	2015-12-08 3:26:40 AM
3		S Ashland Ave	9	8038	6002	20305	95 Ash	95 Red		2015-12-08	3:22:11 AM	2015-12-08 3:32:48 AM	2015-12-08 3:33:05 AM
4		S Ashland Ave	9	8038	6002	20305	95 Red	95 Ash		2015-12-08	3:45:40 AM	2015-12-08 3:45:40 AM	2015-12-08 3:45:52 AM
5		S Ashland Ave	9	8038	6002	20305	63 Ash	47 Ash		2015-12-08	3:45:40 AM	2015-12-08 4:07:03 AM	2015-12-08 4:07:28 AM
6		S Ashland Ave	9	8038	6002	20305	47 Ash	AshOrg		2015-12-08	3:45:40 AM	2015-12-08 4:13:10 AM	2015-12-08 4:13:51 AM
7		S Ashland Ave	9	8033	6005	24375	95 Red	95 Ash		2015-12-08	4:15:48 AM	2015-12-08 4:15:48 AM	2015-12-08 4:16:10 AM
8		S Ashland Ave	9	8038	6002	20305	AshOrg	CerAsh		2015-12-08	3:45:40 AM	2015-12-08 4:23:23 AM	2015-12-08 4:27:32 AM
9		S Ashland Ave	9	8033	6005	24375	95 Ash	79 Ash		2015-12-08	4:15:48 AM	2015-12-08 4:23:53 AM	2015-12-08 4:24:52 AM
10		S Ashland Ave	9	8038	6002	20305	CerAsh	MadAsh		2015-12-08	3:45:40 AM	2015-12-08 4:29:56 AM	2015-12-08 4:30:45 AM
11		S Ashland Ave	9	8033	6005	24375	79 Ash	74 Ash		2015-12-08	4:15:48 AM	2015-12-08 4:32:45 AM	2015-12-08 4:33:21 AM
12		S Ashland Ave	9	8033	6005	24375	74 Ash	63 Ash		2015-12-08	4:15:48 AM	2015-12-08 4:35:21 AM	2015-12-08 4:35:51 AM
13		S Ashland Ave	9	8033	6005	24375	63 Ash	47 Ash		2015-12-08	4:15:48 AM	2015-12-08 4:40:49 AM	2015-12-08 4:42:13 AM
14		S Ashland Ave	9	8033	6005	24375	47 Ash	AshOrg		2015-12-08	4:15:48 AM	2015-12-08 4:48:24 AM	2015-12-08 4:49:03 AM
15		S Ashland Ave	9	8038	6002	20305	DvnAsh	CorAsh		2015-12-08	3:45:40 AM	2015-12-08 4:48:27 AM	2015-12-08 4:48:56 AM
16		S Ashland Ave	9	8038	6002	20305	MadAsh	DvnAsh		2015-12-08	3:45:40 AM	2015-12-08 4:48:27 AM	2015-12-08 4:48:27 AM
17		S Ashland Ave	9	8038	6002	20305	CorAsh	BelAsh		2015-12-08	3:45:40 AM	2015-12-08 4:53:19 AM	2015-12-08 4:53:22 AM
18		S Ashland Ave	9	8033	6005	24375	AshOrg	CerAsh		2015-12-08	4:15:48 AM	2015-12-08 4:58:18 AM	2015-12-08 5:00:33 AM
19		S Ashland Ave	9	8033	6005	24375	CerAsh	MadAsh		2015-12-08	4:15:48 AM	2015-12-08 5:02:17 AM	2015-12-08 5:04:32 AM
20		S Ashland Ave	9	8038	6002	20305	BelAsh	BplClk		2015-12-08	3:45:40 AM	2015-12-08 5:03:02 AM	2015-12-08 5:03:11 AM
21		S Ashland Ave	9	8038	6002	20305	BplClk	BelAsh		2015-12-08	5:13:30 AM	2015-12-08 5:13:30 AM	2015-12-08 5:22:32 AM
22		S Ashland Ave	9	8033	6005	24375	MadAsh	DvnAsh		2015-12-08	4:15:48 AM	2015-12-08 5:16:20 AM	2015-12-08 5:16:58 AM

TPtoTP

To_Arrival_DateTime	To_Depart_DateTime	Trip_ID	Block_ID	Pattern_ID	Direction
2015-12-08 3:26:00 AM	2015-12-08 3:26:40 AM	93216988	248006726	1748	2
2015-12-08 3:32:48 AM	2015-12-08 3:33:05 AM	93216988	248006726	1748	2
2015-12-08 3:43:25 AM	2015-12-08 3:45:40 AM	93216988	248006726	1748	2
2015-12-08 3:51:20 AM	2015-12-08 3:51:27 AM	93217220	248006726	7500	1
2015-12-08 4:13:10 AM	2015-12-08 4:13:51 AM	93217220	248006726	7500	1
2015-12-08 4:23:23 AM	2015-12-08 4:27:32 AM	93217220	248006726	7500	1
2015-12-08 4:23:53 AM	2015-12-08 4:24:52 AM	93217222	248006730	7500	1
2015-12-08 4:29:56 AM	2015-12-08 4:30:45 AM	93217220	248006726	7500	1
2015-12-08 4:32:45 AM	2015-12-08 4:33:21 AM	93217222	248006730	7500	1
2015-12-08 4:48:27 AM	2015-12-08 4:48:27 AM	93217220	248006726	7500	1
2015-12-08 4:35:21 AM	2015-12-08 4:35:51 AM	93217222	248006730	7500	1
2015-12-08 4:40:49 AM	2015-12-08 4:42:13 AM	93217222	248006730	7500	1
2015-12-08 4:48:24 AM	2015-12-08 4:49:03 AM	93217222	248006730	7500	1
2015-12-08 4:58:18 AM	2015-12-08 5:00:33 AM	93217222	248006730	7500	1
2015-12-08 4:53:19 AM	2015-12-08 4:53:22 AM	93217220	248006726	7500	1
2015-12-08 4:48:27 AM	2015-12-08 4:48:56 AM	93217220	248006726	7500	1
2015-12-08 5:03:02 AM	2015-12-08 5:03:11 AM	93217220	248006726	7500	1
2015-12-08 5:02:17 AM	2015-12-08 5:04:32 AM	93217222	248006730	7500	1
2015-12-08 5:16:20 AM	2015-12-08 5:16:58 AM	93217222	248006730	7500	1
2015-12-08 5:08:32 AM	2015-12-08 5:13:30 AM	93217220	248006726	7500	1
2015-12-08 5:29:52 AM	2015-12-08 5:30:13 AM	93217244	248006726	7495	2
2015-12-08 5:24:09 AM	2015-12-08 5:25:00 AM	93217222	248006730	7500	1

2.3.4 Patterns and Timepoints

To number the segments in the **TPtoTP** table, the **PatternsAndTimepoints** table is matched to the **TPtoTP** table using unique pattern IDs. This table is derived from the input file used for Timepoint to Timepoint data (Runtime file for CTA – e.g. TSP_RUNTIME_ROUTE9.txt) by tabulating all unique segments for every pattern. In other words, every unique Segment-Pattern_ID combination should be included exactly once.

Exhibit 2-8 describes the columns required to set up the **PatternsAndTimepoints** table in the Access database and **Exhibit 2-9** shows a sample image of the table in Access.

Exhibit 2-8: Description of the Columns in the PatternsAndTimepoints Table

COLUMN NAME	DESCRIPTION	DATA TYPE
Segment	Number of the segment along the pattern.	Number (Integer)
Route_ID	ID of the route.	Text
From_TP	Starting timepoint of the entry, formatted as two three-character IDs, as appearing in the Runtime files.	Text
To_TP	Ending timepoint of the entry, formatted as two three-character IDs, as appearing in the Runtime files.	Text
Pattern_ID	ID for each pattern. A unique pattern ID exists for each pattern of stops. **Note**: Please do not include any pattern ID values that are not found in the **TPtoTP** table.	Number (Integer)
Direction	Direction of the run. “1” represents northbound/eastbound and “2” represents southbound/westbound.	Number (Integer)

Exhibit 2-9: Sample Screenshot of the **PatternsAndTimepoints** Table

PatternsAndTimepoints

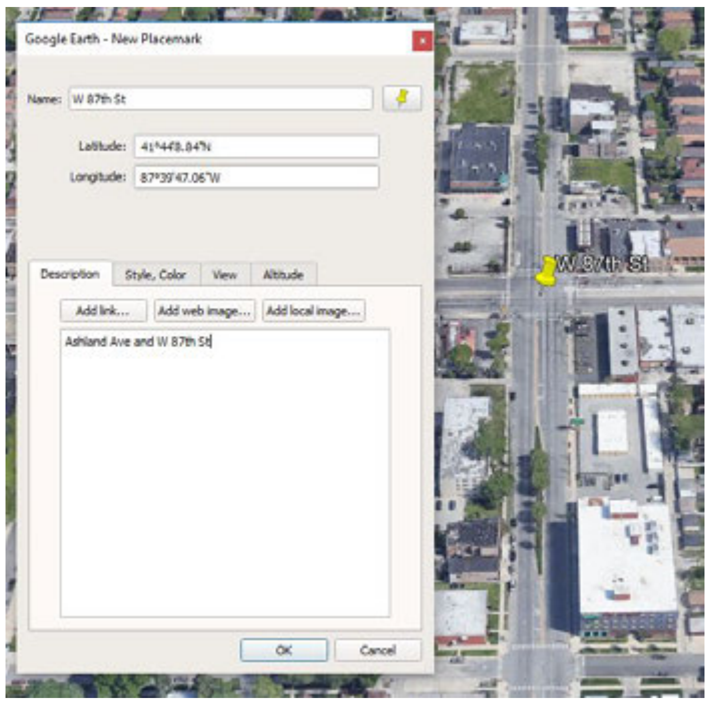
ID	Segment	Route_ID	From_TP	To_TP	Pattern_ID	Direction
1	1	9	74 Ash	79 Ash	1748	2
2	2	9	79 Ash	95 Ash	1748	2
3	3	9	95 Ash	95 Red	1748	2
4	1	9	74 Ash	79 Ash	3634	2
5	2	9	79 Ash	95 Bev	3634	2
6	1	9	95 Bev	79 Ash	3637	1
7	2	9	79 Ash	74 Ash	3637	1
8	1	9	BplClk	BelAsh	7492	2
9	2	9	BelAsh	CorAsh	7492	2
10	3	9	CorAsh	DvnAsh	7492	2
11	4	9	DvnAsh	MadAsh	7492	2
12	5	9	MadAsh	CerAsh	7492	2
13	6	9	CerAsh	AshOrg	7492	2
14	7	9	AshOrg	47 Ash	7492	2
15	8	9	47 Ash	63 Ash	7492	2
16	9	9	63 Ash	74 Ash	7492	2
17	1	9	BplClk	BelAsh	7494	2
18	2	9	BelAsh	CorAsh	7494	2

2.3.5 Points of Interest KML File

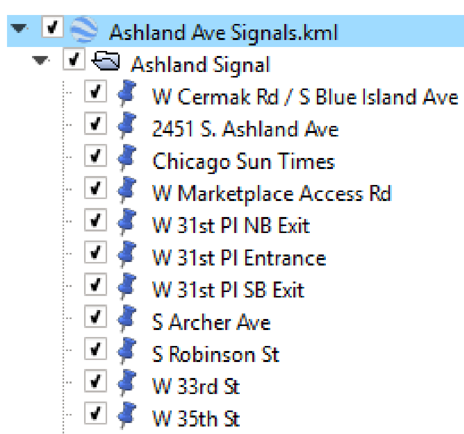
Points of interest (POIs) such as signalized intersections and bus stops (denoted as nearside, mid-block or farside) are used to create runs from the GPS data. In Google Earth, place pins at the centre of each intersection and at stops.

- First, click the “add pin” icon at the top of the window.

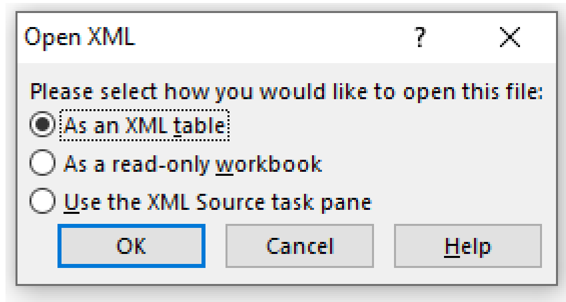
- Place the pin at the POI. When placed, the pin can be named.



- Use a standardized naming convention for the pins and save them under a single folder.



- Click on the folder, then click File → Save → Save Place As, and change the file type to .kml.
- Opening the .kml file in Excel will trigger the following prompt:



- Select “As an XML table”.
- Open a table in Excel which includes the latitude and longitude of each pin.
- Convert these coordinates from latitude and longitude to UTM (Northing and Easting), the same as was done for the AVL Data table in **Section 2.3.1**.

Please ensure every POI on a route is accounted for terminus-to-terminus. The POI data will be inputted in the **POIData** table in the Access database. **Exhibit 2-10** describes the columns required to set up the table and **Exhibit 2-11** shows a sample image of the table in Access.

Exhibit 2-10: Description of the Columns in the POIData Table

COLUMN NAME	DESCRIPTION	DATA TYPE
ID	Index of the record. **Note**: This does not need to be included in the input as Access is able to index tables upon importing. See **Section 3.2.1** for more details.	Number (Integer)
Route_ID	ID of the route.	Text
Route	Name of the route in the format “Route Name Route#” (e.g. “S Ashland Ave 9”, “S Ashland Ave X9” etc.). Note for single-digit routes do not include the leading “0”.	Text
Direction	Direction of the run. Input “Northbound”, “Southbound”, “Eastbound”, or “Westbound”.	Text
Ref_Index	Represents the order of the POIs for each route branch in each direction. Begins at 1 and counts upwards until the final POI. Resets to 1 for the next branch or direction.	Number (Integer)
Dir_Index	Direction of the run. 1 represents northbound/eastbound and 2 represents southbound/westbound.	Number (Integer)
Name	Name of the POI. Note that this will be the name that appears when referencing a POI in the output files.	Text
Northing	Includes converted longitudes.	Number (Decimal)

COLUMN NAME	DESCRIPTION	DATA TYPE
Easting	Includes converted latitudes.	Number (Decimal)
Signal	Type of POI. Input: • "Signal" for signalized intersection; • "Farside" for far-side stop; • "Nearside" for near-side stop; and • "Stop" for mid-block stop.	Text
Speed_Limit	Speed limit in **mph.**	Number (Integer)
Distance_Limit	Minimum of half of the distance to the nearest POI (in feet) or 98 ft.	Number (Integer)
TimingPoint	A TRUE/FALSE Boolean field. A TRUE value if the mid-block or farside POI is a timing point, a FALSE value if not. For nearside timing points, do not select TRUE for this**.** Instead, select TRUE for the associated traffic signal POI. For all regular (non-timing point) stops, select FALSE.	Boolean (Yes/No)

Exhibit 2-11: Sample Screenshot of the **POIData** Table

POIData

ID	Route_ID	Route	Direction	Ref_Index	Dir_Index	Name	Northing	Easting	Signal	Speed_Limit	Distance_Limit	TimingPoint
1	9	S Ashland Ave 9	Northbound	1	1	6131	4618945.687	444882.4935	Stop	30	98	True
2	9	S Ashland Ave 9	Northbound	2	1	W 95th St	4619037.126	444877.5511	Signal	30	82	False
3	9	S Ashland Ave 9	Northbound	3	1	6147	4619085.752	444889.2575	Farside	30	82	False
4	9	S Ashland Ave 9	Northbound	4	1	6148	4619232.461	444888.6391	Stop	30	98	False
5	9	S Ashland Ave 9	Northbound	5	1	6149	4619434.212	444884.6522	Stop	30	98	False
6	9	S Ashland Ave 9	Northbound	6	1	W 91st St	4619844.176	444869.4077	Signal	30	65	False
7	9	S Ashland Ave 9	Northbound	7	1	14781	4619883.609	444880.1558	Farside	30	65	False
8	9	S Ashland Ave 9	Northbound	8	1	6153	4620227.984	444876.7082	Stop	30	98	False
9	9	S Ashland Ave 9	Northbound	9	1	6155	4620640.142	444870.0809	Nearside	30	98	False
10	9	S Ashland Ave 9	Northbound	10	1	W 87th St	4620655.603	444858.5148	Signal	30	98	False
11	9	S Ashland Ave 9	Northbound	11	1	W 85th St	4621060.408	444853.9423	Signal	30	65	False
12	9	S Ashland Ave 9	Northbound	12	1	15455	4621094.812	444863.2617	Farside	30	49	False
13	9	S Ashland Ave 9	Northbound	13	1	6159	4621453.011	444861.3956	Nearside	30	98	False
14	9	S Ashland Ave 9	Northbound	14	1	W 83rd St	4621464.028	444849.076	Signal	30	98	False
15	9	S Ashland Ave 9	Northbound	15	1	6160	4621658.079	444857.8358	Stop	30	98	False
16	9	S Ashland Ave 9	Northbound	16	1	W 81st St	4621869.049	444844.5299	Signal	30	82	False
17	9	S Ashland Ave 9	Northbound	17	1	15456	4621921.199	444854.5977	Farside	30	82	False
18	9	S Ashland Ave 9	Northbound	18	1	6162	4622062.655	444852.6643	Stop	30	98	False
19	9	S Ashland Ave 9	Northbound	19	1	6163	4622261.68	444851.7732	Nearside	30	98	False
20	9	S Ashland Ave 9	Northbound	20	1	W 79th St	4622273.09	444839.8667	Signal	30	98	True
21	9	S Ashland Ave 9	Northbound	21	1	6165	4622668.287	444845.8159	Stop	30	98	False
22	9	S Ashland Ave 9	Northbound	22	1	6166	4622868.715	444843.9855	Nearside	30	98	False
23	9	S Ashland Ave 9	Northbound	23	1	W 76th St	4622879.289	444833.2557	Signal	30	98	False
24	9	S Ashland Ave 9	Northbound	24	1	6168	4623273.415	444841.3597	Nearside	30	98	False
25	9	S Ashland Ave 9	Northbound	25	1	W 74th St	4623283.159	444830.1564	Signal	30	98	True
26	9	S Ashland Ave 9	Northbound	26	1	6169	4623476.807	444838.7837	Stop	30	98	False
27	9	S Ashland Ave 9	Northbound	27	1	6171	4623878.452	444835.4885	Nearside	30	98	False
28	9	S Ashland Ave 9	Northbound	28	1	W 71st St	4623888.541	444823.117	Signal	30	98	False

2.3.6 Routes and Master Routes

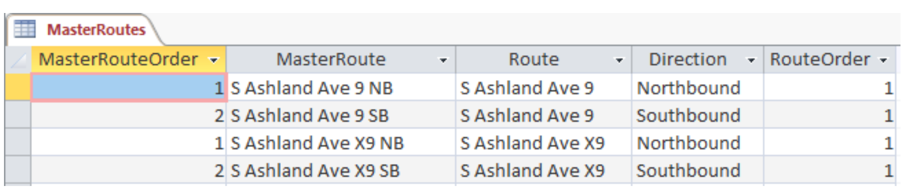
The **MasterRoutes** and **Routes** tables are used to track the different branches and directions along each corridor. The **MasterRoutes** table lists all branch-direction combinations on the corridor and the **Routes** table lists all routes. These tables come included with the database and can be manually edited, or imported from Excel as long as they are set up as described by **Exhibit 2-12** and **Exhibit 2-14**.

Exhibit 2-12 and **Exhibit 2-14** describe the columns required to set up the **MasterRoutes** and **Routes** tables, respectively. **Exhibit 2-13** and **Exhibit 2-15** show sample images of the **MasterRoutes** and **Routes** tables, respectively, in Access.

Exhibit 2-12: Description of the Columns in the MasterRoutes Table

COLUMN NAME	DESCRIPTION	DATA TYPE
MasterRouteOrder	Direction order of the route. 1 represents northbound/eastbound and 2 represents southbound/westbound.	Number (Integer)
MasterRoute	Name and direction of the route.	Number (Integer)
Route	Name of the route in the format "Route Name Route#" (e.g. "S Ashland Ave 9", "S Ashland Ave X9" etc.). It is important this format be used as this field will be matched to other tables. Note for single-digit routes do not include the leading "0".	Text
Direction	Direction of the route. Input "Northbound", "Southbound", "Eastbound", or "Westbound".	Text
RouteOrder	Used to track split runs. Default value 1. Refer to the bulleted list below on splitting runs.	Number (Integer)

Exhibit 2-13: Sample Screenshot of the **MasterRoutes** Table


MasterRoutes

MasterRouteOrder	MasterRoute	Route	Direction	RouteOrder
1	S Ashland Ave 9 NB	S Ashland Ave 9	Northbound	1
2	S Ashland Ave 9 SB	S Ashland Ave 9	Southbound	1
1	S Ashland Ave X9 NB	S Ashland Ave X9	Northbound	1
2	S Ashland Ave X9 SB	S Ashland Ave X9	Southbound	1

Exhibit 2-14: Description of the Columns in the Routes Table

COLUMN NAME	DESCRIPTION	DATA TYPE
Route	Name of the route. Must be the same as the Route column in the **MasterRoutes** table.	Text
Beginning	Name of the first POI on the route.	Text
End	Name of the last POI on the route.	Text
Directions	Number of directions along the route (typically 2 – either northbound and southbound or eastbound and westbound).	Number (Integer)

Exhibit 2-15: Sample Screenshot of the **Routes** Table

Routes

Route	Beginning	End	Directions
S Ashland Ave 9	W 95th St	W Cermak Rd	2
S Ashland Ave X9	W 95th St	W Cermak Rd	2

Notes:

- If the input data does not include all branches of a route, or only includes one route direction, please **do not** include a row of the branch(es)/direction(s) not found in the input dataset in the **MasterRoutes** table.
- For runs which must be split in two (2) (e.g. the driver takes an extended break at a stop), refer to the following steps to preserve the data:
    - Input the route twice and update the "RouteOrder" column of the **MasterRoutes** table with ascending numbers corresponding to the order in which the route is driven.
    - Input the "Route" column with the route name and route order.
    - If Route X is split into two (2) runs, name the first segment driven "Route X-1" with route order 1 and the second segment "Route X-2" with route order 2.
    - Update the "Route" column of the **Routes** table with the same route names as in the **MasterRoutes** table. The "MasterRoute" column in the **MasterRoutes** table does not have to be split up by route order.
    - If there are no split runs, then the "RouteOrder" column should be 1.

2.3.7 Time Periods

The **TimePeriods** table specifies the time periods in which surveys are conducted (i.e. AM Peak, Midday, and PM Peak) depending on the survey type. These can be modified as desired per the official time period ranges. This table can be found already uploaded in the database and can be manually edited, or otherwise re-imported from Excel. **Exhibit 2-16** describes the columns of the **TimePeriods** table and **Exhibit 2-17** shows a sample image of the table in Access.

Exhibit 2-16: Description of the Columns in the TimePeriods Table

COLUMN NAME	DESCRIPTION	DATA TYPE
SurveyType	Type of survey being conducted. Records can be added for additional surveys.	Text
SurveyCode	Three-letter code used to denote survey type (see **Exhibit 2-1** for details).	Text
Period	Name of the time period.	Text
Start_Time	Start time of the time period. Can be modified if desired.	Time (h:mm:ss XM)

COLUMN NAME	DESCRIPTION	DATA TYPE
End_Time	End time of the time period. Can be modified if desired.	Time (h:mm:ss XM)

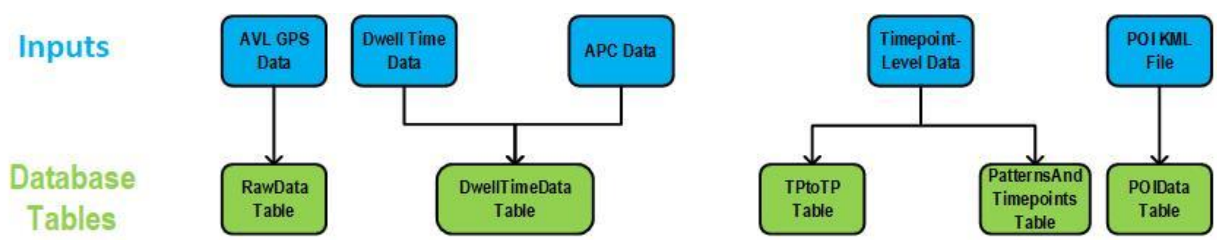
Exhibit 2-17: Sample Screenshot of the **TimePeriods** Table

TimePeriods

SurveyType	SurveyCode	Period	Start_Time	End_Time
Arterials	art	AM Peak	7:00:00 AM	9:40:00 AM
Arterials	art	Midday	10:00:00 AM	3:10:00 PM
Arterials	art	PM Peak	3:30:00 PM	6:40:00 PM
Expressways	exp	AM Peak	6:00:00 AM	9:30:00 AM
Expressways	exp	Midday	12:00:00 PM	2:00:00 PM
Expressways	exp	PM Peak	3:30:00 PM	6:30:00 PM
Highways	hwy	AM Peak	6:30:00 AM	9:30:00 AM
Highways	hwy	Midday	12:00:00 PM	2:00:00 PM
Highways	hwy	PM Peak	3:30:00 PM	6:30:00 PM
Local Roads	loc	AM Peak	7:00:00 AM	9:40:00 AM
Local Roads	loc	Midday	10:00:00 AM	3:10:00 PM
Local Roads	loc	PM Peak	3:30:00 PM	6:40:00 PM
Mixed	mix	AM Peak	7:00:00 AM	9:40:00 AM
Mixed	mix	Midday	10:00:00 AM	3:10:00 PM
Mixed	mix	PM Peak	3:30:00 PM	6:40:00 PM

A summary of the tables requiring external input data is shown in **Exhibit 2-18**.

Exhibit 2-18: Summary of Input Data and Database Tables



3 Process

This section will describe the inputting and running process of the Access database and its modules.

If a shared drive is being used to store the data and database, it is recommended to copy everything to a local folder, which allows for shorter running times.

- Please ensure that the directory in which the database will be run has a subfolder called "Output" for the output files.

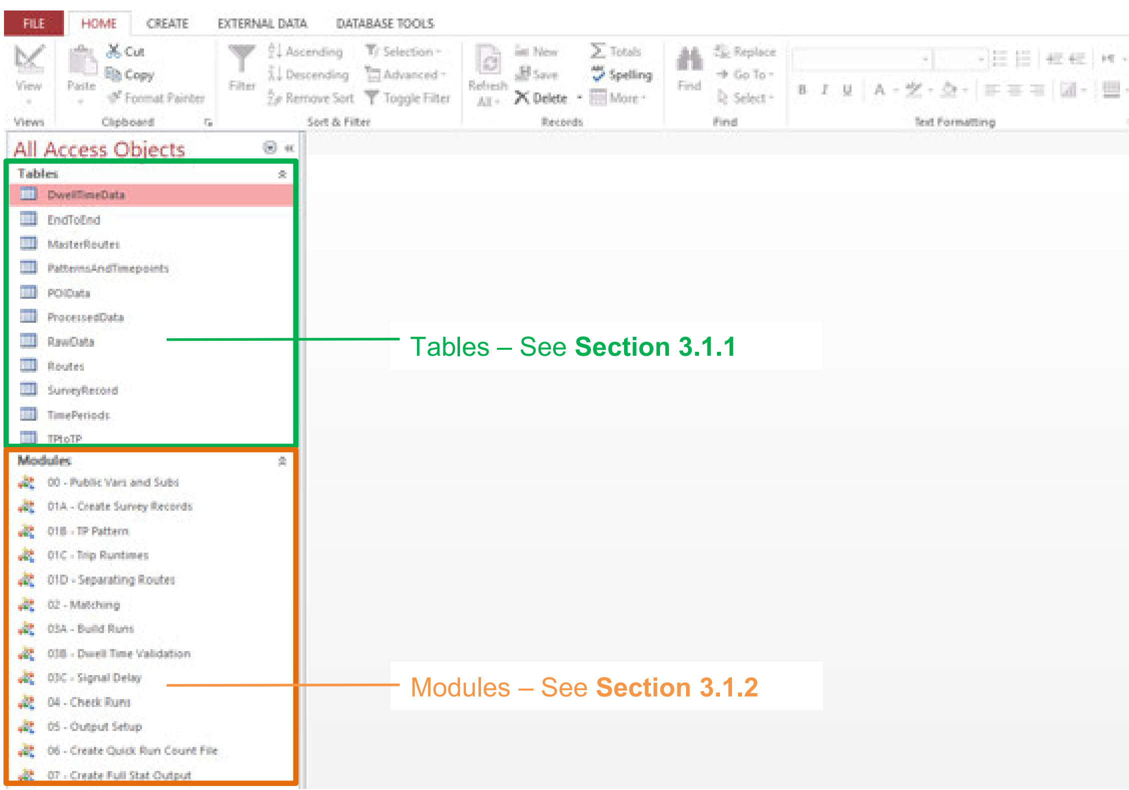
If prompted, it is also recommended to let the database compact when opening and closing the file. This prevents file corruption and preserves the data.

Please note that Microsoft Access have file size limits of **2GB**.

3.1 Database Navigation

Upon opening the Access file, a screen similar to **Exhibit 3-1** will appear.

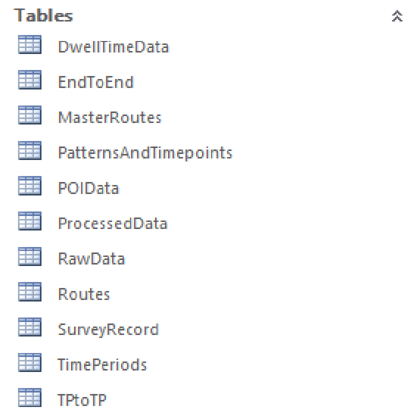
Exhibit 3-1: Opening Screen of Access Database



Database navigation is done through the All Access Objects toolbar on the left side of the screen. Tables and modules can be opened from this toolbar by double-clicking on the desired object.

3.1.1 Tables

Tables are found in the top section of the All Access Objects toolbar.

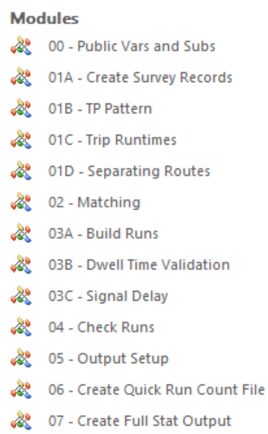


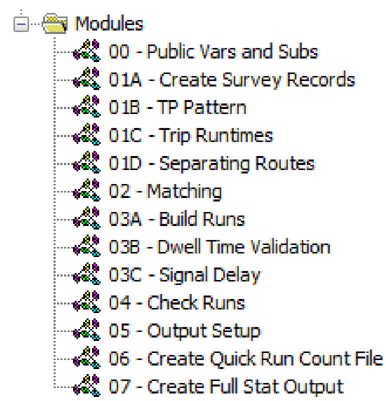
Double-click a desired table to open it in the main window. The table will open as a tab labelled by its name.

- In an open table, columns can be filtered or sorted by values by clicking on the arrow in the column header.
- Multiple tables can be opened and the displayed table can be switched by selecting the table's tab.
- To close a table, right-click the tab and select "Close". To close all tables, right-click a table's tab and select "Close All".

It is important to note that adjusting a table's formatting (e.g. column widths) or applying sorts or filters to the data will prompt a "save changes" dialogue box when closing the table. However, modifying or deleting data in a table **is permanent** and will not prompt a "save changes" dialogue box. Be aware of this when working with a table.

3.1.2 Modules





Modules are found in the bottom section of the toolbar on the left side (as shown here on the left).

Double-clicking on a module will open its code. While in the code window, different modules can be opened by double-clicking a module from the window on the left side (as shown here on the right).

Module windows are separate from the primary Access window, so modules and tables can be viewed simultaneously.

Please do not modify any of the code in any module, with the exception of the Public Constants in Module 00 – Public Vars and Subs which will be discussed in ***Section 3.2.2****. Modifications to code may result in errors and unsuccessful runs.*

3.2 Database Set-Up

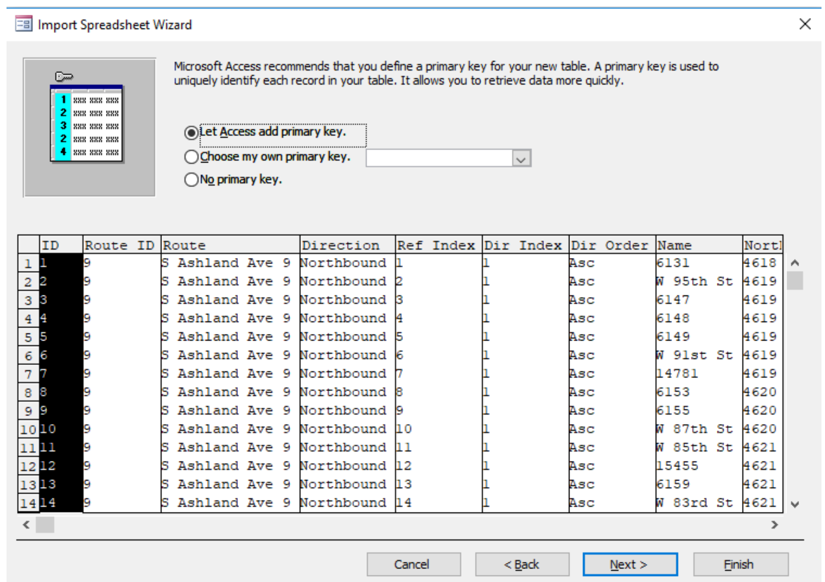
This section highlights the steps and checks that must be completed prior to running the modules. These steps should also be followed when rerunning the code on new data.

3.2.1 Importing Tables

Five (5) tables of transit data must be inputted into the Access database. Refer to **Sections 2.3.1 - 2.3.5** for setting up the columns and formatting of each input, and which input becomes which table in the Access database. These five tables are listed in **Exhibit 3-2** along with a sample filename of a CTA file which is used as the basis for the database table.

Exhibit 3-2: Database Tables to be Imported

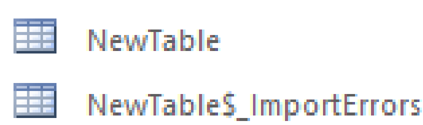
DATABASE TABLE	CTA INPUT FILE EXAMPLE
RawData	1060_160316.txt (CTA BWLOG)
DwellTimeData	TSP_AVAS_ROUTE9_2016_03.txt
TPtoTP	TSP_RUNTIME_ROUTE9.txt
PatternsAndTimepoints	TSP_RUNTIME_ROUTE9.txt
POIData	Google Earth KML File (See **Section 2.3.5**)



If importing from files, it is recommended the files be in **.xlsx** format. Please ensure the column headers (properly named as per the tables in **Section 2**) are included in the Excel files.

When importing, allow Access to index each of the tables by ensuring “Let Access add primary key” is selected when this window (shown here on the right) appears in the importing stage. This will give the “ID” fields listed in the tables in **Section 2.3**.

It is recommended to check if there are any Import Errors after importing the tables. Typically Import Errors occur when there is a data type mismatch in a column (e.g. the some of the column is comprised of numbers and some is comprised of text). Columns in Access must be comprised of a single data type (e.g. all Run_ID values in the **TPtoTP** import table must be stored as a text). An Import Error table will automatically be generated and named with “$_ImportErrors” in its name, as seen on the right.



If there are any Import Errors, ensure the input files are formatted correctly and re-import.

Notes:

- Check the first few rows of each imported table to ensure they are in the same order as the input file. Access occasionally changes the row order when importing and indexing. This is particularly important for the **RawData** table, as the generated “ID” column is used in the data analysis process. This table should be sorted first by “Survey” then by “DATETIME”. If the table rows are not imported in the proper order, delete the table and re-import.
- Ensure all date-time fields are inputted correctly. Some importing methods, such as importing from CSV files, may remove the seconds of a date-time column.

3.2.2 Defining Public Constants

When running a new route, Public Constants must be defined in Module 00 – Public Vars and Subs. These include:

- The file path of the Access database and outputs. Please ensure there is a backslash "\" at the end of the file path;
- The maximum number of POIs found in the **POIData** table over all route branches and directions (i.e. the maximum "Ref_Index" value found in the table);
- The route directions (strDir1 = Northbound/Eastbound, strDir2 = Southbound/Westbound);
- The route number;
- The route survey type (see **Section 2.2** for a list of survey types); and
- The maximum number of anticipated runs built per route branch and direction (Note: the default value is set to 200 and should be more than sufficient for very large datasets. If more than 200 runs are built, this value should be increased.)

Double-click to open the module. At the very top of the window, the seven (7) Public Constants are listed. Change each constant as required.

```
'*********************************************************************
Public Const RootPath As String = "C:\Users\User\Desktop\TransitData\" 'Set to base path (with trailing slash) (where database is located)
Public Const intLastIntersectionNum As Integer = 89 'Set to the Ref_Index of the last intersection before END (i.e. second-highest index in POIData)
Public Const strDir1 As String = "Northbound" 'Set as direction 1 in MasterRoutes (either "Northbound" or "Eastbound")
Public Const strDir2 As String = "Southbound" 'Set as direction 2 in MasterRoutes (either "Southbound" or "Westbound")
Public Const RouteNumber As String = "09" 'Primary route number - NOTE: If single-digit, include a "0" in front (e.g. Route "09")
Public Const RouteSurveyType As String = "art" 'Survey type. Refer to Section 2.2 in the User Guide for survey type codes
Public Const MaxRuns As Integer = 200 'Maximum number of anticipated built runs per route branch per direction
'*********************************************************************
```

Only the Public Constants are to be changed. Once these are updated, save and close the module. This module is now fully set up and does not need to be "run" in the same way that all others do.

3.2.3 Clearing Data

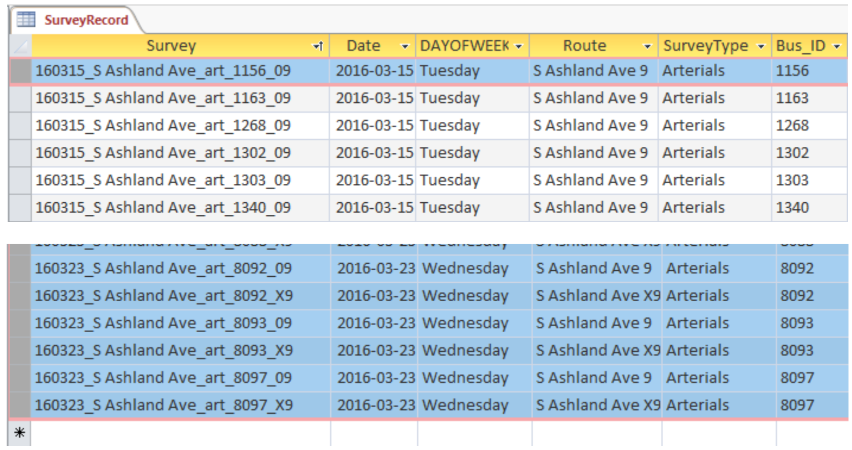
Restarting from the beginning for the same dataset requires resetting many columns and tables. If the user is restarting, tables which were imported must be re-imported (**Section 3.2.3.1**), and tables and columns which were generated by the code must be cleared (**Sections 3.2.3.2** and **3.2.3.3**). If restarting from the beginning, ensure that each of the following is done:

3.2.3.1 Re-importing Tables

Tables to be re-imported must first be deleted. To delete a table, ensure the table is closed in the main window. Right-click the table in the All Access Objects toolbar and click "Delete". Refer to the steps outlined in **Section 3.2.1** to import tables. The **RawData** table must be re-imported when restarting the process with the same dataset. If beginning the process with new data, refer to **Section 3.2.1** for the tables to be imported.

3.2.3.2 Clearing Tables

Tables that are created during the process will have to be cleared with the column headers maintained. Follow these steps to clear a table:



SurveyRecord

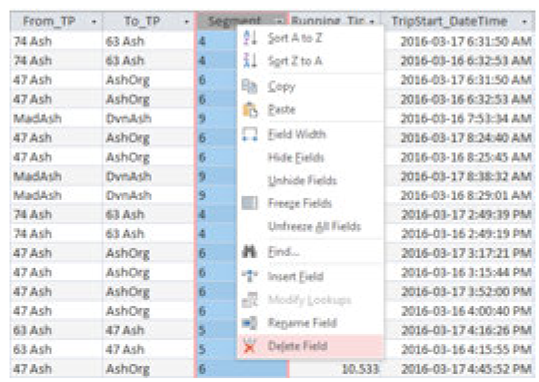
Survey	Date	DAYOFWEEK	Route	SurveyType	Bus_ID
160315_S Ashland Ave_art_1156_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1156
160315_S Ashland Ave_art_1163_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1163
160315_S Ashland Ave_art_1268_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1268
160315_S Ashland Ave_art_1302_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1302
160315_S Ashland Ave_art_1303_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1303
160315_S Ashland Ave_art_1340_09	2016-03-15	Tuesday	S Ashland Ave 9	Arterials	1340
160323_S Ashland Ave_art_8092_09	2016-03-23	Wednesday	S Ashland Ave 9	Arterials	8092
160323_S Ashland Ave_art_8092_X9	2016-03-23	Wednesday	S Ashland Ave X9	Arterials	8092
160323_S Ashland Ave_art_8093_09	2016-03-23	Wednesday	S Ashland Ave 9	Arterials	8093
160323_S Ashland Ave_art_8093_X9	2016-03-23	Wednesday	S Ashland Ave X9	Arterials	8093
160323_S Ashland Ave_art_8097_09	2016-03-23	Wednesday	S Ashland Ave 9	Arterials	8097
160323_S Ashland Ave_art_8097_X9	2016-03-23	Wednesday	S Ashland Ave X9	Arterials	8097

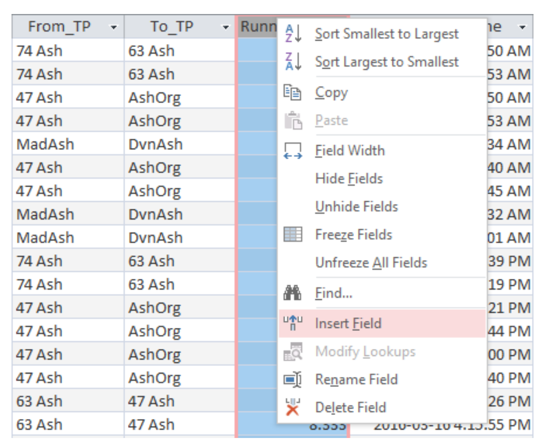
- Highlight the top row by clicking the grey box to its left;
- Scroll to the bottom of the table, hold the SHIFT key, and highlight the bottom row. This will select all rows; and
- Press the DELETE key

The following tables must be cleared to rerun the process from the beginning:

- **SurveyRecord**;
- **EndToEnd**; and
- **ProcessedData**.

3.2.3.3 Resetting Columns





Throughout the process, some columns are created on originally inputted tables. These columns should be cleared if the process is being rerun. The following steps show how to clear columns:

- Highlight the column by clicking on the column header
- Right click and click “Delete Field”. Click “Yes” on the prompt.
- Right click on the column header to the right of where the column is to be reinserted and click “Insert Field”
- Right click the column header of the new column (which will be titled “Field1”) and click “Rename Field”. Make sure to rename it exactly how it was before

The following columns must be reset to rerun the code from the beginning with the same dataset:

- From the **TPtoTP** table:
  - “Segment”; and
  - “Survey”.
- From the **DwellTimeData** table:
  - “ValidatedDwell”

Notes:

- **Exhibit 3-4** will show the required steps to restart from a specific module if desired instead of from the beginning.

3.3 Running the Code

Modules must be run individually and sequentially, with the exception of Module 00 – Public Vars and Subs (i.e. the first module to run is Module 01A – Create Survey Record). Each module performs a function, as described in **Exhibit 3-4**. Please ensure the correct module window is open before running a module.

3.3.1 Running Modules

This message will be found in every module to run near the top of the code window.

```
'*********************************************************************
'RUN THIS SUBROUTINE' (i.e. place cursor here and hit F5)
'*********************************************************************
```

As the message says, place the cursor on the message and press the F5 key to run the module. If the cursor is placed in the section above this box, an error may arise. While the module is running, "[running]" will appear at the very top of the code window between the Access filename and the Module name.

Note that depending on the computer used, "(Not Responding)" may also appear. This is not an issue and processing will continue. When the module has finished running, the "[running]" at the top will disappear.

To stop the running module, click the Stop button at the top of the window.

If an error is encountered and disrupts the code, a window will pop up with the options of "End" and "Debug". "Debug" will map the location of the error in the code. "End" will reset the code to allow for rerunning.

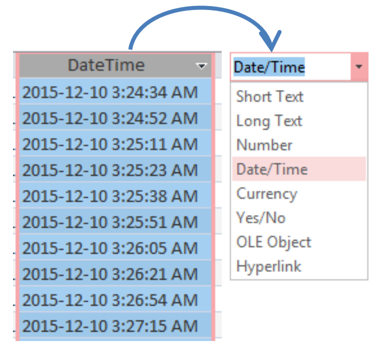
3.3.2 General Troubleshooting

The following subsection describes general errors which may be encountered. Module-specific errors and troubleshooting will be discussed in **Section 3.3.3.**

3.3.2.1 Type Mismatch Error

Encountering a Type Mismatch Error occurs when an expression is attempting to operate values of two different types. For example, the source of an error may be attempting to add a number to a text value. Type mismatch errors typically occur if a table column is not the proper data type, and likely originates from incorrectly formatting the input tables. Click "Debug" on the error window and locate the source of the type mismatch error.

- Hovering over variables in the expression will show the value of the variable. If a value has quotations marks "" surrounding it, it is stored as a text.



Refer to the tables in **Section 2.2** for data types of each column. To change a column's data type:

- Open the table and highlight the column;
- Open the Fields tab at the top of the window
- In the Formatting box, select the desired data type from the Data Type menu

<u>Notes:</u>

- The computer's date format must also match those of the database. To check the computer's date settings:
  - Open the computer's calendar by clicking on the date and time on the toolbar;
  - Click "Date and time settings";
  - At the bottom of the window, click "Change date and time formats";
  - Ensure "Short date" is set to "**yyyy-MM-dd**"

For additional resources, refer to the following documentation:

https://docs.microsoft.com/en-us/office/vba/language/reference/user-interface-help/type-mismatch-error-13

3.3.2.2 Out of Memory

Microsoft Access requires processing large amounts of data, and as a result will use large quantities of RAM. Often, restarting the computer will solve this error. If the error persists, refer to the following link for more information:

https://docs.microsoft.com/en-us/office/vba/language/reference/user-interface-help/out-of-memory-error-7

3.3.2.3 Max Locks per File

Modules may yield the following error:

<u>"File sharing lock count exceeded. Increase MaxLocksPerFile registry entry."</u>

When performing operations, databases lock elements such as rows or columns to preserve their integrity and ensure data does not get erroneously modified. Microsoft Access databases have a pre-set parameter, *MaxLocksPerFile*, which sets the maximum number of locks allowed in a database. There are two (2) methods to circumvent this error.

Method 1:

1) In the module VBA window, open an Immediate Window. This can be found in View -> Immediate Window, or by typing Ctrl+G.
2) In the window, type the following and press Enter:

   DAO.DBEngine.SetOption dbmaxlocksperfile,15000

Note**:** **I**f the error persists, repeat this step with a value greater than 15000

Method 2:

This solution requires reconfiguring a setting on the computer for which the user may not have permission. Refer to the following Microsoft Office Support page and follow the steps corresponding to the appropriate Microsoft Access version and Windows operating system.

https://support.microsoft.com/en-ca/help/815281/file-sharing-lock-count-exceeded-error-message-during-large-transactio

3.3.3 Module Descriptions and Outputs

Modules must be run sequentially starting with Module 01A – Create Survey Record. Refer to **Exhibit 3-4** to determine whether every module must be run for a given case. Each module serves a purpose and modules build upon one another. Other than setting the Public Constants in Module 00 as described in **Section 3.2.2**, no code in any module requires editing. **Exhibit 3-3** shows visually the overall process, displaying the input tables and outputs of each module. **Exhibit 3-4** provides a detailed summary for every individual module, including:

- Whether the module is mandatory;
- The approximate running time of the module (Note: run times are based on processing a 250MB Raw Data table, with three (3) complete days of Route 09 and X9 data, using a laptop computer with 16GB RAM and a Core i5 processor. Running times may vary significantly depending on dataset size and machine used);
- Which database tables are used in the module;
- What is created or updated by the module;
- A brief summary of what the module does and how;
- If the module must be rerun, what steps must be taken. If an error occurs and is resolved, this part notes the steps to take, rather than rerunning the lengthy process from the very beginning. (If rerunning from the beginning is desired, follow the steps outlined in **Section 3.2**);
- Common errors which may arise and how to address them (Note: if an error occurs, a dialog box will appear. Once the error has been resolved, ensure “End” has been selected on the dialog box); and
- Additional notes to consider when running the module.

Modules 01A – 05 are used for data processing, and Modules 06 – 07 are used to generate output files.

Exhibit 3-3: Overall GPS Analysis Tool Process

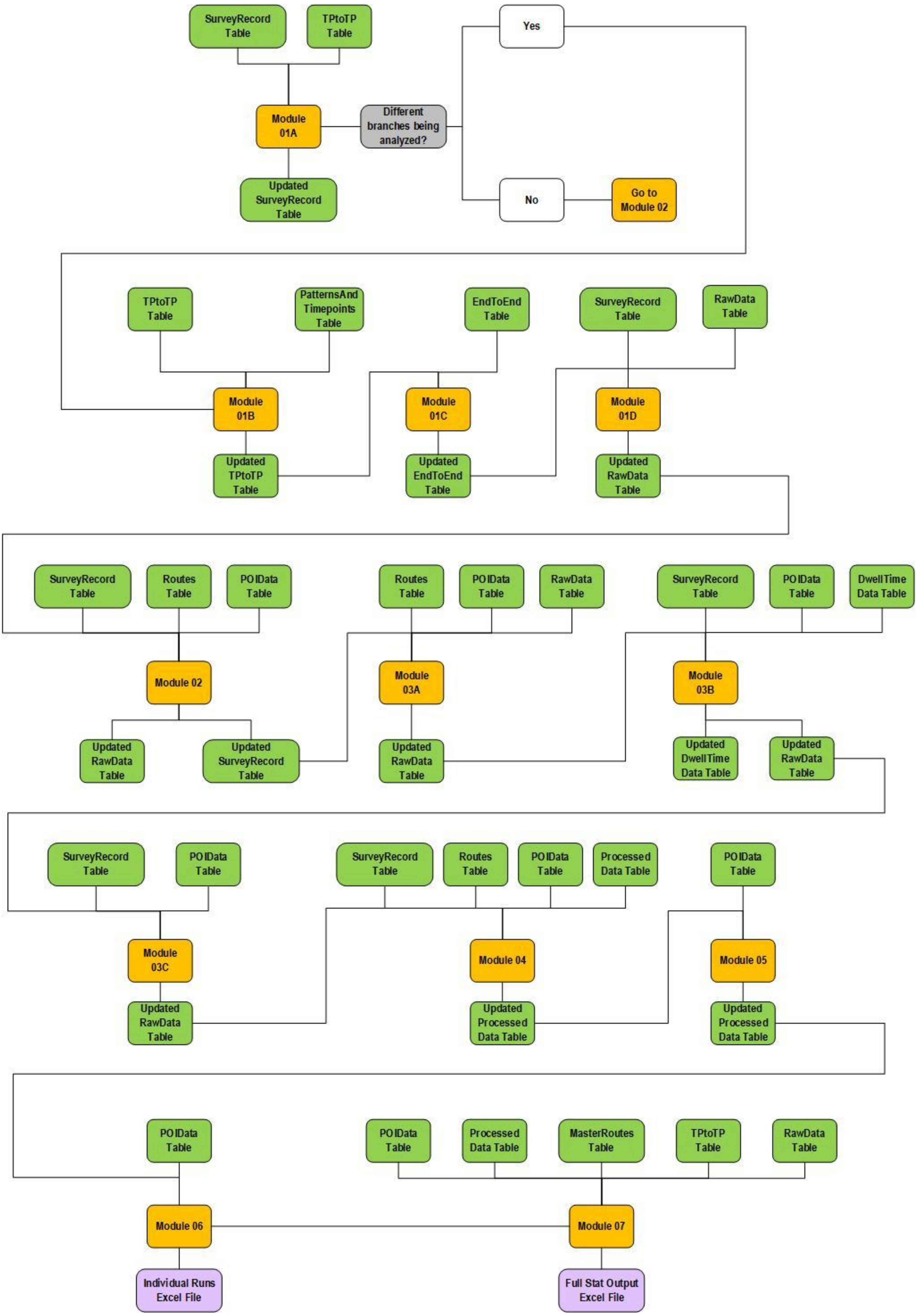


Exhibit 3-4: Module Inputs, Descriptions, and Outputs

Module 00 – Public Vars and Subs	
Mandatory?	Yes
Approx. Running Time	N/A
Tables Used	N/A
Output(s)	• Sets up the following Public Constants: • RootPath; • intLastIntersectionNum; • strDir1 and strDir2; • RouteNumber; and • MaxRuns.
Summary	This module exists to set constants, variables, and sub-functions that will be found throughout this code. The Public Constants must be changed when running a new route. Everything else must be kept the same. Note that this module does not need to be "run", just saved. Refer to **Section 3.2.2** for more details.
If Rerun	N/A
Common Errors	N/A
Additional Notes	This module does not need to be "run".

Module 01A – Create Survey Records	
Mandatory?	Yes
Approx. Running Time	3 minutes
Tables Used	• **TPtoTP**; and • **SurveyRecord**.
Output(s)	• “Survey” column in **TPtoTP** table • **SurveyRecord** table
Summary	This module creates a list of unique survey records found in the data and summarizes them in the **SurveyRecord** table. Survey records are the key to matching runs from raw AVL and APC data and are comprised of a route, date, and bus ID.
If Rerun	• Delete and recreate the “Survey” column in the **TPtoTP** table • Delete all rows of the **SurveyRecord** table
Common Errors	The date format in the “TripStart_DateString” column of the **TPtoTP** table is important. It must be formatted as “YYYY-MM-DD” to properly create survey records.
Additional Notes	If only a single route branch is being analyzed in a run (e.g. only Route 09, **not** Routes 09 and X9, or only Route 49, **not** Routes 49 and 49B), proceed to Module 02 – Matching. If branches exist, run Modules 01B – 01D.

Module 01B – TP Pattern	
Mandatory?	Only if different branches of the route are being analyzed at the same time (e.g. 09 and X9, 49 and 49B)
Approx. Running Time	5 seconds
Tables Used	• **PatternsAndTimepoints**; and • **TPtoTP**.
Output(s)	• “Segment” column in the **TPtoTP** table
Summary	This module adds the segment ID (unique ID denoting segment between two timing points for a given pattern ID) to the **TPtoTP** table from the **PatternsAndTimepoints** table by matching the “Pattern ID” and “From TP” fields.
If Rerun	• Delete and recreate the “Segment” column in the **TPtoTP** table
Common Errors	N/A
Additional Notes	N/A

Module 01C – Trip Runtimes	
Mandatory?	Only if different branches of the route are being analyzed at the same time (e.g. 09 and X9, 49 and 49B)
Approx. Running Time	15 seconds
Tables Used	• **TPtoTP**; and • **EndToEnd**.
Output(s)	• **EndToEnd** table
Summary	This module generates the **EndToEnd** table from the **TPtoTP** table, which will in turn be used to correct survey records in the **RawData** table.
If Rerun	• Delete all rows in the **EndToEnd** table
Common Errors	N/A
Additional Notes	N/A

Module 01D – Separating Routes	
Mandatory?	Only if different branches of the route are being analyzed at the same time (e.g. 09 and X9, 49 and 49B)
Approx. Running Time	5 minutes
Tables Used	• **SurveyRecord**; • **RawData**; and • **EndToEnd**.
Output(s)	• Updated the "Survey" column in the **RawData** table
Summary	Surveys in the **RawData** table may not differentiate between different branches of the same route (e.g. 09 and X9, 49 and 49B etc.) as buses may switch branches on the fly. Using the **SurveyRecord** and **EndToEnd** tables created from Modules 01B and 01C respectively, this module updates the "Survey" column in the **RawData** table.
If Rerun	• Re-import the **RawData** table
Common Errors	This module commonly experiences the "Max Locks per File" error (see **Section 3.3.2.2** for details).
Additional Notes	N/A

<table>
<tr><th colspan="2">Module 02 – Matching</th></tr>
<tr><td>Mandatory?</td><td>Yes</td></tr>
<tr><td>Approx. Running Time</td><td>45 minutes</td></tr>
<tr><td>Tables Used</td><td>SurveyRecord;
Routes;
RawData; and
POIData.</td></tr>
<tr><td>Output(s)</td><td>Updated the “DIR1_MATCH” and “DIR2_MATCH” columns in the RawData table
Updated the “MATCHED” column in the SurveyRecord table</td></tr>
<tr><td>Summary</td><td>This module matches POIs from the POIData table with their closest individual AVL points from the RawData table for each survey record. This is done using the POI matching algorithm. POIs have a unique assigned index value for a given route branch and direction, listed in the “Ref_Index” column of the POIData table. Once a point has been matched to a POI, the “Ref_Index” value of the POI will be listed in the “DIR1/2_MATCH” columns of the RawData table.</td></tr>
<tr><td>If Rerun</td><td>Re-import the RawData table
Rerun Module 01D (if route branches exist)
Delete and recreate the “MATCHED” column in the SurveyRecord table. Ensure the Data Type is set to “Yes/No” (checkbox). All boxes should be unchecked.</td></tr>
<tr><td>Common Errors</td><td>After running this module, check the “DIR1_MATCH” and “DIR2_MATCH” columns to ensure that some points were matched. If no points were matched in the entirety of the RawData table, this is likely an issue with the coordinates of the POIData table. Ensure the POI coordinates are accurate. If not, re-create the POIData table and rerun this module.

This module commonly experiences the “Out of Memory” error (see Section 3.3.2.2 for details).</td></tr>
<tr><td>Additional Notes</td><td>It should be noted that the vast majority of “DIR1/2_MATCH” values will still be 0 due to the sheer number of GPS points in the RawData table. Additionally, if a survey returns with matched POIs, the “MATCHED” box in the SurveyRecord table for that survey will be checked.</td></tr>
</table>

Module 03A – Build Runs	
Mandatory?	Yes
Approx. Running Time	5 minutes
Tables Used	• **SurveyRecord**; • **Routes**; • **POIData**; and • **RawData**.
Output(s)	• Updated the "DIR1_RUN" and "DIR2_RUN" columns in the **RawData** table
Summary	Using the POI-matched data points from Module 02, this module builds terminus-to-terminus bus runs. A complete run consists of a data point matched to every POI in a given route branch and direction, as listed in the **POIData** table. Runs are numbered sequentially if more than one run is built for a given survey, and the run numbers will appear in the "DIR1/2_RUN" columns in the **RawData** table. Note that not every row with a "DIR1/2_MATCH" value will have a corresponding run value, but every "DIR1/2_RUN" value will have a corresponding match value.
If Rerun	• Re-import the **RawData** table • Rerun Module 01D (if route branches exist) and 02.
Common Errors	After running this module, check the "DIR1_RUN" and "DIR2_RUN" columns to ensure that runs were built. Another way to check this is to check if any boxes are checked in the "RUNS_BUILT" column of **SurveyRecord**. If no runs were built for any survey, it is likely one of the POI coordinates is incorrect. If one set of coordinates is incorrect, no runs can be built. Re-create the **POIData** table and rerun beginning from Module 02.
Additional Notes	It should be noted that the vast majority of "DIR1/2_RUN" values will still be 0, and not every non-zero "DIR1/2_MATCH" row will have a corresponding non-zero "DIR1/2_RUN" value.

Module 03B – Dwell Time Validation	
Mandatory?	Yes
Approx. Running Time	10 hours
Tables Used	• **SurveyRecord**; • **RawData**; • **DwellTimeData**; and • **POIData**.
Output(s)	• “ValidatedDwell” column in the **DwellTimeData** table • “Dwell_Time” column in the **RawData** table
Summary	First, this module determines and validates the dwell time at every stop in the **DwellTimeData** table using the validated dwell time algorithm. Once this column is populated, dwell times are matched to the POI-matched AVL points of built runs (found in Module 03A) in the **RawData** table. Matching is done by connecting the stop IDs (“Stop_ID” column in the **DwellTimeData** table) to POI index values (“DIR1/2_MATCH” columns in the **RawData** table) using the **POIData** table.
If Rerun	• Delete and recreate the “ValidatedDwell” column in the **DwellTimeData** table • Delete and recreate the “Dwell_Time” column in the **RawData** table • Delete and recreate the “VALIDATED” column in the **SurveyRecord** table. Ensure the Data Type is set to “Yes/No” (checkbox). All boxes should be unchecked.
Common Errors	N/A
Additional Notes	It should be noted that even for fully successful runs, the vast majority of cells in the “Dwell_Time” column will still be blank. Only GPS points of built runs matched to POIs will consist of dwell times. It should be noted that to comply with the TSP Performance Measures Algorithm, which will be used in Module 03C, this module matches dwell times of near-side stops with the associated signal and not the stop itself. Additionally, if a survey is found in the **DwellTimeData** table, the “VALIDATED” box in the **SurveyRecord** table for that survey will be checked. If possible, run this module overnight due to its long processing time.

Module 03C – Signal Delay	
Mandatory?	Yes
Approx. Running Time	30 seconds
Tables Used	• **RawData**; • **SurveyRecord**; and • **POIData**.
Output(s)	• "Delay" column in the **RawData** table
Summary	This module applies the signal delay algorithm to the **RawData** table and determines the signal delay at every signal for built runs.
If Rerun	• Delete and recreate the "Delay" column in the **RawData** table
Common Errors	After running this module, browse the newly populated "Delay" column and check for negative values. Negative values imply some error in the "DATETIME" column of the **RawData** table. Note that date-time columns may lose seconds data, particularly when converting a file from Excel to CSV. Ensure seconds data is present. If not, re-upload the **RawData** table and rerun beginning from Module 01D.
Additional Notes	It should be noted that even for fully successful runs, the vast majority of cells in the "Delay" column will still be blank. Only GPS points of built runs matched to signal POIs will consist of dwell times.

Module 04 – Check Runs	
Mandatory?	Yes
Approx. Running Time	10 minutes
Tables Used	• **SurveyRecord**; • **Routes**; • **TimePeriods**; • **POIData**; • **RawData**; and • **ProcessedData**.
Output(s)	• **ProcessedData** table
Summary	This module moves the points of all built trips in the **RawData** table (found from Module 03A) into a new table, **ProcessedData**. Each row of the new **ProcessedData** table represents a POI for a given built trip. Columns include dwell time (found from Module 03B) for stops and signal delay (found from Module 03C) for signals. For surveys with multiple complete runs, a run index is assigned in the "Run" column. This module also calculates the travel time and distance travelled from the previous POI for that trip. Note that the **ProcessedData** table does not include near-side stops. Similar to Module 03B, dwell times found for near-side stops have instead been assigned to the associated signal.
If Rerun	• Delete all rows in the **ProcessedData** table
Common Errors	N/A
Additional Notes	N/A

Module 05 – Output Setup	
Mandatory?	Yes
Approx. Running Time	30 seconds
Tables Used	• **ProcessedData**; and • **POIData**.
Output(s)	• "Speed" column in the **ProcessedData** table • "POI_Index" column in the **ProcessedData** table
Summary	This module prepares the **ProcessedData** table for generating outputs by generating two columns, "Speed" and "POI_Index". "Speed" refers to the average speed in miles per hour between two POIs, and "POI_Index" is an updated "Ref_Index", incrementally indexing POIs while excluding near-side stops.
If Rerun	• Delete and recreate the "Speed" column in the **ProcessedData** table • Note: ensure this is a "Short Text" data type and NOT a "Number" data type. Data type can be set by selecting the column, clicking the Fields ribbon, and selecting "Short Text" from the Data Type menu in the Formatting panel • Delete and recreate the "POI_Index" column in the **ProcessedData** table
Common Errors	N/A
Additional Notes	Make sure to check the "Speed" column to ensure it is stored as a text with decimals. Storing the "Speed" column as a number changes the values to integers and data is lost, even if decimals are added.

Module 06 – Create Quick Run Count File	
Mandatory?	Yes
Approx. Running Time	3 minutes (highly dependent on number of runs created and route branches)
Tables Used	• **ProcessedData**; and • **POIData**.
Output(s)	• **Trip-by-Trip Outputs for different times of day** (Excel output #1)
Summary	This module creates the Trip-by-Trip output Excel files for each time period (AM Peak, midday, PM Peak) from the **ProcessedData** table
If Rerun	• Delete output Excel files
Common Errors	N/A
Additional Notes	These files will be sent to the Output folder in the setup directory (as noted at the beginning of **Section 3**). Ensure this folder exists in the directory. After generating the outputs from this module, check the outputs to see if any route is missing built runs for a direction over **all** time periods (e.g. Southbound Route X9 has no runs built for any of AM Peak, Midday, or PM Peak). If this is the case, delete that route/direction record from the **MasterRoutes** table.

Module 07 – Create Full Stat Output	
Mandatory?	Yes
Approx. Running Time	1.5 minutes (highly dependent on number of runs created and route branches)
Tables Used	• **ProcessedData**; • **MasterRoutes**; • **POIData**; • **TPtoTP**; and • **RawData**.
Output(s)	• **Full Stat Output** (Excel output #2)
Summary	This module creates the Full Stat Output Excel file. This file contains tabs for each time period (AM Peak, midday, PM Peak) and a summary tab for the entire route corridor.
If Rerun	• Delete output Excel files
Common Errors	Some formatting errors may occur in the period sheets of the Full Stat Output if a route + direction has no runs built for any time period. If so, follow the steps listed in the Additional Notes of Module 06 and rerun the module.
Additional Notes	This file will be sent to the Output folder in the setup directory (as noted at the beginning of **Section 3**). Ensure this folder exists in the directory.

4 Outputs

This section summarizes the outputs created by the TSP performance measures analytics tool.

4.1 Full Stat Output

An Excel file is created which summarizes several performance measurements for each corridor. Each time period has a tab which exhibits this information for each segment along each route. This file is found in the “Output” folder and has the filename “FullStat.xlsx”. **Exhibit 4-1** describes each column in each time period of the run (likely AM Peak, Midday, and PM Peak), represented as tabs of the Full Output file. A run’s time period is based on the period in which the run began. Each row of this output represents a segment, or stretch of route between two POIs. Dwell times and signal delays represent those found at the end POI of each segment.

Please note that near-side stop POIs are incorporated with their associated signal POI (i.e. a signal POI with a near-side stop will have data for dwell time and signal delay). Near-side POI segments are not listed in isolation.

Exhibit 4-1: Summary of the Time Period Tabs in the Full Output Excel file

COLUMN NAME	DESCRIPTION
Route	Name of the route, including branch and direction.
Begins at	The starting POI of the segment.
Ends at	The ending POI of the segment.
Segment Length (miles)	Length of the segment in miles.
Runs	Number of built runs along the segment for that branch, direction, and time period.
Average Travel Time (hh:mm:ss) [Measure 1-A]	Average travel time of all runs along the segment.
Variance of Travel Time	Variance of travel time of all runs along the segment.
Standard Deviation of Travel Time [Measure 1-B]	Standard deviation of travel time of all runs along the segment.
Speed Limit (mph)	Speed limit along the segment in miles per hour.
Nearside	1 if POI is a signal with a near-side stop. 0 otherwise.
Mid-Block	1 if POI is a mid-block stop. 0 otherwise.
Farside	1 if POI is a farside stop. 0 otherwise.
Red Signal Stop Rate	Number of stops at a red light divided by the number of runs built along the segment.
Number of Stops on Red [Measure 1-D]	Number of stops at a red light
Average Dwell Time (hh:mm:ss)	Average dwell time at the stop.

COLUMN NAME	DESCRIPTION
Max Signal Delay	Maximum signal delay of all runs along the segment.
Min Signal Delay	Minimum signal delay of all runs along the segment.
Average Signal Delay [Measure 1-C]	Average signal delay of all runs along the segment.
Variance of Signal Delay	Variance of signal delay of all runs along the segment.
Standard Deviation of Signal Delay	Standard deviation of signal delay of all runs along the segment.

The “Corridor” tab consists of a summary for each corridor during each time period. Corridor results are sorted into individual route branches and directions. **Exhibit 4-2** describes each column in the “Corridor” tab of the Full Output file. The data represents the average values per run on the corridor in a given direction and peak period.

Exhibit 4-2: Summary of the Corridor tab in the Full Output Excel file

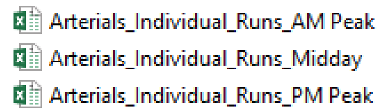
COLUMN NAME	DESCRIPTION
Corridor	Name of the corridor. Includes route name, branch, and direction.
Travel Time	Average travel time per run along the corridor.
Std Dev Travel Time	Standard deviation of travel time for all runs along the corridor.
Signal Delay	Average signal delay per run along the corridor.
Dwell Time	Average dwell time per run along the corridor.
Stops	Average number of stops per run along the corridor.
Timepoint Delay	Average timing point delay per run along the corridor.

4.2 Individual Runs

An “Individual Runs” Excel file will be outputted for each time period (i.e. AM Peak, Midday, and PM Peak) depending when the trip begins. These files summarize the date, time, and travel time of each segment (i.e. POI to POI) for each run.

- Runs for the first direction (Northbound/Eastbound) will be found in the top of the Excel sheet, and runs of the second direction (Southbound/Westbound) will be found below those of the first direction.

- Different route branches along the corridor (e.g. 09 and X9) can be found on a different tab in the Excel file.
- These outputs are found in the “Output” folder with the filename “[survey_type]_Individual_Runs_[period].xlsx”.



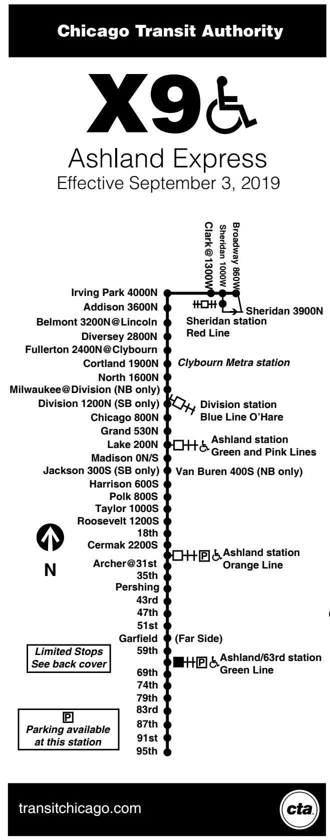
Appendix F

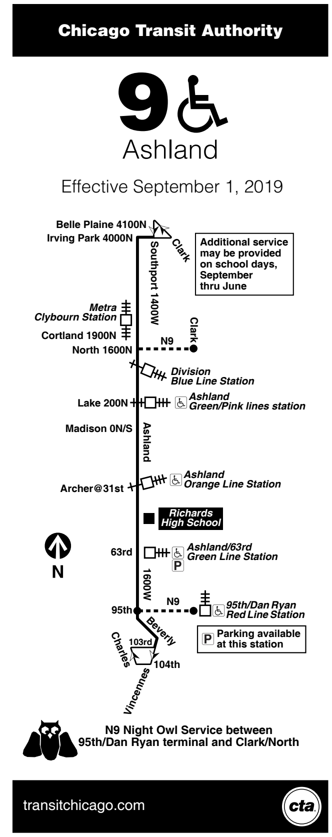
CTA / Pace Corridor Fact Sheets

Regional Transit Signal Priority Implementation Program (RTSPIP)

Ashland Avenue Corridor

- Boundaries: Irving Park Road to 95th Street
- Near Term TSP Segment(s): Cermak Road to 95th Street
- Routes on corridor: CTA 9 and X9
- Average weekday ridership (2018): 10,020 (Route 9) and 8,113 (Route X9)
- Total number of signals on corridor: 42
- Total number of controllers replaced: 40
- Total number of signals with TSP: 40





Key Destinations And/Or Transfer Locations Along Corridor

Ashland Avenue is a route that is used to access the University of Illinois at Chicago (UIC), the Illinois Medical District (IMD), and the United Center (all of which are located North Cermak Road). Along this stretch of Ashland there is a CTA Orange Line stop north of the intersection of Ashland and 31st Place. A station that serves the CTA Green Line is also present at Ashland and 63rd.

of

Transit Characteristics On The Corridor That Warrant TSP Implementation

Ashland Avenue is a CTA corridor that exhibits heavy ridership (over 8 million annual riders) through the 9 miles that routes 9 and X9 cover. The X9 route on this corridor is unique because of the limited stops it makes during weekdays A.M. and P.M. rush hours. This level of ridership, combined with this long stretch of roadway, results in schedule and headway maintenance difficulties.

Key Information Attained From TSP Implementation

Overall, TSP implementation provided the most benefit during the midday time period, in both directions. Average bus travel time was also reduced during the northbound PM peak period, and the number of stops at red signals were reduced in the northbound PM peak period and the southbound AM peak period.

TABLE 1: CTA ASHLAND AVENUE (ROUTE 9) PERFORMANCE MEASURES

South Ashland Avenue for CTA Route 9 (Cermak Rd. to 95th St.)									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	AVL SYSTEM	BASELINE	NOV. 2015	55.90	52.65	56.50	54.25	59.12	65.52
		OPTIMIZED W/OUT TSP	MARCH 2016	59.48	48.10	52.73	53.20	53.03	51.92
		OPTIMIZED WITH TSP	JUNE 2016	66.82	48.53	55.53	54.53	52.18	59.70
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		6%	-9%	-7%	-2%	-11%	-26%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		11%	1%	5%	2%	-2%	13%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		16%	-8%	-2%	0%	-13%	-10%
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	AVL SYSTEM	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE	NOV. 2015	10.40	9.78	10.12	10.92	11.73	14.18
		OPTIMIZED W/OUT TSP	MARCH 2016	15.48	12.62	13.85	15.87	14.88	17.17
		OPTIMIZED WITH TSP	JUNE 2016	16.32	14.00	14.67	18.65	14.43	21.40
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		33%	22%	27%	31%	21%	17%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		5%	10%	6%	15%	-3%	20%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		36%	30%	31%	41%	19%	34%
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE	NOV. 2015	17	17	19	19	18	22
		OPTIMIZED W/OUT TSP	MARCH 2016	21	22	22	25	21	22
		OPTIMIZED WITH TSP	JUNE 2016	22	21	19	22	19	24
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		19%	23%	14%	24%	14%	0%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		5%	-5%	-16%	-14%	-11%	8%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		23%	19%	0%	14%	5%	8%
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	FLOATING CAR (2016) HERE DATA (2016 - 2019)	BASELINE	NOV. 2015	29.27	27.93	30.30	28.12	29.15	31.47
		OPTIMIZED W/OUT TSP	MARCH 2016	27.93	27.55	27.53	26.25	28.15	30.73
		OPTIMIZED W/OUT TSP	APRIL 2016	27.25	27.33	27.21	29.17	27.12	30.83
		OPTIMIZED WITH TSP	SEPT. 2016	38.35	31.41	27.87	32.89	27.32	37.86
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		-5%	-1%	-10%	-7%	-4%	-2%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		29%	13%	2%	11%	1%	19%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

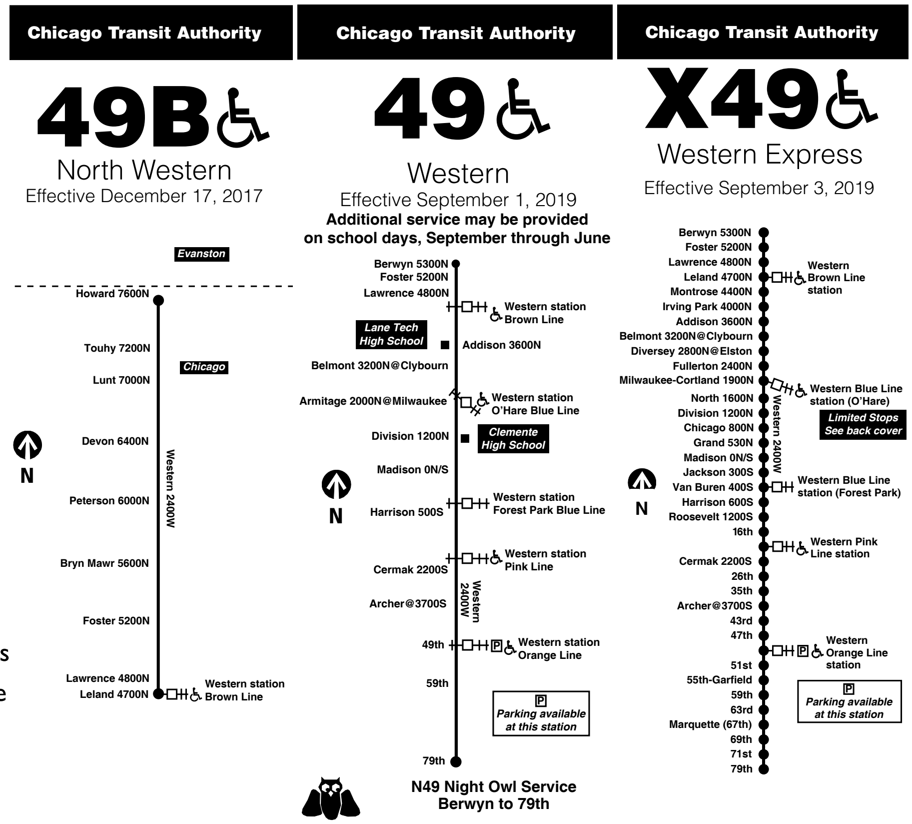
TABLE 2: CTA ASHLAND AVENUE (ROUTE X9) PERFORMANCE MEASURES

South Ashland Avenue for CTA Route X9 (Cermak Rd. to 95th St.)										
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	AVL SYSTEM	BASELINE							
		OPTIMIZED W/OUT TSP	MARCH 2016	46.62	39.68	49.70	47.88	42.58	37.53
		OPTIMIZED WITH TSP	JUNE 2016	50.40	39.30	43.23	40.73	41.40	47.23
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		8%	-1%	-15%	-18%	-3%	21%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	AVL SYSTEM	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE							
		OPTIMIZED W/OUT TSP	MARCH 2016	15.48	12.62	13.85	15.87	14.88	17.17
		OPTIMIZED WITH TSP	JUNE 2016	16.32	14.00	14.67	18.65	14.43	21.40
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		22%	-7%	51%	-46%	-7%	39%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE							
		OPTIMIZED W/OUT TSP	MARCH 2016	19	22	22	25	18	21
		OPTIMIZED WITH TSP	JUNE 2016	21	19	16	20	17	21
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		10%	-16%	-38%	-25%	-6%	0%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	FLOATING CAR (2016) HERE DATA (2016 - 2019)	BASELINE	NOV. 2015	29.27	27.93	30.30	28.12	29.15	31.47
		OPTIMIZED W/OUT TSP	MARCH 2016	27.93	27.55	27.53	26.25	28.15	30.73
		OPTIMIZED W/OUT TSP	APRIL 2016	27.25	27.33	27.21	29.17	27.12	30.83
		OPTIMIZED WITH TSP	SEPT. 2016	38.35	31.41	27.87	32.89	27.32	37.86
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		-5%	-1%	-10%	-7%	-4%	-2%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP		29%	13%	2%	11%	1%	19%
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

Regional Transit Signal Priority Implementation Program (RTSPIP)

Western Avenue Corridor

- Boundaries: Howard Street to 79th Street
- Near Term TSP Segment(s): Howard Street to 79th Street
- Routes on corridor: CTA 49, 49B, and X49
- Average weekday ridership (2018): 15,724 (Route 49), 5,176 (Route 49B), and 6,411 (Route X49)
- Total number of signals on corridor: 103
- Total number of controllers replaced: N/A
- Total number of signals with TSP: 83



Key Destinations And/Or Transfer Locations Along Corridor

The Western Avenue Corridor provides access to different schools along its path such as Lane Tech High School and Clemente High School. Metra stations accessible on this corridor include the Western Avenue/18th (BNSF) Station and the Western Avenue/Grand (Milw-W/N, NCS) Station. Additionally on this corridor, there are multiple CTA Western train stations for the Orange Line, Pink Line, Brown Line, and Blue Line (two separate branches – one leading to Forest Park and the other to O'Hare).

Transit Characteristics On The Corridor That Warrant TSP Implementation

The weekday ridership for the Western Avenue corridor is heavy with an average of 27,311 riders throughout the approximately 19 miles that Routes 49, 49B, and X49 cover. Route 49 provides daily transit services roughly every 5 to 12 minutes between its 79th Street stop and Berwyn 5300N stop. The 49B route operates daily roughly every 9 to 11 minutes between its Leland 4700N stop and Howard 7600N stop. Route X49 mimics the same 49 route stretch, but it is a weekday-limited service.

Key Information Attained From TSP Implementation

Along the Western Avenue corridor, transit travel times and travel time variability were reduced in both the AM and PM Peak periods in both directions for the Route X49. After TSP deployment, travel time reductions ranged between a 3.4 and 9 percent, and travel time variability reductions ranged from 14 to 50 percent.

The CTA Route 49 experienced a small increase in transit travel times and travel time variability in all periods of the day after TSP deployment, while the Route 49B on the northern segment of Western Avenue saw a reduction in transit travel times and travel time variability in the northbound direction in both the AM and PM Peak periods after TSP deployment.

TABLE 1: CTA WESTERN AVENUE (ROUTE 49) PERFORMANCE MEASURES

Western Avenue CTA Route 49 Berwyn to 79th Street									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	AVL SYSTEM	BASELINE	FALL 2018	96.57	91.28	97.34	102.01	104.31	107.40
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	96.88	92.02	100.86	100.17	106.08	112.54
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		0%	1%	3%	-2%	2%	5%
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	AVL SYSTEM	BASELINE	FALL 2018	13.98	9.03	8.48	8.57	12.53	15.60
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	11.73	11.21	8.88	8.83	12.54	16.15
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		-19%	20%	5%	3%	0%	3%
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	43.93	38.72	36.73	39.45	50.20	56.72
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	49	51	49	51	54	58
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	HERE DATA (2018 - 2019)	WESTERN AVENUE ROUTE 49 (BERWYN TO 79TH STREET)							
		OPTIMIZED W/OUT TSP	SEPT. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		OPTIMIZED WITH TSP	SEPT. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		0%	-35%	-3%	1%	-2%	-4%

Table 2: CTA Western Avenue (Route X49) Performance

Western Avenue CTA Route X49 Berwyn to 79th Street									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	AVL SYSTEM	BASELINE	FALL 2018	99.67	89.23			101.79	112.59
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	96.39	83.90			96.55	103.35
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		-3%	-6%			-5%	-9%
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	AVL SYSTEM	BASELINE	FALL 2018	10.02	8.75			8.38	7.64
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	8.02	5.83			8.38	7.64
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		-25%	-50%			-14%	-42%
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	38.70	48.88			35.33	57.68
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	42	47			47	53
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	HERE DATA (2018 - 2019)	WESTERN AVENUE ROUTE X49 (BERWYN TO 79TH STREET)							
		OPTIMIZED W/OUT TSP	SEPT. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		OPTIMIZED WITH TSP	SEPT. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		0%	-35%	-3%	1%	-2%	-4%

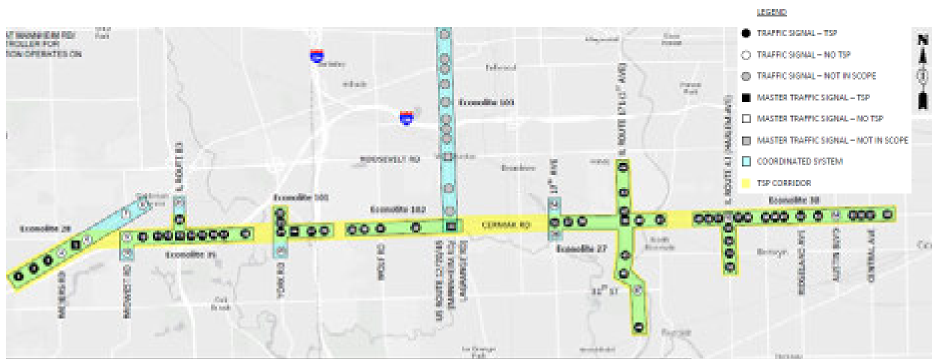
Table 3: CTA Western Avenue (Route 49B) Performance Measures

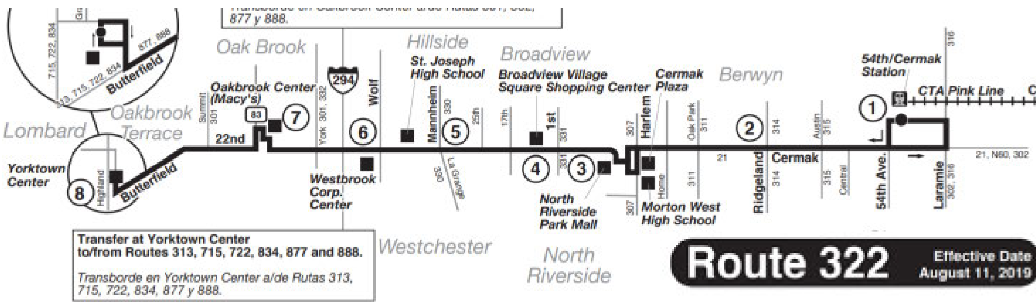
Western Avenue CTA Route 49B Howard Street to CTA Brown Line Station									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	AVL SYSTEM	BASELINE	FALL 2018	22.10	24.53	22.64	23.19	25.43	25.80
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	21.55	26.88	22.49	25.84	24.70	27.58
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		-3%	9%	-1%	10%	-3%	6%
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	AVL SYSTEM	BASELINE	FALL 2016	3.57	3.98	3.23	3.07	3.87	3.58
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP	FALL 2019	3.37	4.62	3.43	3.77	3.63	4.10
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		-6%	14%	6%	19%	-7%	13%
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	8:26	9:40	6:46	8:08	10:25	11:37
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE	FALL 2016	11	13	11	13	13	13
		OPTIMIZED W/OUT TSP	FALL 2018						
		OPTIMIZED WITH TSP	FALL 2019						
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	HERE DATA (2018 - 2019)	WESTERN AVENUE ROUTE 49B (HOWARD STREET TO LELAND)							
		OPTIMIZED W/OUT TSP	SEPT. 2018	19.56	17.80	15.22	14.66	18.64	18.84
		OPTIMIZED WITH TSP	SEPT. 2019	21.11	17.76	17.42	14.41	20.00	18.48
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP		7%	-0%	13%	-2%	7%	-2%

Regional Transit Signal Priority Implementation Program (RTSPIP)

Cermak Road Corridor

- Boundaries: IL Route 56 (Butterfield Road) & Lambert Road to Cicero Avenue
- Near Term TSP Segment(s): IL Route 56 (Butterfield Road) to 54th Avenue
- Routes on corridor: Pace 322
- Average weekday ridership (2018): 2,209 (Route 322)
- Total number of signals on corridor: 68
- Total number of controllers replaced: 43
- Total number of signals with TSP: 55





Key Destinations And/Or Transfer Locations Along Corridor

The Cermak Road/22nd Street corridor is used to access popular shopping centers - namely, the North Riverside Park Mall, Broadview Village Square Shopping Center, Oakbrook Shopping Center (transfers to Pace routes 301, 332, 877, & 888 are accessible here), and Yorktown Shopping Center (transfers to Pace routes 313, 715, 722, 834, 877, & 888 are accessible here). This route can also be taken to travel to and from the neighborhood schools – Morton West High School and St. Joseph High School. Additionally, along this corridor there is accessibility to the CTA Pink Line 54th/Cermak station which heads toward Chicago.

Transit Characteristics On The Corridor That Warrant TSP Implementation

The Cermak Road/22nd Street corridor's average weekday ridership is about 2,300 weekday riders over the approximate 7 miles it covers. The Pacw 322 route is a route that provides daily service connecting areas between Lombard, IL and Berwyn, IL. Transit between the several favored shopping establishments, high schools, and transfers/connecting services indicates that TSP implementation would support decreased travel time and increased efficiency.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization.

Table 1: Pace Cermak Road Performance Measures Summary

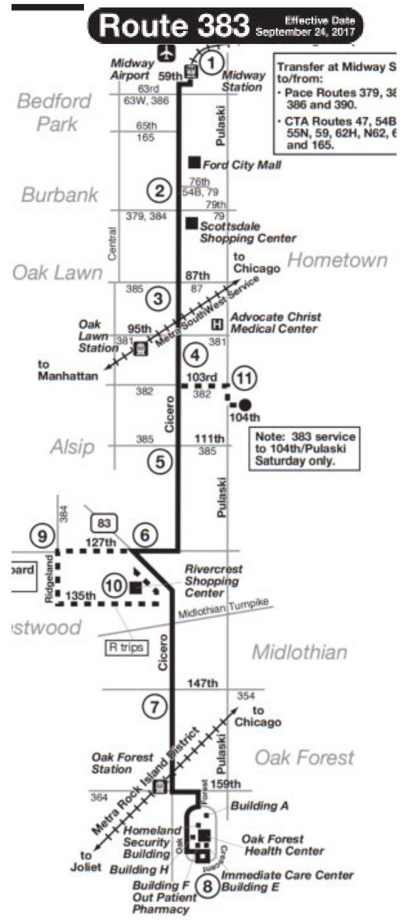
Cermak Road for Pace Route 322 from IL Route 56 (Butterfield Rd.) to 54th Avenue									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	JULY - SEPT. 2012						
		OPTIMIZED W/OUT TSP	OCT. 2012 - APRIL 2013						
		OPTIMIZED W/OUT TSP	SUMMER 2019	54.51	57.58	60.24	60.33	66.49	60.81
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2013)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	JULY - SEPT. 2012						
		OPTIMIZED W/OUT TSP	OCT. 2012 - APRIL 2013						
		OPTIMIZED W/OUT TSP	SUMMER 2019	3.82	6.49	7.25	4.22	10.18	5.53
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2013)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012 -2013); HERE DATA (2019)	BASELINE	JULY - SEPT. 2012	26.04	27.54	27.33	27.49	35.55	27.21
		OPTIMIZED W/OUT TSP **	OCT. 2012 - APRIL 2013	22.95	22.9	23.37	24.16	25.27	25.7
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	36.52	40.37	38.14	39.45	46.08	42.59
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2013)**		-12%	-17%	-14%	-12%	-28%	-6%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.
** Speed / Delay Studies conducted by signal consultant along multiple signal systems of Cermak Road between July 2012 and April 2013 between IL Route 56 (Butterfield Road) to 54th Avenue.
*** HERE Data collected between IL Route 56 (Butterfield Road) to 54th Avenue.

Regional Transit Signal Priority Implementation Program (RTSPIP)

Cicero Avenue Corridor

- Boundaries: 59th Street to 167th Street
- Near Term TSP Segment(s): 89th Street to US Route 6 (159th Street)
- Routes on corridor: Pace 379, 382, 383, 384, 385, and CTA route 54B
- Average weekday ridership (2018): 1,738 (Route 379), 209 (Route 382), 1,249 (Route 383), 535 (Route 384), 807 (Route 385), and 2,866 (CTA route 54B)
- Total number of signals on corridor: 47
- Total number of controllers replaced: 24
- Total number of signals with TSP: 33

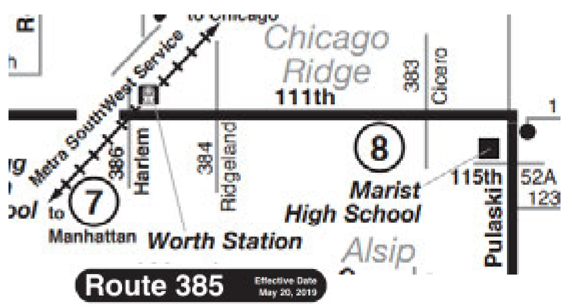


Key Destinations And/Or Transfer Locations Along Corridor

The Cicero Avenue corridor can be utilized to access Midway International Airport as well as the CTA Orange Line. A few miles south there is access to shopping centers such as Ford City Mall. Two Metra Stations (Oak Lawn & Oak Forest) are accessible using this corridor. Also, there are two medical institutions along Cicero Avenue, Advocate Christ Medical Center & Oak Forest Health Center.

Transit Characteristics On The Corridor That Warrant TSP Implementation

The Cicero Avenue corridor exhibits average weekday ridership of around 7,400 riders, through several CTA and Pace bus routes. Traveling to Midway International Airport could warrant TSP implementation to reduce travel times from nearby towns along Cicero Avenue (Burbank, Oak Lawn, Crestwood, Etc.), and make trips more convenient.



Key Information Attained From TSP Implementation

Transit travel time variability was reduced between 10 and 12 percent in the southbound direction during the AM and PM peak periods after signal timing optimization. General vehicle travel times were reduced in all periods of the day after signal timing optimization.

Regional Transit Signal Priority Implementation Program (RTSPIP)

Table 1: Pace Cicero Avenue Performance Measures Summary

Cicero Avenue for Pace Route 383 87th Street to US Route 6 (159th St.)									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	NOV. 2012	11.82	10.29	10.76	10.43	11.18	11.03
		OPTIMIZED W/OUT TSP	JULY 2013	12.05	9.80	11.39	10.46	11.18	10.92
		OPTIMIZED W/OUT TSP	SUMMER 2019	39.44	38.39	41.91	40.42	41.23	41.42
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2013)**		2%	-5%	6%	0%	0%	-1%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (STD. DEV. IN MINUTES)	TIMEPOINT DATA	BASELINE	NOVEMBER 2012	1.83	1.81	2.29	1.98	2.08	2.11
		OPTIMIZED W/OUT TSP	JULY 2013	2.01	1.61	2.22	1.93	2.43	1.85
		OPTIMIZED W/OUT TSP	SUMMER 2019	3.07	4.20	3.87	5.13	4.06	3.84
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2013)**		10%	-11%	-3%	-3%	17%	-12%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012 -2015); HERE DATA (2019)	BASELINE	NOV. 2012 & MAR. 2015	21.87	22.4	22.44	22.54	25.21	28.49
		OPTIMIZED W/OUT TSP **	JULY 2013 & JUNE 2015	19.65	19.39	22.03	20.61	22.85	23.7
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	27.51	25.29	24.25	25.89	27.56	29.06
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2015)**		-10%	-13%	-2%	-9%	-9%	-17%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

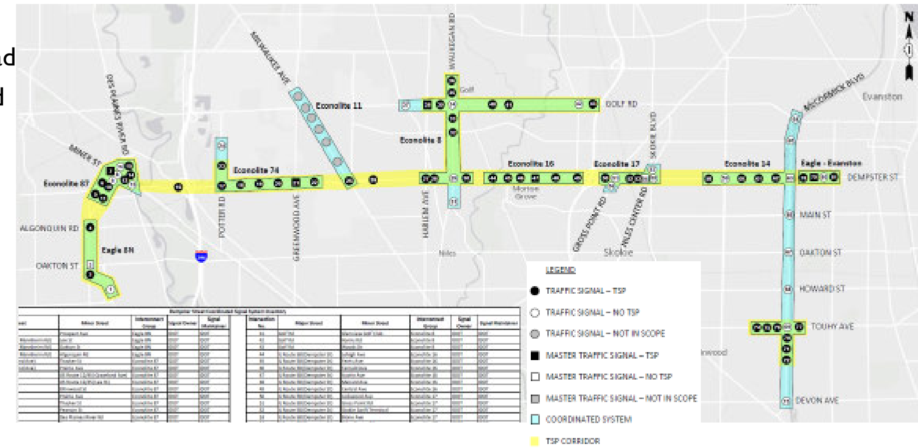
* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between 87th Street to 115th Street in 2012/2013 and separately between 115th and 159th Street in 2015

*** HERE Data collected between 87th Street and US Route 6 (159th Street)

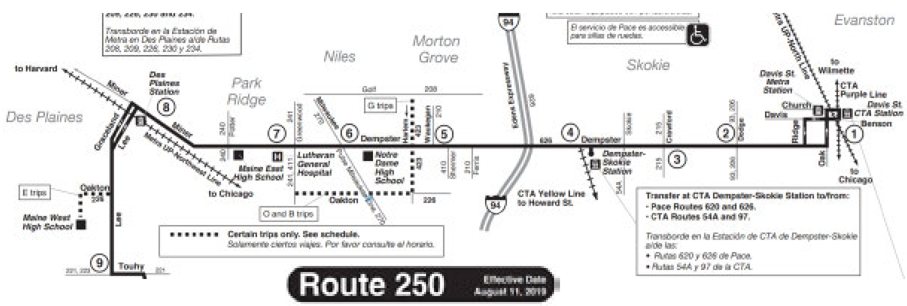
Regional Transit Signal Priority Implementation Program (RTSPIP)

Dempster Street Corridor



- Boundaries: Sheridan Road to Elmhurst Road
- Near Term TSP Segment(s): Mannheim Road to Dodge Avenue
- Routes on corridor: Pace 230 and 250
- Average weekday ridership (2018): 350 (Route 230), and 2,682 (Route 350)
- Total number of signals on corridor: 82
- Total number of controllers replaced: 23
- Total number of signals with TSP: 55

Key Destinations And/Or Transfer Locations Along Corridor



The Dempster Street corridor provides transportation to considerable locations such as downtown Evanston, the Lutheran General Hospital, the Rivers Casino, and the O'Hare International Airport (Kiss-N-Fly). Academic establishments accessible through this route include Maine West High School, Maine East High School, and Notre Dame High School. This corridor also provides access to three CTA stations (Blue Line Rosemont Station, Purple Line Davis Street Station, and the Yellow Line Dempster-Skokie Station) and two Metra Stations (Metra UP-Northwest Line Des Plaines Station and Metra UP-North Line Davis Street Station).

Transit Characteristics On The Corridor That Warrant TSP Implementation

The Dempster Street corridor supports an average weekday ridership (under 3,000 weekday riders) through the approximate 30 miles that Routes 230 & 250 encompass. Route 230 provides weekday services with rush hour extensions/trips, and the 250 route provides daily services along its posted stops only. Transportation to and from the O'Hare Airport and popular locations along this route may call for TSP implementation to make traveling more convenient and time efficient.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization. Small increase in transit travel times variability were also observed in both directions.

Regional Transit Signal Priority Implementation Program (RTSPIP)

Table 1: Pace Dempster Street Performance Measures Summary

Dempster Street for Pace Route 250 from Mannheim Road to Dodge Avenue									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	FEB. 2012	16.43	15.61	15.73	15.56	17.94	18.44
		OPTIMIZED W/OUT TSP	MAY 2012	16.36	15.77	18.17	16.27	20.22	20.21
		OPTIMIZED W/OUT TSP	SUMMER 2019	51.92	52.34	53.52	54.07	57.93	57.67
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**		0%	1%	16%	5%	13%	10%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	FEB. 2012	3.80	4.18	3.68	4.23	3.71	5.99
		OPTIMIZED W/OUT TSP	MAY 2012	3.84	4.79	3.56	4.65	3.68	6.55
		OPTIMIZED W/OUT TSP	SUMMER 2019	4.79	6.34	5.12	5.90	5.23	7.48
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**		1%	15%	-3%	10%	-1%	9%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012); HERE DATA (2019)	BASELINE	FEB. 2012	15.28	16.65	14.53	14.98	19.36	18.20
		OPTIMIZED W/OUT TSP **	MAY 2012	13.68	13.91	11.31	12.71	16.56	19.23
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	48.65	42.4	45.24	44.76	45.26	51.1
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)		-10%	-16%	-22%	-15%	-14%	6%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

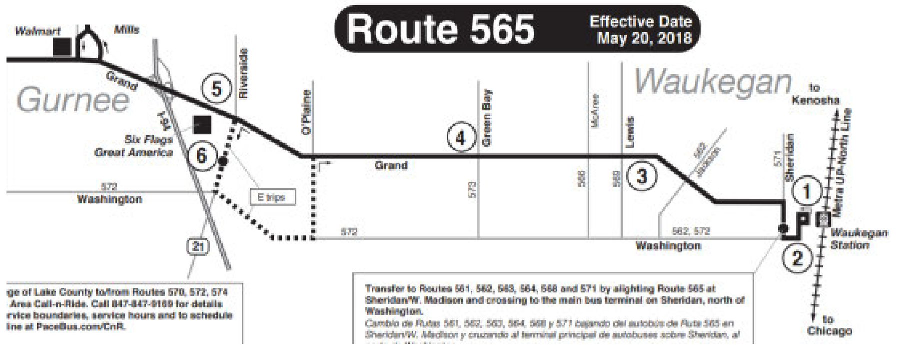
** Speed / Delay Studies conducted by signal consultant from Potter Road to Cumberland Avenue and from Harlem Avenue to Skokie Boulevard.

*** HERE Data collected between Mannheim Road in city of Des Plaines and Dodge Avenue in city of Evanston.

Regional Transit Signal Priority Implementation Program (RTSPIP)

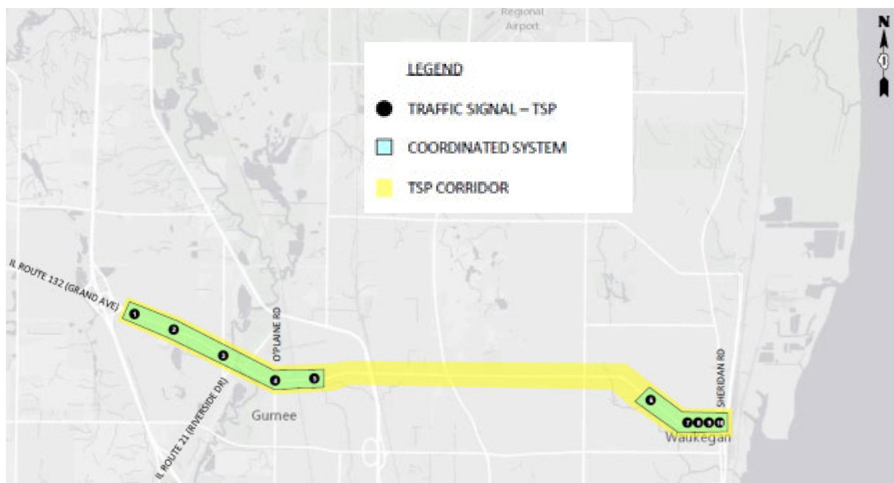
Grand Avenue Corridor

- Boundaries: Sheridan Road to US Route 45
- Near Term TSP Segment(s): Dilleys Road to Sheridan Road
- Routes on corridor: Pace 565
- Average weekday ridership (2018): 971 (Route 565)
- Total number of signals on corridor: 10
- Total number of controllers replaced: 2
- Total number of signals with TSP: 10



Key Destinations And/Or Transfer Locations Along Corridor

The Grand Avenue corridor provides accessibility to the downtown area of Waukegan, IL and popular attractions located in Gurnee, IL - such as the Six Flags Great America Amusement Park (ease of access for visitors and employees) and the Gurnee Mills (a shopping/outlet center). Also, this corridor is a connecting service to the Union Pacific/North Line Metra Station and supplies transportation for the College of Lake County.



Transit Characteristics On The Corridor That Warrant TSP Implementation

The Grand Avenue corridor serves a ridership of approximately 1,000 for an average weekday. The 565 route covers approximately 16 miles and provides an intra-community daily service within its endpoints at the Waukegan Metra Station and the College of Lake County. The 565 route also provides additional seasonal services for amusement park employees with a detour that grants them access to other entrance points within Six Flags.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization.

Table 1: Grand Avenue Performance Measures Summary

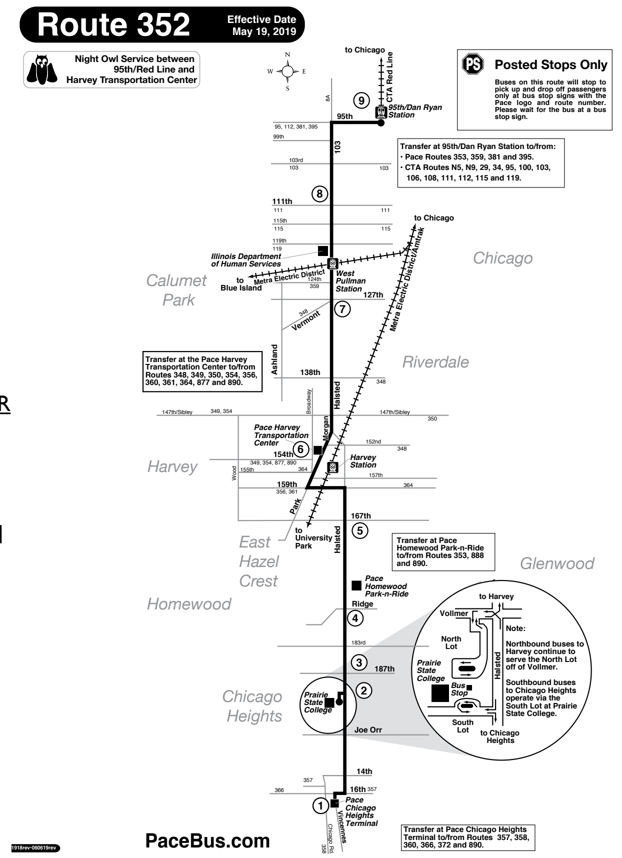
Grand Avenue (Lake County) for Pace Route 565 from Dilleys Road to Sheridan Road									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	DEC. 2014						
		OPTIMIZED W/OUT TSP	APRIL 2015						
		OPTIMIZED W/OUT TSP	SUMMER 2019	18.25	27.49	20.39	28.13	24.15	30.16
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2014 - 2015)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	DEC. 2014						
		OPTIMIZED W/OUT TSP	APRIL 2015						
		OPTIMIZED W/OUT TSP	SUMMER 2019	2.55	2.58	3.02	4.45	3.18	4.55
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2014 - 2015)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2014 -2015); HERE DATA (2019)	BASELINE	DEC. 2014	2.23	2.23	2.61	2.17	2.3	2.31
		OPTIMIZED W/OUT TSP **	APRIL 2015	1.93	1.94	2.28	2.14	2.12	2.22
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	15.21	14.22	16.04	15.05	17.26	16.07
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		-13%	-13%	-13%	-1%	-8%	-4%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.
** Speed / Delay Studies conducted by signal consultant from Jackson Street to Sheridan Road in Dec. 2014 / April 2015.
*** HERE Data collected between Dilleys Road and Sheridan Road.

Regional Transit Signal Priority Implementation Program (RTSPIP)

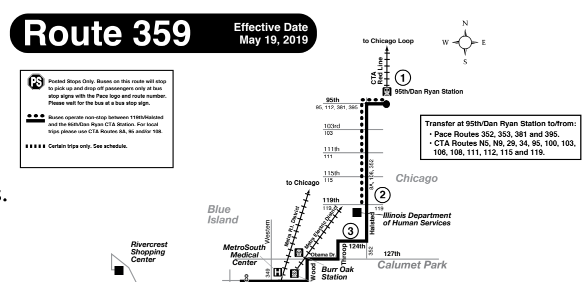
Halsted Street Corridor

- Boundaries: 95th Street to Chicago Heights Terminal
- Routes on corridor: Pace 352, 359, 348 and 890
- Average weekday ridership (2018): 4,999 (Route 352), 1,217 (Route 359), 252 (Route 348), and 220 (Route 890)
- Total number of signals on corridor: N/A
- Total number of controllers replaced: N/A
- Total number of signals with TSP: N/A



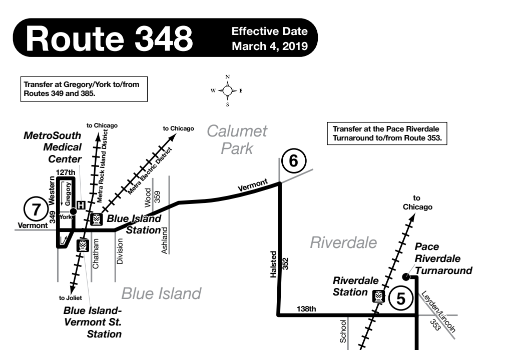
Key Destinations And/Or Transfer Locations Along Corridor

The Halsted Street corridor provides transportation to two Metra stations (West Pullman & Harvey Station). Additionally, this corridor allows access to the Pace Harvey transportation center, Pace Homewood Park-N-Ride, and the Pace Chicago Heights Terminal. These Terminals/Transportation centers work as a hub for riders to transfer to the available bus routes. This route also gives access to educational and government buildings such as Prairie State College and the Illinois Department of Human services. On the northern part of the Halsted Street corridor, there is access to the 95th/Dan Ryan CTA Red Line Station, which provides transportation service to Downtown Chicago.



Transit Characteristics On The Corridor That Warrant TSP Implementation

The Halsted Street corridor operates with a weekday average ridership of about 6,700 on over 15 miles of roadway for route 352. This route provides daily transit services with about 20 - 30 minutes in between buses. Because of the several terminals/transportations centers located in this corridor, TSP Implementation could be warranted for this corridor.



Key Information Attained From TSP Implementation

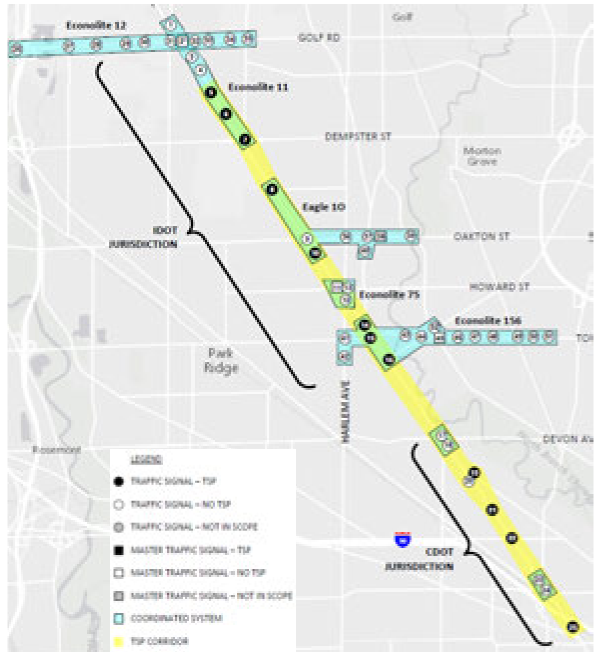
TABLE 1: PACE HALSTED STREET PERFORMANCE MEASURES SUMMARY

Pace Halsted Street from 95th Street to Chicago Heights Terminal									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012); HERE DATA (2019)	BASELINE							
		OPTIMIZED W/OUT TSP	SEPT. 2019	35.44	34.91	35.89	36.96	35.71	37.58
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

Regional Transit Signal Priority Implementation Program (RTSPIP)

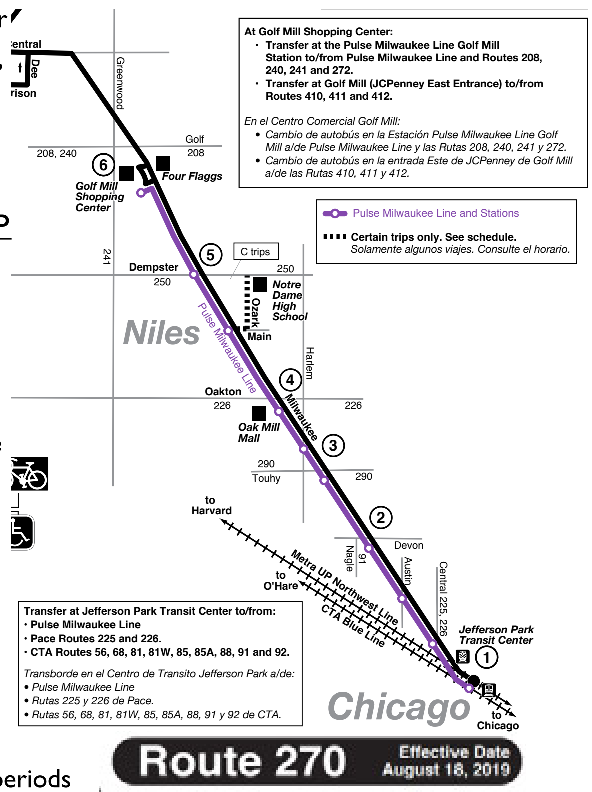
Milwaukee Avenue Corridor

- Boundaries: Golf Road (Route 21) to Jefferson Park CTA Station
- Near Term TSP Segment(s): Golf Road (Route 21) to Jefferson Park CTA Station
- Routes on corridor: Pace 270, 410, and 411
- Average weekday ridership (2018): 2,853 (Route 270), 263 (Route 410), and 257 (Route 411)
- Total number of signals on corridor: 23
- Total number of controllers replaced: 12
- Total number of signals with TSP: 12



Key Destinations And/Or Transfer Locations Along

The Milwaukee Avenue corridor is used to access shopping centers like Golf Mill and Oak Mill Mall. North of Golf Mill, there is access to Glenbrook Hospital in Glenview. Selected trips on Pace route 270 service Notre Dame High School. At the far south end of the corridor, there is access to the Jefferson Park transfer center. This transfer center gives access to CTA/Pace bus routes, Metra Station to Harvard/Chicago, and the CTA Blue Line - which takes you to O'Hare International Airport.



Transit Characteristics On The Corridor That Warrant TSP Implementation

The Milwaukee Avenue corridor exhibits an average weekday ridership of just under 3,400 riders. The majority of this ridership comes from route 270, which travels along the Milwaukee Avenue corridor passing through Chicago, Niles, and Glenview. Route 270 travels along the same corridor as the Pace Pulse Milwaukee line, which is a bus route with limited stops. TSP implementations could have positive outcomes by reducing travel times for individuals using this corridor to ultimately get to O'Hare International Airport.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization. Transit travel times were reduced in all periods of the day ranging between 2 and 4 percent after signal timing optimization. Southbound transit travel time variability was reduced by 22 percent in the AM peak period after signal timing optimization.

TABLE 1: PACE MILWAUKEE AVENUE PERFORMANCE MEASURES SUMMARY

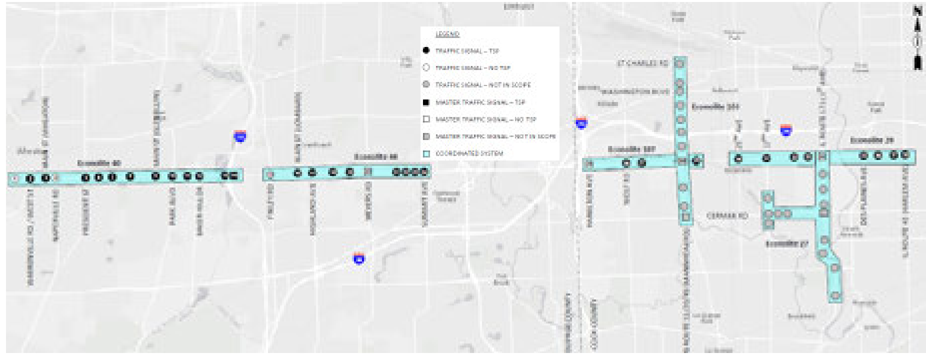
Milwaukee Avenue for Pace Route 270 Golf Mill Mall and Jefferson Park CTA Station									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	NB	SB	NB	SB	NB	SB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	DEC. 2010	20.81	22.52	21.49	23.62	22.31	26.87
		OPTIMIZED W/OUT TSP	APRIL 2011	20.47	21.91	21.93	23.23	21.31	26.37
		OPTIMIZED W/OUT TSP	SUMMER 2019	25.9	26.2	26.7	27.1	26.3	31.4
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2010 - 2011)**		-2%	-3%	2%	-2%	-4%	-2%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	DEC. 2010	6.6	9.8	6.7	7.2	8.1	6.7
		OPTIMIZED W/OUT TSP	APRIL 2011	6.2	7.6	6.3	6.8	9.1	6.6
		OPTIMIZED W/OUT TSP	SUMMER 2019	2.7	2.4	2.8	2.9	2.8	5.2
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2010 - 2011)**		-6%	-22%	-6%	-5%	13%	-2%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2010 -2011); HERE DATA (2019)	BASELINE	DEC. 2010	19.38	17.25	18.58	17.63	20.65	23.86
		OPTIMIZED W/OUT TSP **	APRIL 2011	16.60	15.62	15.65	15.46	17.59	20.17
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	23.4	21.1	20.4	21.1	21.1	30.9
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2010 - 2011)**		-14%	-9%	-16%	-12%	-15%	-15%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

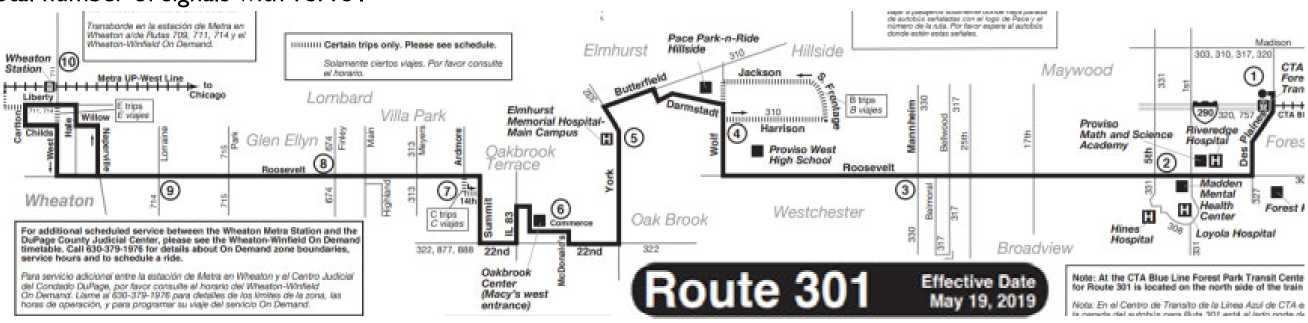
* Second-by-second AVL data not available from Pace AVL system during evaluation period
** Speed / Delay Studies conducted by signal consultant between Golf Road and Gale Street
*** HERE Data collected between Golf Mill Mall to Jefferson Park CTA Station

Regional Transit Signal Priority Implementation Program (RTSPIP)

Roosevelt Road Corridor

- Boundaries: Carlton Avenue to Laramie Avenue
- Near Term TSP Segment(s): IL Route 56 (Butterfield Road) to 54th Avenue
- Routes on corridor: Pace 301 and 305
- Average weekday ridership (2018): 1,721 (Route 301), and 536 (Route 305)
- Total number of signals on corridor: 82
- Total number of controllers replaced: 26
- Total number of signals with TSP: 31





Key Destinations And/Or Transfer Locations Along Corridor

The Roosevelt Road corridor provides access to numerous health institutions such as the Hines Hospital, Elmhurst Memorial Hospital – Main Campus, Riveredge Hospital, Madden Mental Health Center, and Loyola Hospital. Major locations within this corridor include the DuPage County Judicial Center (Building 505), Oakbrook Center Mall, and the Forest Park Mall. This corridor also provides access to the Metra UP-West Line Wheaton Station, CTA Blue Line Forest Park Transit Center, and the CTA Blue Line Cicero Station. Academic facilities within this route are the Proviso West High School and the Proviso Math and Science Academy.

Transit Characteristics On The Corridor That Warrant TSP Implementation

The Roosevelt Road corridor's average weekday ridership is approximately 2,300 weekday riders over the approximately 20 miles it covers. Route 301 provides weekday services with specific rush hour trips serving only the posted stops along its route, and route 305 is a short daily service that connects the CTA Blue Line Forest Park transit center and CTA Blue Line Cicero station. Transportation to/from the many health establishments, popular sites, and other serviced transit routes indicate that TSP implementation would be beneficial for decreasing travel time for this corridor.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization.

TABLE 1: PACE ROOSEVELT ROAD PERFORMANCE MEASURES SUMMARY

Roosevelt Road for Pace Route 301 from Warrenville Rd. / West Street to IL Route 43 (Harlem Ave.)									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	APRIL 2012	15.81	20.63	15.79	20.96	17.07	25.19
		OPTIMIZED W/OUT TSP	JULY 2012	16.45	19.94	17.75	22.73	16.66	24.84
		OPTIMIZED W/OUT TSP	SUMMER 2019	69.86	70.81	74.51	76.8	87.56	83.92
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)		4%	-3%	12%	8%	-2%	-1%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	APRIL 2012						
		OPTIMIZED W/OUT TSP	JULY 2012						
		OPTIMIZED W/OUT TSP	SUMMER 2019	3.12	4.94	3.95	6.36	7.87	7.21
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012 -2015); HERE DATA (2019)	BASELINE	APRIL 2012 & NOV. 2014	30.18	27.76	26.8	25.74	36.02	30.16
		OPTIMIZED W/OUT TSP **	JULY 2012 & DEC. 2015	18.58	16.68	17.49	16.07	20.85	17.38
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	44.1	32.8	36.3	30.1	47.4	38.0
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP		-39	-40%	-35%	-38%	-42%	-42%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

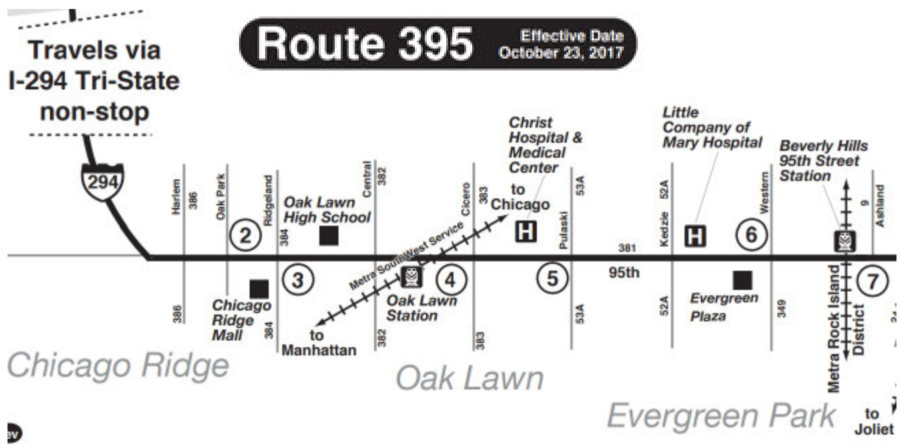
* Second-by-second AVL data not available from Pace AVL system during evaluation period.
** Speed / Delay Studies conducted by signal consultant from Carleton to I-355 in April 2012 / July 2012 and from Hamilton Avenue / Harrison Street to IL 43 (Harlem Avenue) in Nov. 2014 / Dec. 2015.
*** HERE Data collected between Warrenville Road./ West Street to IL Route 43 (Harlem Avenue).

Regional Transit Signal Priority Implementation Program (RTSPIP)

95th Street Corridor

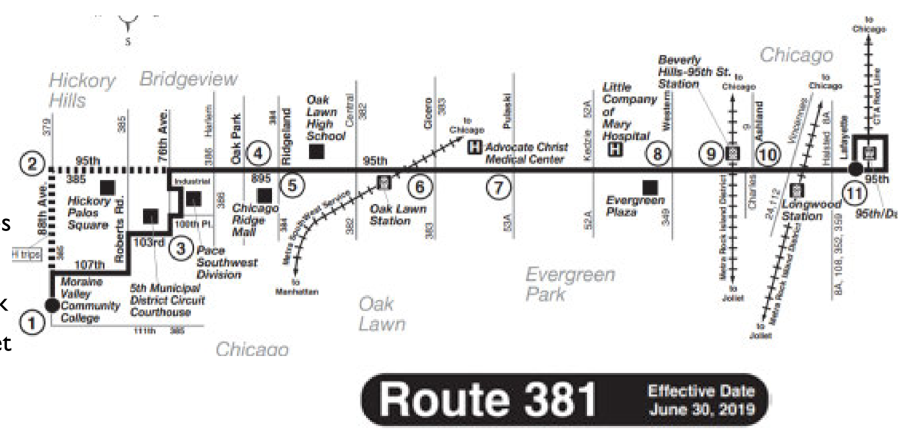
- Boundaries: 88th Avenue to Stony Island Avenue
- Near Term TSP Segment(s): Roberts Road to Western Avenue
- Routes on corridor: Pace 381 and 395
- Average weekday ridership (2018): 2,604 (Route 381), and 360 (Route 395)
- Total number of signals on corridor: 28
- Total number of controllers replaced:18
- Total number of signals with TSP: 22

Key Destinations And/Or Transfer Locations Along Corridor



The 95th Street corridor is used to access the Moraine Valley Community College (MVCC), Chicago Ridge Mall, and the 5th Municipal District Courthouse. Health institutions accessible via this route include the Advocate Christ Medical Center and the Little Company of Mary Hospital. Also, along this stretch there is access to the CTA Red Line 95th/Dan Ryan Station and three Metra Stations (Oak Law Metra Station, Beverly Hills 95th St. Station, and Longwood Station).

Transit Characteristics On The Corridor That Warrant TSP



The 95th Street corridor operates with an average weekday ridership (under 3,000 weekday riders) over the approximately 24 miles that routes 381 and 395 cover. The 381 route provides daily services and selected trips in peak weekday periods - it also operates via 95th Street and 88th Avenue in Hickory Hills on Saturdays/ Sundays. The 395 route provides weekday limited-stop service between CTA Red Line 95th/

Key Information Attained From TSP Implementation

Transit travel times were reduced in all periods of the day before and after traffic signal timing optimization in both directions. General vehicle travel times were reduced in all periods of the day after signal timing optimization.

REGIONAL TRANSIT SIGNAL PRIORITY IMPLEMENTATION PROGRAM (RTSPIP)

Regional Transportation Authority

pace

TABLE 1: PACE 95TH STREET PERFORMANCE MEASURES SUMMARY

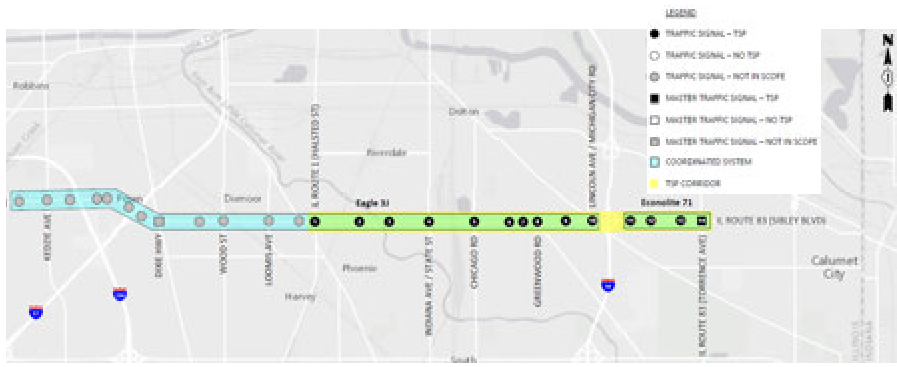
95th Street for Pace Route 381 Roberts Road to Western Avenue									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	MAY 2012	21.42	22.35	23.42	22.53	26.13	23.70
		OPTIMIZED W/OUT TSP	OCT. 2012	21.38	21.08	22.67	21.03	25.19	22.67
		OPTIMIZED W/OUT TSP	SUMMER 2019	26.5	28.08	31.39	29.49	33.31	29.24
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**		-1%	-1%	-6%	-3%	-7%	-4%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	MAY 2012	5.98	4.79	5.56	4.74	6.45	4.51
		OPTIMIZED W/OUT TSP	OCT. 2012	4.61	4.46	5.24	5.38	6.42	4.86
		OPTIMIZED W/OUT TSP	SUMMER 2019	2.72	2.99	4.18	3.19	4.85	3.78
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012)**		-23%	-7%	-6%	14%	-1%	8%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012 -2014); HERE DATA (2019)	BASELINE	MAY 2012 & OCT. 2014	17.7	19.51	20.82	22.69	24.94	25.81
		OPTIMIZED W/OUT TSP **	OCT. 2012 & DEC. 2014	14.39	17.25	17.94	18.56	18.43	18.53
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	20.79	23.37	22.11	23.94	25.57	25.47
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2012 - 2014)**		-19%	-12%	-14%	-18%	-26%	-28%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

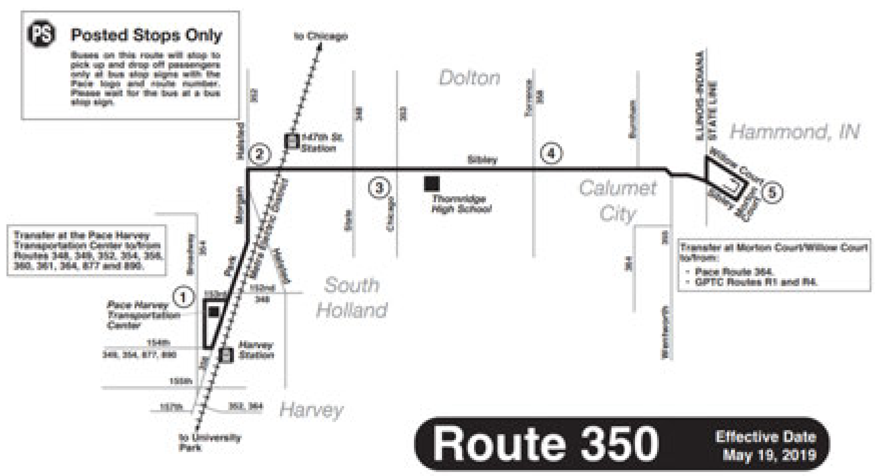
* Second-by-second AVL data not available from Pace AVL system during evaluation period
** Speed/Delay Studies conducted by signal consultant between Oak Park Avenue to Western Avenue and from Roberts Road to I-294
***HERE Data collected between Roberts Road in the city of Hickory Hills to Western Avenue in the village of Evergreen Park

Regional Transit Signal Priority Implementation Program (RTSPIP)

147th Street/Sibley Boulevard Corridor

- Boundaries: Cicero Avenue to State Line Road
- Near Term TSP Segment(s): IL Route 1 (Halsted Street) to IL Route 83 (Torrence Avenue)
- Routes on corridor: Pace 350 and 354
- Average weekday ridership (2018): 1,541 (Route 350), and 409 (Route 354)
- Total number of signals on corridor: 14
- Total number of controllers replaced: 12
- Total number of signals with TSP: 14





Key Destinations And/Or Transfer Locations Along Corridor

The 147th Street corridor provides access to Thornridge High School and to the Harvey transportation center. This center works as a transfer hub to the Metra Harvey station as well as to several Pace bus route that take you to nearby towns such as South Holland, Dolton, Calumet City, Harvey, Blue Island, Chicago Heights, Etc. The corridor also provides access to the Illinois - Indiana state line near Hammond.

Transit Characteristics On The Corridor That Warrant TSP Implementation

The 147th Street corridor operates with an average weekday ridership of about 2,000 between both route 350 and 354. Route 350 provides a daily transit service with roughly 15-20 minutes in between buses while route 354 has a longer headway in between buses, roughly an hour. Because of the access to the Harvey transportation center, TSP implementation would benefit this corridor by improving connections between buses.

Key Information Attained From TSP Implementation

General vehicle travel times were reduced in all periods of the day after signal timing optimization.

REGIONAL TRANSIT SIGNAL PRIORITY IMPLEMENTATION PROGRAM (RTSPIP)

Regional Transportation Authority
pace

TABLE 1: PACE 147TH STREET PERFORMANCE MEASURES SUMMARY

147th Street / Sibley Boulevard for Pace Route 350 from IL Route 1 (Halsted St.) to IL Route 83 (Torrence Ave.)									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	NOV. 2015						
		OPTIMIZED W/OUT TSP	DEC. 2015						
		OPTIMIZED W/OUT TSP	SUMMER 2019	12.06	13.9	14.17	14.93	15.8	14.02
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2015)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	NOV. 2015						
		OPTIMIZED W/OUT TSP	DEC. 2015						
		OPTIMIZED W/OUT TSP	SUMMER 2019	1.43	1.31	2.59	2.31	2.43	1.85
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2015)**							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2015); HERE DATA (2019)	BASELINE	NOV. 2015	28.53	28.6	28.66	29.7	32.1	35.38
		OPTIMIZED W/OUT TSP **	DEC. 2015	21.53	23.21	22.47	23.72	25	28.18
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	11.69	12.95	11.41	13.15	12.99	15.09
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2015)**		-25%	-19%	-22%	-20%	-22%	-20%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

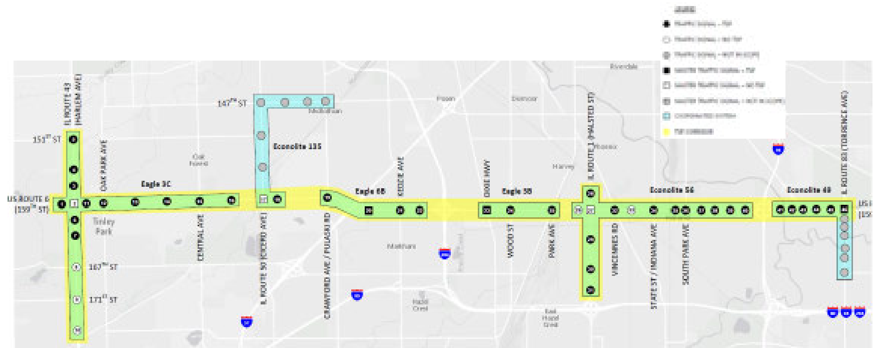
** Speed / Delay Studies conducted by signal consultant from Homan Avenue to Michigan City Road and from Torrence Avenue to Madison Avenue in Nov. 2015 and Dec. 2015.

*** HERE Data collected between Warrenville Road / West Street to IL Route 43 (Harlem Avenue).

Regional Transit Signal Priority Implementation Program (RTSPIP)

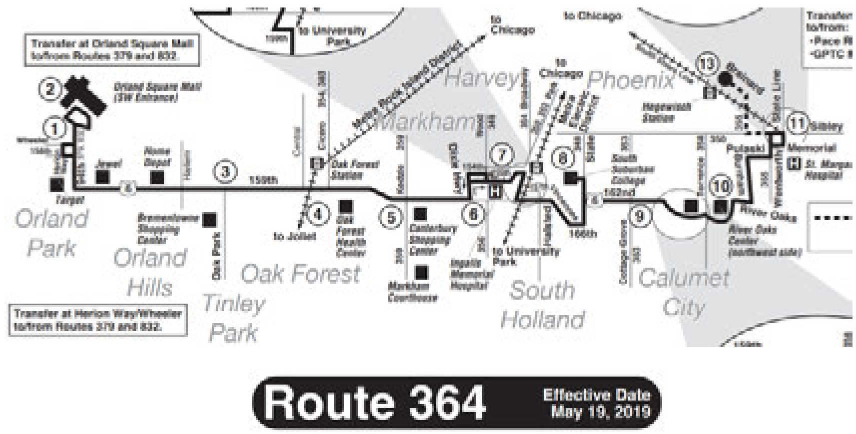
159th Street Corridor

- Boundaries: 94th Avenue to IL Route 83 (Torrence Avenue)
- Near Term TSP Segment(s): Park Center Drive to IL Route 83 (Torrence Avenue)
- Routes on corridor: Pace 364
- Average weekday ridership (2018): 1,978 (Route 364)
- Total number of signals on corridor: 46
- Total number of controllers replaced: 29
- Total number of signals with TSP: 38



Key Destinations And/Or Transfer Locations Along Corridor

The 159th Street corridor provides access to River Oaks Shopping Center. There is access to two Metra stations (Oak Forest station & Harvey station) along this corridor. Municipal and institutional buildings, such as South Suburban College (East of Park Ave.), Ingalls Memorial Hospital, and the Cook County Sixth Municipal District Courthouse in Markham, are located on the 159th Street corridor.



Transit Characteristics On The Corridor That Warrant TSP Implementation

The 159th Street corridor operates with a weekday average ridership of about 2,000 on over 20 miles of roadway for route 364. This route provides daily transit service with roughly 20 to 30 minutes in between buses. TSP implementation could benefit the individuals traveling to the Cook County Courthouse in Markham and South Suburban college in South Holland.

Key Information Attained From TSP Implementation

Transit travel times were reduced in the midday periods after traffic signal timing optimization in both directions. General vehicle travel times were reduced in all periods of the day after signal timing optimization.

Regional Transit Signal Priority Implementation Program (RTSPIP)

Table 1: Pace 159th Street Performance Measures Summary

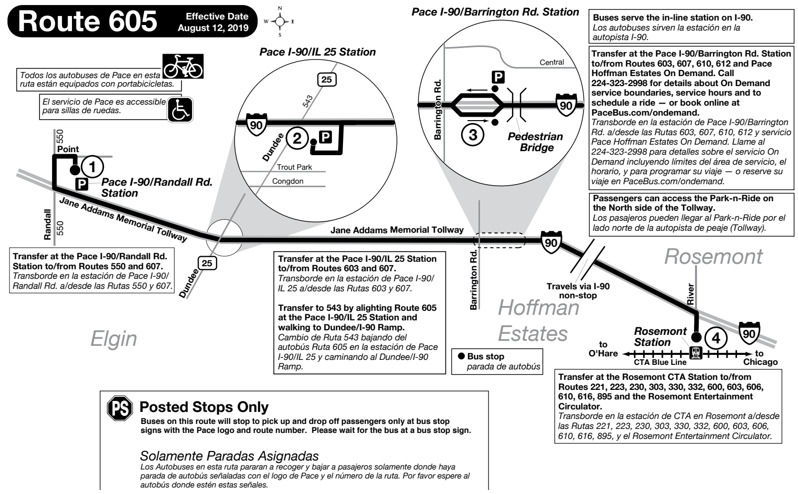
159th Street Corridor for Pace Route 364 Park Center Drive to IL 83 (Torrence Ave.)									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE	JAN. 2013	17.3	16.7	16.5	17.8	17.2	17.3
		OPTIMIZED W/OUT TSP	APRIL 2013	16.8	17.0	16.2	17.0	17.0	18.1
		OPTIMIZED W/OUT TSP	SUMMER 2019	57.5	60.6	60.2	62.0	62.1	60.7
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2013)**		-3%	2%	-2%	-5%	-1%	5%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (MINUTES)	TIMEPOINT DATA	BASELINE	JAN. 213	2.88	2.70	4.13	3.09	3.40	3.93
		OPTIMIZED W/OUT TSP	APRIL 2013	3.19	3.42	4.36	3.61	3.81	4.68
		OPTIMIZED W/OUT TSP	SUMMER 2019	3.4	4.0	5.2	4.6	5.3	4.1
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2013)**		10%	27%	6%	17%	12%	19%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2013); HERE DATA (2019)	BASELINE	JAN. 2013	7.41	7.68	7.84	8.32	8.41	8.75
		OPTIMIZED W/OUT TSP **	APRIL 2013	7.36	7.72	7.35	7.42	7.27	7.56
		OPTIMIZED W/OUT TSP ***	SEPT. 2019	29.0	28.7	30.2	29.4	32.9	31.8
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP (2013)**		-1%	1%	-6%	-11%	-14%	-14%
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.
** Speed / Delay Studies conducted by signal consultant between Crawford Avenue and Park Avenue.
*** HERE Data collected between Park Center Drive to IL 83 (Torrence Avenue).

Regional Transit Signal Priority Implementation Program (RTSPIP)

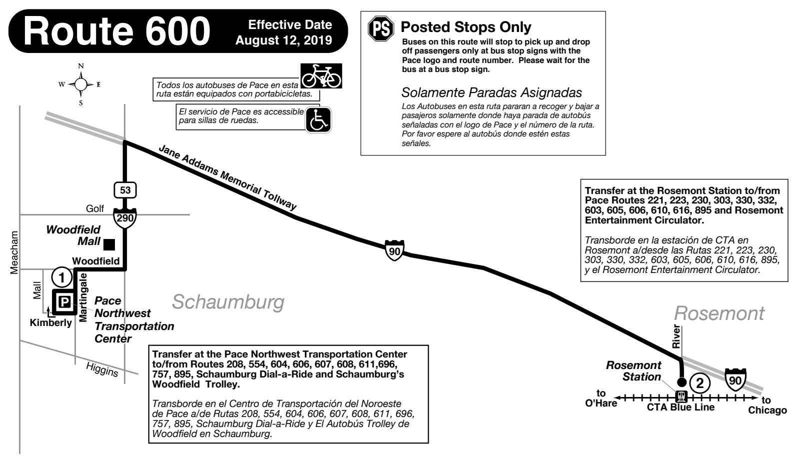
I-90 Tollway Corridor

- Boundaries: Randall Rd. to Rosemont CTA Station
- Routes on corridor: Pace 600, 603, 605, 606, 607, 610, and 616
- Average weekday ridership (2018): 860 (Route 600), 221 (Route 603), 292 (Route 605), 1,670 (Route 606), 41 (Route 607), 279 (Route 610), and 151 (Route 616)
- Total number of signals on corridor: N/A
- Total number of controllers replaced: N/A
- Total number of signals with TSP: N/A



Key Destinations And/Or Transfer Locations Along Corridor

The I-90 Tollway Corridor provides access to several terminals/stations on its nearly 25 mile stretch. This corridor has a connection to the Pace I-90/Barrington Rd. Station, I-90/IL-25 Station, and the I-90/Randall Rd. Station. These stations are access points for the nearby towns/suburbs along the I-90 corridor such as Elgin, Hoffman Estates, Rosemont, and the Schaumburg - Woodfield Mall Area. On the most eastern part of this corridor, there is access to the Rosemont CTA Station. This station provides access to several Pace Bus routes as well as access to the CTA Blue Line which takes you to Downtown Chicago & O'Hare International Airport.



Transit Characteristics On The Corridor That Warrant TSP Implementation

The I-90 Tollway Corridor exhibits a weekday average ridership of about 3,500 riders. Pace 605 is the main route that utilizes all 25 miles of the I-90 corridor. This route provides daily transit service with about a 20-30 minute headway for AM/PM periods. TSP implementation can reduce those commute times from nearby towns/suburbs along the I-90 corridor (Elgin, Rosemont, Schaumburg, Etc.)

Key Information Attained From TSP Implementation

Regional Transit Signal Priority Implementation Program (RTSPIP)

Table 1: Pace I90 Tollway Performance Measures Summary

Pace I90 Tollway corridor Randall Rd. to Rosemont CTA Blue Line Station									
PERFORMANCE MEASURE	DATA SOURCE	CORRIDOR CONDITIONS	PERIOD	AM PEAK		MIDDAY		PM PEAK	
			DIRECTION	EB	WB	EB	WB	EB	WB
1-A: AVERAGE BUS TRAVEL TIME (MINUTES)	TIMEPOINT DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-B: BUS TRAVEL TIME VARIABILITY (STD. DEV. IN MINUTES)	TIMEPOINT DATA	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-C: TRAFFIC SIGNAL DELAY (MINUTES)	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
1-D: NUMBER OF STOPS AT RED SIGNALS	SECOND-BY-SECOND AVL DATA*	BASELINE							
		OPTIMIZED W/OUT TSP							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							
2: GENERAL VEHICLE TRAVEL TIMES (MINUTES)	SPEED/DELAY STUDIES (2012 -2015); HERE DATA (2019)	BASELINE							
		OPTIMIZED W/OUT TSP **							
		OPTIMIZED W/OUT TSP ***							
		OPTIMIZED WITH TSP							
		% CHANGE - BASELINE VS. OPTIMIZED W/ OUT TSP							
		% CHANGE OPTIMIZED W/ O TSP VS. WITH TSP							
		% CHANGE BASELINE VS. OPTIMIZED WITH TSP							

Appendix G

Summary of HERE Data on CTA / Pace Corridors

Appendix G – Summary of HERE Data on CTA / Pace Corridors

#	CTA TSP Corridor	CTA TSP Corridor Limits: From	To	Data Collection Period (Month / Year)	Direction	General Vehicle Travel Times (in minutes): AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)		Notes
1	Ashland Avenue (CTA) Route 9 / X9	Cermak Road	95th St.	Optimized without TSP (April 2016)	NB	25.14	24.71	24.66		
					SB	25.01	26.63	28.20		
				Optimized with TSP (July 2016)	NB	29.42	29.81	29.32		
					SB	29.55	32.16	33.92		
				Optimized with TSP (Sept. 2018)	NB	36.10	26.58	28.75		
					SB	28.71	29.63	34.42		
				Optimized with TSP (Sept. 2019)	NB	38.35	27.87	27.32		
					SB	31.41	32.89	37.86		
2	Ashland Avenue (CTA) Route 9 / X9	Irving Park Rd.	Cermak Road	Baseline (April 2016)	NB	26.67	25.61	29.90		
					SB	26.58	25.40	29.43		
				Baseline (July 2016)	NB	36.12	38.66	43.10		
					SB	35.68	36.57	42.64		
				Baseline (Sept. 2018)	NB	38.26	33.82	44.08		
					SB	44.83	31.75	39.55		
				Baseline (Sept. 2019)	NB	39.51	34.27	43.63		
					SB	42.02	33.94	45.72		
3	Western Avenue (CTA) Route 49 / X49	Berwyn	79th St.	Baseline (Sept. 2016*)	NB	74.67	63.34	71.72		
					SB	66.82	62.03	85.31		
				Baseline (Sept. 2018)	NB	101.76	81.11	90.41		
					SB	90.51	77.79	116.16		
				Optimized with TSP (Sept. 2019)	NB	102.12	78.93	88.73		
					SB	66.82	78.65	111.34		
4	Western Avenue (CTA) Route 49B	Howard	Leland	Baseline (Sept. 2016*)	NB	15.00	11.85	14.30		
					SB	13.11	11.24	13.47		
				Baseline (Sept. 2018)	NB	19.56	15.22	18.64		
					SB	17.80	14.66	18.84		
				Optimized with TSP (Sept. 2019)	NB	21.11	17.42	20.00		
					SB	17.76	14.41	18.48		

* Note: September 2016 data taken before Belmont viaduct removal.

Appendix G – Summary of HERE Data on CTA / Pace Corridors

	Pace TSP Corridor	Near Term Segments of TSP Deployment by Pace: From	Near Term Segments of TSP Deployment by Pace: To	Data Collection Period (Month / Year)	Direction	General Vehicle Travel Times (in minutes): AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)	Notes
1	Cermak Road / 22nd Street	IL Route 56 (Butterfield Road) and Fairfield Avenue in the village of Lombard	54th Avenue in the town of Cicero	Optimized without TSP (Sept. 2019)	WB	40.37	39.45	42.59	
					EB	36.52	38.14	46.08	
				Optimized with TSP	WB				
					EB				
2	IL Route 50 (Cicero Avenue)	87th Street in the village of Oak Lawn	US Route 6 (159th Street) in the city of Oak Forest	Optimized without TSP (Sept. 2019)	NB	27.51	24.25	27.56	
					SB	25.29	25.89	29.06	
				Optimized with TSP	NB				
					SB				
3	IL Route 58 (Dempster Street)	Mannheim Road in the city of Des Plaines	Dodge Avenue in the city of Evanston	Optimized without TSP (Sept. 2019)	WB	42.40	44.76	51.10	
					EB	48.65	45.24	45.26	
				Optimized with TSP	WB				
					EB				
4	Grand Avenue (Lake County)	Dilleys Road in the village of Gurnee	Sheridan Road in the city of Waukegan	Optimized without TSP (Sept. 2019)	WB	14.22	15.05	16.07	
					EB	15.21	16.04	17.26	
				Optimized with TSP	WB				
					EB				
5	Milwaukee Avenue	Golf Mill	Jefferson Park CTA Station	Optimized without TSP (Sept. 2019)	NB	23.41	20.36	21.08	Extends into City limits
					SB	21.14	21.05	30.86	
				Optimized with TSP	NB				
					SB				
6	IL Route 38 (Roosevelt Road)	Warrenville Road/West Street in the city of Wheaton	IL Route 43 (Harlem Avenue) in the village of Forest Park	Optimized without TSP (Sept. 2019)	WB	32.77	30.11	37.97	
					EB	44.07	36.33	47.45	
				Optimized with TSP	WB				
					EB				

Appendix G – Summary of HERE Data on CTA / Pace Corridors

	Pace TSP Corridor	Near Term Segments of TSP Deployment by Pace: From	Near Term Segments of TSP Deployment by Pace: To	Data Collection Period (Month / Year)	Direction	General Vehicle Travel Times (in minutes): AM Peak Period (7-9am)	General Vehicle Travel Times (in minutes): Midday Period (11am-1pm)	General Vehicle Travel Times (in minutes): PM Peak Period (4-6pm)		Notes
7	95th Street	Roberts Road in the city of Hickory Hills	Western Avenue in the village of Evergreen Park	Optimized without TSP (Sept. 2019)	WB	23.37	23.94	25.47		Extends into City limits
					EB	20.79	22.11	25.57		
				Optimized with TSP	WB					
					EB					
8	IL Route 83 (147th St./Sibley Blvd.)	IL Route 1 (Halsted Street) in the city of Harvey	IL Route 83 (Torrence Avenue) in Calumet City	Optimized without TSP (Sept. 2019)	WB	12.95	13.15	15.09		
					EB	11.69	11.41	12.99		
				Optimized with TSP	WB					
					EB					
9	US Route 6 (159th Street)	Park Center Drive in the village of Orland Park	IL Route 83 (Torrence Avenue) in Calumet City	Optimized without TSP (Sept. 2019)	WB	28.70	29.37	31.79		
					EB	29.05	30.24	32.93		
				Optimized with TSP	WB					
					EB					

Appendix G – Summary of HERE Data on CTA / Pace Corridors

Pace TSP Corridor		Full Corridor Limits From	To	Data Collection Period (Month / Year)	Direction	General Vehicle Travel Times (in minutes) AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)		Notes
1	Cermak Road / 22nd Street	Butterfield Road / Lambert Road	Cicero Avenue	Optimized without TSP (Sept. 2019)	WB	51.90	50.99	57.63		
					EB	51.18	49.30	58.14		
				Optimized with TSP	WB					
					EB					
2	IL Route 50 (Cicero Avenue)	59th Street	167th Street	Optimized without TSP (Sept. 2019)	NB	43.89	38.23	42.63		
					SB	38.17	38.82	46.59		
				Optimized with TSP	NB					
					SB					
3	IL Route 58 (Dempster Street)	Elmhurst Road	Ridge Avenue	Optimized without TSP (Sept. 2019)	WB	46.21	48.85	56.56		
					EB	53.72	49.50	50.28		
				Optimized with TSP	WB					
					EB					
4	Grand Avenue (Lake County)	U.S. 45	Sheridan Road	Optimized without TSP (Sept. 2019)	WB	21.43	23.30	23.34		
					EB	23.94	26.39	26.54		
				Optimized with TSP	WB					
					EB					
5	Halsted Street and Harvey TSP System Upgrade	95th Street	Chicago Heights Terminal	Optimized without TSP (Sept. 2019)	NB	35.44	35.89	35.71		
					SB	34.91	36.96	37.58		
				Optimized with TSP	NB					
					SB					
6	Milwaukee Avenue	Golf Mill	Jefferson Park CTA Station	Optimized without TSP (Sept. 2019)	NB	23.41	20.36	21.08		Extends into City limits
					SB	21.14	21.05	30.86		
				Optimized with TSP	NB					
					SB					

Appendix G – Summary of HERE Data on CTA / Pace Corridors

Pace TSP Corridor		Full Corridor Limits		Data Collection Period (Month / Year)	Direction	General Vehicle Travel Times (in minutes)				Notes
		From	To			AM Peak Period (7-9am)	Midday Period (11am-1pm)	PM Peak Period (4-6pm)		
7	IL Route 38 (Roosevelt Road)	Carlton Avenue	Laramie Avenue	Optimized without TSP (Sept. 2019)	WB	46.66	41.77	54.72		
					EB	53.71	43.58	56.68		
				Optimized with TSP	WB					
					EB					
8	95th Street	88th Avenue	Stony Island Avenue	Optimized without TSP (Sept. 2019)	WB	42.24	43.29	45.36		Extends into City limits
					EB	41.77	42.37	47.07		
				Optimized with TSP	WB					
					EB					
9	IL Route 83 (147th St./Sibley Blvd.)	Cicero Avenue	State Line Road	Optimized without TSP (Sept. 2019)	WB	28.68	28.77	31.46		
					EB	28.59	28.65	31.40		
				Optimized with TSP	WB					
					EB					
10	US Route 6 (159th Street)	94th Avenue	Torrance Avenue	Optimized without TSP (Sept. 2019)	WB	31.59	33.26	35.27		
					EB	33.02	35.21	37.71		
				Optimized with TSP	WB					
					EB					

Appendix H

Performance Measures for Long Term CTA / Pace TSP Corridors

Table 6A – CTA South Ashland Avenue Route 9 Performance Measures Summary

South Ashland Avenue for CTA Route 9 (Cermak Rd. to 95th St.)									
Performance Measure	Data Source	Corridor Conditions	Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Nov. 2015	57.76	53.99	58.15	61.51	57.38	62.15
		Optimized w/out TSP	March 2016	52.53	49.28	54.28	55.92	53.45	56.65
		Optimized with TSP	June 2016	52.24	49.55	54.9	54.85	52.26	63.46
		% Change – Baseline vs. Optimized w/o TSP		-10%	-10%	-7%	-10%	-7%	-10%
		Optimized w/o TSP vs. with TSP		-1%	1%	1%	-2%	-2%	11%
		Baseline vs. Optimized with TSP		-11%	-9%	-6%	-12%	-10%	2%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Nov. 2015	4.15	4.04	4.48	5.43	5.14	7.00
		Optimized w/out TSP	March 2016	3.12	3.60	3.78	4.75	2.91	5.37
		Optimized with TSP	June 2016	3.98	3.90	6.17	5.76	3.61	8.17
		% Change – Baseline vs. Optimized w/o TSP		-33%	-12%	-18%	-14%	-77%	-30%
		Optimized w/o TSP vs. with TSP		22%	8%	39%	18%	19%	34%
		Baseline vs. Optimized with TSP		-4%	-4%	27%	6%	-42%	14%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline*	Nov. 2015	10.40	9.78	10.12	10.92	11.73	14.18
		Optimized w/out TSP	March 2016	15.48	12.62	13.85	15.87	14.88	17.17
		Optimized with TSP	June 2016	16.32	14.00	14.67	18.65	14.43	21.40
		% Change – Baseline vs. Optimized w/o TSP		33%	22%	27%	31%	21%	17%
		Optimized w/o TSP vs. with TSP		5%	10%	6%	15%	-3%	20%
		Baseline vs. Optimized with TSP		36%	30%	31%	41%	19%	34%
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline*	Nov. 2015	17	17	19	19	18	22
		Optimized w/out TSP	March 2016	21	22	22	25	21	22
		Optimized with TSP	June 2016	22	21	19	22	19	24
		% Change – Baseline vs. Optimized w/o TSP		19%	23%	14%	24%	14%	0%
		Optimized w/o TSP vs. with TSP		5%	-5%	-16%	-14%	-11%	8%
		Baseline vs. Optimized with TSP		23%	19%	0%	14%	5%	8%
2: General Vehicle Travel Times (in minutes)	Floating Car (2015-2016) / HERE Data (2016-2019)	Baseline	November 2015	29.27	27.93	30.30	28.12	29.15	31.47
		Optimized w/out TSP	March 2016	27.93	27.55	27.53	26.25	28.15	30.73
		Optimized w/out TSP	April 2016	25.14	25.01	24.71	26.63	24.66	28.2
		Optimized with TSP	July 2016	29.42	29.55	29.81	32.16	29.32	33.92
		% Change – Baseline vs. Optimized w/o TSP		-5%	-1%	-10%	-7%	-4%	-2%
		Optimized w/o TSP vs. with TSP		15%	15%	17%	17%	16%	17%
		Baseline vs. Optimized with TSP							

*Baseline values are from field data collected by EJM as opposed to the TSP PMAT that analyzed CTA second-by-second AVL data in other phases. Percent changes are not calculated for data sets that were obtained with different methodologies.

** HERE data collected in April 2016 and July 2016 as two points of comparison (before and after TSP deployment on the corridor).

Table 6B – CTA North Ashland Avenue Route 9 Performance Measures Summary

North Ashland Avenue for CTA Route 9 (Irving Park Rd. Cermak Rd.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change –		-	-	-	-	-	-
		Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP	-						
		% Change –		-	-	-	-	-	-
		Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline*	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change –		-	-	-	-	-	-
		Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline*	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change –		-	-	-	-	-	-
		Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-2019)	Baseline	Sept. 2018	38.26	44.83	33.82	31.75	44.08	39.55
		Baseline	Sept. 2019	39.51	42.02	34.27	33.94	43.63	45.72
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-

Table 7A – CTA South Ashland Avenue Route X9 Performance Measures Summary

South Ashland Avenue for CTA Route X9 (Cermak Rd. to 95th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	46.2	41.72	--	--	44.88	44.98
		Optimized with TSP	June 2016	49.74	41.98	42.8	40.84	44.14	49.28
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		7%	1%	-	-	-2%	9%
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	
		Optimized w/out TSP	March 2016	13.70	12.03	17.45	17.82	12.35	10.13
		Optimized with TSP	June 2016	17.47	11.27	11.57	12.23	11.52	16.55
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		22%	-7%	-51%	-46%	-7%	39%
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	19	22	22	25	18	21
		Optimized with TSP	June 2016	21	19	16	20	17	21
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		9.52%	-15.79%	-37.50%	-25.00%	-5.88%	0.00%
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Floating Car (2016) / HERE Data (2016-2019)	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	March 2016	29.27	27.93	30.30	28.12	29.15	31.47
		Optimized with TSP	June 2016	27.93	27.55	27.53	26.25	28.15	30.73
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP		-5%	-1%	-10%	-7%	-4%	-2%
		Baseline vs. Optimized with TSP							

Table 7B – CTA North Ashland Avenue Route X9 Performance Measures Summary

North Ashland Avenue for CTA Route X9 (Irving Park Rd. Cermak Rd.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	-	-	-	-	-	-	-
		Optimized w/out TSP	-	-	-	-	-	-	-
		Optimized with TSP	-	-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-2019)	Baseline	Sept. 2018	38.26	44.83	33.82	31.75	44.08	39.55
		Optimized w/out TSP	Sept. 2019	39.51	42.02	34.27	33.94	43.63	45.72
		Optimized with TSP		-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-

Table 8 – CTA Western Avenue (Route 49) Performance Measures Summary

Western Avenue for CTA Route 49 (Berwyn to 79th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	96.57	91.28	97.34	102.01	104.31	107.40
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	96.88	92.02	100.86	100.17	106.08	112.54
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		0%	1%	3%	-2%	2%	5%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	13.98	9.03	8.48	8.57	12.53	15.60
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	11.73	11.21	8.88	8.83	12.54	16.15
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-19%	19%	5%	3%	0%	3%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	43.93	38.72	36.73	39.45	50.20	56.72
		Optimized w/out TSP	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	49	51	49	51	54	58
		Optimized w/out TSP	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route 49 (Berwyn to 79th)					
		Optimized w/out TSP	Sept. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		Optimized with TSP	Sept. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		0%	-35%	-3%	1%	-2%	-4%

Table 9 – CTA Western Avenue (Route X49) Performance Measures Summary

Western Avenue for CTA Route X49 (Berwyn to 79th St.)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	99.67	89.23	--	--	101.79	112.59
		Optimized w/out TSP				--	--		
		Optimized with TSP	Fall 2019	96.39	83.90	--	--	96.55	103.35
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		-3%	-6%	--	--	-5%	-9%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	10.02	8.75	--	--	9.58	10.89
		Optimized w/out TSP				--	--		
		Optimized with TSP	Fall 2019	8.02	5.83	--	--	8.38	7.64
		% Change – Baseline vs. Optimized w/o TSP				-	-		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		-25%	-50%	--	--	-14%	-42%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	38.70	48.88	--	--	35.33	57.68
		Optimized w/out TSP	Fall 2018			--	--		
		Optimized with TSP	Fall 2019			--	--		
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP				--	--		
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	42	47	--	--	47	53
		Optimized w/out TSP	Fall 2018			--	--		
		Optimized with TSP	Fall 2019			--	--		
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP				--	--		
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route X49 (Berwyn to 79th)					
		Optimized w/out TSP	Sept. 2018	101.76	90.51	81.11	77.79	90.41	116.16
		Optimized with TSP	Sept. 2019	102.12	66.82	78.93	78.65	88.73	111.34
		% Change – Baseline vs. Optimized w/o TSP				--	--		
		Optimized w/o TSP vs. with TSP				--	--		
		Baseline vs. Optimized with TSP		0%	-35%	-3%	1%	-2%	-4%

Table 10 – CTA Western Avenue (Route 49B) Performance Measures Summary

Western Avenue for CTA Routes 49B (Howard to Brown Line Station)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Baseline	Fall 2018	22.10	24.53	22.64	23.19	25.43	25.80
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	21.55	26.88	22.49	25.84	24.70	27.58
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-3%	9%	-1%	10%	-3%	6%
1-B Bus Travel Time Variability (in minutes)	AVL System	Baseline	Fall 2018	3.57	3.98	3.23	3.07	3.87	3.58
		Optimized w/out TSP							
		Optimized with TSP	Fall 2019	3.37	4.62	3.43	3.77	3.63	4.10
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		-6%	14%	6%	19%	-7%	13%
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data	Baseline	Fall 2016	8.43	9.67	6.77	8.13	10.42	11.62
		Optimized w/out TSP	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data	Baseline	Fall 2016	11	13	11	13	13	13
		Optimized w/out TSP	Fall 2018						
		Optimized with TSP	Fall 2019						
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	HERE Data (2018-19)			Western Avenue Route 49B (Howard to Leland)					
		Optimized w/out TSP	Sept. 2018	19.56	17.80	15.22	14.66	18.64	18.84
		Optimized with TSP	Sept. 2019	21.11	17.76	17.42	14.41	20.00	18.48
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP		7%	0%	13%	-2%	7%	-2%

Table 11 – Pace Cermak Road Performance Measures Summary									
Cermak Road for Pace Route 322 from IL Route 56 (Butterfield Rd.) to Cicero Avenue									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP	Summer 2019	54.51	57.58	60.24	60.33	66.49	60.81
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP	Summer 2019	3.82	6.49	7.25	4.22	10.18	5.53
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP					-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-13) ; HERE Data (2019)	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP***	Sept. 2019	51.18	51.90	49.30	50.99	58.14	57.63
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

*** HERE Data collected between IL Route 56 (Butterfield Rd.) to 54th Avenue.

Table 12 – Pace Cicero Avenue Performance Measures Summary

Cicero Avenue for Pace Route 383 from 59th Street to 167th Street

Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Nov. 2012						
		Optimized w/out TSP	July 2013						
		Optimized w/out TSP	Summer 2019	53.27	54.12	58.66	57.45	58.61	61.12
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Nov. 2012						
		Optimized w/out TSP	July 2013						
		Optimized w/out TSP	Summer 2019	3.46	5.02	5.15	5.47	5.28	5.79
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-13)**							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change –		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change –		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-15); HERE Data (2019)	Baseline	Nov. 2012 and Mar. 2015						
		Optimized w/out TSP**	July 2013 and June 2015						
		Optimized w/out TSP***	Sept. 2019	43.89	38.17	38.23	38.82	42.63	46.59
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-15)**							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between 87th Street to 115th Street in 2012 / 2013 and separately between 115th and 159th Street in 2015.

*** HERE Data collected between 87th Street and US Route 6 (159th Street).

Table 13 – Pace Dempster Street Performance Measures Summary										
Dempster Street for Pace Route 250 from Elmhurst Road to Ridge Avenue										
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak		
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound	
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Feb. 2012	16.43	15.61	15.73	15.56	17.94	18.44	
		Optimized w/out TSP	May 2012	16.36	15.77	18.17	16.27	20.22	20.21	
		Optimized w/out TSP	Summer 2019	51.92	52.34	53.52	54.07	57.93	57.67	
		Optimized with TSP								
		% Change – Baseline vs. Optimized w/o TSP		0%	1%	16%	5%	13%	10%	
		Optimized w/o TSP vs. with TSP								
		Baseline vs. Optimized with TSP								
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Feb. 2012	3.80	4.18	3.68	4.23	3.71	5.99	
		Optimized w/out TSP	May 2012	3.84	4.79	3.56	4.65	3.68	6.55	
		Optimized w/out TSP	Summer 2019	4.79	6.34	5.12	5.90	5.23	7.48	
		Optimized with TSP								
		% Change – Baseline vs. Optimized w/o TSP		1%	15%	-3%	10%	-1%	9%	
		Optimized w/o TSP vs. with TSP								
		Baseline vs. Optimized with TSP								
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-	
		Optimized w/out TSP		-	-	-	-	-	-	
		Optimized with TSP								
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-	
		Optimized w/o TSP vs. with TSP								
		Baseline vs. Optimized with TSP								
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-	
		Optimized w/out TSP		-	-	-	-	-	-	
		Optimized with TSP								
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-	
		Optimized w/o TSP vs. with TSP								
		Baseline vs. Optimized with TSP								
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012); HERE Data	Baseline								
		Optimized w/out TSP								
		Optimized w/out TSP***	Sept. 2019	53.72	46.21	49.50	48.85	50.28	56.56	
		Optimized with TSP								
		% Change – Baseline vs. Optimized w/o TSP								
		Optimized w/o TSP vs. with TSP								
		Baseline vs. Optimized with TSP								

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant from Potter Road to Cumberland Avenue and from Harlem Avenue to Skokie Boulevard.

*** HERE Data collected between Mannheim Road in city of Des Plaines and Dodge Avenue in city of Evanston.

Table 14 – Pace Grand Avenue (Lake County) Performance Measures Summary									
Grand Avenue (Lake County) for Pace Route 565 from US 45 to Sheridan Road									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Dec. 2014						
		Optimized w/out TSP	Apr. 2015						
		Optimized w/out TSP	Summer 2019	42.15	51.95	47.88	54.79	53.14	57.40
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Dec. 2014						
		Optimized w/out TSP	Apr. 2015						
		Optimized w/out TSP	Summer 2019	3.35	3.39	4.16	4.91	4.24	5.88
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2014-15); HERE Data (2019)	Baseline							
		Optimized w/out TSP**							
		Optimized w/out TSP***	Sept. 2019	23.94	21.43	26.39	23.30	26.54	23.34
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

*** HERE Data collected between Dilleys Road and Sheridan Road.

Table 15 – Pace Halsted Street Performance Measures Summary

Halsted Street for Pace Route 352 from 95th St. to Chicago Heights Bus Terminal

Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP	Summer 2019	61.26	66.97	65.36	74.00	66.06	75.15
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP	Summer 2019	4.19	4.89	4.18	8.12	5.21	8.67
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP		-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP		-	-	-	-	-	-
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP		-	-	-	-	-	-
2: General Vehicle Travel Times (in minutes)	HERE Data (2019)	Baseline		-	-	-	-	-	-
		Optimized w/out TSP**		-	-	-	-	-	-
		Optimized w/out TSP***	September 2019	35.44	34.91	35.89	36.96	35.71	37.58
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.
** Speed / Delay Studies conducted by signal consultant along multiple signal systems of Cermak Road between July 2012 and April 2013 between IL Route 56 (Butterfield Rd.) to 54th Avenue.
*** HERE Data collected between IL Route 56 (Butterfield Rd.) to 54th Avenue.

Table 16 – Pace Milwaukee Avenue Performance Measures Summary									
Milwaukee Avenue for Pace Route 270 Golf Mill Mall and Jefferson Park CTA Station									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Dec. 2010	20.81	22.52	21.49	23.62	22.31	26.87
		Optimized w/out TSP	April 2011	20.47	21.91	21.93	23.23	21.31	26.37
		Optimized w/out TSP	Summer 2019	25.9	26.2	26.7	27.1	26.3	31.4
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-2%	-3%	2%	-2%	-4%	-2%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Dec. 2010	6.6	9.8	6.7	7.2	8.1	6.7
		Optimized w/out TSP	April 2011	6.2	7.6	6.3	6.8	9.1	6.6
		Optimized w/out TSP	Summer 2019	2.7	2.4	2.8	2.9	2.8	5.2
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-6%	-22%	-6%	-5%	13%	-2%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2010-11); HERE Data (2019)	Baseline	Dec. 2010	19.38	17.25	18.58	17.63	20.65	23.86
		Optimized w/out TSP**	April 2011	16.6	15.62	15.65	15.46	17.59	20.17
		Optimized w/out TSP***	Sept. 2019	23.4	21.1	20.4	21.1	21.1	30.9
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2010-11)**		-14%	-9%	-16%	-12%	-15%	-15%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Golf Road and Gale Street.

*** HERE Data collected between Golf Mill Mall to Jefferson Park CTA Station.

Table 17 – Pace Roosevelt Road Performance Measures Summary									
Roosevelt Road for Pace Routes 301 / 305 from Carlton Avenue to Laramie Avenue									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP (Route 301)	Summer 2019	69.86	70.81	74.51	76.8	87.56	83.92
		Optimized w/out TSP (Route 305)	Summer 2019	22.05	20.93	24.27	21.74	28.05	24.70
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP (Route 301)	Summer 2019	3.12	4.94	3.95	6.36	7.87	7.21
		Optimized w/out TSP (Route 305)	Summer 2019	5.22	2.58	4.97	2.85	5.38	4.45
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP					-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP		-	-	-	-	-	-
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-15); HERE Data	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP***	Sept. 2019	53.71	46.66	43.58	41.77	56.68	54.72
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

*** HERE Data collected between Warrenville Rd. / West Street to IL Route 43 (Harlem Ave).

Table 18 – Pace 95th Street Performance Measures Summary

95th Street for Pace Route 381 (88th Avenue to Stony Island Avenue)

Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	May 2012	21.42	22.35	23.42	22.53	26.13	23.70
		Optimized w/out TSP	Oct. 2012	21.28	21.08	22.67	21.03	25.19	22.67
		Optimized w/out TSP	Summer 2019	26.5	28.08	31.39	29.49	33.31	29.24
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)**		-1%	-1%	-6%	-3%	-7%	-4%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	May 2012	5.98	4.79	5.56	4.74	6.45	4.51
		Optimized w/out TSP	Oct. 2012	4.61	4.46	5.24	5.38	6.42	4.86
		Optimized w/out TSP	Summer 2019	2.72	2.99	4.18	3.19	4.85	3.78
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012)**		-23%	-7%	-6%	14%	-1%	8%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2012-14); HERE Data (2019)	Baseline							
		Optimized w/out TSP**							
		Optimized w/out TSP***	Sept. 2019	41.77	42.24	42.37	43.29	47.07	45.36
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2012-14)**		-19%	-12%	-14%	-18%	-26%	-28%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Oak Park Avenue to Western Avenue and from Roberts Road to I-294.

*** HERE Data collected between Roberts Road in the city of Hickory Hills to Western Avenue in the village of Evergreen Park.

Table 19 – Pace 147th Street Performance Measures Summary

147th Street / Sibley Boulevard for Pace Route 350 / 354 from Cicero Avenue to State Line Road

Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP (Route 350)	Summer 2019	18.26	22.40	20.89	23.35	22.85	22.53
		Optimized w/out TSP (Route 354)	Summer 2019	10.41	10.68	10.73	10.76	11.45	11.65
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2015)**							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline							
		Optimized w/out TSP (Route 350)	Summer 2019	2.02	2.04	3.21	2.81	2.85	2.62
		Optimized w/out TSP (Route 354)	Summer 2019	1.17	1.44	1.87	1.88	1.99	1.84
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2015)**							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2015); HERE Data (2019)	Baseline							
		Optimized w/out TSP							
		Optimized w/out TSP***	Sept. 2019	28.59	28.68	28.65	28.77	31.40	31.46
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP							
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

*** HERE Data collected between Warrenville Rd. / West Street to IL Route 43 (Harlem Ave).

Table 20 – Pace 159th Street Performance Measures Summary

159th Street Corridor for Pace Route 364 (Park Center Drive to IL 83 (Torrence Avenue)									
Performance Measure	Data Source		Period	AM Peak		Midday		PM Peak	
			Direction	East-bound	West-bound	East-bound	West-bound	East-bound	West-bound
1-A Average Bus Travel Time (in minutes)	Timepoint Data	Baseline	Jan. 2013	17.3	16.7	16.5	17.8	17.2	17.3
		Optimized w/out TSP	April 2013	16.8	17.0	16.2	17.0	17.0	18.1
		Optimized w/out TSP	Summer 2019	57.5	60.6	60.2	62	62.1	60.7
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		-3%	2%	-2%	-5%	-1%	5%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-B Bus Travel Time Variability (in minutes)	Timepoint Data	Baseline	Jan. 2013	2.88	2.70	4.13	3.09	3.40	3.93
		Optimized w/out TSP	April 2013	3.19	3.42	4.36	3.61	3.81	4.68
		Optimized w/out TSP	Summer 2019	3.4	4	5.2	4.6	5.3	4.1
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		10%	27%	6%	17%	12%	19%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-C Traffic Signal Delay (in minutes)	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-	-	-	-	-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
1-D Number of Stops at Red Signals	Second-by-Second AVL Data*	Baseline		-	-	-	-	-	-
		Optimized w/out TSP		-	-	-	-	-	-
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP		-	-				-
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							
2: General Vehicle Travel Times (in minutes)	Speed / Delay Studies (2013); HERE Data (2019)	Baseline	Jan. 2013	7.41	7.68	7.84	8.32	8.41	8.75
		Optimized w/out TSP**	April 2013	7.36	7.72	7.35	7.42	7.27	7.56
		Optimized w/out TSP***	Sept. 2019	33.02	31.59	35.21	33.26	37.71	35.27
		Optimized with TSP							
		% Change – Baseline vs. Optimized w/o TSP (2013)**		-1%	1%	-6%	-11%	-14%	-14%
		Optimized w/o TSP vs. with TSP							
		Baseline vs. Optimized with TSP							

* Second-by-second AVL data not available from Pace AVL system during evaluation period.

** Speed / Delay Studies conducted by signal consultant between Crawford Avenue and Park Avenue.

*** HERE Data collected between Park Center Drive to IL 83 (Torrence Avenue).

Pace TSP Corridor		Near Term Segments of TSP Deployment by Pace		Near Term Pace Routes			Full Corridor Limits of TSP Deployment by Pace		Long Term Pace Routes			Notes
		From	To	Route	Timepoint Boundaries		From	To	Route	Timepoint Boundaries		
1	Cermak Road / 22nd Street	IL Route 56 (Butterfield Rd.) and Fairfield Ave (village of Lombard)	54th Avenue in the town of Cicero	322	Timepoint 1	Timepoint 8	Butterfield Road/Lambert Road	Cicero Avenue	322	Timepoint 1	Timepoint 8	Very small difference in near and long term segments. Recommend to use same route 322 timepoints as noted.
2	IL Route 50 (Cicero Avenue)	87th Street in the village of Oak Lawn	US Route 6 (159th Street) in the city of Oak Forest	383	Timepoint 3	Timepoint 8	59th Street	167th Street	383	Timepoint 1	Timepoint 8	Will need to include additional timepoints as noted for the longer term corridor for Route 383.
3	IL Route 58 (Dempster St.)	Mannheim Road in city of Des Plaines	Dodge Avenue in city of Evanston	250	Timepoint 1	Timepoint 9	Elmhurst Road	Ridge Avenue	250	Timepoint 1	Timepoint 9	Difference noted in near and long term segments, but recommended to use same timepoints for Route 250 on this corridor.
4	Grand Avenue (Lake County)	Dilleys Road in the village of Gurnee	Sheridan Road in city of Waukegan	565	Timepoint 1	Timepoint 5	U.S. 45	Sheridan Road	565	Timepoint 1	Timepoint 8	Will need to include additional timepoints as noted for the longer term corridor.
5	Halsted Street and Harvey TSP System Upgrade						95th Street	Chicago Heights Terminal	352	Timepoint 1	Timepoint 9	Will need to include timepoints as noted for the longer term corridor.
6	Milwaukee Avenue	Golf Mill	Jefferson Park CTA Station	270	Timepoint 1	Timepoint 6	Golf Mill	Jefferson Park CTA Station	270	Timepoint 1	Timepoint 6	No difference in near and long term segments.
7	IL Route 38 (Roosevelt Rd.)	Warrenville Rd. / West Street in the city of Wheaton	IL Route 43 (Harlem Ave) in village of Forest Park	301	Timepoint 1	Timepoint 10	Carlton Avenue	Laramie Avenue	301 + 305	Timepoint 1 (301) Timepoint 1 (305)	Timepoint 10 (301) Timepoint 4 (305)	Will need to include additional timepoints as noted for the longer term corridor for Route 305. No difference with Route 301.
8	95th Street	Roberts Road in the city of Hickory Hills	Western Avenue in the village of Evergreen Park	381	Timepoint 3	Timepoint 8	88th Avenue	Stony Island Avenue	381	Timepoint 2	Timepoint 11	Need to request route 353 summer 2019 AVL data, do not have this yet.
9	IL Route 83 (147th St. / Sibley Blvd.)	IL Route 1 (Halsted St.) in the city of Harvey	IL Route 83 (Torrence Avenue) in Calumet City	350	Timepoint 2	Timepoint 4	Cicero Avenue	State Line Road	350 + 354	Timepoint 2 (350) Timepoint 5 (354)	Timepoint 5 (350) Timepoint 7 (354)	Will need to include additional timepoints as noted for the longer term corridor for Route 350, and add the Route 354 to this summary.
10	US Route 6 (159th Street)	Park Center Drive in the village of Orland Park	IL Route 83 (Torrence Avenue) in Calumet City	364	Timepoint 1	Timepoint 10	94th Avenue	Torrance Avenue	364	Timepoint 1	Timepoint 10	Very small difference in near and long term segments. Recommend to use same route 364 timepoints as noted.

Appendix I

CTA AVL Data Summary Tables (Performance Measures 1-A and 1-B)

Appendix I - CTA AVL Data Summary Tables (Performance Measures 1-A and 1-B)

Ashland Avenue for CTA Route 9								
Performance Measure	Data Source	Period	AM Peak		Midday		PM Peak	
		Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	November 2015	57.76	53.99	58.15	61.51	57.38	62.15
		March 2016	52.53	49.28	54.28	55.92	53.45	56.65
		June 2016	52.24	49.55	54.90	54.85	52.26	63.46
		Spring 2018	49.92	49.42	50.10	54.05	50.37	56.23
		Fall 2018	50.85	49.13	52.04	56.12	50.60	55.97
		Spring 2019	52.43	47.55	53.65	51.95	49.82	55.93
		Fall 2019	55.30	47.92	54.80	54.74	51.08	56.74
1-B Bus Travel Time Variability (std. dev. In minutes)	AVL System	November 2015	4.15	4.04	4.48	5.43	5.14	7.00
		March 2016	3.12	3.60	3.78	4.75	2.91	5.37
		June 2016	3.98	3.90	6.17	5.76	3.61	8.17
		Spring 2018	6.26	3.52	3.46	4.68	3.83	6.47
		Fall 2018	6.37	4.95	4.77	7.85	4.43	7.80
		Spring 2019	3.95	3.77	4.61	4.88	4.81	5.38
		Fall 2019	4.50	3.64	4.81	4.99	3.58	5.03

Ashland Avenue for CTA Route X9								
Performance Measure	Data Source	Period	AM Peak		Midday		PM Peak	
		Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	March 2016	46.20	41.72	--	--	44.88	44.98
		June 2016	49.74	41.98	42.80	40.84	44.14	49.28
		Spring 2018	43.38	42.45	40.30	44.78	39.17	49.30
		Fall 2018	46.20	43.73	41.32	43.67	41.76	47.67
		Spring 2019	43.87	40.95	41.83	40.13	39.85	48.03
		Fall 2019	46.94	42.18	41.32	42.80	39.91	47.60
1-B Bus Travel Time Variability (std. dev. In minutes)	AVL System	March 2016	3.64	3.38	NA	NA	5.29	3.06
		June 2016	4.74	4.37	2.58	5.03	4.63	5.07
		Spring 2018	3.89	3.33	2.36	3.90	2.70	4.80
		Fall 2018	4.67	5.24	3.56	4.18	4.25	5.75
		Spring 2019	4.07	3.49	3.37	3.79	3.33	4.52
		Fall 2019	4.79	3.43	2.65	3.93	3.31	4.63

Appendix I - CTA AVL Data Summary Tables (Performance Measures 1-A and 1-B)

Western Avenue for CTA Route 49								
Performance Measure	Data Source	Period	AM Peak		Midday		PM Peak	
		Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Fall-Winter 2016	95.48	93.48	97.62	104.47	103.83	108.85
		Fall 2017	97.27	91.65	97.35	101.85	104.10	109.02
		Spring 2018	96.03	91.20	97.23	102.18	103.10	109.42
		Fall 2018	96.57	91.28	97.34	102.01	104.31	107.40
		Spring 2019	96.58	92.52	101.58	100.35	107.10	109.85
		Fall 2019	96.88	92.02	100.86	100.17	106.08	112.54
1-B Bus Travel Time Variability (std.dev. In minutes)	AVL System	Fall-Winter 2016	13.43	8.33	8.35	7.28	12.64	14.66
		Fall 2017	12.95	9.64	8.76	8.94	12.30	15.14
		Spring 2018	11.97	9.22	8.69	8.63	12.86	15.21
		Fall 2018	13.98	9.03	8.48	8.57	12.53	15.60
		Spring 2019	9.97	8.84	8.78	8.95	12.21	15.40
		Fall 2019	11.73	11.21	8.88	8.83	12.54	16.15

Western Avenue for CTA Route X49								
Performance Measure	Data Source	Period	AM Peak		Midday		PM Peak	
		Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Fall-Winter 2016	93.12	86.22	N/A	N/A	99.48	109.45
		Fall 2017	94.62	88.88	N/A	N/A	97.87	106.03
		Spring 2018	94.31	86.74	N/A	N/A	98.18	105.78
		Fall 2018	99.67	89.23	N/A	N/A	101.79	112.59
		Spring 2019	94.27	83.27	N/A	N/A	98.57	102.77
		Fall 2019	96.39	83.90	N/A	N/A	96.55	103.35
1-B Bus Travel Time Variability (std.dev. In minutes)	AVL System	Fall-Winter 2016	8.22	6.85	N/A	N/A	9.32	10.10
		Fall 2017	7.85	7.36	N/A	N/A	8.41	7.72
		Spring 2018	8.12	7.38	N/A	N/A	8.68	8.84
		Fall 2018	10.02	8.75	N/A	N/A	9.58	10.89
		Spring 2019	7.52	5.48	N/A	N/A	7.94	6.93
		Fall 2019	8.02	5.83	N/A	N/A	8.38	7.64

Western Avenue for CTA Route 49B								
Performance Measure	Data Source	Period	AM Peak		Midday		PM Peak	
		Direction	North-bound	South-bound	North-bound	South-bound	North-bound	South-bound
1-A Average Bus Travel Time (in minutes)	AVL System	Fall-Winter 2016	22.23	23.35	21.85	21.58	25.22	23.63
		Fall 2017	22.72	26.10	22.05	23.18	25.13	25.95
		Spring 2018	21.73	24.79	22.38	23.78	25.26	25.87
		Fall 2018	22.10	24.53	22.64	23.19	25.43	25.80
		Spring 2019	21.63	27.28	22.30	25.92	25.13	27.48
		Fall 2019	21.55	26.88	22.49	25.84	24.70	27.58
1-B Bus Travel Time Variability (std.dev. In minutes)	AVL System	Fall-Winter 2016	4.14	4.10	3.16	2.78	3.49	3.30
		Fall 2017	3.74	4.40	3.23	2.77	3.27	3.41
		Spring 2018	3.48	3.73	3.31	3.35	3.63	4.11
		Fall 2018	3.57	3.98	3.23	3.07	3.87	3.58
		Spring 2019	3.25	4.42	3.01	3.37	3.79	4.06
		Fall 2019	3.37	4.62	3.43	3.77	3.63	4.10