PROPOSAL FOR:

REQUEST FOR PROPOSALS

Technology for Buses

RFP No. TM-24-01

Automatic Passenger Counting (APC) System

Prepared for:

Topeka Metropolitan Transit Authority

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December 13 2023

Mr. Richard Appelhanz
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Attached to this letter is the technical and cost proposal of Urban Transportation Associates (UTA) in response to **Topeka METRO RFP TM-24-01 TECHNOLOGY FOR BUSES .** UTA's attached proposal is focused solely on providing METRO with a high quality Automatic Passenger Counting (APC) system.

Given the increased importance of accurate and reliable Ridership information, the transit marketplace is moving toward separating the APC function from an overall on-bus ITS configuration. Over the past few years, a growing number of transit agencies have chosen to implement StandAlone APC systems rather than APC configurations that require dependency on the performance of the CAD/AVL system.

UTA is the only firm in North America that is solely dedicated to providing high quality APC systems to transit agencies. Over three (3) decades and in more than 150 transit agencies, UTA's APC system has been providing information that allows transit managers to improve the quality and productivity of local transit service. UTA employs ten (10) full-time engineers with more than fourteen (14) advanced (MS+) degrees and with an average of fifteen (15) years of experience in the development and application of APC technology. UTA is uniquely qualified to provide METRO with a high quality APC system that will meet METRO's Ridership information needs, including NTD reporting, for the next decade.

In UTA's experience, UTA has integrated UTA's APC system with more than twenty-five (25) different AVL system suppliers. From this experience, UTA has encountered frequent anomalies and malfunctions of the AVL system which impact the quality and quantity of APC data. Quite simply, the implementation and operation of a high quality APC system is much more difficult than assumed by CAD/AVL suppliers and, often, local transit staff. UTA's StandAlone APC system (both on-vehicle hardware and analytic software) is far superior to the APC systems provided by ITS suppliers.

UTA's President/CEO, Thomas W. Kowalski, will have responsibility for the implementation of UTA's APC system at METRO in accordance with costs and schedules presented in the attached proposal. All UTA staff referenced in UTA's proposal will contribute to the implementation and support of UTA's APC system at METRO.

We look forward to providing METRO with the highest quality APC system available in the transit marketplace.

Yours truly

Thomas W. Kowalski
President/CEO

Executive Summary

Urban Transportation Associates (UTA), Inc. proposes to provide Topeka Metropolitan Transit Authority (Metro) with an Automatic Passenger Counting (APC) system installed on Metro's fleet of twenty-six (26) buses along with an APC Software package that will fulfill Metro's Service Development analytic needs, including National Transit Database (NTD) reporting. UTA's APC system is in compliance with Metro's objectives and specifications referenced in **Metro RFP No. TM-24-01.**

UTA is the recognized leader in the development and application of APC technology in North America. For more than three (3) decades and in more than 150 transit agencies, UTA's APC system, on buses and rail cars, has been providing accurate and reliable information to transit managers. UTA is the only firm in North America specializing solely in the provision of high-quality APC systems to transit organizations.

Over the past 5-10 years a significant portion of UTA's annual revenues have been generated from transit agencies that did not receive an effective APC system as part of an ITS procurement. Metro's experience with an APC sub-system provided by an AVL suppliers appears to be consistent with dozens of transit agencies that received an ineffective APC system from an AVL supplier. These transit agencies contact UTA to provide APC software, and in many cases, replace on-vehicle APC hardware in order to obtain the critical information generated by an APC system, including NTD reporting. Within UTA's experience applying UTA's APC Software to more than twenty-five (25) different AVL suppliers. It is likely that UTA has processed APC data from every supplier submitting proposals to Metro in response to RFP TM-24-01. Given UTA insight into the quality and quantity of APC data provided by AVL suppliers, UTA can confidently state that the quality and quantity of APC data generated by UTA's APC system is far superior to that provided by the AVL suppliers.

UTA's belief is that it is in Metro's best interest to seriously consider a StandAlone APC system rather than an APC system integrated within an AVL system. Based on communications at the recent APTA EXPO, there is a distinct trend in the marketplace toward a StandAlone APC system.

For analytic reporting, including NTD, 100% of the bus fleet does not need to be equipped with APC systems. Deploying a subfleet (50% APC-equipped) of APC-equipped buses across Metro's fixed-route service will generate sample sizes that will meet FTA's NTD requirements as well as standard local monthly Ridership reporting.

Presented in this Executive Summary are key attributes of UTA's APC system for which detail is presented in the subsequent sections of this proposal.

APC On-Vehicle Hardware:

Over the past decade, UTA's APC system has been installed on more than 10,000 buses and more than 200 rail cars in North America. In UTA's bus and rail APC applications, APC passenger counting accuracies (98%-99%) and reliability (APC Data Yield 95+%) have exceeded user requirements. Included in UTA's most recent APC applications on buses, Driver Seat Monitoring and Multi-Slot Bike Rack Monitoring are unique features provided by UTA. UTA's APC system does not require any scheduled preventive maintenance. The design of UTA's APC system is modular which allows for easy replacement of APC components. UTA's APC system does not require any driver initialization/login. With a draw of less than 200 milliamps, UTA's APC CPU draws power from the vehicle power source (battery) and provides a complete set of APC data both in revenue service and outside of revenue service.

UTA's on-bus APC configuration includes the transfer of raw APC data in real-time in a GTFS-RT format. At both SMART (Sonoma County) and WATA (Williamsburg), Real-Time displays of vehicle location and Passenger Load are active.

UTA's use of best-of-breed components, including cables and connectors, also utilized in heavy manufacturing and defense applications contribute to the ruggedness of UTA's APC system and the availability of spare parts. UTA's on-bus APC system reliability routinely exceeds 99% in the harsh transit operating environment.

UTA will install state-of-the-art APC sensors using stereoscopic vision technology manufactured by Hella. UTA has installed Hella APC sensors on thousands of buses and rail cars over the past decade with excellent accuracy, reliability and cost effectiveness. UTA has also been executing tests of multiple APC sensors on a given bus in order to compare accuracy and reliability. For the two (2) most commonly utilized APC sensors (Hella & IRMA) the side-by-side comparisons indicate a 1%

difference which is insignificant in analytic applications. Metro should be wary of proposals that state the superiority of a given APC sensor. UTA has worked with virtually all APC sensors active in the transit marketplace and has found consistent accuracy among the various APC sensors.

APC Software:

UTA's APC Software is recognized as the most comprehensive APC analytic software package available in the transit marketplace. UTA's APC Software package routinely generates high quality analytics from on-bus AVL/APC systems provided by UTA or numerous CAD/AVL suppliers. It is common for UTA's APC Software to be implemented at transit agencies where non-UTA APC hardware was installed by AVL system providers years previous. See Section 1.3 for a list of transit agencies that have implemented UTA's APC Software package to process APC data from non-UTA on-vehicle APC hardware.

UTA's APC Software package produces more than sixty (60+) Analytic and Administrative Control reports and is easily adapted to meet specific Metro analytic preferences. From detailed Bus Stop-level Ridechecks to macro–System Service Standards Compliance and NTD analyses, UTA's analytic software will extract all possible information from the raw APC data.

UTA's APC Administrative Control software module provides the ability to consistently monitor the performance of the APC system in order to produce high-quality information over the long life (10-15 years) of UTA's APC system. Meeting the full range of Metro's analytic needs, including NTD reporting, represents the primary objective of UTA's APC system. UTA's APC Administrative Control features provide users with the ability to execute substantiation and audits of APC-generated analyses.

UTA's APC Software package can be installed on a local Metro server or on UTA's cloud server (AWS). On an Metro APC Server, UTA's web-based reporting will allow Metro users (at least 40 concurrent) to access a full range of APC analytics at any time using a web-browser from each Metro user workstation.

UTA's APC system will provide the detailed service utilization metrics to the Federal Transit Administration (FTA) within the National Transit Database (NTD) program. Federal funding allocations are based, in part, on the Unlinked Passenger Trips (UPT) and Passenger Miles Traveled (PMT) submitted by transit agencies**.** At a number of UTA APC sites, Section 5307 Formula Funding allocations have been increased as a result of higher and more accurate PMT values generated from UTA's APC system.

FTA has approved every (100%) of the proposals from UTA APC users to apply APC-generated data to NTD reporting requirements.

FTA, along with UTA's APC users, recognize the depth with which UTA approaches APC applications and has confidence in the analytics produced from UTA's APC system. Included in UTA's proposal is the preparation of a request to FTA to obtain approval for Metro's application of APC data to NTD reporting.

Experience/Knowledge:

UTA's more than three (3) decades of experience in implementing APC systems in over one-hundred-fifty (150+) large and small transit organizations has provided UTA with a depth of APC experience unmatched in the North American transit marketplace. Specifically, UTA has successfully installed UTA's APC system on more than ten thousand (10,000+) buses and approximately two hundred (200) rail cars in either StandAlone or Integrated configurations.

UTA staff applied to Metro's APC Software application will bring more than two hundred (200+) cumulative years of direct experience in implementing APC systems in transit organizations. Academically, the UTA engineers supporting Metro's APC implementation have more than twelve (12) advanced degrees (MS+) in technical/engineering fields. **No other firm in the APC marketplace can offer the combination of technical skill and transit APC experience as UTA.**

UTA's combination of technical knowledge and transit experience should provide Metro with reassurance that UTA is most capable of implementing an APC system that will meet Metro's current and future analytic needs.

Included in UTA's Project Team is Mr. Keith Gates, recently retired as FTA's Manager of NTD. Mr. Gates will serve as the Qualified Statistician in preparing Metro's application to FTA to request approval to apply APC data to NTD reporting. Mr. Gates will provide assurance that Metro's APC application is fully compliant with FTA requirements.

Business Model:

UTA is an employee-owned firm in excellent financial condition. UTA's only business is providing APC technology to transit organizations which has resulted in a focus and energy that is not typically found in the transit marketplace. UTA takes pride in satisfying the wide range of information needs of transit users.

Over the past decade, UTA has consistently posted healthy profits in the 15%-25% range. UTA does not carry *any* long-term debt. In 1995, UTA retired long-term debt from its original start-up. UTA has an operating Line of Credit in the amount of $750,000 from Fifth Third Bank with whom UTA has had a business relationship for the past twenty-five (25) years. From a financial institution's perspective, UTA demonstrates financial strength through consistent, long-term financial performance (profitability).

UTA is the only firm in the U.S. transit marketplace that solely specializes in providing high quality APC systems to transit agencies. UTA's singular focus on APC applications has allowed UTA to develop an APC system consisting of on-vehicle hardware and analytic software that produces APC system performance levels unmatched in the transit marketplace. The lack of long-term debt and absentee ownership along with a highly dedicated staff has allowed UTA to develop a flexibility directed at meeting the needs of transit users. UTA routinely adapts UTA's APC system to the unique characteristics of a transit agency that only become apparent after contracts are signed and the APC system implementation takes place. UTA is not burdened by internal corporate administrative/bureaucratic rules which has resulted in an organizational culture that allows UTA the freedom to take whatever actions are necessary to meet the needs of UTA's users. It is this approach that has allowed UTA to achieve technical and financial success in the transit marketplace.

UTA enjoys positive and productive relationships with all UTA subcontractors. Each UTA supplier has been supplying goods and services to UTA for at least five (5) to ten (10) years. UTA suppliers are satisfied with the Terms and Conditions under which UTA supplier payment is generated in accordance with the Payment Schedule of each APC implementation.

UTA APC Support:

UTA supports UTA's APC system at an extremely high level that is unmatched in the transit marketplace. The majority of UTA's annual revenues are generated from UTA APC users expanding UTA's APC system which serves as a sound indicator of the level of user satisfaction. Not only will UTA staff provide direct support of Metro's APC system, but UTA APC users routinely share applications with each other to advance the use of APC technology. UTA's APC users are another available resource to Metro staff.

UTA APC Performance vs Capability:

Often, in ITS procurements similar to that being executed by Metro, specifications and proposals focus on the capabilities of the ITS system, e.g., capable of meeting 95%+ accuracy levels. Proportionately less focus is given to the monitoring and achieving high levels of actual ITS system performance.

For example, virtually all current APC sensors in the marketplace have the capability of achieving 95%-99% levels of accuracy. However, factors such as sensor misalignment, dirty lenses, vandalism, etc. produce actual performance levels less than the high levels of capability. UTA's APC Administrative Control methodologies assure the achievement of actual APC system performance levels that match APC system capabilities. It UTA's focus on actual APC system performance monitoring that contributes to the long-term effectiveness of UTA APC applications (hardware and/or software).

UTA's guiding philosophy in implementing APC systems is the overall objective of providing accurate and reliable APC-generated information that ultimately improves the quality and productivity of Metro service.

1. Understanding of the Scope and Specifications

1.1 UTA APC Hardware Description

Per Metro's preference, UTA will utilize the existing Hella APC Eco sensors installed on Metro's fleet.

UTA has over 5,800 Hella Eco sensors configured for UTA's APC system throughout north America. UTA's proposed APC configuration for Metro is a comprehensive and mature approach based on three (3) decades of experience successfully implementing APC systems at transit agencies, both rail and bus.

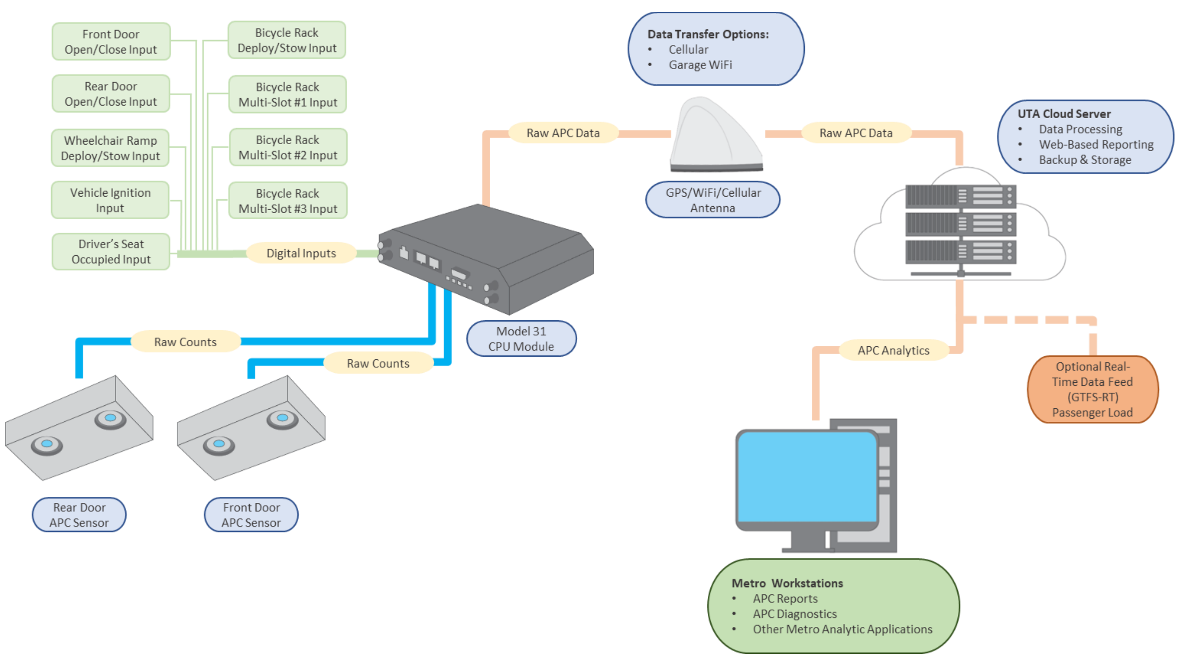
For buses in Metro's fleet without existing APC hardware, UTA will utilize the Hella APS-B sensor.
See section 2.1.1 for more information regarding the installation and performance of the Hella APS-B passenger counter.

UTA engineers and technicians, have rigorously tested and applied APC sensors, data acquisition devices, and communication equipment, and the most thorough APC analytic software package available to the transit marketplace.

In UTA's proposed hardware configuration, each bus will be equipped with UTA's highly reliable APC CPU (M31). Above each of the doorway, UTA will install industry-leading 3D-video passenger counting sensors (Hella), proven to produce passenger counting accuracy in excess of 98%-99% in rail and bus applications.

The diagram below illustrates the major components of UTA's on-bus APC system and connectivity.

Each APC sensor will have a dedicated Ethernet cable connecting it to the Model 31 APC Controller.



UTA's Model 31 APC CPU is capable of receiving GPS data (time, location, speed, heading, etc.) from its embedded GPS receiver or from an external source. UTA utilizes a single tri-mode antenna to provide LTE/Cellular connectivity, GPS, and WiFi connectivity to the Model 31 CPU Module. UTA's preferred standard approach is to utilize the Model 31 APC CPU's onboard GPS receiver for time/location data.

All APC data processing for NTD reporting and service analysis is performed on the UTA hosted APC cloud server. This approach assures fleetwide system reliability, data quality, and data yield and is not limited by reliance on regular schedule updates to each UTA APC Passenger Counter Sensor.

UTA's passenger counting sensor is a 3-D vision-based sensing system manufactured by Hella Aglaia GmbH. It is capable of being mounted at various positions in the vehicle doorways at various angles (does not need to be vertical), any rotation (does not need to be parallel to the door), with the same levels of passenger counting accuracy (97%-99%).

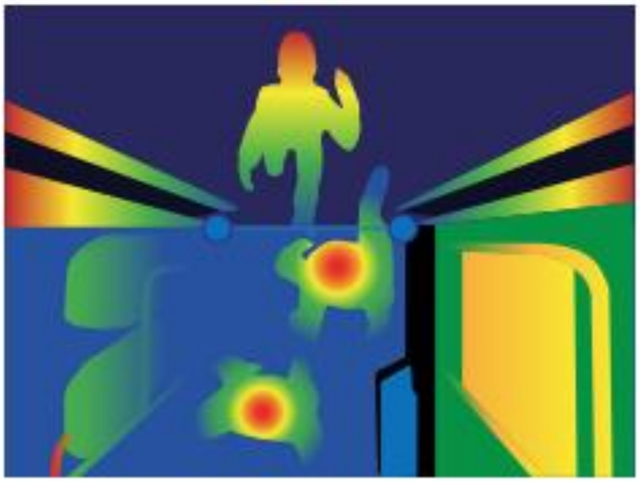
The Hella overhead APC sensor offers considerable flexibility in mounting the sensor where wiring access is simplified, and aesthetics are improved.

By using sophisticated machine-vision, the Hella sensor is not only able to detect and count passengers with unparalleled accuracy, but it can also distinguish categories, or classes of passengers moving through its field of view. The APC sensor can detect, and separately report Adults, Children, and non-Human objects (e.g., Bicycles, mobility devices).

UTA's APC sensor represents the current state-of-the art in passenger counting and object-detection technology. Combining a pair of High Dynamic Range (HDR) color video cameras with sophisticated machine-vision image processing algorithms developed by Hella GmbH, one of the world's largest automotive suppliers, the UTA APC sensor is unmatched in accuracy and reliability in passenger counting applications. Hella has drawn upon its experience in providing adaptive, radar and vision-based automotive driver-assistance and safety systems (used by some of the world's premier auto manufacturers) to produce a passenger counting sensor that is superior in capability and performance to other APC sensor technologies (passive/active infrared, laser, time-of-flight).

In addition to improved accuracy over other APC technologies, the UTA APC sensor offers a variety of additional features and benefits not available with other sensors. For example, typical active/passive and time-of-flight APC sensors have a limited field of view, and therefore a fixed limit on the width of doorway which they can accurately detect passenger movement. The UTA APC sensor, by using wide-angle video cameras, is able to monitor a much wider doorway for a given mounting height than infrared technologies. In a typical transit environment, a single sensor can easily monitor a doorway over 5ft in width, where "pencil beam" or overhead infrared technologies may require two, or even three sensors for a similar door width. Furthermore, older overhead sensor technologies required a vertical, or near-vertical mounting location above the "counting line" or the point in the doorway where a passenger count would be recorded. Often, especially in rail applications, the doorway geometry does not lend itself to easy (or aesthetically pleasing) mounting of a sensor at the door threshold.

Stereoscopic, color, video cameras continually acquire images from within a user-definable area. Onboard software evaluates video images, and objects (passengers) within the detection area are identified and tracked by comparing their position against subsequent video frames. A calculated 3D image based on the distances for all pixels to the device is calculated for each frame of video. The color indicates the distance to the device (blue = far, red = near). From this 3D image, passengers and objects are detected and tracked.



3D “Heat Map”

Each UTA APC sensor will communicate with the APC Controller via UDP over Ethernet. Each sensor will be connected Ethernet cabling to an ethernet switch installed near the APC CPU Module. Each APC sensor will be polled by the APC Controller via UDP message every (1) second for passenger count updates.

Upon receipt of Passenger Count Request message, each sensor will respond independently with current (rolling) count values for both boardings and alightings as well as the Door ID# and/or IP address of each sensor for doorway identification.

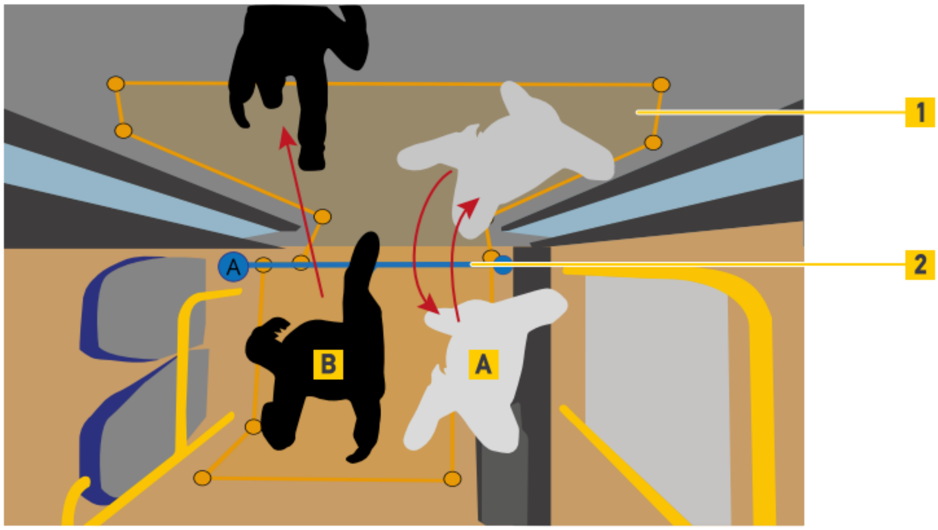
Being a self-contained processing device, the UTA APC sensor also provides a much more intuitive means of setup/calibration and diagnostics than older sensing systems. The UTA APC sensor provides a Web-Based interface GUI for configurating counting parameters, communication settings, and technician diagnostics. This web interface requires no special software, simply a laptop with a web browser.

A single APC Sensor will be mounted above each vehicle doorway. Mounted inboard of each door, vertically overhead, UTA’s sensors are capable of accurately monitoring passenger movements regardless of door opening width, high or low-floor vehicle, or unusual doorway configurations.

A configurable “floor area” is established via a web GUI (by establishing a connection to each sensor via web browser) which defines the area within the overall field of view of the sensor camera where passenger movement should be identified and tracked.

Within the “floor area”, a “counting line” is established, usually at or near the door threshold, though this can vary depending on the particular doorway configuration, where a counting “decision” is made. That is, when a passenger crosses the “counting line” when or if to consider passenger movement to be a boarding, alighting, or ignored.

The parameters of the counting line establish what circumstances determine a “count decision”, a boarding, alighting, or ignored. The direction of travel across the counting line determines boarding/alighting, and time delays can be established to prevent false/erroneous counts, detect U-turns or double-backs.



1 Floor area 2 Counting line

UTA's APC sensor achieves accurate (99%-100%) passenger counts through the following capabilities:

Differentiation of Persons

UTA's APC sensor is not affected by variations in ambient light levels, passenger size, passenger volume (bidirectional movements, parallel movements, crowding), or passenger movement speed. Additionally, the APC sensor is capable of separately reporting passenger classes: Adult, Child, non-human objects (e.g., bicycles).

Identification of Objects

UTA's APC sensor technology is capable of distinguishing non-human objects from human passengers and either omitting non-human objects from passenger counts and/or reporting those counts separately.

Doorway/Sensor Blocking

UTA's APC sensor technology has sufficient field of view and image processing capability to be unaffected by crowding conditions or stationary objects/passengers/crew within the counting area.

Simultaneous Boarding/Alighting

UTA's APC sensors are capable of continuous identification and tracking of passenger densities up to five (5) persons per square meter. Continuous tracking allows for accurate counts in cases of bidirectional movement, double-backs and re-crossings.

1.1.1 UTA Model 31 - APC CPU

UTA's APC Controller (APC CPU) utilizes the capabilities of the CalAmp LMU.

The UTA APC Controller is a highly reliable data acquisition and logging device used in many Automatic Vehicle Location (AVL) and mobile data acquisition applications (Police/Fire, Public Transit, School Bus fleets, Heavy-duty trucking fleets, etc.).

In UTA's proposed APC Hardware Configuration for Metro, the APC Controller is responsible for the creation of the basic APC raw data record, APC data storage, and transmission. The on-bus APC Controller continually (every one second) queries each APC Sensor for passenger boardings and alightings, monitors digital inputs for vehicle door state (open/close), and receives/parses incoming GPS time/location data. These data (counts, location, time, door events) are recorded and stored in onboard memory in the form of UTA APC Data Records.

In the APC data transfer configuration proposed for Metro, server connectivity will be virtually continuous. In the event of temporary loss of connectivity APC data is stored onboard the APC Controller until network connectivity to the APC Server is available. Storage capacity onboard the APC Controller is sufficient for approximately 60-days of stored APC data.

In the event of a network failure, the UTA APC CPU Module is capable of retaining APC data onboard for up to one (1) year. Stored APC data can be collected manually via several methods:

- Laptop PC via WIFI – The UTA APC Controller has built-in WIFI capability. This WIFI module can be configured to provide Metro technicians wireless access to the APC Controller for management, configuration and manual data retrieval. A small antenna on the APC Controller will be used for this purpose, no external antenna is required.

- Laptop PC via Ethernet – Stored APC data can be manually downloaded via a laptop PC directly connected over ethernet.

- USB Memory Stick – The UTA APC Controller has built-in USB connectivity. A USB memory device can be used to retrieve stored APC data.

In the configuration proposed for Metro, the capability exists for the APC CPU to support real-time applications of APC data. Examples of this capability may include vehicle location (including speed and heading) for display on internal Metro or passenger-facing Automatic Vehicle Location (AVL) applications, real-time passenger load display by car and by train, real-time overcrowding reporting, and others.

1.1.1.1 Metro Bus Data Transfer

UTA's proposed APC hardware configuration provides one (1) APC CPU per vehicle. UTA's APC CPU will continually query each APC Sensor for passenger count information and collect and store accumulated counts in onboard memory in the form of UTA APC Data Records.

Raw APC Data Records provide the basis for all real-time and statistical reporting functions such as NTD and a wide range of service-analysis reports. Each UTA Data Record contains the following information:

- Record Type
  - Timestamp (every 30 seconds)
  - Door Open event
  - Door Close event
  - System Initialization event
  - Sensor Diagnostic
- Current Date / Time
- Current Latitude / Longitude, Speed, Heading
- Current Passenger Count values from each door:
  - (continuously incrementing)
- Vehicle Number

APC Data Records are transmitted via cellular by the Model 31 APC CPU to the APC processing server immediately upon generation. The processing server receives incoming APC Data, stores each record in raw form for nightly/statistical reporting, as well as calculates current passenger load, analyzes for any hardware failures/anomalies, and produces an updated GTFS-RT feed to any third-party systems/subscribers for real-time presentation.

If Metro chooses to utilize any existing mobile router solution currently available or in the future, UTA's Model 31 APC CPU can use an on-board mobile router to transfer on-bus APC data.

1.1.2 UTA APC Cabling and Connectors

All connectors are secure, weatherproof, locking connectors where possible to ensure reliability. UTA's cable assemblies are assembled by a reputable wire and cable manufacturer which regularly serves the automotive OEM, heavy equipment, and defense industries. Assemblies are done in accordance with IPC/WHMA-A-620 standards which describe the Wiring Harness Manufacturers Association's criteria for wire crimps, mechanical connections, and solders/welds. The proper selection of components, and assembly by qualified personnel, under tight quality standards all serve to ensure UTA's wire and cable assemblies deliver the highest reliability in the transit environment.

UTA designs and manufactures cable assemblies which are specific to each railcar type on which the APC system is to be installed. This approach comes from decades of experience in the transit marketplace with dozens of types/manufacturers transit vehicles. This allows UTA's cabling systems to properly fit each vehicle's physical dimension, minimizing excess cable, and ensuring any interconnections with the vehicle's electrical system are done with the proper connectors and fittings. This eliminates the need to cut or splice into existing vehicle wiring to obtain power or signals and allows for easy disconnection of the APC system or signals in the event such disconnection is required by vehicle maintenance personnel. Vehicle-specific cable designs also provide for efficient installation into the vehicle eliminating unnecessary modification of the vehicle's systems, nor the APC equipment.

1.1.3 UTA APC System Accuracy

For more than thirty (30) years and in more than one hundred fifty (150+) UTA APC applications, APC Accuracy evaluations (formal or informal) have taken place at each site. UTA's APC Accuracy has consistently been evaluated to meet or exceed the specifications of the local transit agency.

One the following page is a table of recent accuracy evaluations illustrating UTA APC accuracy as compared with experienced manual checkers. Passenger count data collected by UTA's APC system regularly concurs with manual counts in excess of 98% both in Boardings and Alightings. Overall, UTA APC vs. Manual concurrence over 30,000 Boarding/Alighting observations exceeds 98%.

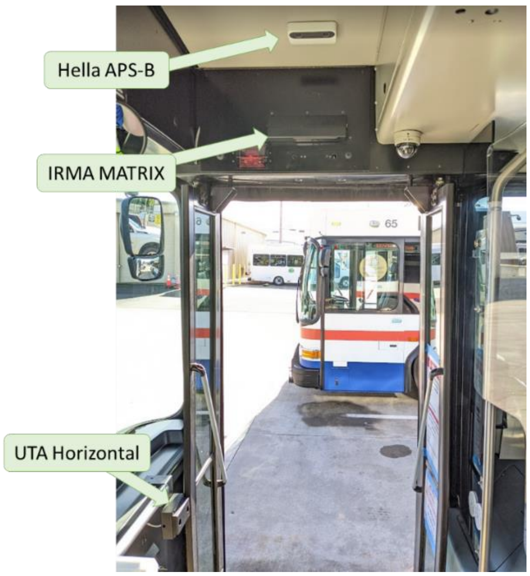
Transit Agency	Manual Ridership	APC Ridership	Manual/APC Concurrence	Manual Passenger Miles	APC Passenger Miles	Manual/APC Passenger Mile Concurrence
Tampa, FL	194	197	98.5%	876	910	96.2%
Sonoma County (Rail)	591	593	99.7%	22,824	22,841	99.9%
Miami, FL	2,260	2,278	99.2%	9,814	10,125	96.9%
Buffalo, NY (Rail)	358	356	99.4%	991	1,005	98.6%
Savannah, GA	319	329	96.9%	1,641	1,704	96.2%
Charlottesville, VA	339	342	99.1%	1,177	1,153	98.0%
Monterey, CA	567	590	96.1%	3,893	3,815	98.0%
Salisbury, NC	144	145	99.3%	539	559	96.4%
Columbia, MO	98	101	97.0%	255	258	98.8%
Jacksonville, FL	814	856	95.1%	4,292	4,131	96.1%
Mishawaka, IN	182	179	98.3%	1,173	1,188	98.7%
Albuquerque, NM	565	579	97.6%	2,151	2,168	99.2%
Boise, ID	337	329	97.6%	2,013	2,007	99.7%
Napa, CA	124	126	98.4%	886	896	98.9%
Hanford, CA	230	240	95.8%	2,143	2,115	98.7%
Thousand Oaks, CA	194	198	98.0%	955	959	99.6%
Antioch, CA	397	414	95.9%	1,989	1,958	98.4%
San Luis Obispo, CA	494	497	99.4%	7,143	7,112	99.6%
Bloomington, IL	378	397	95.2%	907	898	99.0%
Asheville, NC	170	178	95.5%	596	584	97.9%
Columbus, OH	1,125	1,094	97.2%	5,344	5,329	99.7%
Fayetteville, NC	356	372	95.7%	1,478	1,428	96.5%
Durham, NC	664	657	98.9%	2,167	2,210	98.1%
Gainesville, FL	1,785	1,786	99.9%	4,947	5,186	95.4%
Greensboro, NC	441	440	99.8%	1,879	1,961	95.8%
Highpoint, NC	200	208	96.2%	542	557	97.3%
NCSU	753	757	99.5%	1,224	1,263	96.9%
Piedmont, NC	139	145	95.9%	2,501	2,409	96.2%
Racine, WI	242	251	96.4%	838	869	96.4%
Williamsburg, VA	302	302	100.0%	1,635	1,566	95.6%
Pinellas, FL	943	938	99.5%	5,181	5,428	95.4%
Dallas, TX	1,172	1,175	99.7%	5,611	5,539	98.7%
Ventura, CA	303	317	95.6%	6,667	6,959	95.8%
Bradenton, FL	681	700	97.3%	3,779	3,617	95.5%
Missoula, MT	578	599	96.5%	2,172	2,244	96.8%

1.1.4 UTA's APC Sensor Evaluation Program

Over the years, in the transit APC marketplace, UTA has encountered many anecdotes from transit agencies relative to the performance of various APC passenger counting sensors. In 2014, UTA began a program to evaluate various APC passenger counting sensors by installing multiple APC passenger counting sensors on individual buses. It is common for certain buses at various transit agencies across the U.S. to have 2-4 APC passenger counting sensor configurations present as part of UTA's APC sensor evaluation program.

UTA is able to execute 'side-by-side' comparisons in order to observe the performance of various APC sensors in actual revenue service operation over extended periods of time.

UTA's side-by-side testing of various APC sensors compliments UTA insight gained from applications of UTA's APC Software package at transit agencies that have various APC sensors provided by various AVL suppliers.



1.1.4.1 On-Bus Side-by-Side Sensor Testing

Sites where multiple APC passenger counting sensors have been installed on buses include:

- COTA-Columbus OH
- SunMetro-El Paso TX
- DART-Dallas TX
- DTPW-Miami FL
- HTA-Eureka CA
- NFTA Rail-Buffalo NY
- JTRAN-Jackson MS

APC Passenger Counting Sensors which UTA has evaluated in revenue service operation include:

- UTA Horizontal
- Hella Overhead
- Dilax Overhead
- InfoDev Overhead
- IRMA Overhead
- Red Pine Horizontal
- Angel Trax Video

In UTA's 'side-by-side' evaluation of various APC sensors, differences between sensors periodically appear. In cases when APC sensor observations differ, UTA utilizes video to determine which APC sensor generated the most accurate observation. For example, in a recent evaluation, differences in Boardings at a major transfer center were observed. The video showed that the differences were generated by a particular sensor missing small children. The particular APC sensor had to adjusted outside the manufacturer's specification in order to count the small children. Once adjusted, the particular APC sensor was able to generate counts of small children.

An example of a recent 'side-by-side' comparative analysis of the two (2) most heavily used APC sensors is presented below:

Hella vs IRIS Side by Side Sensor Comparison				
Month	**Stop_Observations**	**HELLA_On**	**IRMA_On**	**Hella v IRMA % Concurrence**
Feb-2021	1,147	565	568	99.5%
Mar-2021	2,153	1,236	1,219	98.6%
Apr-2021	2,650	1,353	1,343	99.3%
May-2021	2,899	1,433	1,457	98.3%
Jun-2021	3,799	1,422	1,479	96.0%
Jul-2021	725	515	510	99.0%
Total	13,373	6,524	6,576	99.2%

The conclusion from UTA's 6-7 years of testing APC sensors is that both APC sensors under consideration for application at Metro, have the capability of generating accurate (95%+) passenger counts. It is the identification and resolution of APC sensor failures/anomalies that will determine the long-term effectiveness of a particular APC sensor on a particular vehicle configuration.

To UTA's knowledge, no other firm in the transit APC marketplace has such an active APC sensor evaluation program.

UTA's APC Passenger Counter Sensor Evaluation program provides UTA with insight into the strengths and weaknesses of each APC Passenger Counting Sensor allowing UTA to utilize the best APC sensor for the specific vehicle and doorway configuration. For Metro’s STREETCAR application, the Hella APS-R APC sensor offers the best combination of accuracy, reliability and cost.

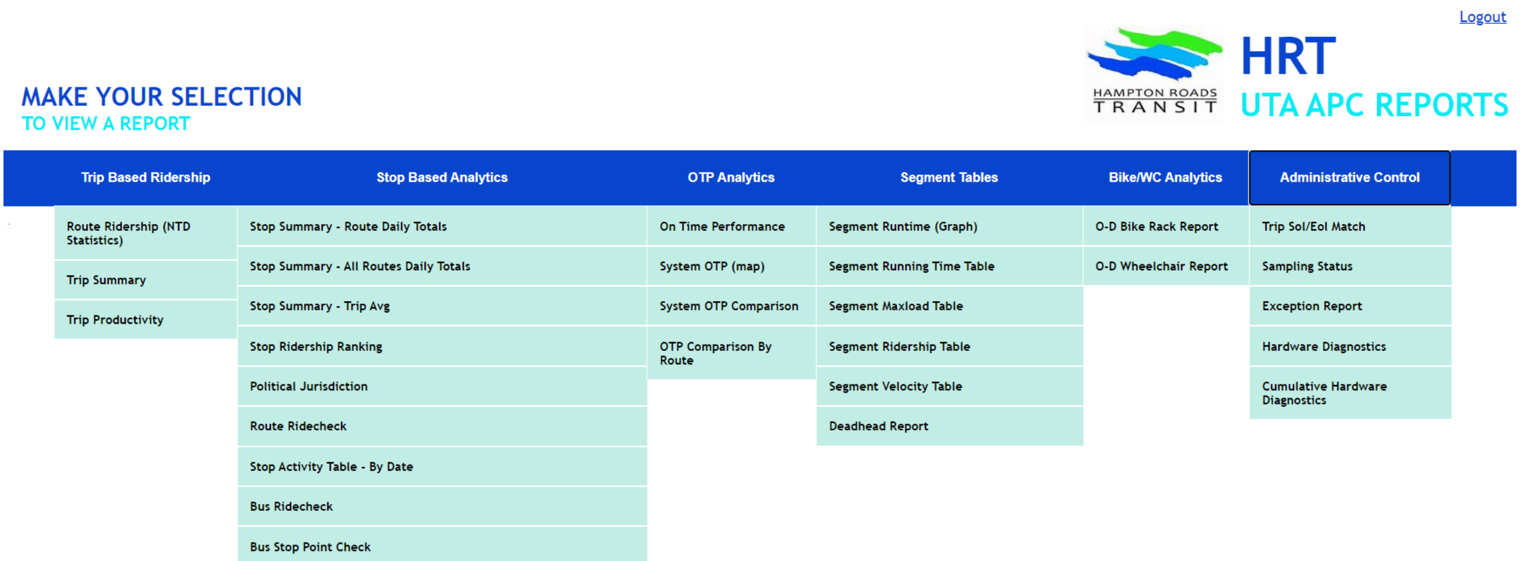
1.1.5 Bicycle Counting Capability

A clear and decisive trend has been noted in virtually all urban areas related to the movement of the population. The public increasingly abandons the conventional approach of traveling by private car, many even abandon ownership of a private car altogether. UTA’s APC technology has incorporated the ability to count bicycles using stereoscopic vision hardware. UTA’s APC System is able to deliver reliable, bidirectional bicycle count data by utilizing the sophisticated 3D vision technology of the Hella APC sensor. Collected bicycle count data provides the end-user the opportunity to generate a wide range of statistical and operational metrics on bicycle ridership. Analysis of the current state of APC sensor technology, particularly the Hella APC sensor suggests accurate bicycle detection at levels of approximately 70-80%.

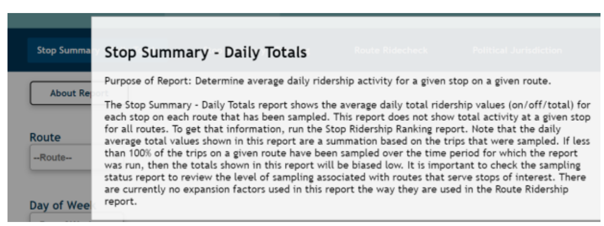
1.2 UTA APC Software Package

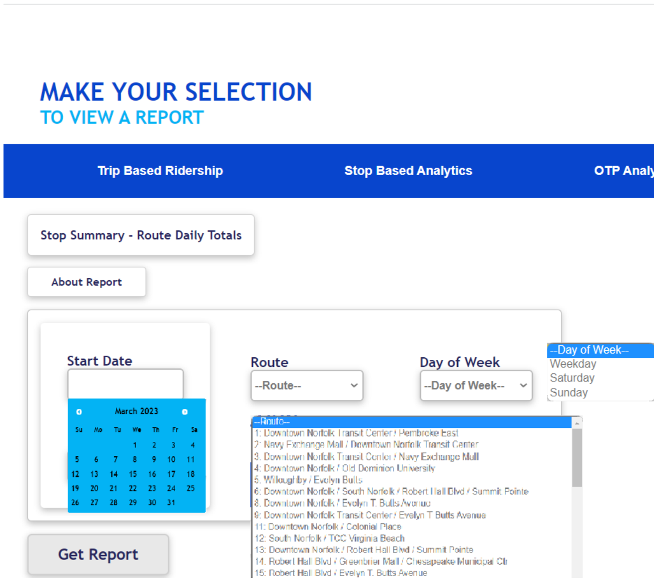
The UTA hosted APC Analytic Reporting Tool is a password protected website with an easy-to-access intuitive interface. Metro staff will interact with a user-defined, highly detailed set of reports allowing the user to dynamically query the APC database. Users are capable of drilling down from macro-analytics (initial summary reports) to micro-analytics (detailed direct individual observations).

1.2.1 Main Menu – UTA Web Based Reporting



Each report push button includes an “About Report” description button providing the user specific details of the analytic content generated.





1.2.2 Route Ridership Reports

Many transit agencies organize their analytic reporting in monthly route level ridership totals. The UTA Route Ridership report allows you to select any date range desired by the user and will return the day type average ridership (weekday, Saturday, Sunday, Holiday) ridership during that time frame as well as the total ridership for each route and each day type during the chronological period specified.

The example below is from UTA's APC system during the Fall 2022 APC software demo. The report reflects data collected in August-December 2021. The report contains both day type averages of UPT (AVG Daily Ridership) and PMT (AVG Daily Pass-Miles) as well as monthly totals for day type UPT (Monthly Ridership) and PMT (Monthly Pass Miles). The report has a single-click export to CSV option to quickly get the report content into a manipulable Excel file and total summary statistics at the bottom for quick answers to requested questions.

ROUTE RIDERSHIP (NTD STATISTICS)

09/01/2022 - 09/30/2022

Export Table To CSV File

Route Name	Day Type	Avg Daily Ridership (UPT)	Avg Daily Pass-Miles (PMT)	Avg Trip Length (PTL)	Day Count	09/01/2022-09/30/2022 Ridership (UPT)	09/01/2022-09/30/2022 Pass-Miles (PMT)	09/01/2022-09/30/2022 Revenue Miles	09/01/2022-09/30/2022 Revenue Hours
1: Downtown Norfolk Transit Center / Pembroke East	1-Weekday	1,340	6,854	5.12	22	32,328	165,373	22,678	1,563.5
1: Downtown Norfolk Transit Center / Pembroke East	2-Saturday	1,043	5,439	5.22	4	4,976	25,954	4,224	279.3
1: Downtown Norfolk Transit Center / Pembroke East	3-Sunday	441	2,047	4.65	4	2,093	9,724	1,983	127.2
2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	439	2,013	4.59	22	9,656	44,281	8,901	693.1
2: Navy Exchange Mall / Downtown Norfolk Transit Center	2-Saturday	93	577	6.20	4	875	5,429	1,582	105.2
2: Navy Exchange Mall / Downtown Norfolk Transit Center	3-Sunday	141	792	5.61	4	872	4,886	1,395	99.4
3: Downtown Norfolk Transit Center / Navy Exchange Mall	1-Weekday	959	4,305	4.49	22	24,491	109,934	19,472	1,234.4
3: Downtown Norfolk Transit Center / Navy Exchange Mall	2-Saturday	460	2,305	5.02	4	3,229	16,194	3,763	232.3

Total 09/01/2022-09/30/2022 Ridership
636,802

Total 09/01/2022-09/30/2022 Pass-Miles
3,390,939

1.2.3 Trip Reports

A basic unit of transit analysis is Trip-level summarization of raw APC data. UTA's APC Software automatically generates a Trip Ridership record which can serve as the foundation for a number of Ridership-related analytics, including NTD. Of note, unlike other APC software products, UTA APC Software does not need to identify each of the Bus Stops on a Trip in order to generate Trip-level records.

TRIP SUMMARY: 2: Navy Exchange Mall / Downtown Norfolk Transit Center

09/01/2022 - 09/30/2022

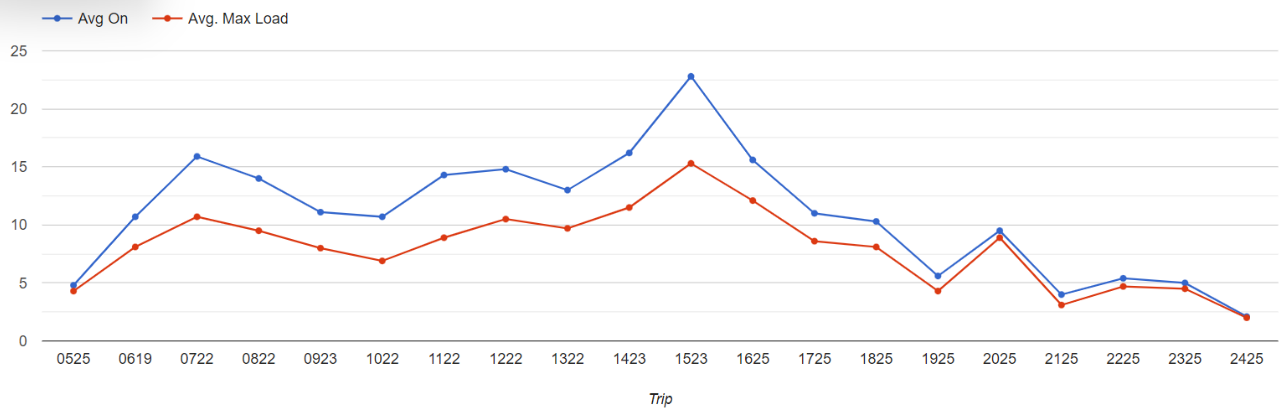
Day of Week: Weekday

Choose a direction to view the chart

Outbound

Inbound

Outbound



Export Table To CSV File

Export Graph to JPG

Route	Route Name	Day of Week	Direction	Trip	Observations	Avg On	Avg Off	Avg. Max Load	Avg PMiles	Avg Trip Run Time (min.)
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	0511	11	8.5	9.5	6.2	44.9	47.8
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	0611	11	18.5	18.8	11.9	62.5	47.7
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	0711	11	13.8	13.8	12.1	78.5	50.6
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	0811	11	14.3	15.1	10.5	64.1	53.5
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	0911	11	13.5	15.1	9.3	60.9	49.0
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	1011	12	12.8	13.2	9.3	58.3	52.5
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	1111	11	10.7	12.3	7.0	46.2	48.8
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	1211	11	12.9	12.5	8.3	64.4	49.6
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1-Weekday	Inbound	1311	11	14.5	12.3	9.0	59.2	60.8

Total Avg On	Total Avg Off	Total Avg PMiles	Avg Trip Run Time (min.)
433.5	438.9	2,012.8	47.3

1.2.4 APC Ridecheck Report

The most traditional/basic type of transit analytic is the Ridecheck, which presents observations at each Bus Stop per Trip . UTA's APC Ridecheck Report automates the information historically provided by a Manual Ridecheck, making detailed and precise bus stop observations available to all users. The Ridecheck Report is often utilized when completing the NTD APC Certification procedure and validating APC system performance.

TRIP SUMMARY: RIDECHECK

Date: 2022-09-16

Trip: 0811

Direction: Inbound

Day of Week: Weekday

Export Table To CSV File

Route	Route Name	Stop Seq. ID	Stop ID	Stop Name	Day of Week	Direction	Trip	Date	Arr. Time	Passengers On	Passengers Off	Passenger Load	Passenger Miles	Interstop Distance (mi)	Bus
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	1	454	DNTC	1-Weekday	Inbound	0811	2022-09-16	08:10:40	8	0	8	0.000	0.00	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	2	5605	VIRGINIA BEACH & GRANBY	1-Weekday	Inbound	0811	2022-09-16	08:22:10	1	0	9	6.897	0.86	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	3	5701	OLNEY & MOWBRAY	1-Weekday	Inbound	0811	2022-09-16	08:24:19	0	0	9	2.013	0.22	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	4	203	OLNEY & COLONIAL	1-Weekday	Inbound	0811	2022-09-16	08:24:52	0	0	9	2.013	0.22	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	5	204	OLNEY & STOCKLEY GARDENS	1-Weekday	Inbound	0811	2022-09-16	08:25:15	0	0	9	1.365	0.15	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	6	205	OLNEY & NORFOLK GENERAL	1-Weekday	Inbound	0811	2022-09-16	08:26:34	1	1	9	1.953	0.22	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	9	432	COLLEY & RALEIGH	1-Weekday	Inbound	0811	2022-09-16	08:30:27	0	0	9	3.103	0.34	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	10	5779	REDGATE & CHILDRENS WAY	1-Weekday	Inbound	0811	2022-09-16	08:33:26	4	3	10	8.865	0.99	2124
2	2: Navy Exchange Mall / Downtown Norfolk Transit Center	11	209	HAMPTON & PRINCESS ANNE	1-Weekday	Inbound	0811	2022-09-16	08:42:37	0	0	10	6.853	0.69	2124

Total On 16

Total Off 16

Total PMiles 67

1.2.5 Bus Stop Summaries

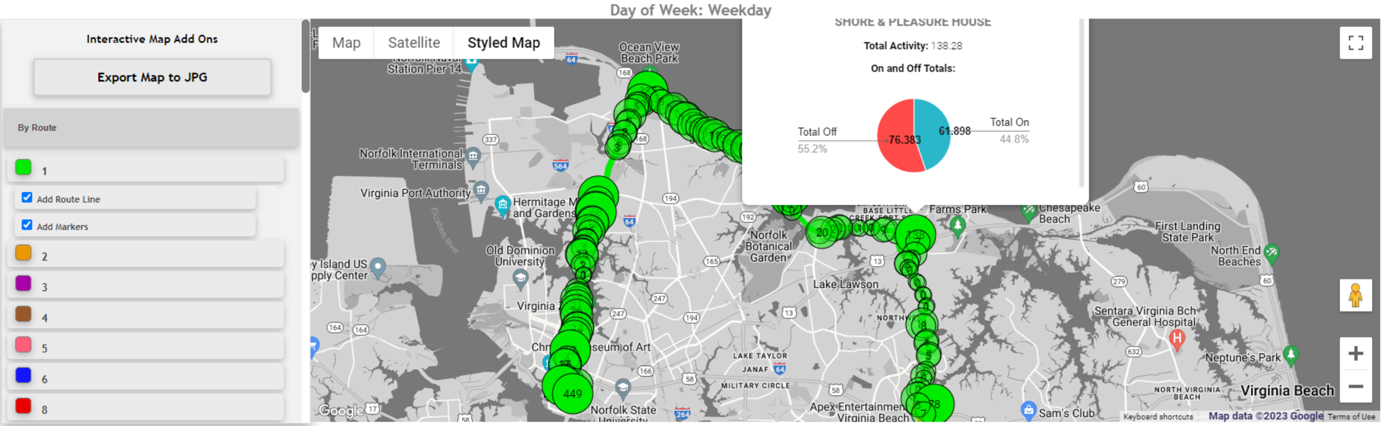
A common APC-generated analytic report is the Bus Stop Summary in which Average Daily Bus Stop Ridership is generated for each Route and the overall transit system. The example below is generated from APC data collected between August 2021 and Jan 2022.

A unique feature of UTA's Bus Stop Summary Report is the CUMULATIVE LOAD column. The CUMULATIVE LOAD variable presents the Number of Passengers being carried past each Bus Stop. Analytic questions such as Passengers being brought into the CBD during the AM Peak, and Passengers being carried over a bridge which will be shut down for maintenance can be addressed with CUMULATIVE LOAD.

STOP SUMMARY BY ROUTE

09/01/2022 - 09/30/2022

Day of Week: Weekday



Export Table To CSV File

Day of Week	Route	Route Name	Direction	Master Stop Seq ID	Stop ID	Stop Name	Total On	Total Off	Total Activity	Cumulative Load	Wheelchair
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	1	106	PEMBROKE MALL	35	0	35	35	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	2	5853	VIRGINIA BEACH & CENTRAL PARK	5	2	7	38	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	3	110	INDEPENDENCE & BROAD	8	1	8	46	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	4	111	INDEPENDENCE & HINSDALE	2	0	2	47	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	5	112	INDEPENDENCE & CONSTITUTION	0	0	1	47	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	6	113	INDEPENDENCE & HESSIAN	0	0	0	47	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	7	114	INDEPENDENCE & PEMBROKE	0	6	7	42	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	8	115	INDEPENDENCE & WITCHDUCK	3	2	5	43	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	9	116	INDEPENDENCE & WISHART	2	7	8	38	0
1-Weekday	1	1: Downtown Norfolk Transit Center / Pembroke East	Outbound	10	117	INDEPENDENCE & WAKEFIELD	0	0	1	38	0

Total Day On
1,340

Total Day Off
1,336

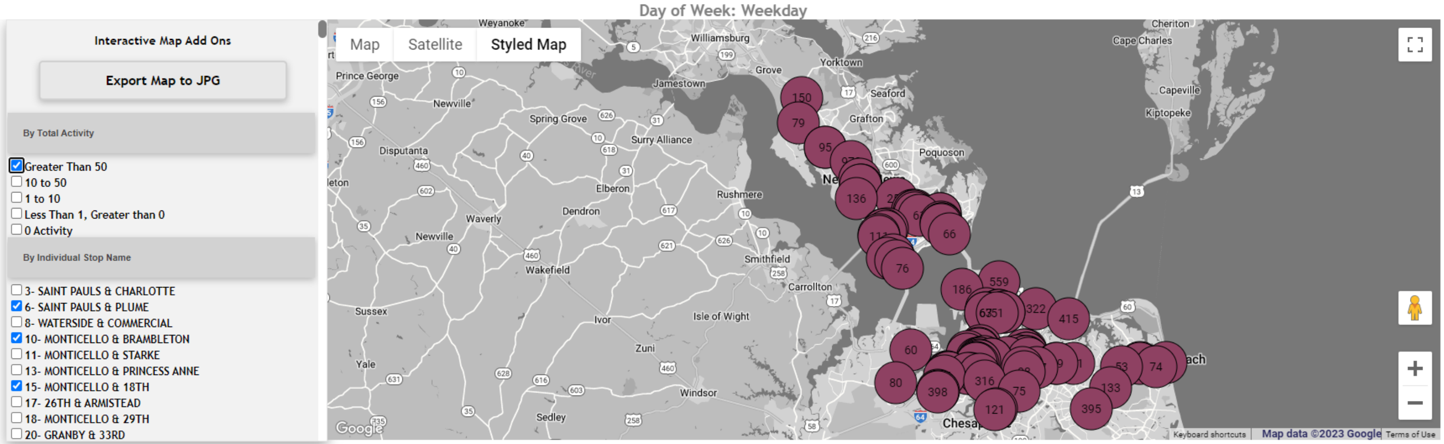
Total Day Total
2,677

Average Daily Total Bus Stop Ridership - Ranked

STOP RIDERSHIP RANKING

09/01/2022 - 09/30/2022

Day of Week: Weekday

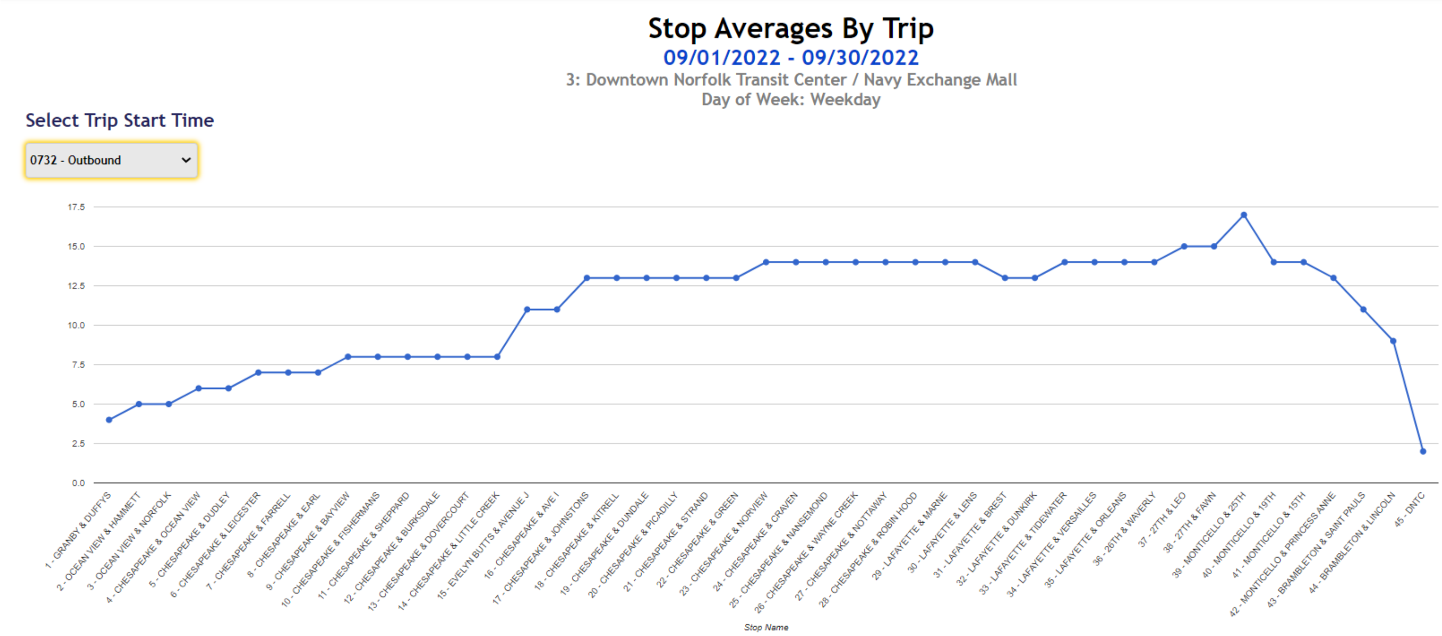


Export Table To CSV File

Day of Week	Stop ID	Stop Name	Total On	Total Off	Total Activity	Cumulative Load	Wheelchair
Weekday	454	DNTC	1,778	1,458	3,236	1,955	0
Weekday	2000	NEWPORT NEWS TRANSFER CENTER	1,092	962	2,054	1,320	0
Weekday	354	EVELYN BUTTS & AVENUE J	542	462	1,004	804	0
Weekday	5818	PATRICK HENRY MALL	489	484	972	595	0
Weekday	2047	HAMPTON TRANSIT CENTER	567	335	902	1,322	0
Weekday	5741	NEWTOWN RD STATION	437	460	897	1,127	0
Weekday	916	MILITARY CIRCLE MALL	404	353	757	1,247	0
Weekday	39	WARDS CORNER TRANSFER	361	338	699	1,038	0
Weekday	1550	COUNTY & COURT	376	305	680	790	0
Weekday	106	PEMBROKE MALL	274	317	591	920	0

Average Passenger Load Per Bus Stop per Trip

Included in UTA's Bus Stop Summary Reporting module is the generation of plots which present the Passenger Load at each Bus Stop on a given Trip. The plot below was generated for Rock Region Metro in order to learn the location and duration of Passenger Loads exceeding Metro's Maximum Load Standard.



Export Table To CSV File

Export Graph to JPG

Day Of Week	Route	Route Name	Stop ID	Stop Seq ID	Stop Name	Direction	Trip	Block	Avg On	Avg Off	Avg Load	Observations
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	53	1	GRANBY & DUFFYS	Outbound	0732	0891045	4	0	4	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	54	2	OCEAN VIEW & HAMMETT	Outbound	0732	0891045	1	0	5	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	55	3	OCEAN VIEW & NORFOLK	Outbound	0732	0891045	1	0	5	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	5751	4	CHESAPEAKE & OCEAN VIEW	Outbound	0732	0891045	1	0	6	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	5957	5	CHESAPEAKE & DUDLEY	Outbound	0732	0891045	0	0	6	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	343	6	CHESAPEAKE & LEICESTER	Outbound	0732	0891045	1	0	7	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	344	7	CHESAPEAKE & FARRELL	Outbound	0732	0891045	0	0	7	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	346	8	CHESAPEAKE & EARL	Outbound	0732	0891045	0	0	7	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	347	9	CHESAPEAKE & BAYVIEW	Outbound	0732	0891045	1	0	8	12
1-Weekday	3	3: Downtown Norfolk Transit Center / Navy Exchange Mall	348	10	CHESAPEAKE & FISHERMANS	Outbound	0732	0891045	0	0	8	12

Average Daily Bus Stop Ridership – Map Display

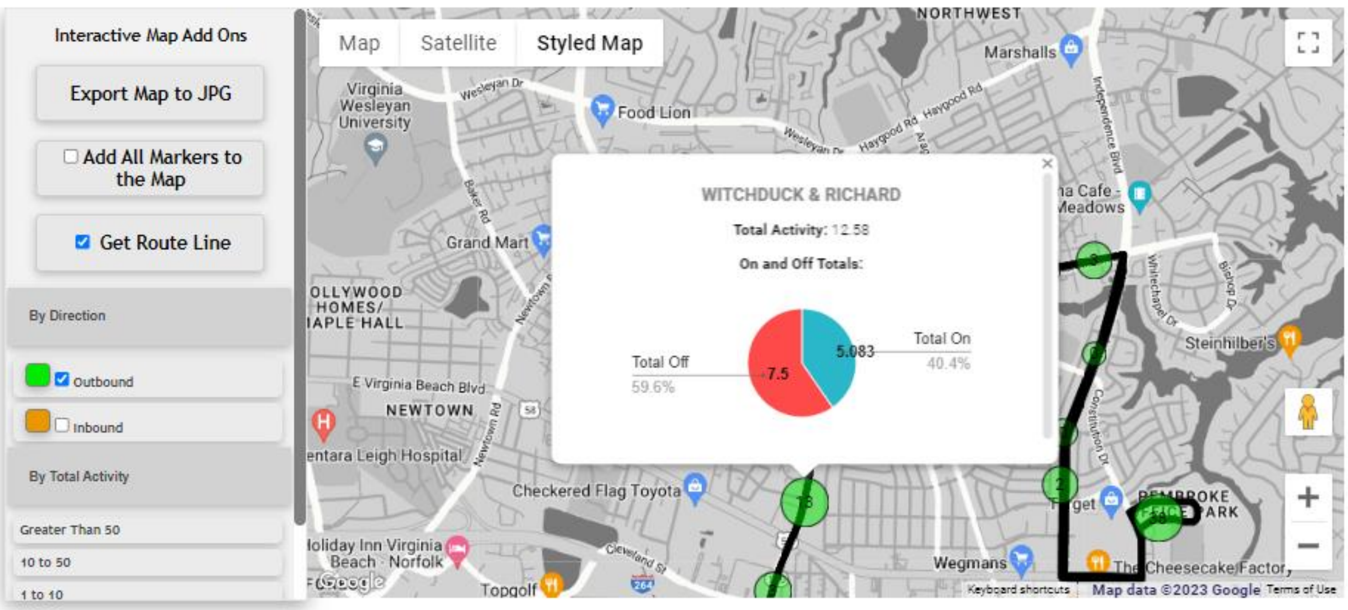
The UTA Hosted APC Analytic Reporting Tool also offers quick and easy ability to see APC stop activity data plotted on a map. The example below is from Metro Route.

DAILY STOP TOTALS

09/01/2022 - 09/30/2022

Route: 24: Pembroke East / Robert Hall Blvd

Day of Week: Weekday



Export Table To CSV File

Route	Route Name	Direction	Master Stop Seq ID	Stop ID	Stop Name	Total On	Total Off	Total Activity	Cumulative Load
24	24: Pembroke East / Robert Hall Blvd	Outbound	1	488	ROBERT HALL & MILITARY	32	0	32	32
24	24: Pembroke East / Robert Hall Blvd	Outbound	2	489	BATTLEFIELD & ROBERT HALL	1	0	1	33
24	24: Pembroke East / Robert Hall Blvd	Outbound	3	5425	WOODLAKE & SENTINEL	1	4	5	30
24	24: Pembroke East / Robert Hall Blvd	Outbound	4	5127	EDEN & GREENBRIER	1	3	4	31
24	24: Pembroke East / Robert Hall Blvd	Outbound	5	5130	GREENBRIER MALL	5	3	8	30
24	24: Pembroke East / Robert Hall Blvd	Outbound	6	5426	VOLVO & EDEN WAY S	2	1	3	32
24	24: Pembroke East / Robert Hall Blvd	Outbound	7	5461	VOLVO & IVYSTONE	1	0	1	33
24	24: Pembroke East / Robert Hall Blvd	Outbound	8	5427	VOLVO & EDEN WAY N	0	1	1	32
24	24: Pembroke East / Robert Hall Blvd	Outbound	9	5428	VOLVO & RELLEN	0	1	1	31

Total Day On	Total Day Off	Total Day Total
123	133	256

1.2.6 Service Standards Compliance Report

A key function of an APC system is to provide feedback relative to the compliance of on-street service to the local transit service standards. Often, Service Standards Compliance analyses requires considerable effort to compile. UTA's APC Software package compiles the APC data in a form that can be directly compared to local Service Standards. An example from OTS (Honolulu) is presented below:

OTS
OVERALL ROUTE RIDERSHIP/PRODUCTIVITY RANKING
WEEKDAY
JUNE 2019 - AUGUST 2019

ROUTE CATEGORY	ROUTE	TOTAL SAMPLED TRIPS	TOTAL SCHEDLD TRIPS	TOTAL DAILY RIDERS	RIDERSHIP RANKING	PASS PER HOUR	ROUTE LOAD FACTOR	PASS PER MILE	MAX TRIP AVG MAX LOAD	PERCENT TRIP MAXLOAD GT 150%	PERCENT EARLY	PERCENT ON-TIME	PERCENT LATE	PERCENT HDWY MAINT COMPLIANCE	ACTUAL REVENUE HOURS	SCHED REVENUE HOURS	ACTUAL REVENUE MILES	SERVICE TO TOTAL HOURS	PASSMILES PER REV HOUR
URBAN TRUNK																			
	1	130	153	14,020	2	82.5	.787	9.7	91	1%	29%	54%	17%	44%	148.6	146.1	1,696	1.19	213.1
	2	115	171	17,821	1	93.0	.852	16.6	99	2%	24%	43%	33%	32%	138.9	128.8	1,598	1.19	203.3
	3	134	140	10,460	6	69.4	.865	6.6	61	0%	28%	52%	20%	42%	146.7	141.6	1,662	1.24	205.0
	4	98	113	6,010	9	59.0	.687	7.3	61	1%	29%	57%	14%	51%	79.9	87.4	950	1.28	111.9
	6	95	95	5,273	11	55.8	.567	6.5	43	0%	29%	50%	22%	38%	89.9	87.6	809	1.17	106.7
	8	66	144	3,900	16	58.0	.511	16.1	67	3%	19%	49%	32%	35%	34.9	30.3	527	1.35	97.3
	9	62	91	5,988	10	50.2	.661	7.2	52	0%	15%	50%	35%	38%	85.3	80.2	1,222	1.06	127.2
	13	115	129	12,172	3	79.6	.977	10.6	65	2%	22%	53%	25%	42%	143.9	135.7	1,286	1.22	168.5
TOTAL				75,645											868	838	9,752		
AVG						68.5	.739	10.1	67	1%	24%	51%	25%	40%				1.21	154.1

1.2.7 APC/Farebox Ridership Reporting

Historically, transit Ridership was based on information generated by the Fare Collection System. A standard feature of UTA's APC Software package is the ability to compare APC data and Farebox data at the Bus Stop level in order to better understand the difference between APC-generated and Farebox-generated Ridership. Presented below is an example of an APC/Farebox comparative analysis in which differences between APC and Farebox Ridership are highlighted:

VEHNO	DATE	ROUTE	TRIP	DRIVER	STOP	UNIQUE STOP	STOP NAME	APC ARRIVAL TIME	APC DEPARTURE TIME	APC ON	APC OFF	FRBX TIME	FAREBOX TYPE DESCRIPTION	FAREBOX DESCRIPTION	DRIVER COUNT	FRBX RIDER
610	09/01/17															
		0		382				: :	: :			05:56:53	Driver login via GPS	Driver		0
		12		382				: :	: :			05:56:55	Got fare	TTP 18		0
		12		382				: :	: :			05:56:57	Transfer issued	Sequence Number		0
		0	616		1	1	SAVANNAH GARAGE	06:15:11	06:15:11	0	0	: :			0	0
		12		382				: :	: :			06:19:05	Period pass	TTP 13		1
		0	616		999	9999	Not Identified - Cal	06:19:07	06:19:07	0	0	: :			0	0
		0	616		999	9999	Not Identified - Cal	06:19:14	06:19:14	0	0	: :			0	0
		12	628		1	830	W 51ST & HOPKINS WB	06:28:18	06:29:20	1	0	: :			0	0
		12		382				: :	: :			06:28:46	Got fare	TTP 17		1
		12		382				: :	: :			06:28:49	Issue card	Sequence Number		0
		12	628		2	846	HOPKINS & AMARANTH NB	06:30:00	06:30:.0	0	0	: :			0	0
		12	628		3	850	HOPKINS & 49TH NB	06:30:04	06:30:04	0	0	: :			0	0
		12	628		4	847	HOPKINS & 45TH NB	06:30:42	06:30:42	0	0	: :			0	0
		12	628		5	848	HOPKINS & W VICTORY LN NB	06:30:58	06:30:58	0	0	: :			0	0
		12		382				: :	: :			06:31:40	Period pass	TTP 4		1
		12	628		6	852	HOPKINS & 41ST NB	06:31:43	06:33:04	2	0	: :			0	0
		12		382				: :	: :			06:32:32	Got fare	TTP 17		1
		12		382				: :	: :			06:32:35	Issue card	Sequence Number		0
		12	628		7	1074	OGEECHEE & 39TH NB	06:34:06	06:34:06	0	0	: :			0	0
		12	628		8	854	OGEECHEE & 37TH NB	06:34:33	06:34:33	0	0	: :			0	0
		12	628		9	855	OGEECHEE & 35TH NB	06:34:58	06:34:58	0	0	: :			0	0
		12	628		10	857	OGEECHEE & 32ND NB	06:35:26	06:35:26	0	0	: :			0	0
		12		382				: :	: :			06:36:50	Period pass	TTP 2		1
		12		382				: :	: :			06:36:53	Period pass	TTP 4		1
		12	628		11	859	ANDERSON & MLK EB	06:36:55	06:37:43	5	1	: :			0	0
		12		382				: :	: :			06:36:58	Period pass	TTP 3		1
		12		382				: :	: :			06:37:07	Got fare	Preset		1
		12		382				: :	: :			06:37:14	Transfer received	Sequence Number		0

1.2.1 FTA National Transit Database (NTD) Reporting

For more than three (3) decades, UTA APC users have been meeting NTD (previously Section 15) reporting requirements using UTA APC data. Critical to UTA's NTD Reporting are the highly developed APC Administrative Control software modules that assure high quality APC data being available for NTD Reporting. UTA's APC Diagnostics, Data Quality Codes, Filter/Edit Algorithms, Sampling Status, Deployment Plans, Reference File Quality Control are but a few of UTA APC Administrative Control elements that result in high quality APC data for both NTD and non-NTD reporting.

NTD Reporting is a natural by-product of a UTA APC system. The UTA APC Reporting Software has ensured the 100% FTA approval rating by recognizing and filtering out any potential bias of Unlinked Passenger Trips (UPT) and Passenger Miles Travelled (PMT) due to non-revenue door activity from operators/passengers and APC hardware malfunctions.

Critical to successful NTD Reporting is the calculation of Passenger Miles. UTA's APC Software automatically calculates Passenger Miles for each bus stop by multiplying the Passenger Load by the Inter-Stop Distance. With highly refined EOL Load Balancing algorithms assuring an accurate Passenger Load at each Bus Stop and algorithms that convert Lat/Long change into Inter-Stop Distance, UTA's APC Passenger Mile variable is highly accurate and auditable down to the bus stop level. Along with accurate UTA APC generated Ridership, Passenger Trip Length (PTL) is a standard output of UTA's Route Ridership Report.

UTA and FTA NTD staff meet periodically to discuss the application of UTA's APC system to NTD Reporting. FTA staff noticed the large number of UTA APC users that were successfully generating NTD Reports in contrast to the number of transit agencies utilizing non-UTA APC systems that were not able to generate NTD reports.

Maximum Service Vehicles

Vehicles Operated in Annual Maximum Service (VOMS)	40
Vehicles Available for Annual Maxmium Service	52
Total Monthly Ridership VOMS	**40**

Periods Of Service

Field	Average Weekday Schedule	Average Saturday Schedule	Average Sunday Schedule	Weekday AM Peak	Weekday Midday	Weekday PM Peak
Time Service Begins	5:00 AM	5:00 AM	9:00 AM			
Time Service Ends	11:00 PM	7:00 PM	5:30 PM			

Services Supplied

Total Monthly Ridership VRH	38,556
Total Monthly Ridership VRM	625,994

Field	Average Weekday Schedule	Average Saturday Schedule	Average Sunday Schedule	Annual Total
Vehicles in Operation	40	2	2	N/A
Total Actual Vehicle Miles	2,991	795	128	813,695
Total Actual Vehicle Revenue Miles (VRM)	2,291	654	105	625,994
Deadhead Miles	*700*	*141*	*23*	*187,701*
Total Actual Vehicle Hours	187	46	10	50,657
Total Actual Vehicle Revenue Hours (VRH)	141	37	8	38,556
Deadhead Hours	*46*	*9*	*2*	*12,101*
Charter Service Hours	N/A	N/A	N/A	0
School Bus Hours	N/A	N/A	N/A	0

Services Consumed

Total Monthly Ridership Unlinked Passenger Trips (UPT)	96,449

File Home Insert Page Layout Formulas Data Review View Help

B4

	A	B	C	D	E	F	G
1							
2	**Maximum Service Vehicles**						
3	Vehicles Operated in Annual Maximum Service (VOMS)	0					
4	Vehicles Available for Annual Maximum Service						
5	**Total Monthly Ridership VOMS**	**0**					
6							
7	**Periods of Service**						
8	Field	Average Weekly Schedule	Average Saturday Schedule	Average Sunday Schedule	Weekday AM Peak	Weekday Midday	Weekday PM Peak
9	Time Service Begins						
10	Time Service Ends						
11							
12	**Service Supplied**						
13	Total Monthly Ridership VRH	-					
14	Total Monthly Ridership VRM	-					
15							
16	Field	Average Weekly Schedule	Average Saturday Schedule	Average Sunday Schedule	Annual Total		
17	Vehicles in Operation				N/A		
18	Total Actual Vehicle Miles				0		
19	Total Actual Vehicle Revenue Miles (VRM)				0		
20	*Deadhead Miles*	*0*	*0*	*0*	*0*		
21	Total Scheduled Vehicle Revenue Miles				0		
22	Total Actual Vehicle Hours				0		
23	Total Actual Vehicle Revenue Hours (VRH)				0		
24	*Deadhead Hours*	*0*	*0*	*0*	*0*		
25	Charter Service Hours				0		
26	School Bus Hours				0		
27							
28	**Services Consumed**						
29	Total Monthly Ridership Unlinked Passenger Trips (UPT)	-					
30							
31	Field	Average Weekly Schedule	Average Saturday Schedule	Average Sunday Schedule	Annual Total		
32	Unlinked Passenger Trips (UPT)				0		
33	ADA Unlinked Passenger Trips (UPT)				0		
34	Sponsored Service (UPT)				0		
35	Passenger Miles Traveled (PMT)				0		

1.2.1.1 *WE-20 Reporting Compliance*

Published in the March 2023 Federal Register were *National Transit Database: Reporting Changes and Clarifications* which included a new Weekly Reporting cycle referenced as WE-20. FTA's objective for WE-20 is to provide a timely snapshot of service and ridership data to assess trends at the national level.

UTA's APC Software supports the application of APC data to WE-20 reporting. UTA's web-based reporting allows users to specify starting and ending dates of data to be included in a weekly WE-20 report. Critical to the consistent generation of accurate and reliable WE-20 weekly reports of Unlinked Passenger Trips (UPT) and Vehicle Revenue Miles (VRM) is the quality and quantity of APC data being generated.

UTA's StandAlone APC configuration being proposed for Metro provides extremely high APC Data Yields (95%+) and overnight processing that allows minimal estimation of APC-generated UPT and VRM. In the UTA StandAlone APC configuration, APC data collected on Day 1 would be available for analytic reporting, including WE-20, on Day 2.

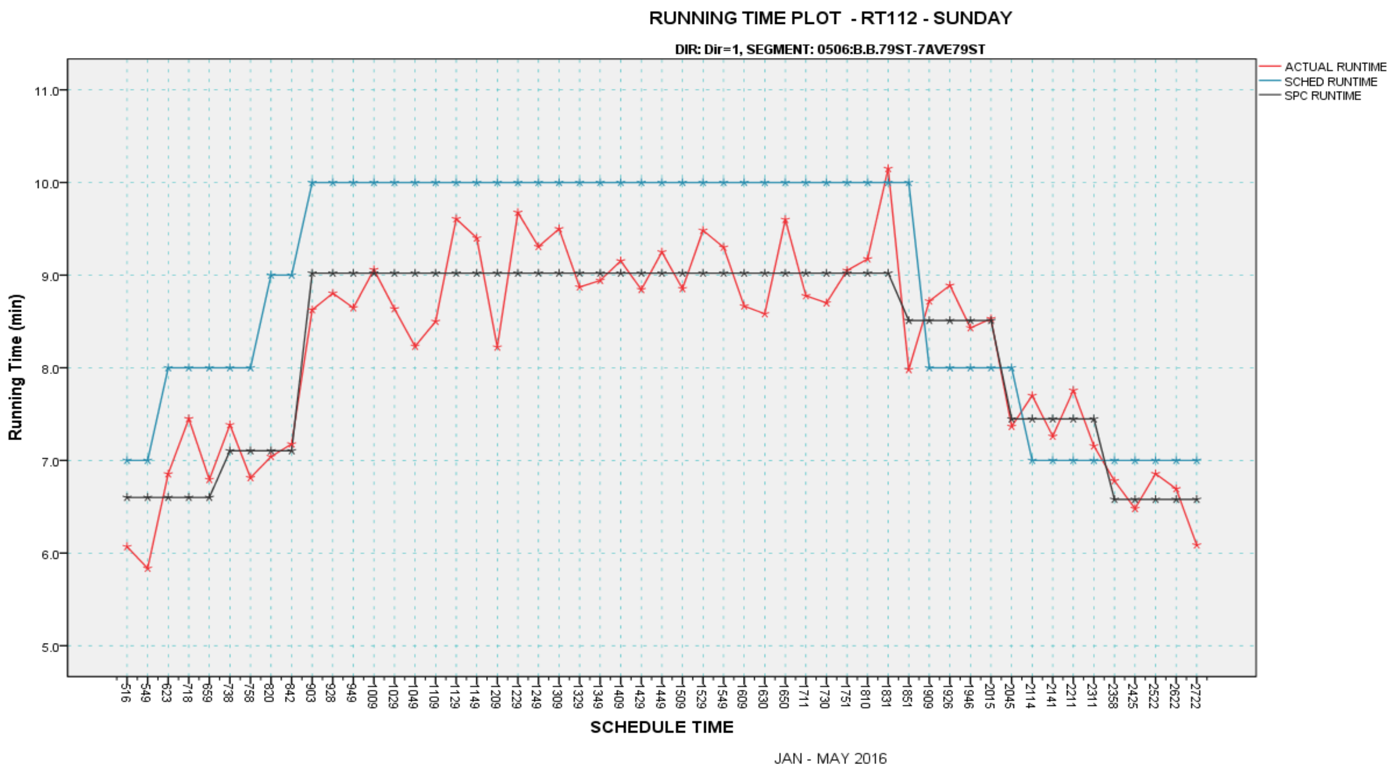
Given UTA's experience in applying UTA's APC Software package to APC data generated by more than twenty-five (25) different AVL suppliers, the quantity and quality of APC data provided by AVL suppliers would typically not support consistent weekly WE-20 reporting.

Implementation of UTA's StandAlone APC system (on-vehicle hardware and APC Software) would allow Metro to be compliant with WE-20 reporting requirements for both Bus and LRV service.

1.2.2 Segment Running Time Report with Statistical Process Control (SPC)

Critical to the creation of transit schedules that allow service to operate on-time is the generation of accurate Segment Running Times. UTA's standard Segment Running Time tables and plots are presented below. These Segment Running Time analytics are based on feedback from Schedulers at the many transit agencies utilizing UTA's APC system.

A unique feature of UTA's Running Time analyses is the application of a powerful statistical tool, Statistical Process Control (SPC), to Segment Running Times. SPC applies established statistical algorithms to raw Segment Running Time data to determine when the Running Time changes. In the plot below, the Blue Line represents the Scheduled Running Time. The Red Line represents the Average Running Time per Trip. The Black Line represented the SPC-generated recommended Running Time. This plot is intended to serve as a guide to the local Scheduler's judgement on applying the optimal Running Time per Segment per Trip.



1.2.3 Ridership Change Analyses

An important function of an APC system is to provide local transit management with information describing changes in Ridership. UTA's APC Software monitors changes in Ridership and generates analytic reports at various spatial and temporal resolutions presenting the magnitude of Ridership change.

Presented below is a recent Ridership Change analysis executed for HART (Tampa) comparing pre-pandemic (Fall 2019) Ridership with current (Fall 2021) Ridership. The spatial level of detail is Route and temporal resolution is Time Period.

HART DATE 09 Feb 22

HART_ROUTE_RIDERSHIP_COMPARISON.SPS

PAGE 1

****

ROUTE RIDERSHIP BY TIME PERIOD

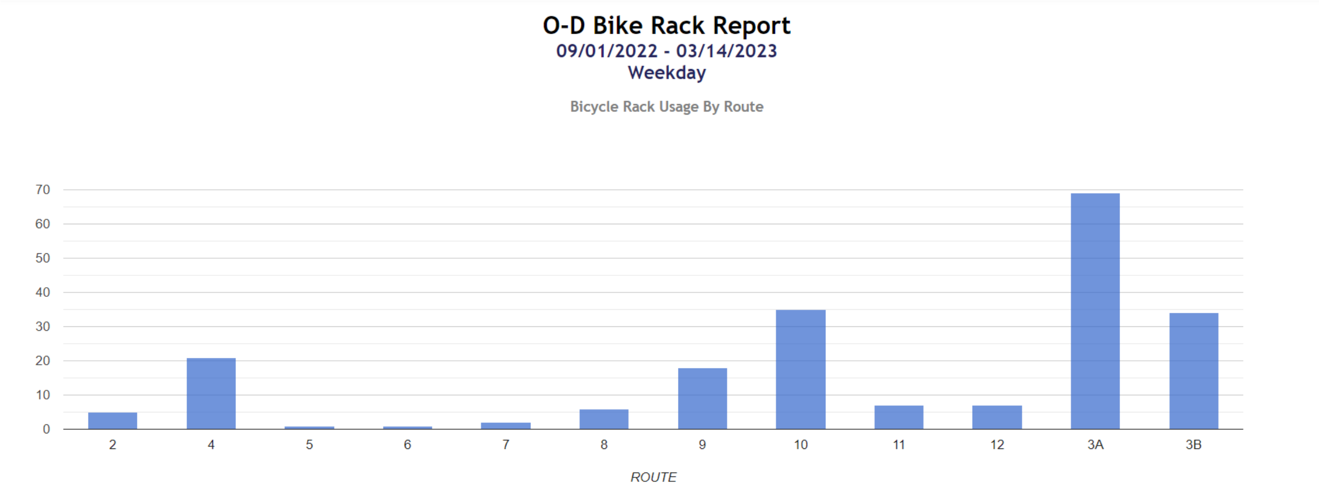
SIGNUPS: FALL 2021 VS FALL 2019

****

DAY OF WEEK	TIME PERIOD	ROUTE	FALL2021 RIDERS	FALL2019 RIDERS	FALL2021 FALL2019 RIDERSHIP DELTA	FALL2021 HOURS	FALL2019 HOURS	FALL2021 FALL2019 HOURS DELTA	FALL2021 MILES	FALL2019 MILES	FALL2021 FALL2019 MILES DELTA
WEEKDAY	06:00AM-09:00AM										
		1	513	677	-24.3%	17.9	19.5	-8.4%	263.7	263.4	.1%
		5	129	306	-57.8%	4.8	9.6	-50.0%	68.3	136.6	-50.0%
		6	564	980	-42.4%	17.6	23.0	-23.7%	262.0	342.9	-23.6%
		7	73	134	-45.7%	2.6	5.1	-50.0%	36.6	74.9	-51.1%
		8	145	294	-50.6%	6.1	13.6	-54.8%	102.7	207.2	-50.4%
		9	94	236	-60.3%	5.0	9.4	-47.3%	66.5	124.8	-46.7%
		12	276	521	-47.2%	9.8	14.7	-33.3%	129.5	183.6	-29.5%
		14	93	239	-61.3%	7.6	8.3	-8.5%	85.7	115.0	-25.5%
		15	98	276	-64.4%	4.6	9.2	-50.0%	67.5	131.3	-48.6%
		16	194	315	-38.6%	9.5	9.0	5.8%	120.4	121.9	-1.3%
		17	53	71	-25.4%	1.9	2.1	-11.9%	31.6	31.2	1.5%
		19	76	198	-61.5%	4.5	7.1	-36.6%	47.9	91.2	-47.5%
		24	15	47	-68.4%	1.2	2.5	-50.0%	34.2	63.0	-45.7%
		25	19	17	11.7%	2.7	1.4	100.0%	60.3	27.5	119.2%
		30	182	213	-14.6%	6.8	7.6	-10.5%	99.4	91.4	8.7%
		31	66	81	-18.4%	7.9	7.3	8.0%	155.9	154.8	.7%
		32	102	260	-60.9%	3.1	8.2	-61.8%	58.2	137.2	-57.6%
		33	98	205	-52.1%	5.8	7.4	-21.6%	92.6	125.3	-26.1%
		34	445	705	-37.0%	17.7	22.6	-21.7%	264.3	335.4	-21.2%
		36	147	310	-52.8%	5.5	11.4	-52.2%	77.3	151.9	-49.1%
		37	93	265	-64.7%	3.1	7.7	-60.5%	61.2	122.2	-49.9%
		38	138	146	-5.7%	5.1	2.2	127.6%	86.7	43.8	97.7%
		39	307	479	-35.9%	12.9	12.9	.0%	223.6	227.0	-1.5%
		42	62	291	-78.8%	2.5	6.5	-61.2%	30.7	74.4	-58.7%
		45	249	195	27.9%	12.3	8.6	42.4%	165.1	120.1	37.5%
		46	28	81	-65.0%	2.5	5.0	-50.0%	42.6	83.1	-48.7%
		48	89	122	-26.7%	3.6	3.6	.0%	68.4	68.8	-.6%
		275	100	152	-33.8%	6.2	8.2	-24.5%	119.2	157.1	-24.1%
		360	135	184	-26.8%	6.2	6.2	.0%	130.0	121.6	6.9%
		400	446	659	-32.3%	18.3	18.5	-1.1%	258.1	261.6	-1.3%
	TOTAL		5,027	8,657		215	278		3310	4190	

1.2.4 Bus Bicycle Rack Usage Analytics (Not Currently Applicable)

Included in UTA's APC Software package are analytic reports presenting Wheelchair Lift and Bicycle Rack usage. Some sample reports are presented below:



Export Table To CSV File | Show rows ungrouped by O-D | Export Chart to JPG

O_D	Block	Bus	Trip Start Stop ID	Trip Start Location	Trip End Stop ID	Trip End Location	Number of O_D Observations
785809-786422	3011	903	785809	KEMPER STREET TRANSFER CENTE	786422	VES RD. NB ACROSS FROM VES S	14
786281-785809	2861	1004	786281	PLAZA TRANSFER CENTER	785809	KEMPER STREET TRANSFER CENTE	8
786422-785809	3011	903	786422	VES RD. NB ACROSS FROM VES S	785809	KEMPER STREET TRANSFER CENTE	8
786425-785809	2843	903	786425	VES RD. (SOUTHBOUND ACROSS F	785809	KEMPER STREET TRANSFER CENTE	8
786417-785809	2843	904	786417	TWELFTH ST. (WESTBOUND CORNE	785809	KEMPER STREET TRANSFER CENTE	8
785809-786410	2843	801	785809	KEMPER STREET TRANSFER CENTE	786410	TWELFTH ST. (EASTBOUND CORNE	6
785809-786281	2862	1008	785809	KEMPER STREET TRANSFER CENTE	786281	PLAZA TRANSFER CENTER	4
785809-786075	2862	807	785809	KEMPER STREET TRANSFER CENTE	786075	FORT HILL VILLAGE SHOPPING C	4
785839-786417	2843	904	785839	BEDFORD AVE. (EASTBOUND TRAN	786417	TWELFTH ST. (WESTBOUND CORNE	4
785809-786324	2853	803	785809	KEMPER STREET TRANSFER CENTE	786324	RIVERMONT AVE. (WESTBOUND CO	4

1.2.5 Productivity Analyses

Route-Level Productivity Ranking

PAGE 1 — Capital Area Transit System — DATE 09 Feb 22

OVERALL ROUTE RIDERSHIP/PRODUCTIVITY RANKING

Aug 2021 Schedule

Weekday

OVERALL PRODUCTIVITY RANKING	ROUTE	TOTAL DAILY RIDERS	RIDERSHIP RANKING	PASS PER HOUR	RANK PASS PER HOUR	ROUTE LOAD FACTOR	LOAD FACTOR RANKING	PASS PER MILE	RANK PASS PER MILE
1	41	475	3	21.6	1	.098	2	1.20	1
2	44	851	1	15.8	2	.090	4	1.04	2
3	47	619	2	15.0	3	.111	1	.757	5
4	17	289	5	14.6	4	.095	3	.786	4
5	21	269	6	14.0	5	.088	5	.734	6
6	12	216	8	11.3	8	.082	8	.550	9
8	14	171	12	12.9	6	.061	14	.912	3
8	57	356	4	9.1	12	.084	7	.467	12
9	18	220	7	10.3	9	.072	10	.530	10
10	23	143	14	12.1	7	.064	12	.641	8
11	22	191	9	9.0	13	.075	9	.480	11
12	70	189	10	8.7	15	.087	6	.413	15
13	46	171	11	7.1	16	.068	11	.372	16
15	8	103	17	9.0	14	.042	18	.716	7
15	58	101	18	9.3	11	.061	13	.431	14
16	59	84	19	9.7	10	.059	15	.454	13
17	60	135	15	6.2	17	.049	16	.353	17
18	15	106	16	5.7	18	.042	17	.307	18
19	11	152	13	5.7	19	.031	19	.298	19

Segment-Level Productivity Ranking

Weekday — Capital Area Transit System

BI-DIRECTIONAL SEGMENT PRODUCTIVITY REPORT

TOTAL DAILY RANKING

Aug 2021 Schedule

SEGMENT NAME	ROUTE	HOURLY PERIODS SAMPLED	DAILY ON	DAILY OFF	DAILY REVENUE HOURS	AVG DIST	AVERAGE BOARDINGS PER HOUR	AVERAGE ON+OFF PER HOUR
CATS - FLORIDAFOSTER	44	17	42	13	1.43	1.59	29.1	37.9
CATS - PLANKCHOCTAW	41	16	47	51	1.79	1.62	26.6	55.9
LEEHIGHLAND - MALLOFLA	47	1	12	2	.58	8.10	20.7	24.2
CATS - EUGENETERRACE	14	16	28	25	1.56	1.21	18.1	34.3
CATS - ELONGTRANSFER	41	15	128	95	6.83	7.43	17.9	31.2
CATS - HIGHLANDVETERANS	47	16	76	73	4.37	3.91	17.5	34.0
CATS - MALLOFLA	17	5	28	5	1.55	7.99	17.4	20.7
CATS - NBONMARCHEHARRY	21	11	93	37	5.93	6.52	16.7	22.9
BURBANKBLUEBONNET - MALLOFLA	47	16	64	8	3.91	3.40	16.5	18.6
CATS - FAIRFIELDSFOSTER	21	17	48	41	3.08	2.85	15.9	29.3
ELONGTRANSFER - PLANKEVANGELINE	41	16	40	36	2.48	2.59	15.7	29.8
CATS - PERKINSCOLLEGE	17	17	62	63	4.16	3.47	15.3	30.2
CORTANAWALMART - FLORIDAFOSTER	44	1	2	0	.13	3.30	15.2	15.2
CATS - CORTANAWALMART	21	10	90	43	6.67	7.33	13.7	20.3
ELONGTRANSFER - PLANKCHOCTAW	41	16	69	19	5.28	5.68	12.5	15.9
HIGHLANDVETERANS - LEEHIGHLAND	47	16	21	22	1.62	1.75	12.4	26.1
CORTANAWALMART - GRNWLSPRGSCRTLND	57	16	69	29	6.33	4.12	11.8	16.8
CATS - MINIDOME	70	6	18	0	1.83	6.63	11.7	11.7
BONCARRE - CORTANAWALMART	44	17	38	35	3.35	2.86	11.6	22.3
MALLOFLA - ONEPERKINSPL	17	17	37	35	3.25	2.75	11.4	22.2
4THSTLAUREL - CATS	44	17	36	66	3.22	2.02	11.1	31.7
ELONGTRANSFER - FOSTERPRESCOTT	23	16	27	23	2.49	1.89	11.0	20.7
CATS - INDEPENDENCEDMV	12	17	38	37	3.87	4.21	10.4	20.0
PLANKCHOCTAW - PLANKEVANGELINE	41	16	16	20	1.55	1.72	10.3	22.6
LATECHCOLLEGE - WOODALECAMELOT	22	15	24	16	2.23	2.77	10.2	17.2
JEFFRSONFLOYNELL - MALLOFLA	60	15	24	2	2.62	2.05	9.6	10.6
FRESHPICKINS - GONEALONEAL	58	10	17	7	1.86	3.67	9.0	12.5
BONCARRE - FLORIDAFOSTER	44	17	21	20	2.37	2.30	8.9	17.2
EUROPESTREET - HOLLYWOODCASINO	22	16	24	5	2.82	1.44	8.7	10.3

1.2.6 Headway Maintenance

Particularly for BRT and Streetcar modes, maintaining consistent headways (time between vehicles) is an important service quality feature.

4240 Airport Rd, Suite # 212, Cincinnati, Ohio 45226. Tel (513) 961 0099 Fax (513) 961 0132

UTA's APC Software package includes a Headway Maintenance set of reports that present the Schedule Deviation of each vehicle at each Timepoint (Station) for a given Route (service). If a Scheduled Headway is set at 15 minutes, riders expect service to arrive at a given location every 15 minutes. The magnitude of difference between Scheduled Headways and Actual Headways will identify times/locations when transit service is not meeting the Scheduled Headways.

The report below is from the Sonoma-Marin Rail Transit District (SMART) which presents one (1) page summary of all Trips in a given Direction on a given Date.

HEADWAY MAINTENANCE REPORT
09/08/22

TRIP	CAR 1	CAR 2	ACTUAL DEPART TIME	SCHED RUN TIME	ACTUAL RUN TIME	ACTUAL DEPART SCHDEV	TP1 NAME	TP2 SCHDEV	TP2 NAME	TP3 SCHDEV	TP3 NAME	TP4 SCHDEV	TP4 NAME	TP5 SCHDEV	TP5 NAME	TP6 SCHDEV	TP6 NAME	TP7 SCHDEV	TP7 NAME	TP8 SCHDEV	TP8 NAME	TP9 SCHDEV	TP9 NAME	TP10 SCHDEV	TP9 NAME	TP11 SCHDEV	TP11 NAME	TP12 SCHDEV	TP12 NAME
4:39	107	110	4:39:01	79	77.9	0.02	SONOMACO	-0.05	SANTAROS	0.12	SANTAROS	-0.02	ROHNERTP	1.1	COTATI	0	PETALUMA	-0.45	NOVATOSA	-0.02	NOVATODO	-0.1	NOVATOHA	0.23	MARINCIV	-0.15	SANRAFAE	-1.1	LARKSPUR
5:02	101	102	5:01:54	79	78.1	-0.1	SONOMACO	-0.03	SANTAROS	-0.13	SANTAROS	-0.25	ROHNERTP	0.67	COTATI	-0.07	PETALUMA	-0.08	NOVATOSA	-0.03	NOVATODO	-0.12	NOVATOHA	0.28	MARINCIV	-0.07	SANRAFAE	-1.05	LARKSPUR
6:06	105	106	6:06:17	79	80.8	0.28	SONOMACO	-0.15	SANTAROS	0.33	SANTAROS	0.53	ROHNERTP	0.97	COTATI	-0.28	PETALUMA	3.82	NOVATOSA	3.75	NOVATODO	3.23	NOVATOHA	3.32	MARINCIV	2.97	SANRAFAE	2.13	LARKSPUR
6:38	103	104	6:37:50	79	79.8	-0.17	SONOMACO	-0.92	SANTAROS	-0.17	SANTAROS	-0.28	ROHNERTP	1.18	COTATI	0.17	PETALUMA	4.23	NOVATOSA	4.22	NOVATODO	1.92	NOVATOHA	2.12	MARINCIV	1.57	SANRAFAE	0.68	LARKSPUR
7:10	115	116	7:10:13	79	78.6	0.22	SONOMACO	0.23	SANTAROS	0.33	SANTAROS	0.17	ROHNERTP	1.98	COTATI	-0.33	PETALUMA	0.3	NOVATOSA	0.67	NOVATODO	0.52	NOVATOHA	0.9	MARINCIV	0.73	SANRAFAE	-0.18	LARKSPUR
7:42	107	110	7:27:36	79	86.3	-14.4	SONOMACO	0.17	SANTAROS	0.7	SANTAROS	0.63	ROHNERTP	1.45	COTATI	0.28	PETALUMA	1.55	NOVATOSA	1.6	NOVATODO	1.27	NOVATOHA	1.42	MARINCIV	1.3	SANRAFAE	0.18	LARKSPUR
8:14	101	102	8:13:56	79	79.2	-0.07	SONOMACO	-0.12	SANTAROS	-0.18	SANTAROS	-0.43	ROHNERTP	0.55	COTATI	-0.13	PETALUMA	2.2	NOVATOSA	2.17	NOVATODO	1.57	NOVATOHA	1.65	MARINCIV	1.05	SANRAFAE	0.12	LARKSPUR
9:18	105	106	9:18:14	79	78.1	0.23	SONOMACO	-0.32	SANTAROS	-0.48	SANTAROS	-0.07	ROHNERTP	0.88	COTATI	-0.62	PETALUMA	0.85	NOVATOSA	0.8	NOVATODO	0.12	NOVATOHA	0.38	MARINCIV	-0.13	SANRAFAE	-0.63	LARKSPUR
12:45	105	106	12:44:49	79	77	-0.18	SONOMACO	6.5	SANTAROS	6.1	SANTAROS	5.58	ROHNERTP	5.62	COTATI	1.88	PETALUMA	1.42	NOVATOSA	1.25	NOVATODO	-0.1	NOVATOHA	0	MARINCIV	-0.58	SANRAFAE	-2.15	LARKSPUR
13:17	107	110	13:16:48	79	78.2	-0.2	SONOMACO	-0.47	SANTAROS	-0.3	SANTAROS	-0.4	ROHNERTP	0.3	COTATI	-0.42	PETALUMA	0.28	NOVATOSA	0.52	NOVATODO	-0.33	NOVATOHA	0.4	MARINCIV	0.05	SANRAFAE	-1.03	LARKSPUR
14:21	101	102	14:21:01	79	79.5	0.02	SONOMACO	0.12	SANTAROS	0.35	SANTAROS	0.9	ROHNERTP	2.15	COTATI	-0.3	PETALUMA	2.62	NOVATOSA	2.67	NOVATODO	2.35	NOVATOHA	2.57	MARINCIV	2.12	SANRAFAE	0.53	LARKSPUR
14:53	115	116	14:53:22	79	78.1	0.37	SONOMACO	0.08	SANTAROS	0	SANTAROS	0.25	ROHNERTP	1.63	COTATI	0.97	PETALUMA	3.4	NOVATOSA	3.23	NOVATODO	1.17	NOVATOHA	1.27	MARINCIV	0.92	SANRAFAE	-0.48	LARKSPUR
15:25	103	104	15:25:01	79	77.4	0.02	SONOMACO	-0.2	SANTAROS	0.38	SANTAROS	0.42	ROHNERTP	1.82	COTATI	-0.2	PETALUMA	-0.22	NOVATOSA	0.15	NOVATODO	-0.12	NOVATOHA	0.27	MARINCIV	0.12	SANRAFAE	-1.57	LARKSPUR
15:57	105	106	15:56:32	79	78.5	-0.47	SONOMACO	-0.45	SANTAROS	0.1	SANTAROS	-0.05	ROHNERTP	0.38	COTATI	-0.18	PETALUMA	1.87	NOVATOSA	1.7	NOVATODO	1.22	NOVATOHA	1.2	MARINCIV	0.62	SANRAFAE	-0.98	LARKSPUR
17:01	107	110	16:59:49	79	83.8	-1.18	SONOMACO	-0.05	SANTAROS	0.43	SANTAROS	2.17	ROHNERTP	6.72	COTATI	5.7	PETALUMA	5.48	NOVATOSA	5.58	NOVATODO	5.45	NOVATOHA	5.77	MARINCIV	5.4	SANRAFAE	4.23	LARKSPUR
17:33	101	102	17:33:28	79	87.4	0.47	SONOMACO	1.7	SANTAROS	1.63	SANTAROS	13.42	ROHNERTP	13.73	COTATI	10.57	PETALUMA	11.82	NOVATOSA	11.73	NOVATODO	10.9	NOVATOHA	10.78	MARINCIV	10.5	SANRAFAE	8.83	LARKSPUR
18:05	115	116	18:05:00	79	90.3	0	SONOMACO	0.62	SANTAROS	2.63	SANTAROS	14.42	ROHNERTP	14.73	COTATI	14.48	PETALUMA	14.38	NOVATOSA	14.22	NOVATODO	13.63	NOVATOHA	13.43	MARINCIV	12.87	SANRAFAE	11.25	LARKSPUR
18:37	103	104	18:37:03	79	95	0.05	SONOMACO	0.13	SANTAROS	0.07	SANTAROS	23.95	ROHNERTP	24.05	COTATI	20.27	PETALUMA	21.18	NOVATOSA	20.98	NOVATODO	18.8	NOVATOHA	18.55	MARINCIV	17.52	SANRAFAE	16.05	LARKSPUR

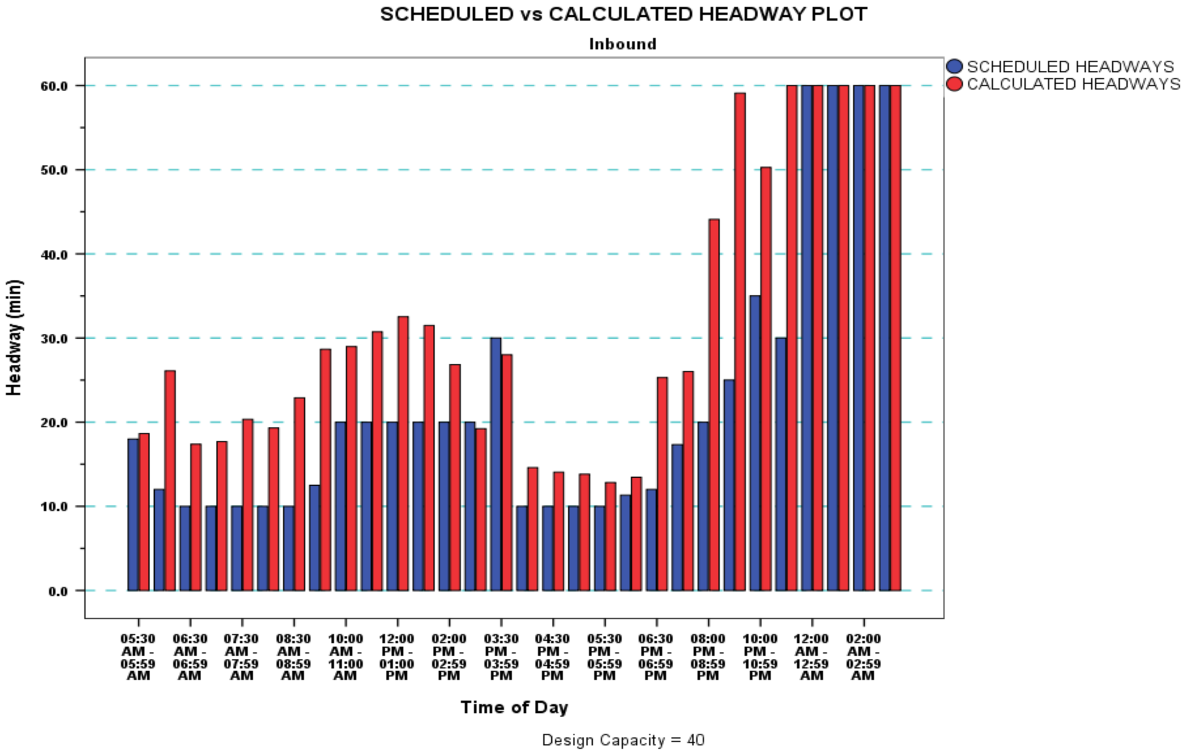
1.2.1 Headway Determination

UTA's Headway Determination application presents a Calculated Headway for a given Route and Direction based on APC-generated Average Passenger Load per Trip per Time Period (30 min Peak, 60 min Off-Peak). The Calculated Headway utilizes a Capacity Factor (100% Seated Load, 125% Seated Load, etc.) input by local users.

This report is typically utilized when budget constraints require a reduction in service and staff is tasked with removing a target level of operating cost.

Miami - DTPW
DATE 14 Mar 23
****
Rt - 11
SCHEDULED VS CALCULATED HEADWAYS
Weekday
****

DIRECTION	TIME PERIOD	SCHEDULED TRIPS PER TP	SAMPLED TRIPS PER TP	EXPANSION FACTOR	TIME PERIOD MAXLOAD SUMMATION	BUSES PER TP	CALCULATED HEADWAY	SCHEDULED HEADWAY
Outbound								
	.	1	1	1.000	22	.5	.	60
	03:00 AM - 04:00 AM	2	2	1.000	75	1.9	32	5
	05:00 AM - 05:29 AM	3	3	1.000	138	3.4	9	14
	05:30 AM - 05:59 AM	4	4	1.000	143	3.6	8	8
	06:00 AM - 06:29 AM	3	3	1.000	107	2.7	11	9
	06:30 AM - 06:59 AM	4	4	1.000	140	3.5	9	8
	07:00 AM - 07:29 AM	3	3	1.000	104	2.6	12	9
	07:30 AM - 07:59 AM	4	4	1.000	100	2.5	12	8
	08:00 AM - 08:29 AM	2	2	1.000	63	1.6	19	15
	09:00 AM - 10:00 AM	4	4	1.000	140	3.5	17	22
	10:00 AM - 11:00 AM	2	2	1.000	70	1.7	34	20
	11:00 AM - 12:00 PM	4	4	1.000	128	3.2	19	20
	12:00 PM - 01:00 PM	2	2	1.000	67	1.7	36	20
	01:00 PM - 02:00 PM	4	4	1.000	150	3.8	16	20
	02:00 PM - 02:59 PM	3	3	1.000	96	2.4	25	19
	03:00 PM - 03:29 PM	3	3	1.000	84	2.1	14	11
	03:30 PM - 03:59 PM	3	3	1.000	79	2.0	15	10
	04:00 PM - 04:29 PM	3	3	1.000	75	1.9	16	10
	04:30 PM - 04:59 PM	3	3	1.000	76	1.9	16	10
	05:00 PM - 05:29 PM	2	2	1.000	54	1.4	22	14
	05:30 PM - 05:59 PM	2	2	1.000	47	1.2	26	13
	06:00 PM - 06:29 PM	2	2	1.000	72	1.8	17	21
	07:00 PM - 07:59 PM	4	4	1.000	72	1.8	33	21
	08:00 PM - 08:59 PM	2	2	1.000	41	1.0	59	33
	09:00 PM - 09:59 PM	2	2	1.000	27	.7	90	29
Outbound								
	10:00 PM - 10:59 PM	1	1	1.000	15	.4	155	60
	12:00 AM - 12:59 AM	1	1	1.000	11	.3	215	71
	01:00 AM - 01:59 AM	1	1	1.000	7	.2	343	60
	02:00 AM - 02:59 AM	1	1	1.000	5	.1	464	60
	03:00 AM - 03:59 AM	1	1	1.000	6	.1	411	60
AVG								25



1.2.2 Intermodal Transfer Analysis

An effective transit system allows riders to conveniently transfer between modes. Bus to Rail and Rail to Bus transfers executed well encourage riders to utilize the modes of transit in an efficient manner. For Metro, with current bus and rail service, UTA's APC Software package includes the analytic capability of merging bus and rail data in order to assess the amount of time available for Bus to Rail and from Rail to Bus transfers.

SACRT RAIL TO BUS - OUTBOUND TRANSFER ANALYSIS
29 ST STATION
AUG 2019 - WEEKDAY

STATION	MODAL TRANSFER	DATE	MODE	RAIL STATION	VEHNO	SCHEDULE TIME	ARRIVAL TIME	DEPARTURE TIME	MODE	VEHNO	ARRIVAL TIME	DEPARTURE TIME	SCHEDULE TIME	DIFFERENCE (MIN)	WAITING STATUS
29ST	RAIL-TO-BUS OUTBOUND	8/5/2019													
			RAIL	16ST	120	6:50	6:50:59	6:52:11	BUS	1502	6:51:50	6:51:50	6:48	0.85	MINIMUM
			RAIL	16ST	222	10:05	10:06:03	10:07:19	BUS	2861	10:19:38	10:19:38	10:18	13.58	REASONABLE
			RAIL	16ST	202	11:50	11:50:56	11:52:14	BUS	1566	11:54:37	11:54:37	11:48	3.68	MINIMUM
			RAIL	16ST	232	13:05	13:06:46	13:07:58	BUS	1514	13:20:47	13:20:47	13:18	14.02	REASONABLE
			RAIL	16ST	202	13:35	13:37:19	13:38:28	BUS	1527	13:50:08	13:50:08	13:48	12.82	REASONABLE
			RAIL	16ST	215	15:20	15:21:54	15:23:07	BUS	1512	15:22:37	15:22:37	15:18	0.72	MINIMUM
			RAIL	16ST	210	15:35	15:35:56	15:37:.0	BUS	1502	15:53:56	15:53:56	15:48	18	EXCESSIVE
			RAIL	16ST	211	18:05	18:09:30	18:10:36	BUS	1527	18:20:28	18:20:28	18:18	10.97	REASONABLE
			RAIL	16ST	116	19:05	19:04:28	19:05:25	BUS	1570	19:05:47	19:05:47	19:07	1.32	MINIMUM
			RAIL	16ST	202	20:05	20:09:31	20:10:37	BUS	1512	20:12:02	20:12:02	20:07	2.52	MINIMUM
			RAIL	16ST	209	21:05	21:05:02	21:06:35	BUS	1566	21:09:33	21:09:33	21:07	4.52	MINIMUM
			RAIL	16ST	218	22:05	22:06:06	22:07:08	BUS	1538	22:08:06	22:08:06	22:07	2	MINIMUM
		AVG												7.08	
		OBS												12	

1.2.3 Actual vs Scheduled EOL Dwell Times

The Actual vs Scheduled EOL Dwell Times report provides a magnitude of difference in actual time and scheduled time at the EOL layover. This report is often utilized to confirm verbal anecdotal comments relative to sufficient time for recovery.

Often, drivers arrive Early and Depart Late which may add a significant number of minutes of the transit vehicle being idle.

This report also illustrates cases, typically in bad weather, when the drivers take less recovery time in order to get back on schedule.

Trinity Metro
SCHEDULE ADHERENCE REPORT
ANALYSIS OF EOL DWELL TIME - INDIVIDUAL OBSERVATIONS
Feb 2019 Schedule

DAY	ROUTE	LOCATION	SCHEDULE DEPART TIME	BLOCK	VEHICLE NO.	DATE	DELTA (FEET)	ACTUAL ARRIVAL TIME	SCHEDULE	ACTUAL DEPARTURE TIME	SCHEDULE DEPARTURE TIME	ARRIVAL SCH DEV	DEPARTURE SCH DEV	NET DIFFERENCE	SCHED DWELL TIME	ACTUAL DWELL TIME
WKD	2	ITC	05:45	64714	1861	2/5/2019	1/28/1900	5:34:11	5:45:00	5:45	5:45:00	-10.82	0.77	11.59	0.00	11.58
				64714	1861	2/8/2019	1/29/1900	5:34:22	5:45:00	5:46	5:45:00	-10.63	1.33	11.96	0.00	11.97
				64714	1861	2/11/2019	1/31/1900	5:34:54	5:45:00	5:45	5:45:00	-10.1	0.57	10.67	0.00	10.67
				64714	1861	2/12/2019	2/10/1900	5:34:18	5:45:00	5:44	5:45:00	-10.7	-0.35	10.35	0.00	10.35
				64714	1861	2/13/2019	2/4/1900	5:37:09	5:45:00	5:45	5:45:00	-7.85	0.12	7.97	0.00	7.97
				64714	1861	2/14/2019	1/24/1900	5:36:40	5:45:00	5:46	5:45:00	-8.33	1.55	9.88	0.00	9.88
				64714	1865	2/15/2019	1/28/1900	5:35:09	5:45:00	5:46	5:45:00	-9.85	1.27	11.12	0.00	11.12
				64714	1861	2/18/2019	1/22/1900	5:34:59	5:45:00	5:45	5:45:00	-10.02	0.22	10.24	0.00	10.23
				64714	1861	2/20/2019	1/28/1900	5:41:44	5:45:00	5:47	5:45:00	-3.27	2.33	5.6	0.00	5.6
				64714	1861	2/21/2019	1/28/1900	5:35:12	5:45:00	5:46	5:45:00	-9.8	1.22	11.02	0.00	11.02
				64714	1864	2/22/2019	1/29/1900	5:35:56	5:45:00	5:47	5:45:00	-9.07	2.03	11.1	0.00	11.1
				64714	1861	2/25/2019	1/27/1900	5:36:23	5:45:00	5:45	5:45:00	-8.62	0.37	8.99	0.00	8.98
				64714	1862	2/26/2019	2/6/1900	5:40:21	5:45:00	5:44	5:45:00	-4.65	-0.28	4.37	0.00	4.37
				64714	1861	2/27/2019	1/29/1900	5:37:33	5:45:00	5:45	5:45:00	-7.45	0.45	7.9	0.00	7.9
				64714	1866	2/28/2019	1/23/1900	5:35:05	5:45:00	5:47	5:45:00	-9.92	2.37	12.29	0.00	12.28
				64714	1866	3/1/2019	1/21/1900	5:33:34	5:45:00	5:50	5:45:00	-11.43	5.57	17	0.00	17
				64714	1863	3/4/2019	1/13/1900	5:32:52	5:45:00	5:45	5:45:00	-15.42	0.15	15.57	0.00	12.28
				64714	1864	3/5/2019	1/29/1900	5:42:17	5:45:00	5:46	5:45:00	-2.72	1.07	3.79	0.00	3.78
				64714	1861	3/6/2019	1/28/1900	5:34:23	5:45:00	5:38	5:45:00	-10.62	-6.13	4.49	0.00	4.48
				64714	1863	3/7/2019	1/9/1900	5:34:15	5:45:00	5:45	5:45:00	-10.75	0.67	11.42	0.00	11.42
				64714	1863	3/8/2019	1/11/1900	5:34:12	5:45:00	5:45	5:45:00	-10.8	0.95	11.75	0.00	11.75
			AVG					-9.18	0.77	9.95	0	9.8				

1.2.1 Deadhead Running Time

At a number of transit agencies, UTA has found that the potential savings due to excess Deadhead Running Times may exceed the cost of the APC system. In other words, APC-generated Deadhead Running Times may identify significant savings.

Also, the Variation in Distance of the Deadhead Trip is an indication of consistency in the route/path the bus followed in executing the Deadhead Trip. Users have utilized the Deadhead Report to identify the best Deadhead route/path when Deadhead routing had not been previously defined.

Deadhead Running Time analyses require a schedule export that contains Deadhead Trips. GTFS exports typically do not contain Deadhead Trips. Also, raw APC data generated by the AVL systems (TripSpark and Clever Devices) need to contain records during the Pull-Out and Pull-In Trips. If these two (2) prerequisites are met, UTA's APC Software can generate Deadhead Running Time reports as the examples below represent:

Deadhead Segment By Block

09/01/2022 - 09/30/2022

Weekday

Export Table To CSV File

Segment	Direction	Block	Trip	Avg Runtime (Minutes)	Avg Sch. Runtime	Avg Miles	Avg Time Diff	Observations
GRANBYDUFFYS - HAMMONDTAUSSIG	8	891047	1759	10.7	26.0	6.2	-15.3	5
DNTC - OLNEYNORFOLKGEN	8	891074	1908	5.9	52.0	1.8	-46.2	4
STARMNTJOLLIFF - PORTSMOUTHCAPRI	8	891074	2050	4.1	26.3	1.3	-22.3	18
STARMNTJOLLIFF - PORTSMOUTHCAPRI	8	891075	1852	3.1	25.4	1.4	-22.4	27
STARMNTJOLLIFF - PORTSMOUTHCAPRI	8	891076	1052	1.3	26.1	1.5	-24.8	9
COUNTYCOURT - QUEENFLORIDA	8	891104	0625	4.9	22.0	2.0	-17.1	5
DNTC - 49THQUARANTINE	8	891106	0641	12.5	19.0	4.0	-6.5	5
EVELYNBUTTSAVEJ - OCEANVW15THVW	8	891107	0653	15.8	24.0	6.3	-8.3	4
COUNTYCOURT - VICTORYCROSSING	8	891108	0639	5.4	24.0	3.6	-18.6	9
STARMNTJOLLIFF - PORTSMOUTHCAPRI	8	891132	2000	1.2	22.0	1.4	-20.8	4
FTNORFOLKSTAT - DNTC	8	891141	0636	6.9	16.0	1.8	-9.1	3

Total Daily Deadhead Minutes (Avg)
2,958.4

Total Daily Deadhead Miles (Avg)
1,522.2

Deadhead Segment Individual Observations

09/01/2022 - 09/30/2022

GRANBYDUFFYS - HAMMONDTAUSSIG

Weekday

Block: 891047

Export Table To CSV File

Note: This report highlights and removes outliers (>3 Std Dev) from the final results. Outlier values are highlighted in the table below.

Segment	Block	Bus	Trip Date	Depart Time	Sch Time	Sch Dev	Runtime (Minutes)	Sch Runtime	Time Diff	Miles	Upper Limit	Lower Limit
GRANBYDUFFYS - HAMMONDTAUSSIG	891047	2117	2022-09-02	18:24:38	18:25:00	-16.35	12.1	26.0	-13.9	5.9	13.4	8.0
GRANBYDUFFYS - HAMMONDTAUSSIG	891047	2125	2022-09-13	18:22:08	18:25:00	-13.75	10.5	26.0	-15.5	6.3	13.4	8.0
GRANBYDUFFYS - HAMMONDTAUSSIG	891047	2117	2022-09-14	18:26:01	18:25:00	-11.67	9.6	26.0	-16.4	6.3	13.4	8.0
GRANBYDUFFYS - HAMMONDTAUSSIG	891047	2125	2022-09-27	18:24:56	18:25:00	-8.02	10.9	26.0	-15.1	6.3	13.4	8.0
GRANBYDUFFYS - HAMMONDTAUSSIG	891047	2004	2022-09-28	18:25:53	18:25:00	-14.42	10.5	26.0	-15.5	6.3	13.4	8.0

Avg Runtime Without Outliers (Minutes)
10.7

Avg Miles Without Runtime Outliers
6.2

1.2.2 Schedule Adherence Consistency

An effective method for improving On-Time Performance is to generate the Schedule Adherence Consistency analysis which identifies the times/locations when/where transit service is consistently Early, On-Time, and Late.

The Schedule Adherence Consistency report presents the times/locations when/where On-Time Performance is consistent. For times/locations where service is consistently Early or Late, modifications to the schedules and/or deployment of street supervisors can resolve the out-of-tolerance OTP condition. For times/locations where On-Time Performance is consistently On-Time, positive recognition, both internal and external to the transit authority, can highlight the high-quality transit service.

Santa Cruz MTD
** Prepared On: 10 Mar 23
SCHEDULE ADHERENCE REPORT
INDIVIDUAL OBSERVATIONS - CONSISTENTLY ONTIME
Weekday
Dec 2022 Schedule
On-Time = Between 0.5 Min Before Sched Time and 5.5 Min After Sched Time
****

ROUTE	DIR	TIME PERIOD	TIME POINT	BLOCK	DATE	VEHNO	ARRIVAL TIME	LAST DOOR CLOSE TIME	DEPART TIME	SCHEDULE TIME	SCHEDULE DEVIATION	STATUS
10	0	07:00 AM - 07:15 AM	SCMC									
				1801	12/28/22	2333	06:56:12	07:09:51	07:10:04	07:10	.07	ON TIME
				1801	01/06/23	2333	06:58:31	07:09:02	07:10:07	07:10	.12	ON TIME
				1801	01/11/23	2333	06:59:51	07:09:56	07:10:27	07:10	.45	ON TIME
				1801	01/23/23	2333	07:01:04	07:09:52	07:10:17	07:10	.28	ON TIME
				1801	01/26/23	2333	07:00:11	07:10:49	07:11:06	07:10	1.10	ON TIME
				1801	01/31/23	2333	06:57:07	07:09:52	07:10:11	07:10	.18	ON TIME
				1801	02/01/23	2333	06:57:18	07:09:19	07:10:07	07:10	.12	ON TIME
				1801	02/02/23	2333	06:56:53	07:09:53	07:10:12	07:10	.20	ON TIME
				1801	02/07/23	2333	06:58:52	07:10:15	07:10:32	07:10	.53	ON TIME
				1801	02/08/23	2333	06:56:35	07:08:34	07:10:00	07:10	.00	ON TIME
				1801	02/09/23	2333	06:56:26	07:09:01	07:10:00	07:10	.00	ON TIME
				1801	02/10/23	2333	06:55:46	07:09:15	07:10:06	07:10	.10	ON TIME
				1801	02/14/23	2333	06:56:41	07:10:00	07:10:17	07:10	.28	ON TIME
				1801	02/15/23	2333	06:54:09	07:10:12	07:10:25	07:10	.42	ON TIME
				1801	02/16/23	2333	06:56:19	07:10:03	07:10:20	07:10	.33	ON TIME
				1801	02/23/23	2333	06:58:16	07:09:03	07:10:14	07:10	.23	ON TIME
				1801	03/01/23	2333	06:59:22	07:09:25	07:09:57	07:10	-.05	ON TIME
				1801	03/02/23	2333	06:56:51	07:09:45	07:10:04	07:10	.07	ON TIME
				1801	03/07/23	2333	06:55:51	07:09:30	07:10:04	07:10	.07	ON TIME
				1801	03/08/23	2333	06:56:04	07:09:21	07:09:58	07:10	-.03	ON TIME
				1801	03/09/23	2333	06:56:47	07:10:22	07:10:42	07:10	.70	ON TIME
			TP AVG								.25	
			STDEV								.28	

SCHEDULE ADHERENCE REPORT
INDIVIDUAL OBSERVATIONS - CONSISTENTLY LATE
Weekday
Dec 2022 Schedule
Late = More Than 5.5 Min After Scheduled Time
****

ROUTE	DIR	TIME PERIOD	TIME POINT	BLOCK	DATE	VEHNO	ARRIVAL TIME	LAST DOOR CLOSE TIME	DEPART TIME	SCHEDULE TIME	SCHEDULE DEVIATION	STATUS
17	0	08:30 AM - 08:45 AM	CALTRAINDEPOT									
				1703	01/17/23	4201	08:37:50	08:50:42	08:50:58	08:30	7.83	LATE
				1703	02/01/23	4201	08:38:59	08:50:00	08:50:27	08:30	8.98	LATE
				1703	02/14/23	4201	08:38:43	08:52:09	08:52:31	08:30	8.72	LATE
				1703	02/15/23	4201	08:38:52	08:50:05	08:50:34	08:30	8.87	LATE
			TP AVG								8.60	
			STDEV								.52	
		AVG									8.60	
		09:30 AM - 10:00 AM	CALTRAINDEPOT									
				1705	01/26/23	4201	10:04:30	10:10:30	10:10:53	09:56	8.50	LATE
				1705	01/30/23	4201	10:05:40	10:11:05	10:11:52	09:56	9.67	LATE
			TP AVG								9.08	
			STDEV								.82	
		AVG									9.08	

Santa Cruz MTD
** Prepared On: 10 Mar 23
SCHEDULE ADHERENCE REPORT
INDIVIDUAL OBSERVATIONS - CONSISTENTLY EARLY
Weekday
Dec 2022 Schedule
Early = Less Than 0.5 Min Before Scheduled Time
****

ROUTE	DIR	TIME PERIOD	TIME POINT	BLOCK	DATE	VEHNO	ARRIVAL TIME	LAST DOOR CLOSE TIME	DEPART TIME	SCHEDULE TIME	SCHEDULE DEVIATION	STATUS
18	0	12:30 PM - 13:00 PM	ALMARSHOPPING									
				1801	01/06/23	2333	12:32:00	12:32:46	12:34:59	12:37	-2.02	EARLY
				1801	02/01/23	2333	12:31:54	12:35:42	12:36:04	12:37	-.93	EARLY
				1801	02/02/23	2333	12:32:34	12:35:38	12:36:01	12:37	-.98	EARLY
				1801	02/07/23	2333	12:33:03	12:33:19	12:35:33	12:37	-1.45	EARLY
				1801	02/08/23	2333	12:32:22	12:32:39	12:34:24	12:37	-2.60	EARLY
				1801	02/16/23	2333	12:32:32	12:33:57	12:34:36	12:37	-2.40	EARLY
				1801	03/01/23	2333	12:35:07	12:35:22	12:35:33	12:37	-1.45	EARLY
			TP AVG								-1.69	
			STDEV								.66	

1.2.3 Summary of Reports/Plots

Presented below is a summary of the wide range of analytic reports within UTA's APC Software package:

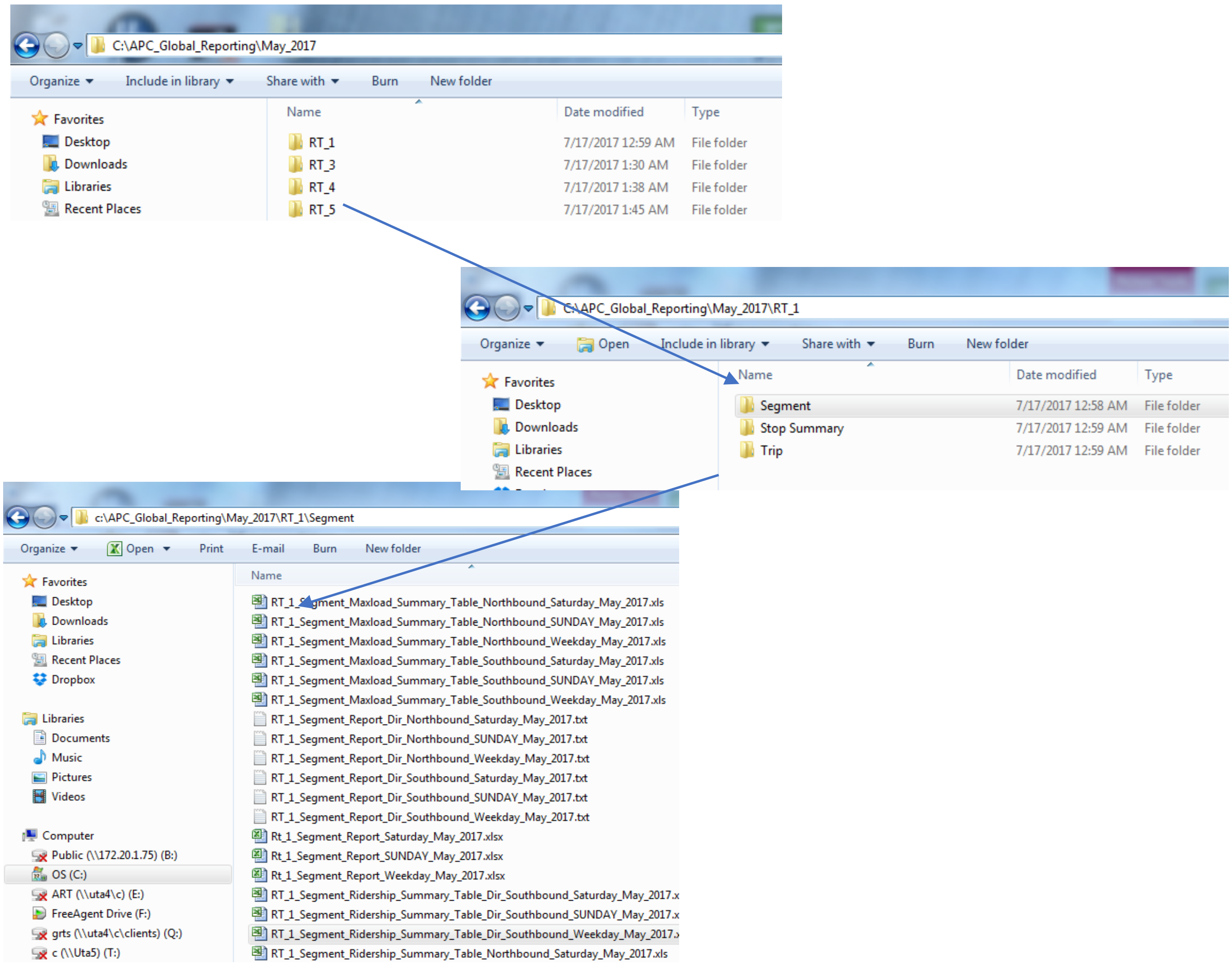
	Reports
	Standard Analytical Reports
1	Ride-check Report
2	Bus Stop: Individual Stop Observations
3	Bus Stop: Daily Ridership Summary by Unique Stop
4	Bus Stop: Load Plot by Stop by Trip
5	Segment Report: Individual Segment Observations
6	Segment Report: Ridership
7	Segment Report: Running Time
8	Segment Report: Max Load
9	Segment Report: Velocity
10	Actual Vs. Scheduled Running Time Plots
11	Trip Report: Individual Observations
12	Trip Report: Summary
13	Trip Report: Ridership/Max Load Plot
14	Trip Report: Route Demand by Direction Plot
15	Trip Report: Route Demand Plot
16	Route Ridership: Route Level Daily Ridership
17	Route Ridership: System Ridership/Trip Length
18	Schedule Adherence: System Totals by Day of Week
19	Schedule Adherence: Time Period Summary
20	Schedule Adherence: Time Point Summary
21	Schedule Adherence: Individual Observations
22	Deadhead Running Time: Individual Observations
23	Deadhead Running Time: Summary by Origin-Destination
24	NTD Reports/Substantiation: Route Summaries
25	NTD Reports/Substantiation: Trip Summary
26	NTD Reports/Substantiation: Individual Trip Observations
27	NTD Reports/Substantiation: Selection of Random Trip Samples
28	Schedule Adherence Consistency
29	Exception Report – Consistent Times/Locations
30	Exception Report – Inconsistent Times/Locations
31	Peak/30 Min Off-Peak Summaries
	Productivity Reports
32	Stop Ridership Ranking Report
33	Stop Productivity Ranking Report
34	Trip Productivity Analysis
35	Exception Report – Low Productivity Trips
36	Exception Report – Overcrowded Trips
37	Route Productivity Ranking
38	Ridership, Passengers/Mile, Passengers/Hour, Passenger Miles
39	Bi-Directional Segment Productivity
40	Daily Totals Report
41	Daily Totals Hourly Summaries
42	Garage Schedule Adherence
43	Wheelchair Lift Usage Report
44	Paired Origin-Destination Observation

45	Frequency Plot by Hour
46	Frequency Plot by Route
47	Municipal Service Utilization Report
48	System Summary – Miles, Hours, Ridership
49	Route Summary – Miles, Hours, Ridership
50	Block Productivity Report
51	EOL Dwell Time Report
52	Scheduled Vs. Actual Individual Observations
53	Scheduled Vs. Actual Summary
54	Headway Maintenance Report
55	Headway Determination Report
56	Multi Markup (Signup) Productivity Analysis by Route
57	Multi Markup (Signup) Productivity Analysis by Time Period
58	Census Tract/ TAZ Productivity Reports
	Administrative Control Reports
59	APC Sampling Status: Trip Sampled Per Route Summary Table
60	APC Sampling Status: Un-Sampled Blocks Report
61	APC Sampling Status: Hourly Sampled/Scheduled Plot
62	APC Deployment Plan: Daily Blocks Per Division Per Bus Type
63	APC Diagnostics: Daily Totals – Last Seven (7) Days
64	APC Diagnostics: Anomaly Report
65	APC Diagnostics: Exception Reporting
66	Bus Stop Geo-Coding Accuracy/Comprehensiveness
67	Summary Exception Report by Non-Compliant Bus Stop
68	Individual Observations
69	Reference File Comparison: Trips/Stops/Time-Points by Route-Dir-Pattern.
70	Reference File Comparison: Trips/Stops/Time-Points by Schedule-Route-Dir-Pattern.
71	Trip Start of Line/End of Line Matching: Summary by Route
72	Trip Start of Line/End of Line Matching: Individual Obser,
73	Trip Start of Line/End of Line Matching: First & Last Trip
74	Time Point Segment Contiguity
75	Schedule Adherence Complaint Validation
76	APC System Performance/Trend (Data Yield Analysis)
77	Next Day Impact Analysis

1.2.4 Global Reporting

The Global Reporting software module is executed on a regular (monthly, schedule or quarter period) basis. Global Reporting generates standard UTA reports for all Routes on Weekdays, Saturdays, and Sundays. The Global Reports generate reports and plots in standard formats (.xlsx, .csv, .jpg, .kml, etc.) which can be specified by Metro. The Global Reports will be stored in a password protected FTP or AWS bucket available for instant download by Metro staff. The global reports eliminate the need for Metro staff to actively review numerous routes quickly on historical data.

See sample screenshots below:



1.2.5 Examples of Ad-Hoc User Requested Analytics

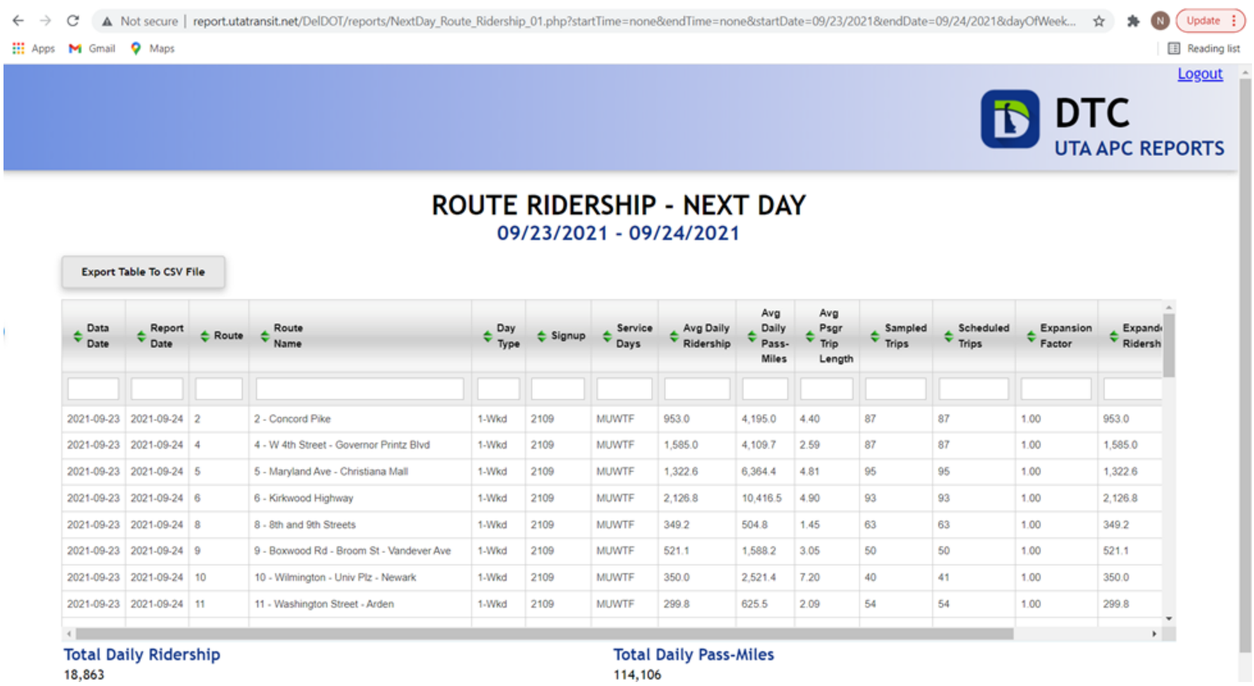
1.2.5.1 Next Day Ridership

The Next Day Ridership Reporting is an optional feature which affords transit managers quick feedback from planning and operations about their ridership from previous day. This feedback is extremely critical not only from operations and planning point but also from political, media and marketing perspective. However, we all know how difficult it is to provide accurate Next Day ridership early in the day to make day to day adaptions in operations and scheduling.

Challenges such as data transfer, differences between scheduled and operational service, detours, missed service, extra service, make it even more difficult to accurately estimate ridership next day.

UTA has been providing Next Day Ridership using an approach that presents individual APC trip observations, then 'backfills' average APC data for any trip data that may not have been collected on the single date due to the challenges listed above. Unsampled trips average ridership is derived from the sample of the same trip data from the preceding day, week, or month.

An excerpt from a Next Day Ridership Report from Delaware DelDot is below:


DTC
UTA APC REPORTS

ROUTE RIDERSHIP - NEXT DAY

09/23/2021 - 09/24/2021

Data Date	Report Date	Route	Route Name	Day Type	Signup	Service Days	Avg Daily Ridership	Avg Daily Pass-Miles	Avg Psgr Trip Length	Sampled Trips	Scheduled Trips	Expansion Factor	Expand Ridersh
2021-09-23	2021-09-24	2	2 - Concord Pike	1-Wkd	2109	MUWTF	953.0	4,195.0	4.40	87	87	1.00	953.0
2021-09-23	2021-09-24	4	4 - W 4th Street - Governor Printz Blvd	1-Wkd	2109	MUWTF	1,585.0	4,109.7	2.59	87	87	1.00	1,585.0
2021-09-23	2021-09-24	5	5 - Maryland Ave - Christiana Mall	1-Wkd	2109	MUWTF	1,322.6	6,364.4	4.81	95	95	1.00	1,322.6
2021-09-23	2021-09-24	6	6 - Kirkwood Highway	1-Wkd	2109	MUWTF	2,126.8	10,416.5	4.90	93	93	1.00	2,126.8
2021-09-23	2021-09-24	8	8 - 8th and 9th Streets	1-Wkd	2109	MUWTF	349.2	504.8	1.45	63	63	1.00	349.2
2021-09-23	2021-09-24	9	9 - Boxwood Rd - Broom St - Vandever Ave	1-Wkd	2109	MUWTF	521.1	1,588.2	3.05	50	50	1.00	521.1
2021-09-23	2021-09-24	10	10 - Wilmington - Univ Plz - Newark	1-Wkd	2109	MUWTF	350.0	2,521.4	7.20	40	41	1.00	350.0
2021-09-23	2021-09-24	11	11 - Washington Street - Arden	1-Wkd	2109	MUWTF	299.8	625.5	2.09	54	54	1.00	299.8

Total Daily Ridership
18,863

Total Daily Pass-Miles
114,106

1.2.5.2 Special Event Ridership Examples

HART Streetcar Gasparilla Festival Ridership – On 01/29/22, Tampa held a downtown event entitled Gasparilla Festival during which HART's Streetcar service was heavily utilized. Each HART Streetcar is equipped with an APC system. On Monday, 01/31/22, UTA provided Gasparilla Ridership on HART's Streetcar Service.

CMTA-Austin South by Southwest Festival (SFSX) – Each year, CMTA adapts service to meet the travel demands associated with SFSX. UTA's APC Software accepts the non-routine schedules and geo-coding in order to generate prompt feedback on SFSX Ridership data.

1.2.6 APC Political Jurisdiction Reports

UTA's Political Jurisdiction reports provide the Ridership, Passenger Miles, Revenue Miles and Revenue Hours for a wide range of political jurisdictions served by a transit agency (census tracts, cities, counties, commissioner districts, traffic zones, etc.). With census tracts, socio-economic variables can be incorporated into the Political Jurisdiction reports that provide information to meet Title VI reporting along with assessing Ridership changes by demographic groupings. also offer easy export JPG graphs which can be used in presentation as well as standard UTA Analytic Reporting features of immediate export of data to CSV files and Macro- to Micro- drill down analytics.

The example below is a Political Jurisdiction Report by Census Tract in which APC observations are assigned to a Census Tract. Once the Census Tract is matched, socioeconomic variables such as Median Income can be included in the report.

Given the presence of Lat/Long and Time of Day on each Boarding and Alighting observation from Metro buses and Streetcars, UTA's APC Software can apply a variety of Political Jurisdictions to each APC record. Political Jurisdictions can include city, county, census tract, commissioner district, traffic zone, zip code, etc. With census tracts, a wide range of socioeconomic variables can be added to the analysis.

Providing periodic summaries by Political Jurisdiction will allow the transit staff and the various communities served by the transit agency to review the amount of service provided and the amount of service utilized.

With census tracts, a wide range of socioeconomic variables can be added to the analyses. Presented below is an example from Sacramento that compared the changes in Ridership by Median Income over two (2) chronological periods.

Urban Transportation Associates, Inc
SACRT
CENSUS TRACT MULTI-MARKUP COMPARISON BY CENSUS TRACT

DAY OF WEEK	TIME PERIOD	CENSUS TRACT	MEDIAN INCOME	AVERAGE DAILY Dec-20 RIDERS	AVERAGE DAILY Dec-19 RIDERS	Dec-20 Dec-19 RIDERSHII DELTA	AVERAGE DAILY Dec-20 HOURS	AVERAGE DAILY Dec-19 HOURS	Dec-20 Dec-19 HOURS DELTA	AVERAGE DAILY Dec-20 MILES	AVERAGE DAILY Dec-19 MILES	Dec-20 Dec-19 MILES DELTA	AVERAGE DAILY Dec-20 PSNGRMILES	AVERAGE DAILY Dec-19 PSNGRMILES	Dec-20 Dec-19 PSNGRMILES DELTA
WEEKDAY	PRE AM PEAK 04:00AM-05:59AM														
		Census Tract 37	$27,765	1	2	-61.20%	7	7	-0.30%	2	2	0.10%	5	13	-59.50%
		Census Tract 38	$51,375	0	1	-83.20%	5.7	5.3	7.50%	2	2	-0.30%	2	9	-82.20%
		Census Tract 39	$63,668	0	6	-94.70%	5.8	6.6	-12.40%	1.9	1.9	-0.40%	6	23	-72.50%
		Census Tract 4	$55,714	0	0	-87.60%	3.3	2.9	14.20%	0.9	0.8	18.70%	1	3	-63.50%
		Census Tract 40.01	$52,500	3	8	-57.60%	23.1	20.4	13.30%	6.2	6.1	0.80%	5	20	-75.30%
		Census Tract 40.04	$89,782	1	5	-73.40%	19	23.1	-18.00%	4.2	4.4	-4.80%	3	6	-48.10%
		Census Tract 40.05	$67,721	0	2	-93.00%	12.5	13.8	-9.30%	5.1	5	3.10%	5	11	-53.40%
		Census Tract 40.06	$52,292	0	2	-86.10%	6.4	7.3	-12.10%	2.5	2.6	-2.40%	2	8	-69.20%
		Census Tract 40.08	$82,415	0	1	-89.30%	9.5	9.1	4.30%	1.9	1.9	-4.10%	1	3	-48.50%
		Census Tract 40.09	$70,833	3	4	-38.10%	17.7	15.7	12.70%	3.2	3.1	2.90%	2	4	-59.90%
		Census Tract 40.10	$41,184	0	3	-100.00%	4.7	5	-7.10%	1.7	1.7	-1.10%	1	3	-75.90%
		Census Tract 40.11	$107,083	1	3	-57.40%	7	6.6	5.70%	1.9	1.8	6.50%	0	2	-79.80%
		Census Tract 40.12	$119,615	0	0	.	1.4	0.7	87.00%	0.2	0.2	6.90%	0	0	.
		Census Tract 41	$29,635	2	9	-77.20%	13.6	13	4.80%	1.8	1.7	7.90%	1	8	-81.80%
		Census Tract 42.01	$43,365	0	1	-78.20%	5	5.4	-7.70%	1.9	1.9	-0.40%	1	6	-78.90%
		Census Tract 42.02	$36,379	0	5	-96.00%	5.6	6.6	-15.50%	2.3	2.3	-0.40%	2	10	-83.00%
		Census Tract 42.03	$35,568	3	4	-21.00%	12.5	13	-3.50%	2.1	2.2	-3.60%	3	11	-73.50%
		Census Tract 43	$43,819	2	4	-45.60%	7.6	6.7	12.70%	2.2	1.7	28.50%	3	3	-8.80%
		Census Tract 44.01	$36,902	1	3	-62.40%	9.9	9.7	2.20%	2	1.9	5.20%	1	7	-83.20%
		Census Tract 44.02	$23,346	2	4	-60.90%	10	9.9	2.00%	2.1	2.1	2.50%	4	10	-62.90%
		Census Tract 45.01	$27,078	0	0	-100.00%	3.8	3	26.40%	0.5	0.6	-11.00%	1	1	-1.60%
		Census Tract 45.02	$26,466	1	2	-65.70%	13.2	15.5	-14.90%	3.9	4.1	-4.70%	4	12	-69.20%
		Census Tract 46.01	$27,194	0	2	-89.00%	8.5	8.9	-4.60%	2.7	2.7	-0.10%	2	6	-68.20%
		Census Tract 46.02	$34,181	3	6	-50.90%	9.4	10.7	-11.90%	2.6	2.6	-0.50%	5	9	-45.90%
		Census Tract 47.01	$24,107	2	10	-83.20%	24.7	31.1	-20.70%	4.3	4.5	-3.60%	7	21	-65.40%
		Census Tract 48.01	$36,369	1	3	-65.10%	12.5	19.7	-36.40%	3.4	4	-15.20%	3	7	-64.70%
		Census Tract 48.02	$32,364	1	4	-76.30%	11.9	13.7	-12.80%	2.9	2.9	-0.40%	3	7	-58.10%

Urban Transportation Associates, Inc
SACRT
CENSUS TRACT MULTI-MARKUP COMPARISON BY CENSUS TRACT

DAY OF WEEK	TIME PERIOD	CENSUS TRACT	MEDIAN INCOME	AVERAGE DAILY Dec-20 RIDERS	AVERAGE DAILY Dec-19 RIDERS	Dec-20 Dec-19 RIDERSHII DELTA	AVERAGE DAILY Dec-20 HOURS	AVERAGE DAILY Dec-19 HOURS	Dec-20 Dec-19 HOURS DELTA	AVERAGE DAILY Dec-20 MILES	AVERAGE DAILY Dec-19 MILES	Dec-20 Dec-19 MILES DELTA	AVERAGE DAILY Dec-20 PSNGRMILES	AVERAGE DAILY Dec-19 PSNGRMILES	Dec-20 Dec-19 PSNGRMILES DELTA
WEEKDAY	PRE AM PEAK 04:00AM-05:59AM														
		Census Tract 37	$27,765	1	2	-61.20%	7	7	-0.30%	2	2	0.10%	5	13	-59.50%
		Census Tract 38	$51,375	0	1	-83.20%	5.7	5.3	7.50%	2	2	-0.30%	2	9	-82.20%
		Census Tract 39	$63,668	0	6	-94.70%	5.8	6.6	-12.40%	1.9	1.9	-0.40%	6	23	-72.50%
		Census Tract 4	$55,714	0	0	-87.60%	3.3	2.9	14.20%	0.9	0.8	18.70%	1	3	-63.50%
		Census Tract 40.01	$52,500	3	8	-57.60%	23.1	20.4	13.30%	6.2	6.1	0.80%	5	20	-75.30%
		Census Tract 40.04	$89,782	1	5	-73.40%	19	23.1	-18.00%	4.2	4.4	-4.80%	3	6	-48.10%
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		Census Tract 40.06	$52,292	0	2	-86.10%	6.4	7.3	-12.10%	2.5	2.6	-2.40%	2	8	-69.20%
		Census Tract 40.08	$82,415	0	1	-89.30%	9.5	9.1	4.30%	1.9	1.9	-4.10%	1	3	-48.50%
		Census Tract 40.09	$70,833	3	4	-38.10%	17.7	15.7	12.70%	3.2	3.1	2.90%	2	4	-59.90%
		Census Tract 40.10	$41,184	0	3	-100.00%	4.7	5	-7.10%	1.7	1.7	-1.10%	1	3	-75.90%
		Census Tract 40.11	$107,083	1	3	-57.40%	7	6.6	5.70%	1.9	1.8	6.50%	0	2	-79.80%
		Census Tract 40.12	$119,615	0	0	.	1.4	0.7	87.00%	0.2	0.2	6.90%	0	0	.
		Census Tract 41	$29,635	2	9	-77.20%	13.6	13	4.80%	1.8	1.7	7.90%	1	8	-81.80%
		Census Tract 42.01	$43,365	0	1	-78.20%	5	5.4	-7.70%	1.9	1.9	-0.40%	1	6	-78.90%
		Census Tract 42.02	$36,379	0	5	-96.00%	5.6	6.6	-15.50%	2.3	2.3	-0.40%	2	10	-83.00%
		Census Tract 42.03	$35,568	3	4	-21.00%	12.5	13	-3.50%	2.1	2.2	-3.60%	3	11	-73.50%
		Census Tract 43	$43,819	2	4	-45.60%	7.6	6.7	12.70%	2.2	1.7	28.50%	3	3	-8.80%
		Census Tract 44.01	$36,902	1	3	-62.40%	9.9	9.7	2.20%	2	1.9	5.20%	1	7	-83.20%
		Census Tract 44.02	$23,346	2	4	-60.90%	10	9.9	2.00%	2.1	2.1	2.50%	4	10	-62.90%
		Census Tract 45.01	$27,078	0	0	-100.00%	3.8	3	26.40%	0.5	0.6	-11.00%	1	1	-1.60%
		Census Tract 45.02	$26,466	1	2	-65.70%	13.2	15.5	-14.90%	3.9	4.1	-4.70%	4	12	-69.20%
		Census Tract 46.01	$27,194	0	2	-89.00%	8.5	8.9	-4.60%	2.7	2.7	-0.10%	2	6	-68.20%
		Census Tract 46.02	$34,181	3	6	-50.90%	9.4	10.7	-11.90%	2.6	2.6	-0.50%	5	9	-45.90%
		Census Tract 47.01	$24,107	2	10	-83.20%	24.7	31.1	-20.70%	4.3	4.5	-3.60%	7	21	-65.40%
		Census Tract 48.01	$36,369	1	3	-65.10%	12.5	19.7	-36.40%	3.4	4	-15.20%	3	7	-64.70%
		Census Tract 48.02	$32,364	1	4	-76.30%	11.9	13.7	-12.80%	2.9	2.9	-0.40%	3	7	-58.10%

1.2.1 Social Vulnerability Index

In 2016, well before the COVID pandemic, the Center for Disease Control (CDC) developed a Social Vulnerability Index (SVI) that utilized census information to identify those census tracts that would be more severely impacted by natural disasters than other census tract.

Within UTA’s APC Software package is the application of census tract data to identify the most socially vulnerable census tracts in a region and the application of APC-generated data to those socially vulnerable census tracts.

Given FTA’s current emphasis in equity in transit service allocation, periodic assessments of the amount of service, quality of service (overcrowding, schedule adherence), and Ridership change will allow the local transit agency to possess current and accurate APC-generated information on service to the most socially vulnerable communities.

Presented below is an example from Westchester County NY representing the March 2020 COVID shutdown period in which the communities with the highest levels of social vulnerability continue to rely on transit to travel to work. These riders were the essential workers traveling to the essential jobs during the shutdown. The most affluent communities (low SVI) were able to work remotely during the March 2020 shutdown.

OVERALL SOCIAL VULNERABILITY RANKING	CENSUS TRACT	PER CAPITA INCOME	OVERALL SOCIOECONOMIC RANKING	OVERALL HOUSEHOLD DISABILITY RANKING	OVERALL MINORITY LANGUAGE RANKING	OVERALL TRANSPORTATION AND HOUSING RANKING	BELOW POVERTY PCT	UNEMPLOYED PCT	NO HIGH SCHOOL DIPLOMA	AGE65 OR OLDER PCT	AGE17 OR YOUNGER PCT	CIVILIAN WITH DISABILIT PCT	SINGLE PARENT HOUSEHOLDS PCT	MINORITY PCT	LIMITED ENGLISH PCT	MULTI UNIT STRUCTURES PCT	MOBILE HOMES PCT	CROWDING PCT	NO VEHICLE PCT	GROUP QUARTERS PCT
223	Census Tract 5	$14,587	2	1	4	24	36.40%	5.50%	41.90%	19.20%	26.60%	20.30%	21.90%	96.20%	20.30%	50.80%	0.00%	8.10%	57.60%	0.40%
222	Census Tract 133	$29,815	1	4	9	18	18.40%	0.90%	35.50%	15.90%	27.90%	12.00%	21.20%	85.40%	20.80%	43.90%	0.00%	8.00%	34.40%	1.80%
221	Census Tract 3	$16,200	24	8	6	3	34.40%	12.80%	42.60%	18.80%	20.80%	14.50%	20.60%	93.40%	21.30%	63.00%	0.00%	17.30%	55.30%	6.20%
220	Census Tract 10	$14,413	18	3	16	1	45.80%	10.80%	28.20%	14.40%	31.20%	17.40%	19.70%	91.40%	13.30%	61.20%	2.10%	10.90%	61.90%	0.80%
219	Census Tract 6	$19,983	6	5	22	7	25.00%	5.40%	28.50%	21.70%	21.50%	14.90%	12.80%	85.20%	13.20%	55.10%	0.00%	9.70%	33.60%	7.70%
218	Census Tract 12	$17,546	27	14	8	12	39.40%	18.40%	34.00%	9.40%	31.10%	11.60%	24.50%	83.90%	22.50%	26.50%	0.20%	17.00%	54.70%	0.30%
217	Census Tract 1.0	$19,897	24	23	4	16	21.10%	7.70%	27.30%	11.70%	25.80%	11.60%	20.50%	97.80%	20.00%	75.00%	0.00%	5.50%	43.10%	1.00%
216	Census Tract 143	$15,990	19	2	14	47	22.80%	8.90%	32.10%	18.30%	27.70%	15.30%	14.60%	85.60%	16.80%	42.10%	0.00%	9.80%	29.50%	0.10%
215	Census Tract 2.0	$16,326	35	31	2	30	19.40%	12.20%	38.30%	10.10%	26.10%	10.80%	23.40%	94.60%	22.50%	64.20%	0.00%	14.60%	58.60%	0.00%
214	Census Tract 36	$21,497	3	49	20	26	23.50%	4.10%	26.50%	11.90%	24.30%	11.30%	12.00%	84.30%	16.20%	33.70%	1.30%	7.90%	37.80%	0.00%
213	Census Tract 63	$20,767	34	29	26	5	14.30%	8.20%	28.70%	18.50%	18.10%	16.70%	8.50%	79.20%	13.70%	52.80%	0.00%	10.20%	40.80%	8.80%
212	Census Tract 13.	$16,252	28	51	7	44	29.80%	11.80%	27.60%	7.50%	27.40%	9.80%	17.20%	90.50%	17.50%	50.80%	0.00%	12.50%	41.50%	0.00%
211	Census Tract 33	$29,385	4	6	47	45	13.20%	2.60%	22.70%	19.60%	21.00%	15.10%	18.60%	96.20%	4.30%	22.40%	2.60%	5.70%	29.30%	0.00%
210	Census Tract 11.	$10,941	11	54	1	83	58.20%	11.00%	55.10%	5.10%	36.30%	7.60%	25.10%	91.90%	29.70%	7.20%	0.00%	12.20%	49.70%	0.00%
209	Census Tract 80	$21,730	9	119	4	29	24.30%	7.30%	40.80%	8.90%	29.10%	5.90%	12.70%	88.80%	28.80%	35.50%	0.00%	18.80%	32.50%	0.30%
208	Census Tract 79	$22,549	33	97	11	21	12.30%	7.50%	36.10%	11.70%	23.40%	9.40%	12.90%	82.80%	21.80%	35.30%	0.00%	13.40%	21.70%	2.20%
207	Census Tract 4.0	$28,210	48	71	25	15	21.10%	9.70%	23.20%	10.50%	19.80%	12.80%	17.20%	94.20%	9.70%	67.40%	0.00%	7.20%	42.00%	0.80%
206	Census Tract 93	$59,034	97	27	24	20	32.90%	12.60%	25.20%	19.90%	16.90%	12.70%	11.50%	76.70%	18.70%	97.50%	0.00%	2.50%	31.20%	5.10%
205	Census Tract 4.0	$32,766	44	94	27	2	26.80%	8.90%	24.80%	8.10%	24.90%	8.90%	16.70%	85.60%	10.60%	74.10%	1.20%	8.40%	38.80%	1.50%
204	Census Tract 62	$24,946	12	82	24	57	18.60%	6.60%	36.90%	10.10%	25.40%	10.30%	8.70%	72.80%	21.50%	21.20%	0.00%	11.90%	31.10%	0.10%
203	Census Tract 58	$24,115	32	82	19	49	12.70%	7.20%	31.90%	15.00%	21.50%	10.00%	8.80%	76.20%	23.30%	43.80%	0.00%	13.20%	35.20%	0.00%
203	Census Tract 142	$29,998	26	41	39	55	22.90%	7.00%	23.30%	7.90%	25.90%	10.90%	16.80%	68.30%	10.60%	21.10%	0.00%	6.80%	15.00%	0.90%
201	Census Tract 37	$31,610	11	22	43	85	19.50%	5.30%	26.40%	17.80%	19.70%	12.60%	13.00%	73.40%	8.10%	27.40%	0.00%	7.50%	22.20%	0.00%
200	Census Tract 2.0	$35,066	62	13	59	13	21.30%	7.10%	13.30%	24.70%	21.60%	22.50%	5.80%	66.90%	6.20%	93.00%	0.00%	3.50%	38.60%	4.60%
199	Census Tract 1.0	$19,700	8	160	19	4	34.50%	6.10%	19.70%	10.40%	22.50%	5.90%	20.20%	86.80%	13.50%	75.40%	0.00%	8.20%	60.00%	3.30%
199	Census Tract 35	$15,884	38	18	28	98	36.10%	15.30%	24.00%	7.50%	27.10%	13.60%	24.10%	90.20%	9.00%	12.70%	0.00%	5.90%	47.00%	0.00%
197	Census Tract 41	$34,975	69	16	46	38	13.20%	5.60%	10.10%	16.90%	23.80%	10.60%	15.30%	94.30%	4.60%	54.10%	0.00%	11.60%	19.70%	0.20%
196	Census Tract 31	$16,263	40	11	78	9	24.50%	11.50%	21.60%	11.20%	30.30%	14.30%	13.60%	99.40%	1.60%	63.70%	0.00%	10.80%	64.40%	1.30%

1.2.2 'Flag Stop' Service Reporting

UTA's Global Reporting Module has been implemented at several UTA APC sites with strong positive user feedback (e.g., DTC, MDTA, DART, PSTA, SEPTA, MBTA, Savannah-CAT, WATA, COTA, SORTA, VRT, Baltimore-MTA and more).

The term "Flag Stop" refers to observations of Boardings/Alightings at locations not in the Bus Stop inventory. "Flag Stops" may be generated by a bus that is not strictly following a path of known stops at known times. This "Flag Stop" Service can fall under the following:

1) Support Bus, Ad-hoc or On-Call Service
2) Known routes with no time scheduling
3) Deviation from scheduled fixed route service

With Support Bus, Ad hoc or On-Call service, the basic Flag Stop matching is not looking for routing or scheduled times. This level of matching allows for the collection of boardings, alightings, miles, and passenger miles.

If Metro service is designed for Flag Stops, UTA obtains the lat/long of each intersection in Metro's service area and assigns the passenger activity (boardings/alightings) to the closest intersection. If the quality of the AVL data allows, UTA will provide lat/long for the locations where Flag Stops take place most often.

The example below of a Known Route with No Time Scheduling shows a bus-day where the bus stop geocoding is known but the schedule is not known.

4240 Airport Rd, Suite # 212, Cincinnati, Ohio 45226. Tel (513) 961 0099 Fax (513) 961 0132

Route: 999 Pa: 0 Block: 9999 Line: 0 Dir: 0 DBN: 1804 Trip ID: 0
Day: 3 DOW: 3 Vehicle: 305 Date: 040118 Start: 0330 End: 2730

ID	Stop Name				Arrive	Depart	On	Off	Load	Dwell Time	Trip Miles
9999	00000001	286 W 46th St	S	E	08:35:38	08:44:54	28	3	25	9.27	8.25
9999	00000002	Rockefeller Center	N	E	08:48:21	08:49:02	3	0	28	0.68	8.71
9999	00000015	Port Authority	S	W	08:57:59	08:58:14	2	0	30	0.25	9.70
9999	00000005	Empire State Building	S	E	09:12:52	09:13:26	21	3	48	0.57	10.88
9999	00000008	Washington Square Park	S	E	09:25:07	09:25:55	0	2	46	0.80	12.41
9999	00000009	SOHO	S	W	09:33:25	09:34:27	2	8	40	1.03	13.19
9999	00000010	Canal Street	S	W	09:37:04	09:37:54	0	8	32	0.83	13.58
9999	00000011	City Hall	S	W	09:41:51	09:43:51	4	13	23	2.00	14.05
9999	00000012	Battery Park	N	W	09:48:29	09:50:07	3	7	19	1.63	14.84
9999	00000992	World Trade Center	N	E	09:56:11	09:57:52	1	16	4	1.68	15.78
9999	00000015	Port Authority	N	E	10:26:27	10:28:23	15	11	8	1.93	19.57
9999	00000001	286 W 46th St	N	E	10:30:03	10:44:02	28	23	13	13.98	19.83
9999	00000005	Empire State Building	S	E	11:17:20	11:18:37	26	11	28	1.28	22.42
9999	00000006	Flat Iron Building	S	W	11:22:58	11:23:15	0	2	26	0.28	23.15
9999	00000008	Washington Square Park	S	E	11:28:03	11:28:13	0	2	24	0.17	23.94
9999	00000009	SOHO	S	W	11:34:53	11:37:52	7	26	5	2.98	24.70
9999	00000010	Canal Street	S	W	11:41:24	11:43:06	12	0	17	1.70	25.10
9999	00000011	City Hall	S	W	11:47:55	11:49:19	2	13	6	1.40	25.59
9999	00000012	Battery Park	N	W	11:54:36	11:56:17	0	14	0	1.68	26.41
9999	00000014	Garment District	N	E	12:17:59	12:18:15	0	4	0	0.27	30.37
9999	00000015	Port Authority	N	E	12:26:35	12:31:34	28	9	19	4.98	31.17
9999	00000001	286 W 46th St	N	E	12:35:46	12:48:23	6	12	13	12.62	31.42
9999	00000002	Rockefeller Center	S	E	12:52:47	12:53:34	6	0	19	0.78	31.78
9999	00000028	Carnegie Deli	N	W	12:58:01	12:58:31	4	0	23	0.50	32.19
9999	00000005	Empire State Building	S	E	13:21:33	13:23:54	10	3	30	2.35	34.00
9999	00000009	SOHO	S	W	13:42:07	13:44:19	1	8	23	2.20	36.31
9999	00000011	City Hall	S	W	13:53:29	13:56:41	3	11	15	3.20	37.30
9999	00000012	Battery Park	S	W	14:01:57	14:04:42	12	22	5	2.75	37.98
9999	00000013	Highline	N	E	14:17:27	14:18:08	0	10	0	0.68	40.83
9999	00000015	Port Authority	N	E	14:35:08	14:35:42	0	15	0	0.57	42.69
9999	00000001	286 W 46th St	N	E	14:38:32	14:53:13	18	12	6	14.68	42.97
9999	00000002	Rockefeller Center	N	E	14:57:26	14:57:57	6	0	12	0.52	43.38

1.2.3 UTA APC Administrative Control Module

A primary reason for UTA's longevity in the transit APC marketplace is the ability of UTA's APC system to produce high quality APC analytics over the long term. Within UTA's APC Software package is a number of applications that review the quality and quantity of APC data and produce feedback to the local staff that utilize the APC data. UTA's Administrative Control module is referenced in NTD/APC proposals to FTA which contributes to FTA's 100% approval rate of NTD/APC applications at UTA APC sites.

1.2.3.1 APC Diagnostics

An important part of the UTA APC Analytic Reporting Tool is the ability to review how well the hardware is functioning. Each tool has a quick 7-day diagnostic check of each vehicle to confirm if it is producing good count data or not. Maintenance staff can review the status of each individual bus to confirm which bus and what part on that bus needs maintenance and all users can see how the system is performing overall. The example below is a recent result from the University of Virginia where UTA APCs have been installed for eight (8) years (2012). Bus 12432 APC sensors are still performing excellent counting 1,355 Boardings and 1,374 Alightings (Percent difference of 1.4%) over the past week.

HARDWARE DIAGNOSTICS
UTA APC System

UVA
UTA APC REPORTS

```
 On  Off D _Date_   Bus  Miles Hours  S/N  WC Bike Sp2 Ini  Clo  104 RdrTC _DBNN_ Day Div     Division       POGarage Mile  Delta

232  236 1 111620 12432   78.4 22.9 12432  2    0   0   1  193  0.0   1.2 201123   4   1          UVA          UVA   0.0   0.0   1.7%
237  231 1 111720 12432   79.8 24.0 12432  6    0   0   0  201  0.0   1.2 201123   5   1          UVA          UVA   0.0   0.0   2.5%
273  281 1 111820 12432   81.6 24.0 12432  2    0   0   0  209  0.0   1.3 201123   6   1          UVA          UVA   0.0   0.0   2.8%
254  256 1 111920 12432   82.7 24.0 12432  2    0   0   0  223  0.0   1.1 201123   7   1          UVA          UVA   0.0   0.0   0.8%
189  193 1 112020 12432   78.4 16.6 12432  2    0   0   0  166  0.0   1.2 201123   8   1          UVA          UVA   0.0   0.0   2.1%
170  177 1 112320 12432   53.4 10.2 12432  2    0   0   1  147  0.0   1.2 201123   4   1          UVA          UVA   0.0   1.3   4.0%
--------------------------------------------------------------------------------------------------------------------------------------
   On:    1355 Off:    1374 Diff:    19 Delt:  1.4%                                                          Avg:    2.3%
                                   QC104:  0.0

Vehicle:  12432      (data)
          12432      (APCBus.ref)
Miles:     454
Start:    04:37:03  11\16\20
End:      14:47:53  11\23\20
Last Lat Long:     38.035282 -78.508308



Data Days: 70   Chron Days: 75   Yield: 0.93


 1 UVA           29 of  30 APC's reporting

APC's reporting in last 7 days:             29
APC's in APCBus.ref:                        30
APC's reporting with suspect GPS:            0
APC's reporting with suspect counts:         0
APC's reporting with good counts and GPS:   29
```

1.2.3.2 Sampling Status

The Sampling Status report allows staff to monitor the comprehensiveness of APC sampling that may require an associated APC Deployment Plan application be provided to Metro operating divisions that will assure comprehensive sampling is achieved.

CATS

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APC SAMPLING STATUS SUMMARY TABLE

WEEKDAY

Sep 2021 - Feb 2022

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		TRIP SAMPLING STATUS					
		NON SAMPLED		SAMPLED		Total	
STATUS		Count	Row N %	Count	Row N %	Count	Row N %
ROUTE	8	0	0.0%	41	100.0%	41	100.0%
	10	0	0.0%	32	100.0%	32	100.0%
	11	0	0.0%	63	100.0%	63	100.0%
	12	4	9.1%	40	90.9%	44	100.0%
	14	0	0.0%	42	100.0%	42	100.0%
	15	0	0.0%	31	100.0%	31	100.0%
	17	0	0.0%	44	100.0%	44	100.0%
	18	0	0.0%	32	100.0%	32	100.0%
	20	55	100.0%	0	0.0%	55	100.0%
	21	0	0.0%	42	100.0%	42	100.0%
	22	0	0.0%	32	100.0%	32	100.0%
	23	0	0.0%	31	100.0%	31	100.0%
	41	1	1.6%	63	98.4%	64	100.0%
	44	0	0.0%	95	100.0%	95	100.0%
	46	0	0.0%	32	100.0%	32	100.0%
	47	0	0.0%	62	100.0%	62	100.0%
	54	32	100.0%	0	0.0%	32	100.0%
	57	0	0.0%	43	100.0%	43	100.0%
	58	3	10.0%	27	90.0%	30	100.0%
	59	2	6.7%	28	93.3%	30	100.0%
	60	0	0.0%	42	100.0%	42	100.0%
	70	0	0.0%	31	100.0%	31	100.0%
	Total	97	10.2%	853	89.8%	950	100.0%

URBAN TRANSPORTATION ASSOCIATES

1.2.3.3 Geocoding Accuracy and Comprehensiveness

UTA's Geocoding Accuracy and Comprehensiveness reporting presents the level of concurrence between the Calibrated Lat/Long and the Actual Lat/Long at each Bus Stop. This analysis is utilized to refine GTFS Bus Stop calibration as well as identifying errors/omissions in the original bus stop calibration file. A recent application of this tool identified over 200 missing Bus Stops from a transit agency's GTFS export.

Capital Area Transit System — PAGE 1

APC RIDERSHIP STATISTICS

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APC STOP SUMMARY - LOCATION SUMMARY

DOOR OPEN-CLOSE OBSERVATIONS ONLY

Rt - 41

Aug 2021 Schedule

Weekday

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DIR	SEQENTL STOP NO	UNIQUE STOP NO	NAME	AVG LATITUDE	AVG LONGITUDE	AVG DELTA	STD DEV DELTA	AVG DWDI	SAMPLES
Outbound									
	1	1681	22ND MAIN - N	30.451930	-91.165954	35	9	2	7
	2	1682	22ND NORTH ST - N	30.452994	-91.165996	22	11	4	8
	3	1683	22ND EDGEWOOD - N	30.454830	-91.166034	30	11	2	7
	4	1684	22ND FUQUA - N	30.457259	-91.166124	12	9	3	38
	5	1685	22ND PLANK - N	30.461277	-91.166410	29	9	0	3
	6	1686	PLANK BIRCH - N	30.463335	-91.165891	45	17	12	13
	7	1687	PLANK WASHINGTON - N	30.465033	-91.165250	44	37	12	20
	8	1688	PLANK FAIRFIELD - N	30.466384	-91.164778	78	26	6	14
	9	1912	PLANK ADAMS - N	30.468388	-91.164060	39	46	6	13
	10	1913	PLANK CHOCTAW - N	30.469667	-91.163617	13	9	53	17
	11	1914	PLANK SENECA - N	30.471178	-91.163067	21	23	3	70
	12	1915	PLANK CHIPPEWA - N	30.472967	-91.162060	238	624	39	26
	13	1916	PLANK DALTON - N	30.473719	-91.162175	21	10	3	12
	14	1917	PLANK ONTARIO - N	30.475142	-91.160745	298	686	24	26
	15	1918	PLANK HURON - N	30.476911	-91.160810	105	338	2	23
	16	1919	PLANK WINBOURNE - E	30.478120	-91.160377	102	319	10	49
	17	1920	PLANK OSWEGO - N	30.480285	-91.159864	23	27	1	25
	18	1921	PLANK WYANDOTTE - N	30.481972	-91.159270	22	12	2	49
	19	1922	PLANK WINNEBAGO - N	30.483208	-91.158701	58	180	2	36
	20	1923	PLANK MOHICAN - N	30.484660	-91.158335	20	10	3	30
	21	1924	PLANK WELLER - N	30.485585	-91.158014	29	11	2	25
	22	1925	PLANK PRESCOTT - N	30.486912	-91.157138	132	535	3	21
	23	1926	PLANK DAYTON - N	30.488299	-91.157045	27	10	2	16
	24	1927	PLANK CLAYTON - N	30.490249	-91.156368	35	51	6	44
	25	1928	PLANK EVANGELINE - N	30.492504	-91.155547	68	60	8	68
	26	1929	PLANK SYCAMORE - N	30.494419	-91.154868	28	27	2	27
	27	1930	PLANK DELMONT VILLAGE - N	30.495295	-91.154560	46	13	2	69
	28	1931	PLANK ST GERARD - N	30.497198	-91.153887	32	28	2	74
	29	1932	PLANK RILEY - N	30.498854	-91.153308	126	20	3	56
	30	1933	PLANK VAUGHN - N	30.501270	-91.152458	41	62	2	26
	31	1934	PLANK JH COONEY - N	30.502904	-91.151883	18	11	1	16
	32	1935	PLANK DENHAM - N	30.504335	-91.151384	25	28	3	31
	33	1936	PLANK CANNON - N	30.505175	-91.151091	13	8	3	86
	34	1937	PLANK DAWSON - N	30.506701	-91.150546	43	20	2	34
	35	2292	AIRLINE HWY BEECHWOOD - S	30.509139	-91.143982	31	35	2	30
	36	1938	AIRLINE FOSTER - S	30.508509	-91.140795	12	7	3	13
	37	1939	MCCLELLAND AIRLINE - S	30.505706	-91.135463	27	8	3	43
	38	1940	MCCLELLAND TOLBERT - S	30.504458	-91.135430	221	29	2	4

4240 Airport Rd, Suite # 212, Cincinnati, Ohio 45226. Tel (513) 961 0099 Fax (513) 961 0132

1.2.3.4 Assignment Performance

UTA's Assignment Performance software compares the amount of APC data being imported into the analytic reporting against the total amount of APC data collected. Periodically, APC data is lost by AVL systems if the bus is off-route or if there is a missing or inaccurate Driver Login.

ASSIGNMENT PERFORMANCE
HIGH MILEAGE DIFFERENCE - LOW ON DIFFERENCE
Aug 2021 Schedule
****

COACH	BLOCK	DATE	DIAGNOSTIC DAILY TOTALS MILES	.TOT MILES	PRCT DIFF	DIFF	DIAGNOSTIC DAILY TOTALS ON	.TOT ON	PRCT DIFF
------	--------	--------	------------	----------	------	------	------------	----------	------
192	0	01/03/22	180.9	166.6	7.9	14.3	108	108	.0
192	0	01/04/22	98.8	91.5	7.4	7.3	73	73	.0
192	0	01/06/22	108.1	100.9	6.7	7.2	104	103	1.0
192	0	01/11/22	177.0	163.3	7.7	13.7	95	95	.0
192	0	01/14/22	98.6	90.3	8.4	8.3	60	60	.0
192	0	01/16/22	215.8	198.9	7.8	16.9	65	64	1.5
192	0	01/17/22	252.8	233.1	7.8	19.7	64	64	.0
192	0	01/23/22	23.2	32.2	-39	-9.0	23	23	.0
192	0	01/24/22	10.5	3.1	70.5	7.4	22	22	.0
192	0	01/25/22	15.6	15.8	-1.3	-.2	29	29	.0
192	0	09/02/21	196.1	181.5	7.4	14.6	230	230	.0
192	0	09/03/21	214.2	197.9	7.6	16.3	84	84	.0
192	0	09/05/21	234.0	215.8	7.8	18.2	106	106	.0
192	0	09/16/21	208.9	193.4	7.4	15.5	2	2	.0
192	0	09/19/21	82.4	76.3	7.4	6.1	2	2	.0
192	0	09/23/21	179.9	166.8	7.3	13.1	2	2	.0
192	0	09/24/21	207.2	191.6	7.5	15.6	5	5	.0
192	0	09/27/21	256.5	236.6	7.8	19.9	2	2	.0
192	0	09/28/21	220.4	203.7	7.6	16.7	0	0	.0
192	0	09/30/21	144.6	138.9	3.9	5.7	3	3	.0
192	0	10/03/21	201.6	186.3	7.6	15.3	4	4	.0
192	0	10/08/21	177.7	164.4	7.5	13.3	136	136	.0
192	0	10/10/21	248.1	228.6	7.9	19.5	102	102	.0
192	0	10/15/21	202.5	187.5	7.4	15.0	145	144	.7
192	0	10/23/21	158.4	146.9	7.3	11.5	180	158	12.2
192	0	10/26/21	230.6	213.0	7.6	17.6	98	98	.0
192	0	10/28/21	229.6	212.0	7.7	17.6	125	125	.0

1.2.3.5 Segment Contiguity

The Segment Contiguity review identifies Missing Timepoints. For On-Time Performance and Running Time analyses, it is critical that all Timepoints be identified by the AVL and/or APC system. Presented below is an example:

Miami-Dade County DTPW

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SEGMENT SAMPLE REPORT

NON-CONTIGUOUS SEGMENTS

20EV Schedule

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ROUTE	DIR	PATTERN	OLD TIMEPOINT	NEW TIMEPOINT	POSTN	NON-CONTIGUOUS SEGMENT SAMPLES	TOTAL TRIP SAMPLES	FREQ OF NON MATCH	AVG RUN TIME	AVG DIST	STD DEV DIST	DELTA1	DELTA2	DWDI1	DWDI2	LAST TIMEPOINT
9	0	2	AVENMALL	6AVE125S	103	18	48	38%	37.9	11.80	1.53	90	49	73	2	167STERM
	1	1	6AVE125S	AVENMALL	406	304	821	37%	38.6	10.86	.22	90	145	73	75	167STERM
TOTAL						322										
35	0	1	NARJ145A	312SWASH	507	461	518	89%	27.8	7.90	.21	93	310	8	0	HMSTHOSP
	0	11	NARJ145A	312SWASH	507	78	96	81%	30.0	8.08	.37	84	275	10	0	HMSTHOSP
	0	22(A)	PALMW4AS	344SP&R-	709	51	61	84%	5.5	1.19	1.28	14	188	16	930	HMSTHIGH
	0	11	PALMW4AS	344SP&R-	810	41	96	43%	9.9	2.00	1.20	20	194	11	781	HMSTHIGH
	1	1	312SWASH	NARJ145A	305	506	565	90%	28.3	7.89	.23	142	64	6	8	HMSTHOSP
TOTAL						1137										
36	1	3	MSPRCIRC	36STLEJN	103	202	356	57%	19.3	4.70	.21	354	88	2	73	36STREDR
	1	4	MSPRCIRC	36STLEJN	103	16	25	64%	16.2	4.74	.10	96	114	4	65	36STREDR
TOTAL						218										
38	1	1	296SBSWY	US#1336S	810	1259	1677	75%	12.0	3.45	.16	79	1904	407	0	344SBSWY
TOTAL						1259										
40	0	1	SW8S129P	122A26ST	103	280	492	57%	17.8	4.66	.31	155	85	27	52	18ST127A
TOTAL						280										
73	0	1	POSTOFFI	W12A49ST	406	342	611	56%	33.6	6.84	.24	74	32	80	49	R-OKEECH

1.2.3.6 2.6 Bus Stop Identification Refinement

The Bus Stop Identification Refinement application compares the Bus Stops identified by the APC system against the Bus Stop Calibration file provided by Metro. Periodically, there are short-term detours (accidents, street repairs, etc.) that are not incorporated into the official Bus Stop geocoding files. However, the APC system is collecting data on Trips that are partially detoured. This UTA APC Administrative Control tool identifies the frequency with which a Bus Stop has been identified relative to the Number of Trips Operated. From this analysis, Route Exceptions can be added to UTA's Bus Stop Identification algorithms that will increase the frequency (to virtually 100%) of identification of a given Bus Stop.

Presented below are tables that present a Before and After the application of this tool:

Identified bus stops that are not matching on each sampled trip.

Route	Pattern	DIR	Seq	Unique	Stopname	STOP_TRIP_PRCT
36	PATLB1	0	4	4231010	5th @ Marquette	0.87
36	PATLB1	0	5	70423003	5th @ Fruit	0.87
36	PATLB1	0	6	4727	Lomas @ 7th	0.83
36	PATLB1	0	7	4729	Lomas @ 11th	0.83
36	PATLB1	0	8	4731	12th @ Granite	0.83
36	PATLB1	0	9	4733	12th @ Rosemont	0.83
36	PATLB1	0	10	4735	12th @ Arias	0.83
36	PATLB1	0	11	4737	12th @ Bellamah	0.83
36	PATLB1	0	12	4739	12th @ Bellamah	0.83
36	PATLB1	0	13	4741	12th @ I-40	0.83
36	PATLB1	0	14	4230965	12th @ Indian School	0.83
36	PATLB1	0	15	4745	12th @ Indian School	0.83

Reprocessed bus stop data calibrated to refine data yield. The refined data shows the stops matching 100% on each sampled trip.

Route	Pattern	DIR	Seq	Unique	Stopname	STOP_TRIP_PRCT
36	PATLB1	0	4	4231010	5th @ Marquette	1.00
36	PATLB1	0	5	70423003	5th @ Fruit	1.00
36	PATLB1	0	6	4727	Lomas @ 7th	1.00
36	PATLB1	0	7	4729	Lomas @ 11th	1.00
36	PATLB1	0	8	4731	12th @ Granite	1.00
36	PATLB1	0	9	4733	12th @ Rosemont	1.00
36	PATLB1	0	10	4735	12th @ Arias	1.00
36	PATLB1	0	11	4737	12th @ Bellamah	1.00
36	PATLB1	0	12	4739	12th @ Bellamah	1.00
36	PATLB1	0	13	4741	12th @ I-40	1.00
36	PATLB1	0	14	4230965	12th @ Indian School	1.00
36	PATLB1	0	15	4745	12th @ Indian School	1.00

1.2.3.7 APC Reference File Quality Control

With appropriate review of transit schedules and geo-coding information from one schedule change to another, transit agencies implement a successful APC Reference File Quality Control procedure to provide accurate reports and analysis. UTA will apply its APC Reference File Quality Control measures at Metro to identify scheduling and/or geo-coding anomalies. Outlined below is brief description and schematic of the APC Reference File Quality Control process.

1.2.3.8 Automated Overnight APC Data Processing

UTA's APC Reporting Software begins with an overnight APC data processing routine scheduled to start after the last bus comes into the garage for the night; and is designed to complete before schedulers and planners arrive each morning. The goal of UTA's APC Reporting Software is to provide schedulers and planners a complete set of analytics at their fingertips that is valid, comprehensive and updated to yesterday.

The overnight data processing is a five-step procedure consisting of four UTA software modules. Each Software Module performs a basic task that builds on the previous, while consisting of its own data validity checks. Each module provides output that allows for data transparency and auditability.

Software Group	Function	Purpose
Concatenate	Merge Raw Data	Converts raw APC data to application file.
Diagnostics	Provide APC Hardware Diagnostics	Determines APC data quality and anomalies for maintenance purpose.
Automated Assignment	Determines Bus to Block Assignment	Automatically determines Metro Block operated by each bus.
File Creation	Creates User-Defined Aggregated Databases	Creates ascii.txt files subsequent reporting and potential database applications.
Database Load	Load data into UTA cloud hosted database	Makes data directly available for users to query from their desktop.

1.2.3.8.1 Automated Overnight Data Processing Input

The overnight data processing requires the following reference files at the start of each schedule period.

APC Reference File	Data Source	APC Function
Master Schedule	GTFS/ Metro/ CSched	Service Provided
Bus Stop Calibration	GTFS/ Metro/ CSched	Bus Stop Identification
Calendar	GTFS/ Metro/ CSched	Determine Service Schedule
APC BUS	Metro /UTA	Provides List of Active APC Vehicles
Route Exception	UTA	Routing Idiosyncrasies

1.2.3.8.2 Automated Overnight Data Processing Output

At the start of each business day the automated overnight data processing has prepared the following: diagnostic reports and processed data files.

The diagnostic reports are in easy-to-read file formats (.txt and .csv) that provide both an APC system administrator a clear understanding of how the APCs are performing across the bus fleet, as well as a maintenance technician precise details of what needs to be repaired and where to repair it.

The processed data files give schedulers and planners the analytics they need with the data quality control included. Schedulers and planners do not need to exercise data cleansing procedures.

1.2.3.8.3 Filter/Edit Software

In the practical day-to-day operation of a transit system, deviations from normal operating procedures sometimes occur. Given a degree of transit operational anomalies and APC system anomalies, the Filter/Edit subsystem serves a critical role by filtering out and/or editing anomalous data. The algorithms present in this subsystem are the result of years of reviewing APC data and determining the optimal set of criteria for maximizing the rejection of anomalous data. Two (2) examples of such algorithms are described below.

- **UTA Trip Balancing Algorithm**

  Typical APC sensors generate APC Passenger Counting accuracies in the 95%+ range. UTA APC Trip Balancing algorithm identifies any discrepancy in the total boarding and alighting and balances the trip total by applying the missing boardings/alightings to appropriate bus stops.

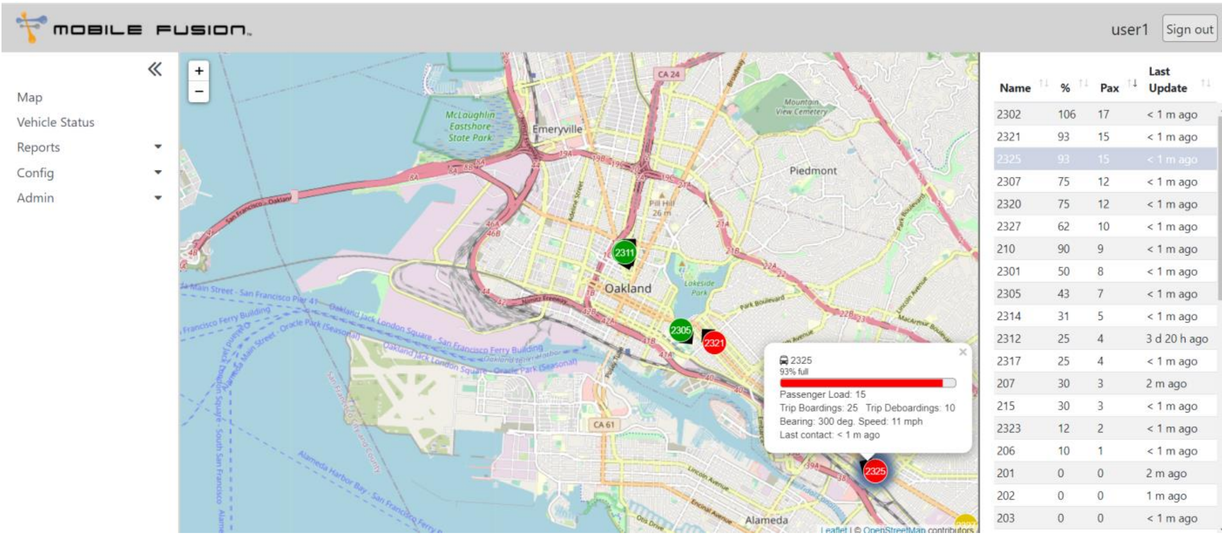
- **UTA End of Line Load Adjustment Algorithm**

  To prevent APC hardware counting errors to propagate from trip to trip, UTA's APC Load Adjust algorithm identifies illogical passenger load at the end of the line location and adjust the load to a logical value. UTA's advanced EOL Load Adjustment algorithms provides more accurate passenger loads and passenger miles for NTD reporting and other analytical needs than more simplified EOL Load Adjustment algorithms.

1.2.3.9 Real-Time Passenger Load Capability - Optional

The benefits of using cellular APC data transfer are both improving data transfer reliability and the availability of real-time APC data. The UTA APC system offers a real-time passenger load module which can inform Metro dispatchers and staff where heavy loads are occurring on Streetcar service.

The image of the UTA interface below from Tempo Line buses in Oakland, CA shows the buses traveling on the street network in real-time with color coded icons demonstrating the current load levels on the bus. Users may select from different alert notifications such as screen pop-ups when a bus reaches the overcrowding threshold, email alerts, color coded icons and table rows flashing. The table to the right of the image allows users to sort active status by user-defined statistics. During the COVID-19 pandemic UTA added the ability for users to define their own bus capacity levels to meet their local social distancing requirements.



UTA APC hardware and data transfer also supports exporting the APC count, location, bike rack usage and time status to different transit agency vendor applications in real-time. Currently, UTA is providing APC data for real-time display to Transloc in High Point, NC, Swiftly in Williamsburg, VA, Moovit in Ft. Wayne, IN as well as Transit APP in Antioch, CA.

2. Firm Experience and Customer References

UTA has implemented APC systems in over one-hundred fifty (150+) large and small North American transit agencies. At the start of this section are summaries of UTA APC applications at transit agencies with similarity to the requirements in Metro's RFP TM-24-01:

2.1 UTA StandAlone APC System Applications

This section will present detail relative to UTA APC applications that have relevance to Metro. Each transit agency has unique operating characteristics that, typically, are not referenced in the APC RFP but must be successfully accommodated in order for the APC application to be successful (i.e., receive FTA NTD/APC certification).

References: (Sites that have moved to StandAlone APC applications)

Central Florida Regional Transportation Authority (LYNX) - UTA APC Configuration

Walter Gant (407) 254-6078

After multiple unsuccessful APC applications from AVL suppliers, LYNX released an APC RFP in late-2019 to provide StandAlone APC systems on Qty=273 buses. UTA was awarded the contract after receiving significantly higher scores from LYNX's Source Evaluation Committee. The other bidders were InfoDev and Dilax. LYNX has received approval from FTA to apply APC data to NTD reporting.

LYNX chose to separate the APC system from LYNX's CAD/AVL system in order to support LYNX Service Development.

Pinellas Suncoast Transit Authority (PSTA) - UTA StandAlone APC w/Horizontal Sensors

Christine McFadden (727) 540-1837

In early-2007, after a competitive APC procurement, UTA was awarded a contract for 10 APC systems (StandAlone) configuration. Based on the performance of the initial 10 UTA APC systems, PSTA added an additional 20 APC systems in late-2007 and early-2008. PSTA continues to expand its use of APCs by adding 33 UTA APC systems since 2010. PSTA includes UTA APC system components on each new bus procurement. In 2013, PSTA was approved by FTA to apply APC data to PSTA's NTD reporting requirements. Since 2013, PSTA has incrementally added UTA StandAlone APC systems to the PSTA bus fleet.

In 2018, PSTA added UTA StandAlone APC systems on Qty=75 buses to complete a 100% APC-equipped bus fleet. PSTA's APC system includes the new Multi-Slot Bike Rack and Driver Seat monitoring features. PSTA has chosen the StandAlone APC configuration rather than integrate with the Clever Devices' AVL system.

Hillsborough Area Regional Transit (HART) Streetcar

Omar Alvarado (813) 384-6553

Since 2010, UTA's APC Software has been processing APC data from HART's APC-equipped bus fleet. In 2018, HART started to specify UTA's APC system on new HART bus purchases. Based on high quality performance of UTA's APC system (hardware, software, and support), in 2019, HART awarded UTA a sole-source contract to provide APC systems on Qty=9 HART Streetcars.

In 2020, HART executed Manual Ridechecks that demonstrated a Manual/APC concurrence of 98% for UPT and 95% for PMT which allowed HART, with UTA support, to submit a request to apply APC data to NTD reporting. FTA approved the request.

Unique UTA APC system challenges with HART's Streetcar service included major construction disruptions, additional ad-hoc service for special events, and staff turnover which created changes in the analytic methodologies.

Given UTA's APC system collecting APC data at all times when the Streetcar is powered, UTA's APC system has produced quality data for special events such as Stanley Cup hockey games and the annual Gasparilla Festival. These special events are not necessarily included in HART's Streetcar schedules. Recent construction in downtown Tampa has also required ad-hoc changes to the operation of the Streetcars.

<u>Suburban Mobility Authority for Regional Transportation (Detroit)– UTA StandAlone APC</u>

Dennis Wesley (248) 419-7961

In 2021, SMART (Suburban Detroit) executed a competitive procurement for a StandAlone APC system. Previously, SMART had an APC system provided by SMART's AVL supplier, Clever Devices that was not meeting SMART's analytic needs. UTA was awarded the contract to implement UTA's StandAlone APC system on SMART's bus fleet. UTA executed the installation in Summer/Fall 2021.

In 2022, SMART received approval from FTA to apply APC data to NTD reporting.

SMART is another example of a transit agency choosing to separate the APC system from the CAD/AVL system.

<u>Monterrey-Salinas Transit, CA (MST) - UTA StandAlone APC System w/Horizontal APC Sensors</u>

Frank Marcos (831) 296-8117

In the early 2010's MST procured the TransitMaster AVL/APC system. MST was not receiving the desired analyses which prompted MST, in 2019, to execute a competitive procurement for a StandAlone APC system which was awarded to UTA over three (3) other bidders. UTA installed APC systems on Qty=170 buses. Per MST specification, the APC software was installed in a UTA-hosted configuration with a complete set of analytic reports. MST chose to implement a StandAlone APC system that operates in parallel with the existing TransitMaster AVL system. MST has been approved by FTA to apply APC data to NTD reporting. MST chose to separate the APC subsystem from the CAD/AVL system in order to improve the quantity and quality of APC data.

<u>Sioux Falls Area Metro – UTA StandAlone APC System (Hardware and Software)</u>

Sam Trebilcock (605) 367-8890

In 2021, Sioux Area Metro (SAM) leased Qty=4 APC systems from UTA in support of a Route Restructuring project. Over a three (3) month period, the Qty=4 APC were deployed across all SAM service resulting in a comprehensive set of Ridership data at the Bus Stop level to be utilized by the planning consultant. With the exposure to APC-generated Ridership information, SAM released an RFP to purchase Qty=34 APC systems and supporting APC software. In April 2022, SAM selected UTA to be the provider of the APC system.

<u>City of Tallahassee, FL (StarMetro) - UTA StandAlone APC System w/Vertical APC Sensors</u>

Andrea Rosser (850) 891-5196

In early 2020, The City of Tallahassee, FL. Executed a competitive procurement for automatic passenger counters for StarMetro's fleet of fifty-seven (57) Gillig buses and four (4) cutaway vehicles operating fixed, deviated, and complementary on-demand ADA service. UTA also provided a web-based stand-alone reporting software package and the required NTD reporting necessary for application to the FTA.

San Antonio Metropolitan Transit (VIA) - UTA StandAlone APC w/Vertical Sensors

Maricela Diaz-Wells (210) 362-2142

In 2016, VIA specified UTA's StandAlone APC system to be included in a major bus procurement which was awarded to Nova Bus. Concurrent with VIA's major bus procurement, VIA also was in the process of designing a major Route Restructure which required considerable Ridership data. To support VIA's Route Restructuring project, in July 2016, UTA installed Qty=10 StandAlone APC systems on VIA buses. In addition to supporting VIA's Route Restructuring project, the Qty=10 APC systems also are providing VIA Planning/Scheduling staff with an introduction to UTA's Analytic and Administrative Control software. In mid-2018, VIA received approximately 280 Nova buses equipped with UTA's StandAlone APC system. In 2019, VIA received the balance of approximately 210 Nova buses with UTA's StandAlone APC system.

VIA has been approved by FTA to apply APC data to NTD reporting.

Niagara Frontier Transportation Authority (NFTA) - Buffalo, NY

Contact: Kelsey Towne (716) 855-7617

UTA's APC implementation on NFTA's rail cars represents UTA's state-of-the-art rail APC configuration. UTA's proposed APC configurations has been successfully operating in NFTA rail revenue service operation since 2016.

In the 2010-2015 period, NFTA tested APC systems from two (2) different (non-UTA) APC suppliers. NFTA's testing of these APC systems resulted in NFTA rejecting the two (2) APC systems. in 2015-2016, UTA was requested to participate in an NFTA APC Pilot Project consisting of a complete APC installation on one (1) NFTA rail car. After six (6) months of APC accuracy, reliability, and analytic testing, NFTA awarded UTA a sole source contract to install APC systems on Qty=27 NFTA rail cars after cars return to NFTA from the mid-life overhaul contractor.

UTA's APC hardware configuration at NFTA includes the Hella APC sensors at each doorway, and UTA's APC CPU w/GPS & cellular data transfer. NFTA's rail service includes seven (7) underground rail stations which required UTA to add RFID readers on each rail car and RFID tags at each NFTA rail station.

The results of NFTA's Manual vs APC comparisons are presented below:

Date	Manual	APC	Manual	APC
10/25/16	225	223	191	199
11/04/16	245	244	228	225
06/09/17	172	171	218	218
07/28/17	169	172	231	233
08/18/17	162	163	164	162
09/01/17	121	121	126	132
11/30/17	165	164	166	168
Totals	1,259	1,258	1,324	1,337
Concurrence	**100.0%**		**99.0%**	

The APC Data Yield on NFTA Rail Cars (Reliability) has been greater than 95% in revenue service operation.

Unique operation conditions at NFTA include underground stations and single tracking. UTA predominately uses GPS for station identification. GPS does not work as well when entering or leaving large buildings and tunnels and does not work underground. GPS can also give misleading information when above ground.

More than one half of the NFTA rail stations are underground. Therefore, the use of GPS for location determination must be augmented with other technology. UTA and NFTA chose RFID tags for underground station identification. The RFIDs are placed at the entrance and exit of each underground station. NFTA prefers platform time for dwell and running time calculations, so the RFID times are used for those time calculations.

Pictures of the NFTA Rail APC application are presented below:

UTA APC HELLA Sensor Installed on an NFTA Rail Car

NFTA has received approval from FTA to apply APC data from APC-equipped rail cars to NTD reporting.

Also present at NFTA is UTA's APC system installed on NFTA buses. Originally, UTA's APC system was integrated with the DRI (now Clever Devices) on-bus AVL system. Over the past three (3) years, NFTA has specified UTA's StandAlone APC configuration on new bus builds. UTA's APC Software is processing APC data from both Bus and Rail. NFTA has received approval from FTA to apply APC data to NTD reporting.

An interesting analytic application at NFTA is the incorporation of Ridership at a particular station that is only utilized for hockey games. Not included in NFTA's Rail Schedules are the special trips to/from the stadium where hockey games take place. UTA has adapted UTA's APC Software to include the Ridership observed at the Coliseum Station when hockey games are played.

<u>Sacramento Regional Transit District (SacRT) - Sacramento,CA</u>

Contact: Casey Courtright (916) 556-0160

In early-2018, SacRT released an RFP for Qty=40 APC systems on SacRT's CAF rail cars. UTA was selected over Dilax to provide the APC system (hardware and software) on SacRT's CAF rail cars. Also included in the project was the application of UTA's APC Software to bus APC data generated by the Clever Devices AVL/APC system. The contract was awarded in August 2018 and UTA started the APC installation in October 2018. The installation was completed in January 2019.

UTA's APC implementation on SacRT rail cars represents UTA's state-of-the-art rail APC configuration.

In 2019, after the successful implementation of UTA's APC hardware and software, SacRT issued a sole-source contract for an additional Qty=60 Siemens rail cars. After the APC installations on Qty=60 Siemens rail cars, SacRT had 100% of the rail car fleet equipped with APC systems.

In late 2019, SacRT and UTA submitted a proposal to FTA to allow SacRT to utilize APC data in NTD reporting. FTA approved SacRT's request.

UTA's APC hardware configuration at SacRT includes the Hella APC sensors at each doorway, and UTA's APC CPU w/GPS & cellular data transfer.

The results of SacRT Manual vs APC comparisons are presented below:

	Boardings		Alightings	
	Manual	**APC**	**Manual**	**APC**
	581	593	658	689
Concurrence	**98.0%**		**95.3%**	

The APC Data Yield on SacRT Rail Cars (Reliability) has been 98.9% in revenue service operation.

In 2021, SacRT assumed the operation of transit in Elk Grove CA. At Elk Grove, GMV-Syncromatics provided the AVL/APC system. Given the performance of UTA's APC Software at SacRT, SacRT requested UTA to include the processing of Elk Grove APC data in the SacRT Bus and Rail UTA Software applications.

Ft Wayne Citilink – UTA StandAlone APC system

John Metzinger (260) 437-7095

In the mid-2010's Citilink received an APC system from an AVL supplier that did not generate usable analytics. Citilink contacted UTA regarding UTA's interest in executing a no-cost demonstration of UTA's APC system on Citilink buses. UTA installed Qty=4 APC systems on Citilink buses in 2019 and generated a complete set of analytics for the following two (2) years. In 2021, Citilink released an APC RFP for Qty=34 buses which was awarded to UTA over three (3) other proposers. Citilink was approved to apply APC data to NTD reporting in 2022.

Kansas City Streetcar – UTA APC Software

Nick Martinez (816) 346-0313

In Kansas City, UTA's APC Software is processing APC data generated from Qty= 6 CAF Streetcars. The on-car APC system was provided by Trapeze/Vontas as part of a TransitMaster AVL/APC application. In 2021, Trapeze/Vontas selected UTA to serve as the APC Software sub-contractor in the Trapeze/Vontas ITS upgrade.

The Kansas City Streetcar operates Bi-Directional Trips (Inbound, Outbound) with the challenge of extracting APC data from the applicable TransitMaster CPU (CPU A for Inbound Trips, CPU B for Outbound Trips). Another challenge was to obtain accurate door-level APC Diagnostics since TransitMaster combines counts from Doors 3 and 4 into Door 3. UTA software was developed to access and translate the TransitMaster data log file for diagnostic information.

KCATA is planning to execute Manual Ridechecks in 2023 which will be applied to Kansas City's proposal to FTA for approving NTD reporting with APC data.

Wilmington NC WAVE – UTA StandAlone APC System

Marie Parker (910) 343-0106

In mid-2021, WAVE released an APC RFP for Qty=38 APC systems. WAVE received six (6) proposals from which UTA was awarded the contract. APC installations took place in late-2021 and early-2022.

Rochester Public Transit – UTA APC Hardware + Software

Erikson Schafer (507) 328-2485

RPT received APC sensors (Hella) from an AVL supplier that did not provide satisfactory APC analytic software. In 2024, Gillig will be building Qty=14 buses and New Flyer will be building Qty=2 articulated buses for RPT. UTA will be providing UTA's Model 31 APC CPU along with the necessary cabling to utilize the existing Hella APC sensors purchased by RPT a number of years ago. UTA will also be providing UTA's APC Software package that will process all APC data from RPT buses.

More UTA APC references are available upon request.

2.2 Organizational Structure

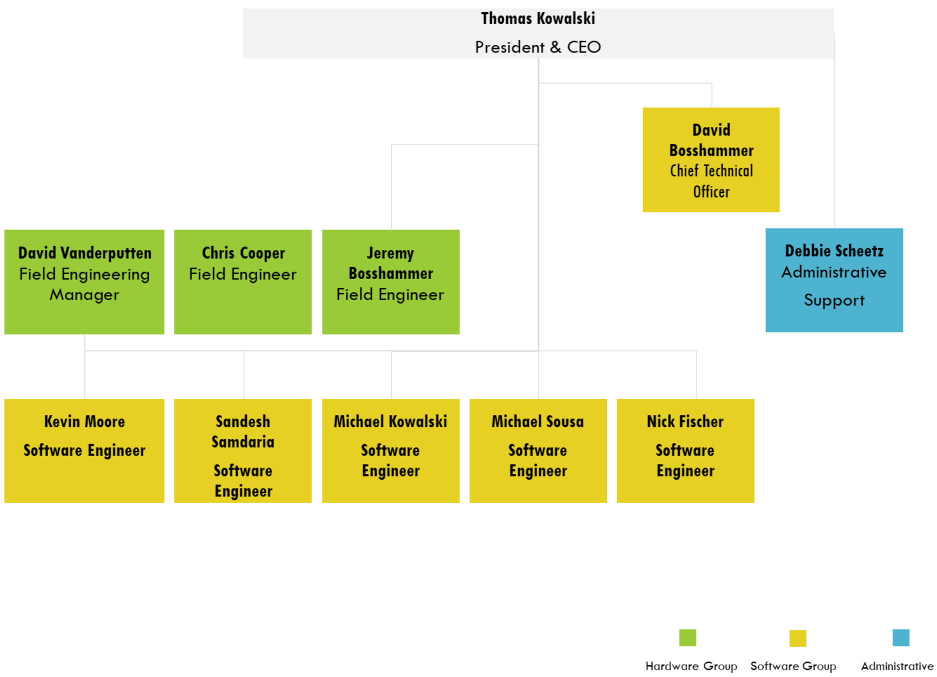
UTA President\CEO, Mr. Thomas W. Kowalski, will have overall project management responsibility for this project.

Mr. David Bosshammer, Mr. Kevin Moore, Mr. Sandesh Samdaria, Mr. Michael Sousa, Mr. Nick Fischer, and Mr. Michael Kowalski will have responsibility for all UTA APC software related aspects of this project.

Mr. David Vanderputten, Mr. Jeremy Bosshammer, Mr. Chris Cooper and Mr. George Perkins will have responsibility for all UTA APC hardware related aspects of this project.

Mr. Keith Gates will provide NTD reporting guidance and serve as the qualified statistician in support of Metro's provision of analytics in support of NTD submissions.

2.2.1 Organizational Chart



2.2.2 Qualifications of Staff

<u>Thomas W. Kowalski</u> – President and CEO

Serving as the principal Project Manager for UTA, Mr. Kowalski will have overall responsibility for UTA's performance in implementing an APC system at Metro.

Mr. Kowalski has degrees in the following areas of expertise: a Bachelor's degree in industrial Engineering; Master's degree in Business Administration and Master's degree in Community Planning. He has also taught at the University of Cincinnati as Adjunct Instructor of Operations Planning in Public Administration.

Mr. Kowalski is a founding partner of UTA and original developer of UTA's analytic software. Mr. Kowalski has managed implementation of virtually all one-hundred (100+) UTA APC projects and ensured each project has been executed within the given schedule and budget as proposed. His other project responsibilities include active involvement in APC reporting needs, new analytic applications, and on-going APC support, as well as, ad-hoc APC reporting requirements.

The following are a sample of projects Mr. Kowalski has successfully implemented: San Antonio VIA, New Orleans RTA, DTC (Delaware), SEPTA (Philadelphia), UTA (Salt Lake City), MBTA (Boston), Metro (Houston), CMTA (Austin), MDTA (Miami-Dade), DART (Dallas), Port Authority (Pittsburgh), LYNX (Orlando), and AC Transit (Oakland).

David Bosshammer - Chief Technical Officer

Responsible for successful operation and integration of all APC software, Mr. Bosshammer has degrees in the following areas of expertise: Bachelor's degree in Physics and a Master's Degree in Electrical and Computer Engineering. Mr. Bosshammer is committed to make the necessary adaptations to standard UTA software to efficiently produce on-board and post processing reports for Metro. Mr. Bosshammer, a member of UTA since 1995, has successfully participated in more than seventy (70) APC projects. UTA SAEJ1708/J1587, GPS, and wireless download interfaces, along with interfaces to all major transit scheduling system have been developed by Mr. Bosshammer.

As UTA's Chief Technical Officer, Mr. Bosshammer has experience overseeing more than one-hundred (150) UTA APC projects in his twenty (20) years with UTA. His primary responsibility is to ensure the integration of APC hardware with on-board equipment and adapt APC software to local operating practices. He is committed to active involvement in the development and implementation of APC data processing software and updates. Current project responsibilities include: LYNX (Orlando), SFMUNI (San Francisco), OTS (Honolulu), Metro (Houston), PAAC (Pittsburg), SEPTA (Philadelphia), Utah Transit (Salt Lake City), MBTA (Boston), and MDTA (Miami Dade).

David Vanderputten – Field Engineering Manager

As a 2007 graduate of Wright State University with a Bachelor of Science degree in Mechanical Engineering, Mr. Vanderputten began his career with UTA in 2001 and has been a full-time member of the UTA engineering team since 2007. David's in-depth knowledge and experience will be applied to the design and installation of the on-bus APC equipment implementation at Metro.

Mr. Vanderputten is the Primary Engineer and Logistics Expert for all UTA APC hardware for OEM bus manufacturers including Gillig. During his tenure of seventeen (17) years with UTA, Mr. Vanderputten participated in successful UTA Rail APC applications at Sonoma Marin Rail (SMART) Sacramento, CA (SacRT), Tampa, FL Streetcar, Salt Lake City, UT (Utah Transit) TRAX and FrontRunner, NFTA (Buffalo, NY) along with numerous bus APC applications including OTS (Honolulu), MDTA (Miami), KCATA (Kansas City) and MBTA (Boston). Mr. Vanderputten is the primary UTA engineer responsible for test/evaluation of the HELLA APC sensors.

Chris Cooper – Field Engineer

Mr. Cooper joined UTA in 2007 after attending Cincinnati State and Miami University for electrical engineering technology. As Field Engineer, he has performed or supervised installations at over twenty (20) customer sites. These projects encompass work on over two thousand (2000) vehicles including work on light and heavy rail applications. Mr. Cooper will assist in the APC installation, warranty maintenance, and quality control responsibilities.

Mr. Cooper performed installations and implemented QA procedures as part of UTA's APC expansion project at MBTA (Boston). In 2008-2009, he supervised the installation of over eight hundred (800) APC installations in MDTA (Miami-Dade) and performed quality assurance checkout inspections and QA reporting.

Sandesh Samdaria – Software Engineer

Mr. Samdaria has been employed by UTA since 1999 initially as a student intern and then as a full-time UTA employee in 2001. Mr. Samdaria has degrees in the following areas of expertise: Undergraduate degree in Architecture (India) and master's degrees in Community Planning (University of Cincinnati) and Housing and Urban Development (The Netherlands).

Mr. Samdaria's involvement with Metro's project includes: overseeing data quality reviews, generating and analyzing reports. Mr. Samdaria's primary UTA responsibilities are: APC files – review and set-up; Report menu design – review and set-up; APC software – installation and set-up; and APC documentation and Support – providing standard and ad-hoc APC reports.

Sandesh's recent APC reporting software installation, set-up and support include the following sites: DTC (Delaware), CMTA (Austin, TX), PSTA (St Petersburg, FL), and DART (Dallas, TX).

Kevin Moore – Software Engineer

Mr. Moore has degrees in the following areas of expertise: A Bachelor of Science in Civil Engineering (Northwestern University) and a Master of Architecture (Massachusetts Institute of Technology). Between 1999 and 2006, Mr. Moore was engaged in development of UTA's APC Reporting Menu and adaptation of UTA's APC software package to specific user applications. Since 2009, Mr. Moore's primary responsibilities include: APC Report Menu Design - review and set-up; APC Reporting Software - set-up and testing; APC documentation and Support – providing standard and ad-hoc APC reports. Recent APC reporting setups and support include: SEPTA (Philadelphia), UTA (Salt Lake City), RTA (Dayton), MBTA (Boston), and MDTA (Miami-Dade). In one current project, Mr. Moore is collaborating with MBTA planners to produce a highly-customized, system-wide ridership report that will present (integrated UTA/TransitMaster) APC ridership data to the transit public.

Nick Fischer –Software Engineer

Mr. Fischer, a member of the UTA's software engineering team since 2007, academic achievements include: a bachelor's degree in Sociology and Political Science and completion of The Ohio State University's Joint Degree in Urban Transportation, through which he obtained a Master of City & Regional Planning (MCRP) and a Master of Science (MS). During his graduate studies, Mr. Fischer had an internship with the Central Ohio Transit Authority (COTA) in their Capital Projects/Planning department. He served as an APC specialist for COTA, where he managed the APC data processing, data quality control review and generated APC analytical reports for the transit authority. Mr. Fischer's anticipated Metro project responsibilities include: Master schedule files, station geo-coding files, and Software quality control.

Mr. Fischer's primary UTA responsibilities include: APC reference files – review and set-up; APC Report Menu Design – design, set-up and review; APC Reporting Software – installation and setup; APC Documentation and Support – providing standard and ad-hoc APC reports. His recent APC reporting installation, set-up and support include the following sites: Houston Metro Rail and Bus, Connect-Transit (Bloomington Normal), BMTA (Baltimore), FAST (Fayetteville), ART (Asheville).

Michael Sousa - Software Engineer

Mr. Sousa joined UTA full-time in 2021. Mr. Sousa's previously served as the Principal Data Analyst and APC Administrator for the Rhode Island Public Transit Authority for three years where he managed the APC data processing, data quality control review, generated APC analytical reports, and managed collecting and reporting the APC data for NTD certification the for the transit authority. Mr. Sousa's primary UTA responsibilities include: Master schedule files, APC reference files – review and set-up, Bus stop geo-coding files, and Software quality control. Mr. Sousa received a Bachelor of Arts degree in Mathematics from the University of Massachusetts – Dartmouth.

Michael Kowalski - Software Engineer/Hardware Maintenance Technician

Michael Kowalski had been working as a part-time UTA software engineer since the early-2000's. In 2006, after receiving a B.S. degree in Environmental Resource Engineering from Humboldt State University, Michael increased the number of hours associated with his part-time UTA efforts. In 2013, Michael joined UTA as a full-time UTA software engineer with associated responsibilities relative to UTA's on-bus APC equipment and Maintenance. Michael's involvement with Metro will be to setup/test UTA's APC Reporting Menu and other ad-hoc IBM-SPSS syntaxes for specific user analytic requirements.

Keith Gates– NTD Qualified Statistician

Mr. Gates recently retired from the Federal Transit Administration (FTA) as Manager of the National Transit Database (NTD). While at FTA, Mr. Gates was responsible for overall NTD program execution and product quality. This included approving passenger counting methods and updating regulations. Prior to serving as Manager of NTD, Mr. Gates was Director of Performance Management for FTA. Mr. Gates has received both bachelor's and master's degrees in Electrical Engineering from Purdue University.

Mr. Gates will also serve the principal role of reviewing Metro's NTD/APC methodologies and contributing to Metro's application to FTA to gain approval for the use of APC-generated data in NTD reporting.

Debbie Scheetz – Administrative Manager

The newest member of UTA's team, Ms. Scheetz joined UTA in 2013 after spending 22 years in the banking industry and specifically served as the company's commercial banker. Her close connection with the financial side of UTA sparked her interest in learning more about the operations of UTA and becoming a contributing member of the team by applying her years of cumulative business experience. Debbie has her B.B.A. in Management and Marketing (University of Cincinnati) and enjoys applying her business experience to help manage the daily administrative responsibilities, as well as the long-term needs of UTA's operations.

The UTA project team represents two-hundred (200+) cumulative years of APC experience applied in North American public transit agencies along with a total of thirteen (13) advanced (Master's +) technical degrees.

No other APC firm in North America can offer the combination of academic achievement and transit experience as is present with the UTA project team.

All of the aforementioned UTA staff, in some manner, will be applied to Metro's APC system implementation.

3. Price

Topeka METRO

APC System Cost Summary

Qty=26 Buses - StandAlone Configuration

Rev001 - 12/13/23

Qty=23 Buses - APC On-Bus M31 CPU + Cables – Utilize Existing APC Sensors

Item	UTA Part No.	Per Bus Cost
A. Model 31 APC Interface Module	5541LW	$ 1,675
B. Cables (2)	$ 474	
C. Antenna (GPS/Cellular)	$ 190	

	Per Bus Total	**$ 2,339**
Installation - UTA Technicians		**$ 375**

Qty=3 Buses - APC On-Bus Complete System

Item	UTA Part No.	Per Bus Cost
A. Model 31 APC Interface Module	5541LW	$ 1,675
B. Cables (6)	$ 975	
C. APC Sensors (Hella)		$ 1,690
C. Antenna (GPS/Cellular)	$ 190	

	Per Bus Total	**$ 4,530**
Installation - UTA Technicians		**$ 525**

4240 Airport Rd, Suite # 212, Cincinnati, Ohio 45226. Tel (513) 961 0099 Fax (513) 961 0132

Item	Per Site Cost
APC Software – UTA Hosted – WebBased Reporting	**$ 36,500**
StandAlone APC Data Configuration	
Data Transfer	
Diagnostics	
Automated Assignment	
File Creation	
Report Generation	
NTD/APC Certification Plan + Qualified Statistician	
Reference File Setup – GTFS Interface	
Schedules	
Geo-Coding	
Global Reporting	
Software Training & Documentation	**$ 4,500**
Cellular Data Transfer (3 Years) ($8/bus/mo)(26buses)(36mo)	**$ 7,488**
Total	**$ 48,488**

Total Project Cost $ 126,075

Annual APC Support $ 5,500/yr

Notes:

1. **Delivery: 6-8 Weeks ARO**
2. **Optional: Real-Time Passenger Load GTFS-RT - $ 8,750/yr**
3. **Taxes Not Included**

PRICE QUOTE

Proposer Urban Transportation Associates, Inc.

RFP Number – TM-24-01 Technology for Buses

Please provide a price quote for each of the items listed below. Metro will select items based on the amount of money available for this project.

AVL/CAD * $______

APC $ 126,075 Please see attached detail sheet

DMS $______

Total Contract Price $______

Installation & Training Start Date ______ Complete Date______

Annual Maintenance, Support and Updates Year 1 $ 0

Note: You may quote dollar amounts for years 2-5, or maximum percentage increases. If there is no cost, enter $0 on each line.

Year 2 $ 5,000

Year 3 $ 5,000

Year 4 $ 5,000

Year 5 $ 5,000

What would Topeka Metro need to provide in order for you to complete this project?

UTA would require schedules and GeoCoding for report generation

Metro is exempt from all taxes – do not include sales tax in your bid pricing. A project exemption certificate will be provided upon request. Price quoted must be the total cost of the contract, including (but not limited to) materials, labor, installation, training and travel expenses.

*** Includes headsign update, annunciator update, customer facing app, and customer service support.**

4. Warranty and Service Agreement

UTA's standard warranty is a one (3) year warranty against any APC failures attributable to defects in UTA-provided materials and/or UTA workmanship on an individual Metro vehicle.

UTA's APC warranty does not include APC defects caused by vandalism, acts of nature, and/or gross negligence. UTA's warranty period starts on the date the APC system is placed in revenue service on a Metro bus and the APC Diagnostics indicates satisfactory APC performance.

UTA assumes the User Acceptance Testing will be executed within a two (2) month period after APC installation.

5. Required Forms

ACKNOWLEDGEMENT
Individual / Partnership

STATE OF Ohio)
)
COUNTY OF Hamilton)
)

I, Debra A Scheetz, a Notary Public in and for said County, in the State aforesaid, do hereby certify that Thomas W Kowalski, who is/are personally known to me, appeared before me this day in person, and acknowledged the signature, seal and delivery of the foregoing instrument as a free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notary seal, this 13th day of December, 20 23.

My Commission Expires:

Debra A Scheetz
NOTARY PUBLIC
In & For State of Ohio
Commission #2018-RE-720079
My Commission Expires 5/2/2028

Notary Public

(SEAL)

ACKNOWLEDGEMENT

Corporation

STATE OF Ohio)
)
COUNTY OF Hamilton)
)

I, Debra A Scheetz, a Notary Public in and for said County, in the State aforesaid, do hereby certify that Thomas W Kowalski, President/CEO, and N/A, of Urban Transportation Associates, Inc. (a corporation), who are each personally known to me, appeared before me this day in person and severally acknowledged that they signed, sealed and delivered the foregoing instrument as their free and voluntary act as officers of the corporation identified above as the Proposer, and as the free and voluntary act of said corporation, for the uses and purposes therein set forth.

Given under my hand and notary seal, this 13th day of December, 2023.

My Commission Expires:

Debra A Scheetz
NOTARY PUBLIC
In & For State of Ohio
Commission #2018-RE-720079
My Commission Expires 5/2/2028

Notary Public

(SEAL)

ACKNOWLEDGEMENT OF ADDENDA

The following form shall be completed and included in the proposal. Failure to acknowledge receipt of all addenda may cause the proposal to be considered unresponsive to the solicitation. Acknowledged receipt of each addendum must be clearly established and included with the Proposal. Make copies of this form if more than five (5) addenda were issued.

ACKNOWLEDGEMENT OF ADDENDA

The undersigned acknowledges receipt of the following addenda to RFP TM-24-01:

Addendum Number 1 Dated: Document not dated

Addendum Number 2 Dated: Document not dated

Addendum Number ________ Dated: ____________________

Addendum Number ________ Dated: ____________________

Addendum Number ________ Dated: ____________________

Proposer Urban Transportation Associates, Inc.

Street Address 4240 Airport Road Suite 212

Street Address ____________________

City, State, Zip Code Cincinnati, Ohio 45226

Authorized Signature [signature] 12/13/23

Name Thomas W Kowalski

Title President and CEO

Telephone Number 513-961-0099

Facsimile Number (FAX) 513-961-0132

E-Mail Address tkowalski@fuse.net

BUY AMERICA CERTIFICATION

Proposer will certify either compliance or non-compliance, not both. This certification must be submitted with the proposer's response.

Certificate of Compliance with 49 USC 5323(j)

The bidder hereby certifies that it will meet the requirements of 49 USC 5323(j), and the applicable regulations in 49 CFR Part 661 and any amendments thereto.

Signature: [signature]

Name & Title: Thomas W Kowalski President and CEO

Company: Urban Transportation Associates, Inc.

Date: December 13, 2023

Certificate of Non-Compliance with 49 USC 5323(j)

The bidder hereby certifies that it cannot comply with the requirements of 49 USC 5323(j) and 49 CFR 661.5, but it may qualify for an exception pursuant to 49 USC 5323(j)(2)(A), 5323(j)(2)(B), or 5323(j)(2)(D), and 49 CFR 661.7.

Signature: ______________________

Name & Title: **N/A**

Company: ______________________

Date: ______________________

DISADVANTAGED BUSINESS ENTERPRISES (DBE) CERTIFICATION

This contract is subject to the requirements of Title 49, Code of Federal Regulations, Part 26, *Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs*. The national goal for participation of Disadvantaged Business Enterprises (DBE) is 10%. Metro's overall 2022-2024 goal for DBE participation is 1.62%; the race neutral goal is 1.25%, and the race conscious goal is 0.37%. There is no contract goal for this procurement.

The contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of this DOT-assisted contract. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as Metro deems appropriate. Each subcontract the contractor signs with a subcontractor must include the assurance in this paragraph (see 49 CFR 26.13(b)).

The contractor is required to pay its subcontractors performing work related to this contract for satisfactory performance of that work no later than 30 days after the contractor's receipt of payment for that work from Metro.

The contractor may not hold retainage from its subcontractors.

The contractor must promptly notify Metro, whenever a DBE subcontractor performing work related to this contract is terminated or fails to complete its work, and must make good faith efforts to engage another DBE subcontractor to perform at least the same amount of work. The contractor may not terminate any DBE subcontractor and perform that work through its own forces or those of an affiliate without prior written consent of Metro.

Signature: [signature]

Name and Title: Thomas W Kowalski President and CEO

Company Name: Urban Transportation Associates, Inc.

Date: December 13, 2023

FLY AMERICA CERTIFICATION

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and sub-recipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

Signature: ______________________

Name and Title: Thomas W Kowalski President and CEO

Company Name: Urban Transportation Associates, Inc.

Date: December 13, 2023

LOBBYING CERTIFICATION

The undersigned contractor certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions. See 49 CFR 20.100.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 USC. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure. [Note: Pursuant to 31 USC 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such expenditure or failure. See 49 CFR 20.400.]

The undersigned contractor certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 USC 3801, et seq, apply to this certification and disclosure, if any.

Signature: [signature]

Name and Title: Thomas W Kowalski President and CEO

Company Name: Urban Transportation Associates, Inc.

Date: December 13, 2023

NON-COLLUSION CERTIFICATION

This is my sworn statement to certify that this proposal was not made in the interest of or on behalf of any undisclosed entity. This proposal is not collusive.

This proposer has not been a party to any agreement or collusion in restraint of freedom of competition by agreement to bid a fixed price, to refrain from bidding, or otherwise. This proposer has not, directly or indirectly, by agreement, communication or conference with anyone, attempted to induce action prejudicial to the interest of Topeka Metropolitan Transit Authority, or of any proposer, or anyone else interested in the proposed contract.

Signature: [signature]

Name and Title: Thomas W Kowalski President and CEO

Company Name: Urban Transportation Associates, Inc.

Date: December 13, 2023

POWER OF EXECUTION

Authorization of Bidder

The undersigned, an Officer of
(officer, partner, proprietor, etc.)

Urban Transportation Associates, Inc.,
(name of company)

a Corporation
(corporation, partnership, proprietorship)

having its principal office or registered agent at 4240 Airport Rd Suite 212, Cincinnati OH 45226 hereby certifies that the Company has duly authorized by appropriate action and/or hereby does

nominate, constitute, appoint and authorize Thomas W Kowalski
(name of individual signing document)

with full power to act Alone, on behalf of
(alone or in conjunction with another person)

Urban Transportation Associates, Inc.,
(name of company)

and thereby to make, execute, seal and deliver on its behalf as CONTRACTOR and as its act and deed any and all proposals, contract proposals, contracts, change orders, monthly and final payment certificates and other like instruments. Such proposals, contract proposals, contracts, change orders, monthly and final payment certificates and other like instruments shall be binding upon said company as fully and to all intents and purposes as if such instruments had been duly executed, acknowledged and delivered by the authorized officers of the company when executed, by the aforementioned person(s).

Urban Transportation Associates, Inc.
Company

[signature] CFO
Signature, Title

December 13, 2023
Date

ATTEST:

[signature]
Notary Public (if proprietorship)
Secretary of Corporation (if corporation)
Partner (if Partnership)

PRICE QUOTE

Proposer Urban Transportation Associates, Inc.

RFP Number – TM-24-01 Technology for Buses

Please provide a price quote for each of the items listed below. Metro will select items based on the amount of money available for this project.

AVL/CAD * $______

APC $ 126,075 Please see attached detail sheet

DMS $______

Total Contract Price $______

Installation & Training Start Date ______ Complete Date______

Annual Maintenance, Support and Updates Year 1 $ 0

Note: You may quote dollar amounts for years 2-5, or maximum percentage increases. If there is no cost, enter $0 on each line.

Year 2 $ 5,000

Year 3 $ 5,000

Year 4 $ 5,000

Year 5 $ 5,000

What would Topeka Metro need to provide in order for you to complete this project?

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Metro is exempt from all taxes – do not include sales tax in your bid pricing. A project exemption certificate will be provided upon request. Price quoted must be the total cost of the contract, including (but not limited to) materials, labor, installation, training and travel expenses.

*** Includes headsign update, annunciator update, customer facing app, and customer service support.**

PROPOSAL CHANGE REQUEST

Complete this form for each condition, exception, reservation, or understanding (i.e., change) in the proposal. See PROPOSAL SCHEDULE, page 5 of this RFP, for the due date of all requested Proposal Changes.

Change Number ____________________

Proposer ____

RFP Number – TM-24-01 Page: __________ Section: ______________

Metro's Current Requirement:

N/A

Proposer's Requested Change:

SUSPENSION / DEBARMENT CERTIFICATION

In regard to 2 CFR Parts 180 and 1200

In accordance with 2 CFR Parts 180 and 1200, the contractor is required to verify that none of its principals or affiliates:

1) is included on the federal government's suspended and debarred list;
2) is proposed for debarment, declared ineligible, voluntarily excluded or disqualified;
3) within three years preceding this proposal, has been convicted of or had a civil judgment rendered against them for (a) commission of fraud or criminal offense pertaining to performing a public transaction, (b) violation of any federal or state antitrust statute, or (c) embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements or receiving stolen property;
4) is indicted or charged by a governmental entity for any of the charges in 3) above; and
5) has had any public transaction terminated for cause or default within three years preceding this proposal.

The contractor is required to include this requirement in any subcontracts related to this contract.

By signing and submitting its proposal, the proposer certifies that the certification in this clause is a material representation of fact relied upon by Metro. If it is later determined that the proposer knowingly rendered an erroneous certification, in addition to remedies available to Metro, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The proposer agrees to verify that none of its principals or affiliates is included on the federal government's suspended and debarred list at any time throughout the period of this contract. The proposer further agrees to include a provision requiring the same compliance in its subcontracts related to this contract.

Signature: [signature]

Name and Title: Thomas W Kowalski President and CEO

Company Name: Urban Transportation Associates, Inc.

Date: December 13, 2023