November 2017

BRITE Transit ITS Study
Study Report and 6-Year Plan

FINAL

CSPDC Central Shenandoah Planning District Commission

brite

Kimley»Horn

Table of Contents

List of Figures

List of Tables

List of Acronyms

ADA	Americans with Disabilities Act
ADAS	Advanced Driver-Assistance System
APC	Automatic Passenger Counter
AVL	Automatic Vehicle Location
BRCC	Blue Ridge Community College
BTAC	BRITE Transit Advisory Committee
CAD	Computer-Aided Dispatch
CAT	Charlottesville Area Transit
CSPDC	Central Shenandoah Planning District Commission
DRPT	Virginia Department of Rail and Public Transportation
FRED	Fredericksburg Regional Transit
FTA	Federal Transit Administration
GPS	Global Positioning System
GTFS	General Transit Feed Specification
HDPT	Harrisonburg Department of Public Transportation
IT	Information Technology
ITS	Intelligent Transportation System
NTD	National Transit Database
O&M	Operations and Maintenance
OLGA	On-Line Grant Application System
RFP	Request for Proposal
SDDA	Staunton Downtown Development Association
TDM	Transportation Demand Management
VRT	Virginia Regional Transit
WWRC	Wilson Workforce & Rehabilitation Center

Executive Summary

Introduction

The Central Shenandoah Planning District Commission (CSPDC), which administers the BRITE public transit system, is interested in exploring opportunities for implementing technology to improve operations for the agency and its customers. BRITE is operated under contract by Virginia Regional Transit (VRT) and provides deviated fixed route and demand response services. Separate urban and rural services are comprised of nine deviated fixed routes and two demand response services in Staunton and Waynesboro. The urban and rural services carried 220,832 and 59,476 riders, respectively, in fiscal year 2017.

Technologies, or intelligent transportation systems (ITS), are an industry best practice for improving transit system operating capabilities. BRITE currently uses a minimal amount of ITS in its service delivery, primarily limited to scheduling software, radio communication, and surveillance camera systems. A consultant team from Kimley-Horn and Associates, Inc. was retained to study this topic for CSPDC.

This study explored ITS that may improve the **reliability of data**, foster **efficiency in service delivery**, and enhance the **transit experience for customers**. The outcome of the study was a 6-year plan and program for implementing technology solutions appropriate for BRITE.

Methodology

Input to the plan was gathered through on-site observations, discussions with staff, and a customer survey. Current data collection, processing, and reporting activities were observed on buses and at the bus operations and maintenance facility. The consultant team gathered input about needs to help justify the implementation of technology from bus operators and transit agency managers. Existing data collection processes are very manual, relying primarily on paperwork and manual data entry. The study identified the need to transition from manual methods of scheduling and collecting data to more technology-assisted methods, particularly if demand for service grows.

BRITE serves a range of customer demographics, so it was important to obtain customer input as a part of the study. In-person and online surveys were conducted to understand customers' desire for real-time information and comfort with using technology while riding the bus. The survey received nearly 50 responses from across multiple routes. Overall, 76 percent of respondents desire real-time information on their bus; similarly, 78 percent of respondents own a smartphone and indicated they would be comfortable with using technology to receive information. The range of customer-facing technologies included in the plan would be welcomed by this segment of customers while still providing benefit to those who are less technology-savvy. **Figure 1** shows a breakdown of desired forms of information.

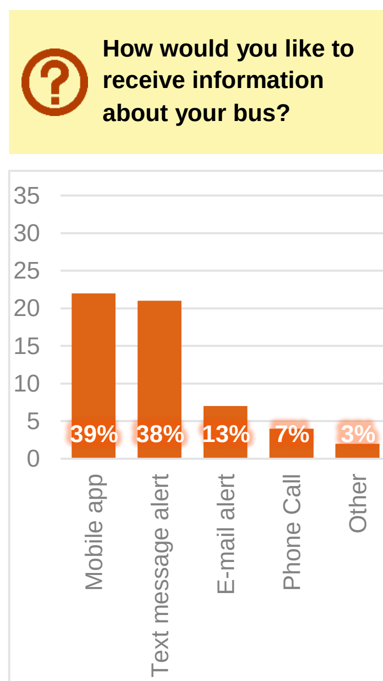


Figure 1: Stated Customer Desire for Real-Time Information

Moreover, the study documented existing ITS and recent procurements for BRITE's peer and neighboring transit agencies in Virginia. While there are limited opportunities for BRITE to ride on contracts for previously deployed ITS, these peers will be useful for information exchange as the CSPDC continues the planning, procurement, and implementation of ITS.

Conclusions

The 6-year plan consists of eight projects that may be implemented during fiscal year 2019 through 2024:

- P-1: GTFS Data Feed and Integration with Google Transit
- P-2: Mobile Data Collection System
- P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software
- P-4: Real-Time Data Feed for Third-Party Applications
- P-5: Next Bus Arrival Text Message Service
- P-6: Traveler Information Displays at Major Activity Centers
- P-7: Advanced Driver-Assistance System
- P-8: Mobile Ticketing

Each project is grounded in user needs expressed by operators, staff, or customers. Cost estimates and schedules were determined for each project and were sequenced into a 6-year program. The total program capital cost was estimated to be $522,400 over six years with an estimated annual operations and maintenance cost of $81,700 at full implementation. Additional staff skills and responsibilities will be needed to implement and operate ITS. The plan identifies the required skills and staffing options. The program would modernize BRITE's data collection methods, overall operations, and improve the system's usability for customers.

1. INTRODUCTION

1.1. Background and Purpose

The Central Shenandoah Planning District Commission (CSPDC) administers transit for the BRITE public transit system which operates in the area of Staunton-Augusta-Waynesboro, Virginia. The CSPDC became the regional transit provider for this area effective January 1, 2014. The transit service is operated under a turnkey contract with Virginia Regional Transit (VRT), which provides the service supervision, the operators, the buses, and all maintenance functions. This is a five-year contract that was executed in March 2017, with an effective date of July 1, 2017, and allows for two – two year extensions.

BRITE operates nine deviated fixed routes and two demand response services in Staunton, Augusta County and Waynesboro. Fixed routes may deviate up to ¾ miles to serve Americans with Disabilities Act (ADA) passengers. The urban and rural services carried 220,832 and 59,476 riders, respectively, in fiscal year 2017. During this time $79,851 in fares were collected. The total operating expense for the urban service was $1,440,918; the CSPDC began administering the rural service in fiscal year 2018.

As a developing transit system, the CSPDC understands the importance of operating within industry best practices. This includes the use of technologies, or intelligent transportation systems (ITS), that improve transit system operating capabilities. ITS technologies benefit the transit operator and customers alike, providing valuable information and making the service safer and more efficient. The CSPDC is interested in exploring options to expand the use of ITS solutions.

This study involved an assessment of existing processes and user needs to determine technology solutions appropriate for BRITE. Tying solutions back to the needs of the system operators and customers will help ensure that technology implementations are justified and suitable to the needs of the system.

The purpose of the study was to explore options for ITS solutions that may improve the **reliability of data**, foster **efficiency in service delivery**, and enhance the **transit experience for customers**. This document presents a plan for enhancing the BRITE public transit system with ITS during the next six years.

The study had the following objectives:

- Document existing data collection processes through bus and operations center observations
- Gather operator and customer needs in relevant application areas
- Identify ITS solutions appropriate for BRITE
- Develop a timeline and budget to implement the solutions
- Communicate the 6-year plan to the BRITE Transit Advisory Committee (BTAC)

1.2. Data Gathering Process

The consultant team conducted a site visit to the BRITE operations and maintenance facility in Fishersville, Virginia on September 7, 2017. The consultant team observed bus operator duties, conducted a survey of customers, and performed observations of activities at the BRITE operations and maintenance facility. The purpose of these bus and facility observations was to gather an understanding of existing workflows, needs, and opportunities for improvements using technology. After the data gathering period, a workshop was held with staff from the CSPDC and VRT to discuss challenges and needs of the BRITE system as well as potential solutions.

Bus Observations

Two consultant staff performed observations for both service types: deviated fixed route and demand response (or paratransit). One observer began the morning at James Madison University Godwin Transit Center in Harrisonburg and rode the Blue Ridge Community College (BRCC) North Shuttle, transferring to the BRCC South Shuttle. Once at the Staunton Hub, observations were conducted riding the 250 Connector heading eastbound to Augusta Health. Observations were also conducted beginning at the Staunton Hub and riding along on two demand response trips in Staunton. Both observers talked with bus operators about their duties relating to data collection, serving passengers, and communication with dispatch and customers.

Customer Survey

During the bus observations, surveys were administered to customers on iPads to gather information about their trip, desire for real-time information, and comfort-level using technology. An online version of the survey was also made available through the BRITE website, social media accounts, and advertisements on the buses directing customers to the survey webpage. Through in-person and online surveys, 49 responses were gathered from customers along six routes and on the demand response service. A high-level summary of findings is listed below and additional details can be found in **Appendix A: Customer Survey Results**.

- 78 percent of customers use the service multiple times a week, and 76 percent of customers regularly ride the same route
- The most common trip purposes are Work (33 percent), Shopping (24 percent), and College/University (20 percent)
- 27 percent of customers desire a different form of fare payment such as a bus pass, transit card, or debit/credit/prepaid cards
- 76 percent of customers desire real-time information on their bus—delivering information about when it will arrive or providing service alerts
- Of those who desire real-time information, roughly equal amounts desire it in the form of a mobile app (39 percent) or text message (38 percent)
- Real-time information is desired throughout the trip (before the trip, at the bus stop, and on the bus), but there was a general stated preference for knowing sooner rather than later, such as before the customer leaves home
- 78 percent of customers indicated they are comfortable with using technology to receive information; similarly, 78 percent of customers own a smartphone

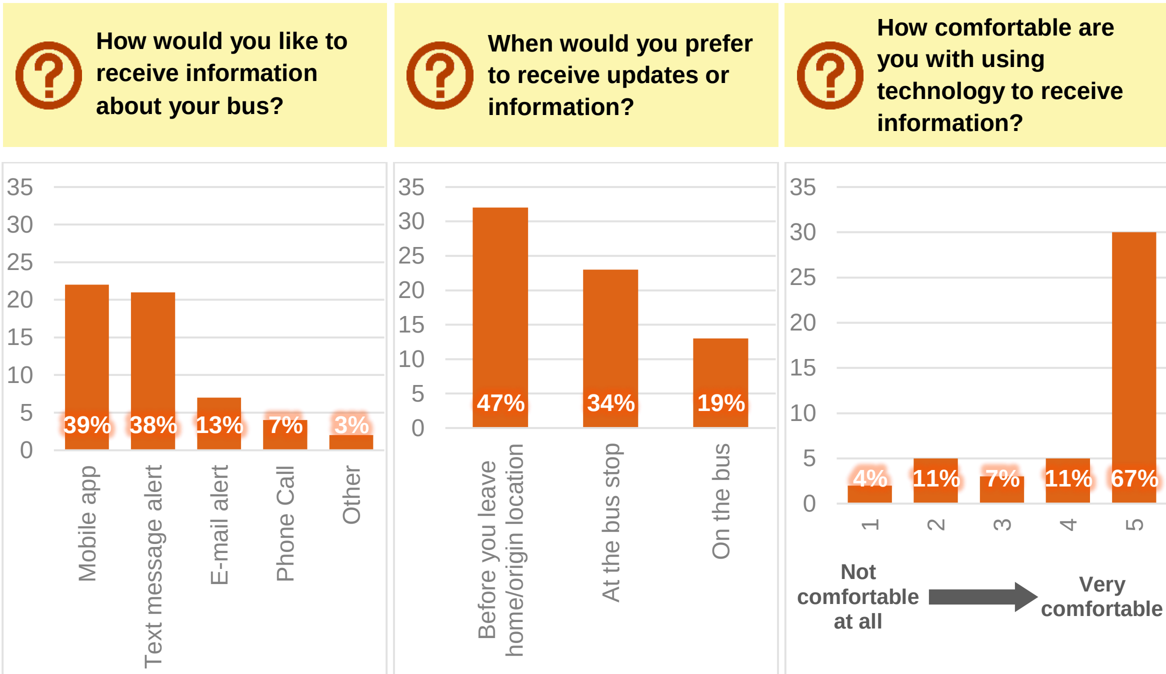


Figure 2: Stated Customer Desire for Real-Time Information and Comfort with Technology

Operations and Maintenance Facility Observations

After administering surveys to customers and interviewing bus operators, additional data about operating procedures was collected at the operations and maintenance facility. Information was gathered about communication procedures between bus operators and dispatch, data entry tasks for the daily driver sheet recordings, Americans with Disabilities Act (ADA) reservation procedures and software, and reports provided to the CSPDC by VRT every month.

Workshop

Observations and preliminary customer surveys were compiled prior to the workshop with staff, which was held later that same day. The workshop was attended by the individuals listed in **Table 1**, and included a Transit Manager from both CSPDC and VRT and a CSPDC Transit Coordinator and Fiscal Officer. It consisted of a recap of the data gathered earlier in the day, a confirmation of needs, and presentation of potential ITS solutions to assist with operations. Discussion was organized around eight application areas for transit technology, which are described in the next section. The workshop provided a clear vision for the direction of a 6-year plan.

Table 1: Site Visit Workshop Attendees

Name	Organization	Role
Nancy Gourley	CSPDC	Transit Manager
Devon Thompson	CSPDC	Transit Coordinator
Cindi Johnson	CSPDC	Fiscal Officer
Susan Newbrough	VRT	Transit Manager
Tyler Beduhn Mike Harris Alan Toppen Alex Fisher	Kimley-Horn	Consultant

1.3. Application Areas

Technology needs and solutions were organized into eight application areas for the purpose of this study. Each application area represents a different but related component of public transit operations and is summarized below. Each application area was considered during the study, but some proved more relevant to BRITE given needs and scale of service. The application areas are prioritized below by relevancy, needs, and BRITE's existing capabilities.

Vehicle Tracking and Dispatch

Vehicle tracking involves real-time location of the fleet using GPS and communication back to a central system. Automatic vehicle location, or AVL, is a baseline and core technology for transit operators that enables many other applications and uses of the data. Vehicle tracking allows dispatchers to see if buses are on schedule and communicate this information to operators and customers.

Traveler Information

Traveler information includes systems that disseminate information of the service to customers such as bus arrival time, service alerts, or bus locations. It may consist of technology at the bus stop, on the bus, or customers' personal mobile devices.

Scheduling

Scheduling involves software tools to assist with scheduling fixed route trips, deviations, and demand response trips. For fixed route, scheduling involves route blocking, run-cutting, and operator assignment. For demand response, it involves call-taking, trip information data entry, trip scheduling, and creating a manifest of customer trips to be served.

Passenger Counting

Passenger counting includes systems to assist with the collection of ridership data. Ridership is a key piece of data used for reporting and performance monitoring.

Business Intelligence

Business intelligence includes software tools with data analytics and report generation capabilities that enable transit operators to track performance and make informed decisions to improve the effectiveness and efficiency of service.

Fare Collection

Fare collection can involve technology to assist with fare collection, whether it be cash or other forms of payment like a bus pass, smart card, or mobile device ticket. Tasks may include registering and validating the payment.

Safety and Security

Safety and security involves technologies to monitor the fleet and facilities. This includes camera surveillance systems and advanced driver assistance systems, which are safety features that alert the driver of potential problems or automate some control of the bus to avoid collisions.

Maintenance

Maintenance includes systems to streamline fleet maintenance activities such as pre-trip inspections, preventative maintenance, parts inventory tracking, and fuel tracking.

2. SUMMARY OF EXISTING TRANSIT SYSTEM

2.1. Characteristics – Routes, Fares, Fleet, Facilities

Service Types and Routes

BRITE has two separately funded components – an urban component and a rural component. The urban service consists of six deviated fixed routes and demand response service in Staunton, Augusta County and Waynesboro:

- 250 Connector
- Waynesboro Circulator
- Staunton Downtown Trolley
- Staunton North Loop
- Staunton West Loop
- Staunton Saturday Night Trolley
- Staunton demand response
- Urban demand response

The fixed routes may deviate up to ¾-mile to pick up approved ADA passengers. The rural service consists of three deviated fixed routes:

- Blue Ridge Community College Shuttle North
- Blue Ridge Community College Shuttle South
- Stuarts Draft Link

All transit services operate weekdays and the 250 Connector, Downtown Trolley, and Saturday Night Trolley have service on Saturdays.

Fares

Fares for fixed routes are $0.50 per boarding, except for the trolleys, which are $0.25 per boarding. Passengers requesting route deviations are required to pay $1.00 and $0.50 for these services, respectively. Fares for Staunton demand response service are $0.50 and $1.00 for all other demand response.

Through its partnership with funding partners, BRITE offers fare-free service to passengers who hold a valid ID. This includes Blue Ridge Community College students, faculty, and staff; Wilson Workforce & Rehabilitation Center residents; and passengers accessing Augusta Health. All students ride free with identification, and children 12 and under also ride free. BRITE distributes tokens to Shenandoah Valley Social Services, which distributes them among its clients.

Fleet

BRITE services are operated using a fleet of 13 revenue service vehicles owned by VRT. The majority of the fleet was purchased in 2017. It consists of a trolley (Downtown Trolley), body-on-chassis buses (most fixed routes and demand response), and heavy-duty low floor buses (BRCC Shuttles). VRT provides all maintenance functions for the fleet.

Facilities

The operations and maintenance facility for BRITE is located at 51 Ivy Ridge Lane in Fishersville. Ownership of the facility was transferred from VRT to the CSPDC in 2017. The facility consists of administrative offices, four maintenance bays, a wash bay, and a secure lot to store the vehicle fleet.

2.2. Funding Partners

Federal Transit Administration

The CSPDC is the direct recipient of Federal Transit Administration (FTA) funds through the Urbanized Area Formula – 5307 program for capital and operating assistance. Similarly, it receives FTA funds through the Formula Grants for Rural Areas – 5311 program, which flows through the Virginia Department of Rail and Public Transportation (DRPT). The federal share for both programs is 80 percent for capital projects and 50 percent for operating assistance.

Agencies receiving funding through the 5307 and 5311 programs are required to submit data to the National Transit Database (NTD). The CSPDC completes NTD reporting annually for the due date of October 31. The data reporting includes:

- Financial Data – revenues, expenses, cost of operations
- Service Data – demographic data, revenue miles, revenue hours, vehicles available and operated for service, unlinked passenger trips, passenger miles traveled

Virginia Department of Rail and Public Transportation (DRPT)

The CSPDC is a grantee of DRPT for annual state aid grant programs such as the Operating Assistance Program, Capital Assistance, Demonstration Project Assistance, and Technical Assistance. The matching ratio and funding available for these programs varies from year-to-year. The CSPDC is required to submit financial and service data to DRPT though the annual application procedure. The due date for grant applications is typically February 1. Data is submitted using DRPT's On-Line Grant Application system (OLGA). Service data is also submitted monthly via OLGA by the 20th of the month for the previous month's activity.

To promote the effectiveness and efficiency of public transit service delivery, the Virginia General Assembly passed Senate Bill 1140 in 2013, which established a performance-based allocation process for state operating assistance to transit agencies. The model allocates annual revenues generated for the Commonwealth Mass Transit Fund above $160 million to grantees based on:

- Net Cost per Passenger (50 percent) – three-year trend
- Customers per Revenue Hour (25 percent) – three-year trend
- Customers per Revenue Miles (25 percent) – three-year trend
- Transit System Sizing – systems are sized equally based on ridership and operating costs and relative to all transit operators eligible for state assistance

Local Funding Partners

The CSPDC receives local contributions from the following funding partners:

- City of Staunton
- City of Waynesboro
- Augusta County
- Augusta Health
- Blue Ridge Community College (BRCC)
- Shenandoah Valley Social Services
- Wilson Workforce Rehabilitation Center (WWRC)
- Staunton Downtown Development Association (SDDA)

These contributions provide matching funds so that the CSPDC and VRT can access the federal and state funding programs. The CSPDC reports performance data to these funding partners monthly. Data reported includes ridership by fare type, service hours, passenger trips per service hour, financial data, and year-to-year and month-to-month trends.

2.3. Existing ITS

BRITE is currently operated with a limited amount of ITS. Existing systems are:

- **In-vehicle camera system** – Seon Explorer MX-HD digital video recorders installed on every bus in the fleet. The system contains an interior rear-facing camera, an interior forward-facing dashboard camera, and an exterior rear-facing camera.

- **Facility camera system** – AVS Uriel System, Inc. Digital Video Recorder v6.41. The system contains interior cameras and exterior cameras in fleet parking lot.

- **Demand response scheduling software** – Transportation Manager System, Version 15.0 provided by Shah Software. This system has been used for over 10 years. It is the software used by dispatchers to schedule demand response trips and route deviations, and generate manifests. The software contains a database of approximately 500 ADA customers. When a reservation call comes in, the dispatcher enters information into the system including the customer, pick-up time, destination, fare type, trip purpose, and whether a mobility assistance device will be used. The dispatcher is responsible for viewing the existing manifest and manually scheduling the new trip. BRITE accepts standing reservations and reservations between 24-hours and two weeks in advance of the trip.

- **Digital radio system** – BRITE uses two-way Motorola radios to communicate between the vehicle operators and dispatch. This communication is provided by Teltronic, which rents the radio towers to VRT. The system is known to have several dead spots along Route 11 and near the Staunton Walmart. Longer antennas were recently installed on the buses to improve the performance of the system.

Figure 3: Existing On-Board Equipment Setup

(Source: Kimley-Horn)

2.4. Existing Data Collection Processes

Data collection is important to transit operations. Aside from being required for reporting to funding partners, it informs decision-making when making changes that improve the effectiveness and efficiency of service delivery. Overall, BRITE's existing data collection process are very manual, relying on operator logs. The key pieces of data collected are:

- Ridership
- Revenue Miles
- Revenue Hours
- Fares
- On-time Performance
- Incoming Calls

Table 2 summarizes how this data is collected, transferred and stored, processed and verified, and reported.

Table 2: Existing Data Collection Processes

Data	Collection	Transfer and Storage	Processing and Verification	Reporting
Ridership	Operators tally boarding passengers by fare type on a paper log. A clicker is used to maintain a tally of the most frequent fare type for the route. Demand response trips are tracked using paper manifests from the scheduling software.	Operators calculate the total passengers and submit the log or manifest to the dispatcher at the end of their shift. The daily logs are entered into a monthly tracking spreadsheet within a few days.	At the time of data entry, the passenger counts are compared against the collected fares. The Transit Manager looks for anomalies, justification, and year-to-year variances monthly. The CSPDC also looks at monthly data trends.	VRT prepares a monthly summary report and submits to the CSPDC, which distributes reports to its stakeholders. The CSPDC reports to DRPT and its local funding partners monthly and NTD annually.
Revenue Hours	Revenue hours are calculated in a monthly spreadsheet based on contracted scheduled hours. Adjustments are made in the spreadsheet on days when service is shut down. Operators also track start and end hours on a paper log or the manifest.	A spreadsheet is used to track and store the data for each day of the month. Demand response revenue hours are entered into the spreadsheet daily based on the scheduled trips.	The Transit Manager looks for anomalies, justification, and year-to-year variances monthly. The CSPDC also looks at monthly data trends.	See Ridership Reporting Revenue hours are the basis for payment of VRT's contracted service delivery.
Revenue Miles	Revenue miles are calculated in a monthly spreadsheet based on contracted scheduled miles. Adjustments are made in the spreadsheet on days when service is shut down. Operators also track start and end miles from the odometer on a paper log or the manifest.	A spreadsheet is used to track and store the data for the month. Demand response revenue miles are entered into the spreadsheet from the odometer readings logged on the manifests.	The Transit Manager looks for anomalies, justification, and year-to-year variances monthly. The CSPDC also looks at monthly data trends.	See Ridership Reporting

Data	Collection	Transfer and Storage	Processing and Verification	Reporting
Fares	Operators tally boarding passengers by fare type on a paper log. The passenger counts are used to calculate the total expected fares collected by the operator.	Fareboxes are emptied and cash is counted daily. The total daily passenger fares collected are entered into a monthly spreadsheet.	Collected fares are reconciled against daily operator logs. Consistent discrepancies are investigated.	See Ridership Reporting.
On-time Performance	A manger rides along on 100 trips per month and manually logs the on-time performance of the trips.	A spreadsheet is used to track and store the data.	N/A	The spreadsheet is submitted to the CSPDC monthly.
Incoming Calls	When a call comes in, the dispatcher tallies the call purpose (reservation, bus location, complaint, etc.) in a spreadsheet.	A spreadsheet is used to track and store the data (number of calls by purpose).	N/A	The spreadsheet is submitted to the CSPDC monthly.

3. PEER AGENCY ITS

This section summarizes what BRITE's peer agencies in Virginia and neighboring operators are doing with ITS. Outreach to these agencies concluded that there are limited opportunities for BRITE to ride on contracts for previously deployed ITS because the contracts used by the peer agencies did not contain these terms. However, there are several lessons learned and opportunities for information exchange as the CSPDC continues through the planning, procurement, and implementation phases of ITS. To that end, the CSPDC should anticipate contracting independently when procuring future ITS. DRPT has shown interest in establishing state contracts for technology purchases, similar to those available for vehicle purchase, so this is another approach the CSPDC should monitor.

3.1. Bay Transit

Bay Transit operates demand response and deviated fixed route service in a large, rural, service area in eastern Virginia with a fleet of approximately 45 revenue vehicles.

Bay Transit has the following ITS:

- RouteMatch mobile data collection system for demand response
- RouteMatch scheduling software for demand response
- RouteMatch notification module – automated call-out reminders and general services alerts (text, phone, or email)
- Mitchel Maintenance Software
- Camera system on buses – four or six cameras
- Camera system at operations and maintenance facility

Figure 4: Bay Transit Fleet

(Source: Kimley-Horn)

Bay Transit procured its RouteMatch system for demand response scheduling, dispatching, and data collection in 2012. Implementation occurred over several years until 2017 when all offices were equipped with the automated and optimized scheduling software. Bay Transit has reported more efficiencies in customers per service hour and service mile with the software.

Now that Bay Transit is comfortable with the system and gaining success, it is planning to expand the system to add on-board tablets and scheduling software for its deviated fixed route service. This approach was selected to have one vendor and system manage all the service data rather than having manual data transfers between multiple software. A competitive proposals procurement, or RFP, approach was used for the initial implementation with an add-on for the deviated fixed route module. With its several years' experience with RouteMatch, Bay Transit is one of the more technologically proficient rural transit agencies in Virginia.

Lessons Learned:

- The technology will not exactly fit what the agency is looking for; be flexible and open to the solutions that vendors offer

- Staffing and training needs *must* be considered when implementing technology; require the vendor to be on-site during implementation and have an on-site follow-up six to eight weeks later
- Use hardware recommended by the vendor; Bay Transit had difficulties with chargers, battery life, and cellular service for some devices
- Have a dedicated staff member commit to the project, enforce requirements, and monitor technology updates
- Do not fully implement without a lot of testing of the system first
- Training bus operators who are unfamiliar with mobile technology takes time but is possible; be prepared for bus operator resistance when implementing technology
- It is valuable to have a dedicated support person on the vendor side rather than navigating multiple tiers of support

3.2. WinTran

WinTran operates fixed route and demand response service in the City of Winchester with a fleet of 11 revenue vehicles.

WinTran has the following ITS:

- RouteMatch mobile data collection system and scheduling system for fixed route service
- CTS scheduling software for demand response service
- RouteMatch tablets on demand response vehicles for driver communication only
- RouteMatch RouteShout for real-time transit information via web, mobile app, and texting
- Automated voice annunciation for fixed route provided by Strategic Mapping
- Sunguard HTE fleet maintenance software
- Camera system on buses – Seon and REI

Figure 5: WinTran RouteMatch Tablet

(Source: Kimley-Horn)

WinTran implemented its fixed route RouteMatch system in 2015 and 2016. A competitive proposals procurement, or RFP, approach was used. Demand response data collection uses a paper manifest, but the agency has expressed interest in moving toward a tablet-based system in the future.

Lessons Learned:

- Geolocating ridership to the correct bus stops required extra configuration effort and time
- There will be a transition time when both manual methods and the electronic system are used to collect data before being comfortable with migrating completely away from manual

3.3. Fredericksburg Transit

Fredericksburg Regional Transit (FRED) operates deviated fixed route service in Fredericksburg using a fleet of approximately 29 revenue vehicles.

FRED has the following ITS:

- RouteMatch mobile data collection system and scheduling system for deviated fixed route service
- RouteMatch RouteShout for real-time transit information via web, mobile app, and texting
- Camera system on buses
- Camera system at operations and maintenance facility

Figure 6: FRED Bus

(Source: Kimley-Horn)

FRED implemented its RouteMatch system in 2014 and 2015, and was fully operational by March 2016. A competitive proposals procurement, or RFP, approach was used.

Lessons Learned:

- Bus operators see the benefit of the RouteMatch system and would not want to go back to manual data collection
- The standard training offered during implementation was not enough to operate the system
- Support during the implementation was a challenge

3.4. Harrisonburg Department of Public Transportation

Harrisonburg Department of Public Transportation (HDPT) operates fixed route and demand response service in Harrisonburg using a fleet of 49 revenue service vehicles.

HDPT has the following ITS:

- Avail Technologies ITS for its fixed route service
    - On-board mobile data terminals for data collection by bus operator
    - Computer-aided dispatch/automatic vehicle location (CAD/AVL)
    - Automated voice annunciation
    - Automated passenger counters (APCs)
    - Real-time bus information via text message, mobile app, and website
    - Reporting and analytics, including NTD reporting
- EnGraph ParaPlan scheduling software and mobile data terminals for demand response service
- Camera system on buses – REI
- Maintenance management software - Flagship

Figure 7: HDPT Operations Center

(Source: Kimley-Horn)

HDPT recently procured ITS that replaced a suite of on-board systems on its fixed route fleet originally implemented in 2010. A competitive proposals procurement, or RFP, approach was used and a contract was awarded to Avail Technologies in December 2016. The system implementation went smoothly for its fleet of 39 buses. The new system was fully running by August 2017. The new system streamlines passenger counting by bus operators and will provide the ability to use APCs as a primary ridership reporting source once certified for NTD reporting within the next two years.

Lesson Learned:

- It is valuable to have an open mind about how vendors will respond to RFPs
- Know what the system requirements are versus having a “wish list”
- The more prepared the agency is with supplying data (such as the schedule), the smoother the implementation process will go

3.5. Charlottesville Area Transit

Charlottesville Area Transit (CAT) operates fixed route service around Charlottesville using a fleet of approximately 36 revenue service vehicles.

CAT has the following ITS:

- Computer-aided dispatch/automated vehicle location system provided by ETA Transit Systems
- Electronic registering fareboxes provided by Trapeze (formerly Fare Logistics), which allows CAT to scan university IDs and smart cards
- Mobile app developed by in-house IT Department that provides real-time information
- Real-time web map provided by ETA Transit Systems
- Maintenance management software
- Camera system on buses
- Camera system at operations and maintenance facility

Figure 8: CAT Farebox

(Source: Kimley-Horn)

CAT implemented its CAD/AVL system in 2016 and fareboxes in 2015. Both used a competitive proposals procurement, or RFP, approach to replace legacy systems.

Lessons Learned:

- Transit ITS companies can experience mergers or acquisitions, which can create implementation challenges; CAT experienced this during its farebox upgrade
- Electronic systems now provide reliable data that can justify the need for service (such as which bus stops are being used) and communicate the amount of service being provided to local partners (such as University of Virginia students and staff)

4. NEEDS ASSESSMENT

An initial step in proper planning for ITS implementation is the solicitation and definition of stakeholder needs. Needs represent the views of those at the operations level: operators, managers, administrators, and customers. They form the basis of system requirements—essentially what capabilities does the technology need to have. They also provide justification for acquiring new technology and should be traced through the entire planning and implementation process.

Needs were collected during the on-site data gathering during the study through a combination of observation of bus operator and operations center activities and a survey of customers. The needs were clarified and confirmed during a roundtable discussion with staff from VRT and the CSPDC during the site visit. The needs were organized around the application areas introduced in Section 1.3. **Table 3** lists the needs gathered during the study and the relevant application areas.

The needs indicated that BRITE could benefit from a transition from manual methods of scheduling and collecting data to more technology-assisted methods, especially if demand for service grows.

The need to know the location of buses in real-time is central to other expressed needs such as providing customers with information, responding to disruptions, and monitoring performance. Technology-assisted data collection could also reduce the burdens of data collection and processing required of staff.

The user needs identified in the study formed the basis for the proposed projects detailed in the next section. Each project of the 6-year plan are grounded in one or more user needs, and the project profiles reference back to the needs in **Table 3**.

Table 3: BRITE ITS Needs

	Needs	Veh. Tracking and Dispatch	Traveler Information	Scheduling	Passenger Counting	Business Intelligence	Fare Collection	Safety and Security	Maintenance
N-1	Flexibility in dispatch and rightsizing the operating fleet to meet changing demands or in response to disruptions	X		X		X			
N-2	Ability for demand response scheduling software to recommend a scheduled trip while maintaining the ability for the dispatcher to manually schedule			X					
N-3	Scalability of demand response scheduling software to handle future growth			X					
N-4	Ability to change or cancel scheduled demand response trips without entirely reentering the trip information			X					
N-5	Reliable communication between operators and dispatch	X						X	
N-6	Ability for dispatch to know real-time vehicle location to assist with operations, provide information to customers, and monitor performance	X	X			X		X	
N-7	A record of vehicle location to help with customer complaint resolution	X	X						
N-8	Real-time feedback to bus operators when they are running off-schedule	X		X					
N-9	Fare payment options other than cash for individual trips						X		
N-10	Reduced burden of fare enforcement to bus operators						X	X	
N-11	Real-time feedback to drivers of potential danger or collision							X	
N-12	Effective traveler information for a range of rider demographics		X						
N-13	Ability to provide information on the impacts to service due to traffic delays	X	X						
N-14	Ability to inform customers of bus location and service alerts before their trip, at the bus stop, and during their trip	X	X						
N-15	Ability to track boardings of multiple passenger and fare types				X				
N-16	Reduced amount of manual data collection effort and paperwork				X				X
N-17	Ability to limit bus operator interactions with on-board technology while driving	X			X				
N-18	Software tools that can be used by staff and bus operators with a range of technology expertise	X	X	X	X	X	X	X	X
N-19	Ability to track and analyze scheduled fixed-route deviations			X		X			

5. 6-YEAR PLAN

The objective of the study was to develop a 6-year plan for the CSPDC to implement ITS solutions of appropriate scale to improve the reliability of data, foster efficiency in service delivery, and enhance the transit experience for riders. The plan consists of several projects the CSPDC would implement over fiscal years 2019 through 2024.

In Section 5.1, each project is detailed with a high-level description, ties to one or more needs, implementation schedule, capital and annual operations and maintenance (O&M) cost estimates, and anticipated useful life.

ITS implementation will require upfront capital costs, on-going O&M costs, lifecycle replacement when systems reach the end of their useful life, and additional staff skills and responsibilities for the contractor and the CSPDC.

Cost estimates are based on the U.S. Department of Transportation ITS Costs Database, discussion with peer agencies and vendors, and engineering judgment. Estimates typically include planning, design, and project management costs as a percentage of implementation costs; 20 percent contingency is also included. Detailed cost estimates and assumptions can be found in **Appendix B: Detailed Cost Estimates and Assumptions.**

Section 5.2 describes the dependencies between projects that impact implementation sequencing and how the projects were prioritized. Section 5.3 summarizes the plan in a 6-year program. Section 5.4 summarizes the staffing requirements to implement and operate the program. Additional staff skills and responsibilities will be needed of the contractor and the CSPDC.

5.1. Projects

The BRITE Transit ITS Plan consists of eight projects:

- P-1: GTFS Data Feed and Integration with Google Transit
- P-2: Mobile Data Collection System
- P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software
- P-4: Real-Time Data Feed for Third-Party Applications
- P-5: Next Bus Arrival Text Message Service
- P-6: Traveler Information Displays at Major Activity Centers
- P-7: Advanced Driver-Assistance System
- P-8: Mobile Ticketing

P-1: GTFS Data Feed and Integration with Google Transit

PROJECT DESCRIPTION

This project would develop a static General Transit Feed Specification (GTFS) for BRITE's fixed route bus service. GTFS is an industry standard data format that specifies the transit schedule, routes, trips, and stops. It is a series of text files with standard fields. Many transit agencies make GTFS publicly available for download on their website allowing the community and developers to write applications to consume the data.

GTFS is a means by which transit agencies can provide schedules and geographic information to the widely-used Google Maps application. Once GTFS is created, BRITE can participate in Google Transit at no cost. This project would benefit customers by providing the bus schedule and trip planning capabilities to Google users on both desktop and mobile devices.

The partnership with Google begins with an online interest form. Once reviewed, a dashboard will be set up to monitor and manage BRITE's data feed. The feed should be published through BRITE's website, and Google will periodically fetch the feed from this location. The dashboard provides validation and error-checking prior to launching it live on Google Maps.

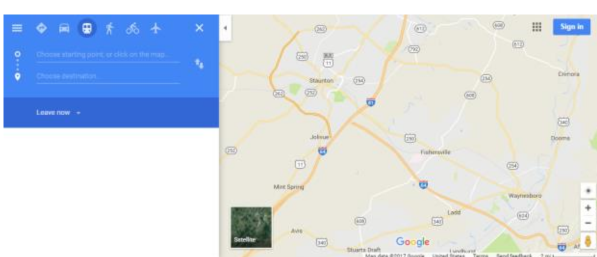


Figure 9: Transit Directions on Google Maps Powered by GTFS

(Source: Google)

NEEDS

N-12

SCHEDULE

Development and Implementation: FY 2019

COST ESTIMATE (2017 $)

Capital Cost: $1,200

Annual O&M Cost: N/A

ANTICIPATED USEFUL LIFE

Indefinitely, with revisions every time schedule changes are made.

PROJECT DEPENDENCIES

The capability of automatically generating GTFS could be an outcome of **P-2: Mobile Data Collection System** and/or **P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software**, since many vendors utilize schedule data in GTFS format. Initially, the CSPDC plans to have GTFS created as part of the recently awarded contract for an upgraded BRITE website, which will contain a Google Maps-based trip planner. In the future, updated GTFS would be automatically generated by the scheduling software. The GTFS will need to be continually maintained as the schedule changes.

VEHICLE TRACKING AND DISPATCH, PASSENGER COUNTING, BUSINESS INTELLIGENCE, MAINTENANCE

P-2: Mobile Data Collection System

PROJECT DESCRIPTION

This project would implement a system of mobile devices on the fleet of buses to track bus location and assist bus operators with counting and classifying passengers and collecting other operations data. Operators would complete data entry tasks using a simple interface on tablets or mobile data terminals while stopped. The GPS and cellular-enabled devices would communicate data and vehicle location in real-time back to a central server hosted by the system vendor. The devices would integrate with BRITE's scheduling software described in project P-3, which would likely be provided by the same vendor. The devices would provide the GPS capabilities to assist with scheduling and providing traveler information.

For deviated fixed routes, operators would tap the appropriate button on the device to count and classify the boarding passengers at each stop. Stop and route-level boarding data would be available through this process. Operators would also view the manifest for route deviations on the screen. For demand response trips, the device would contain the manifest. The device would automatically track trip time and mileage, but the driver could also be prompted to enter start and end mileage on the device for verification.

Additionally, operators would receive feedback on on-time performance such as a color-coded image or time display indicating if the bus is ahead or behind schedule. Operators could also be prompted to enter information that is currently written on paper fuel tracking sheets when the bus is fueled.

The system would provide a web interface for dispatchers and managers to track vehicle location and generate reports. Reports on ridership by stop and route, revenue miles, revenue hours, and on-time performance would be available to view and export to spreadsheets.

The system consists of a ruggedized tablets or mobile data terminals, mounts, cabling, cellular data communication, device software, and web-hosted backend.

Figure 10: Mobile Data Collection System Implemented by Fredericksburg Regional Transit

(Source: Kimley-Horn)

NEEDS

N-1, N-5, N-6, N-7, N-8, N-15, N-16, N-17, N-18

SCHEDULE

Planning and Design: FY 2019

Implementation, Testing, and Training: FY 2020

COST ESTIMATE (2017 $)

Capital Cost: $66,200

Annual O&M Cost: $7,600

ANTICIPATED USEFUL LIFE

10 years, extended with device equipment replacement and software updates.

PROJECT DEPENDENCIES

This project should be implemented concurrently with **P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software**.

VEHICLE TRACKING AND DISPATCH, SCHEDULING, PASSENGER COUNTING, BUSINESS INTELLIGENCE

P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software

PROJECT DESCRIPTION

This project would upgrade VRT's existing demand response scheduling software currently used in the BRITE service, which is nearing end of life. Under the turnkey contract with VRT, the contractor is responsible for providing the scheduling software, related reservation system, and database while the CSPDC retains ownership of the data. VRT plans to acquire and implement a new system in 2018.

The next generation software would provide greater capabilities to dispatchers to improve efficiency as demand for the service grows. The software would provide greater intelligence and optimization of the daily schedule rather than relying completely on the dispatcher's judgment and manual scheduling. The software would still allow the dispatcher to make manual alternations to the schedule. It would also assist with fixed route deviations and "call" stops, and suggest when these trips would be more efficiently served by the demand response buses.

The software would be web-based and hosted by the software vendor, which would allow access to multiple users over the internet and minimize IT infrastructure. If desired by the CSPDC, the software could also introduce new functions such as online trip booking and automated call-out reminders.

The software would integrate with BRITE's mobile data collection system described in project P-2, which would likely be provided by the same vendor. Manifests for demand response and fixed route deviations would automatically be pushed to tablets or mobile data terminals on the buses. Since the on-board devices would be providing dispatchers and the software with real-time bus locations, the software could also assist with quickly adjusting the manifest when delays are encountered.

The software would also have reporting and business intelligence capabilities to help management track performance and make informed decisions to improve efficiency and effectiveness of the service.

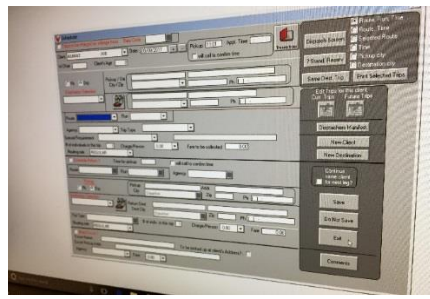


Figure 11: BRITE's SHAH Software Interface (Source: Kimley-Horn)

NEEDS

N-1, N-2, N-3, N-4, N-18, N-19

SCHEDULE

Planning and Design: FY 2019

Implementation, Testing, and Training: FY 2020

COST ESTIMATE (2017 $)

Capital Cost: $182,500

Annual O&M Cost: $21,100

ANTICIPATED USEFUL LIFE

10 years, extended with software updates.

PROJECT DEPENDENCIES

This project should be implemented concurrently with **P-2: Mobile Data Collection System.**

VEHICLE TRACKING AND DISPATCH, TRAVELER INFORMATION

P-4: Real-Time Data Feed for Third-Party Applications

Project Description

This project would implement a data feed of real-time bus arrival times and service alerts to be used by third-party mobile applications. The recommended data format is GTFS Realtime, an extension to static GTFS, which is growing as the industry standard real-time data format. This data would be consumed by free and publicly availably Android and iOS mobile applications such as Google Maps, Transit App, and Moovit. Use of third-party applications rather than a custom developed mobile app for BRITE will reduce capital costs associated with app development and maintenance.

The data feed would likely be generated by the vendor of BRITE's mobile data collection system described in project P-2. The system would use the static schedule, vehicle location data, and prediction algorithms to estimate arrival times at stops. The arrival times and other service alerts would be formatted into GTFS Realtime. The data feeds would be hosted on a web server, allowing Google and other applications to regularly fetch the data. The data would be provided to Google through the partnership established for static GTFS (project P-1) and partnerships with other major app providers.

During procurement of software and services to develop the real-time data feed, the CSPDC should specify that it has full ownership and usage rights of the data.

Customers surveyed during this study indicated that mobile apps were a preferred method for receiving information about the bus. Additionally, 78 percent of customers indicated they owned a smartphone and were comfortable using technology to receive information. Through this project, customers would be able to download their application of choice to their smartphone and receive arrival times and service alerts before making the trip, while at the bus stop, and while on the bus.

Figure 12: Third-Party Mobile App Using Fairfax Connector's Real-Time Data Feed

(Source: Transit App)

Needs

N-6, N-12, N-13, N-14

Schedule

Design, Implementation, and Testing: FY 2021

Cost Estimate (2017 $)

Capital Cost: $30,400

Annual O&M Cost: $3,500

Anticipated Useful Life

10 years, extended with and software updates.

Project Dependencies

This project should be implemented concurrently or after **P-2: Mobile Data Collection System**, which provides the data.

P-5: Next Bus Arrival Text Message Service

PROJECT DESCRIPTION

This project would provide widespread customer access to service alerts and real-time information via a text message service. Customers would be able to access BRITE real-time bus arrival information by texting a stop ID to a specified number. The customer would receive a text back with the next bus arrival times for the routes serving that stop (subject to messaging and data rates). Stop IDs and information on how to use the text message service would be provided by additional sign panels on bus stop signs.

The project would also allow customers to subscribe to text messages for individual bus routes to receive service alerts, such as significant delays, detours, or unscheduled stop of service. These alerts would be configurable to be automatically pushed out or manually pushed out by the dispatcher. Customers could unsubscribe at any time.

The project would use BRITE's real-time bus location data provided by the mobile data collection system and real-time data feed described in projects P-2 and P-4.

Customers surveyed during this study indicated that text message alerts were a preferred method for receiving information about the bus. This project would enhance BRITE's customer information accessibility, especially for those without access to a smartphone. The project would also have ADA benefits because visually impaired customers could use text-to-speech output on their cell phone to receive the information in an accessible format.

Figure 13: Rendering of Potential Bus Stop Sign Panel

(Source: Kimley-Horn)

NEEDS

N-6, N-12, N-13, N-14

SCHEDULE

Design, Implementation, and Testing: FY 2021

COST ESTIMATE (2017 $)

Capital Cost: $59,400

Annual O&M Cost: $7,000

ANTICIPATED USEFUL LIFE

15 years

PROJECT DEPENDENCIES

This project should be implemented concurrently or after **P-2: Mobile Data Collection System** and **P-4: Real-Time Data Feed for Third-Party Applications**, which provide the data.

P-6: Traveler Information Displays at Major Activity Centers

PROJECT DESCRIPTION

The project would implement digital signage displays at major activity centers such as Blue Ridge Community College, Augusta Health, and the Wilson Workforce and Rehabilitation Center. The system would consist of commercial-grade monitors installed at secure indoor locations, such as the building lobby. Outdoor displays are also available if desired by the CSPDC in the future. The visually-appealing displays would provide real-time information on bus arrivals and other service alerts through the real-time data feeds established in project P-4.

The displays would be connected to the internet so that they can be remotely monitored and configured. The display could be customized to display a variety of information in addition to bus arrivals. Weather, traffic conditions, local news, social media posts, advertisements, and other general announcements could be provided to customers.

Implementation costs of the information displays to the CSPDC can be partially offset through partnerships with its funding partners and possibly advertising revenue. These multimodal information displays are also good candidates for transportation demand management (TDM) program grants. By partnering with the organization housing the display, the organization could also use the displays to post announcements.

This project assumes installation of indoor displays at three locations.

NEEDS

N-6, N-12, N-13, N-14

Figure 14: Traveler Information Displayed for Arlington Transit

(Source: Arlington County Commuter Services)

SCHEDULE

Planning, Design, Implementation, and Testing: FY 2022

COST ESTIMATE (2017 $)

Capital Cost: $45,600

Annual O&M Cost: $5,300

ANTICIPATED USEFUL LIFE

10 years

PROJECT DEPENDENCIES

This project should be implemented after **P-2: Mobile Data Collection System** and **P-4: Real-Time Data Feed for Third-Party Applications**, which provide the data.

P-7: Advanced Driver-Assistance System

Project Description

This project would implement an advanced driver-assistance system (ADAS) on the fleet of buses. ADAS consists of sensors on the bus that monitor the road and identifies other vehicles, pedestrians, cyclists, and lane markings. When a potential hazard is detected, the system alerts the bus operator through a visual and/or audible alert. This project would implement such a system. ADAS can also incorporate more automated features where some control tasks are taken over such as steering for lane correction and braking for collision avoidance. These features could be implemented beyond the initial project. BRITE's contracted service provider owns the buses and employs the operators, therefore the project would be the responsibility of the contractor.

At a minimum, the ADAS would provide the operator feedback for:

- Forward collision warning
- Lane departure warning
- Pedestrian and cyclist detection and collision warning
- Blind spot detection, including while reversing

A small on-board display within the operator's line of sight would alert the driver during these events. The project would aim to produce safer driving habits and reduce the risk of collisions. This may reduce insurance claims and insurance premiums for BRITE's contractor. Better driving habits can also contribute to a reduction in fuel consumption.

While not part of the project, ADAS could be integrated into future fleet management or telematics systems. This would provide the link to tie ADAS alerts to vehicle data such as the route, vehicle location, and other vehicle operating characteristics like speed and acceleration.

Figure 15: Example of ADAS Displays and Sensors

(Source: Mobileye)

Needs

N-11, N-17, N-18

Schedule

Planning and Design: FY 2023

Implementation, Testing, and Training: FY 2024

Cost Estimate (2017 $)

Capital Cost: $114,200

Annual O&M Cost: $13,200

Anticipated Useful Life

10 years

Project Dependencies

This project is independent of other projects.

P-8: Mobile Ticketing

PROJECT DESCRIPTION

This project would implement mobile ticketing for customers to purchase bus passes on their smartphones. This would benefit customers by providing payment options other than cash and would benefit BRITE by reducing the staff burden of handling cash. Mobile ticketing use has grown among transit agencies due to the relatively low barrier to entry to deploy and the widespread adoption of smartphones across all demographics.

Many vendors operate in the mobile ticketing market which would allow BRITE to implement a solution with little customization. From a customer's perspective, they would download the app, create an account, add a credit card or debit card, and purchase a pass. Both a day pass and monthly pass should be offered. The app would also be able to offer discounted passes for ADA customers.

The customer would activate the ticket prior to boarding the bus. BRITE would operate using a "flash pass" approach, where the customer shows the bus operator the phone screen with the activated ticket as they board. The ticket would have an animation, countdown, or "color of the day" to help the operator quickly identify if the pass is valid and to deter counterfeiting.

While not part of the initial project, it could be expanded in the future to better serve unbanked and underbanked customers through a retail network. Services like PayNearMe allow these customers to add value to their account by making cash payments and scanning a barcode on their smartphone. PayNearMe has payment locations at CVS Pharmacy, 7-Eleven, and Family Dollar which have several locations in Staunton and Waynesboro. On-board ticket readers could also be installed in the future to reduce the responsibilities of the operator and provide more data on the user.

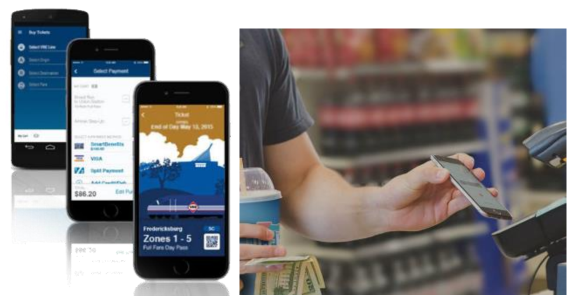


Figure 16: (a) Virginia Railway Express Mobile Ticketing App, (b) Potential Future Use by Cash Customers

(Sources: VRE and PayNearMe)

NEEDS

N-9, N-10, N-16

SCHEDULE

Planning, Design, Implementation, and Testing: FY 2020

Full Rollout: FY 2021 (The app should be tested with a small group of customers prior to full rollout).

COST ESTIMATE (2017 $)

Capital Cost: $22,900

Annual O&M Cost: $24,000

Some vendors have cost models with little to no upfront capital costs but monthly fixed fees and revenue sharing agreements.

ANTICIPATED USEFUL LIFE

15 years, with regular app updates

PROJECT DEPENDENCIES

This project is independent of other projects, but will likely be implemented in coordination with future commuter bus service (dependent on DRPT grant funding). The CSPDC could also begin offering physical bus passes prior to launching mobile ticketing.

5.2. Prioritization

The projects were prioritized and sequenced to develop a 6-year program for ITS technology enhancements for BRITE. Several factors were considered when developing the schedule:

- Feedback of staff from the CSPDC and VRT during the site visit workshop
- Inter-relationships and dependencies between projects
- Estimated project schedules
- Capital costs

Several projects are related and can only occur alongside or after another project is completed. The two projects that are central to the capabilities of many of the other projects are **P-2: Mobile Data Collection System** and **P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software**. These projects would most likely be procured together through the same vendor. They would provide the data required to implement the other traveler information projects. VRT has committed to implement a new scheduling software in 2018.

The CSPDC could consider including projects **P-4: Real-Time Data Feed for Third-Party Applications, P-5: Next Bus Arrival Text Message Service**, and **P-6: Traveler Information Displays at Major Activity Centers** as options in the request for proposal for projects P-2 and/or P-3. Most vendors can also provide these systems.

Projects **P-7: Advanced Driver-Assistance System** and **P-8: Mobile Ticketing** could be implemented independently of other projects. The survey during this study showed that 27 percent of the existing customers surveyed desire a different form a payment than what they currently use, such as a pass, mobile ticket, or smart card. While this may appear as a lower priority to existing customers, it will be important to attracting new commuter riders if the CSPDC implements such service in the future. This project was sequenced in FY 2020 and FY 2021 but this will be dependent on DRPT grant funding for new commuter service. The CSPDC could first implement a physical bus pass (day and month pass) to test the success of this fare policy.

The sequencing of projects also aimed to evenly distribute resource demands as much as possible. This will help ensure the CSPDC does not face a disproportionate amount of capital costs and staff demands at any one time while implementing the plan.

5.3. Schedule and Program

The eight projects outlined in this plan are summarized in the 6-year program shown in **Figure 17**. The program is grounded in the data and needs gathered during the study and introduces ITS solutions to improve the reliability of data, foster efficiency in service delivery, and enhance the transit experience for customers. The total program capital cost is $522,400 over six years with an estimated annual O&M cost of $81,700 at full implementation. It is anticipated that the program will be funded with a combination of federal, state, and local funds.

5.4. Staffing Requirements

Additional staff skills and responsibilities will be needed to implement and operate ITS. These would partially be obtained through trainings during implementation. Many transit ITS vendors also have user group meetings that are useful for on-going capacity building of staff. The need for the following skillsets are anticipated:

- Maintenance of on-board equipment (mobile devices, cabling, ADAS)

- Maintenance of software in coordination with vendor support
- Familiarity with GTFS data format
- Basic spreadsheet and database skills
- Bus operator familiarity with basic mobile device functionality

Overall, transit ITS is best implemented when there is a staff person who “champions” the effort – someone who is dedicated to being the point-person during implementation, taking ownership of the projects, and supporting the training of others. This person should be identified for BRITE prior to beginning implementation.

The staffing requirement to support the implementation and operation of ITS could be done through in-house staff or contracted support staff with expertise in transit ITS. Staffing options are summarized in **Table 4**. Responsibilities would include:

- Project management
- Data verification checks
- System troubleshooting and coordination with vendor support
- Managing data feeds
- Training staff

Table 4: Program Staffing Options

Staffing	Amount	Annual Cost Estimate (2017 $)	Assumptions
In-House	0.5 FTE (Year 1-3) 1.0 FTE (Year 4-6)	$26,200 (Year 1-3) $52,000 (Year 4-6)	Rate of $25/hour
Contracted	15% (312 hours/year)	$46,800	Rate of $150/hour

	Project	Relevant Application Areas	Relevant Needs	Schedule	Cost Estimate (2017 $) Capital[1]	Annual O&M	Anticipated Useful Life	Dependencies	6-Year Schedule FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
P-1	**GTFS Data Feed and Integration with Google Transit**	Traveler Information, Scheduling	N-12	FY 2019	$1,200	N/A	Indefinite	None; Possible outcome of P-2 and/or P-3	Development and Implementation	O&M →				
P-2	**Mobile Data Collection System**	Vehicle Tracking and Dispatch, Passenger Counting, Business Intelligence, Maintenance	N-1, N-5, N-6, N-7, N-8, N-15, N-16, N-17, N-18	FY 2019-2020	$66,200	$7,600	10 years	Concurrent with P-3	Planning and Design	Implementation, Testing, and Training	O&M →			
P-3	**Next Generation Paratransit and Deviated Fixed-Route Scheduling Software[2]**	Vehicle Tracking and Dispatch, Scheduling, Passenger Counting, Business Intelligence	N-1, N-2, N-3, N-4, N-18, N-19	FY 2019-2020	$182,500	$21,100	10 years	Concurrent with P-2	Planning and Design	Implementation, Testing, and Training	O&M →			
P-4	**Real-Time Data Feed for Third-Party Applications**	Vehicle Tracking and Dispatch, Traveler Information	N-6, N-12, N-13, N-14	FY 2021	$30,400	$3,500	10 years	Concurrent or after P-2			Design, Implementation, and Testing	O&M →		
P-5	**Next Bus Arrival Text Message Service**	Vehicle Tracking and Dispatch, Traveler Information	N-6, N-12, N-13, N-14	FY 2021	$59,400	$7,000	15 years	Concurrent or after P-2 and P-4			Design, Implementation, and Testing	O&M →		
P-6	**Traveler Information Displays at Major Activity Centers**	Traveler Information	N-6, N-12, N-13, N-14	FY 2022	$45,600	$5,300	10 years	After P-2 and P-4				Planning, Design, Implementation, and Testing	O&M →	
P-7	**Advanced Driver-Assistance System[2]**	Safety and Security	N-11, N-17, N-18	FY 2022-2023	$114,200	$13,200	10 years	None					Planning and Design	Implementation, Testing, and Training
P-8	**Mobile Ticketing[3]**	Fare Collection	N-9, N-10, N-16	FY 2023-2024	$22,900	$24,000	15 years	None		Planning, Design, Implementation, Testing	Full Rollout	O&M →		

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Capital Cost (BRITE):	$10,800	$79,500	$89,800	$45,600	$0	$0
Annual O&M Cost (BRITE):	$0	$0	$31,600	$42,100	$47,400	$47,400
Capital Cost (Service Contractor):	$26,500	$156,000	$0	$0	$16,600	$97,600
Annual O&M Cost (Service Contractor):	$0	$0	$21,100	$21,100	$21,100	$21,100
Staffing Cost (In-House)[4]:	$26,000	$26,000	$26,000	$52,000	$52,000	$52,000
OR Staffing Cost (Contracted Support)[4]:	$46,800	$46,800	$46,800	$46,800	$46,800	$46,800
Total Cost:	$63,300 - $84,100	$261,500 - $282,300	$168,500 - $189,300	$155,600 - $160,800	$131,900 - $137,100	$212,900 - $218,100

[1]Capital cost estimates include 20% contingency.

[2]Responsibility of BRITE service contractor.

[3]Implemented in conjunction with new commuter bus service; schedule dependent on availability of DRPT funding for service.

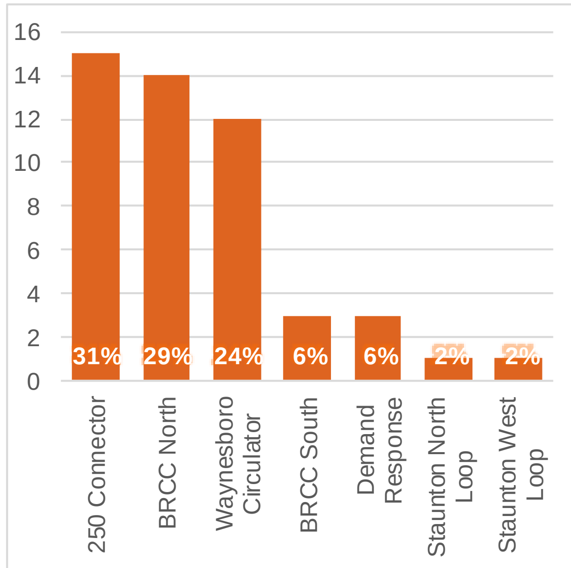
[4]Options for in-house staffing versus contracted support are included. In-house staffing requirement assumed to be 0.5 FTE for years 1-3 and 1 FTE for years 4-6 at a hourly rate of $25. Contracted support staffing assumes 15% utilization (312 hours/year) at an hourly rate of $150.

Figure 17: BRITE ITS 6-Year Program

Appendix A: Customer Survey Results

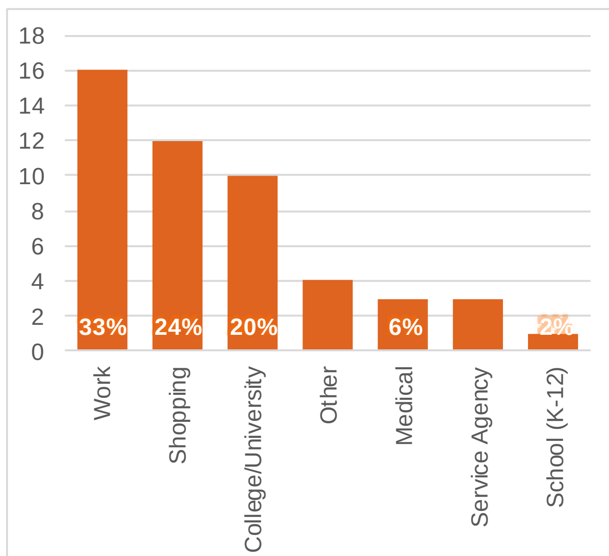
Q1. Which route do you use most often?

BRCC North	14	29%
BRCC South	3	6%
250 Connector	15	31%
Waynesboro Circulator	12	24%
Staunton North Loop	1	2%
Staunton West Loop	1	2%
Demand Response	3	6%



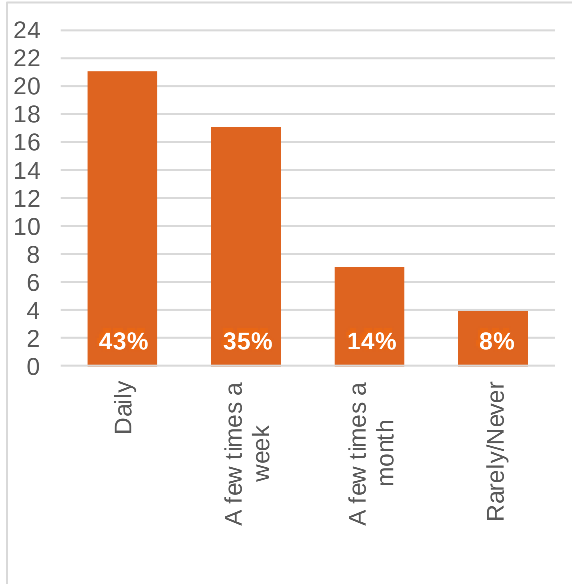
Q2. Thinking about your most frequent trip using BRITE, what is your reason for making this trip?

Work	16	33%
Shopping	12	24%
College/University	10	20%
Other	4	8%
Medical	3	6%
Service Agency	3	6%
School (K-12)	1	2%



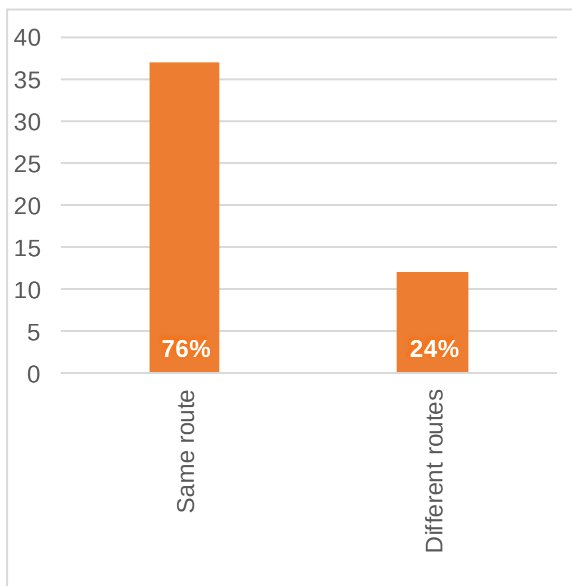
Q3. How often do you ride the bus?

Daily	21	43%
A few times a week	17	35%
A few times a month	7	14%
Rarely/Never	4	8%



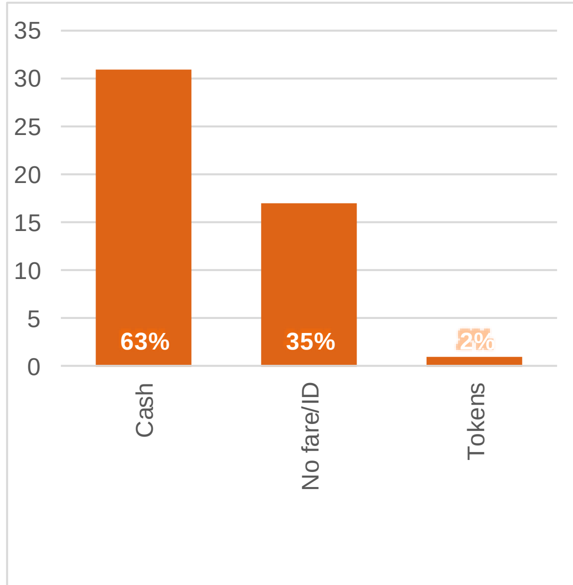
Q4. Do you ride the same route all the time or different routes?

Same route	37	76%
Different routes	12	24%



Q5. How did you typically pay for your trip?

Cash	31	63%
No fare/ID	17	35%
Tokens	1	2%

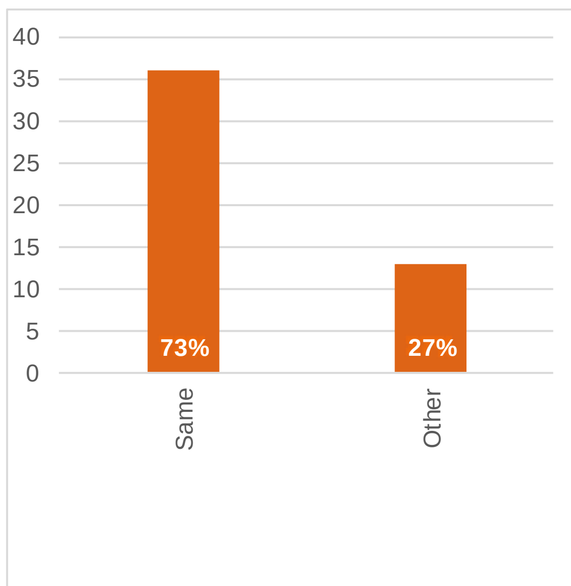


Q6. Is there a different way you would prefer to pay?

Same	36	73%
Other	13	27%

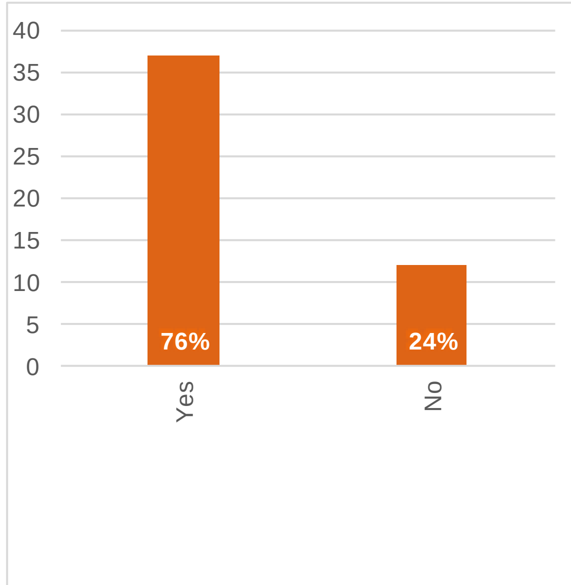
Common Other Responses:

- Bus Pass or Ticket
- Fare Free
- Transit Card
- Apple Pay
- Debit/Credit/Prepaid Card



Q7. Do you need real-time information of where your bus is and when it will arrive?

Yes	37	76%
No	12	24%

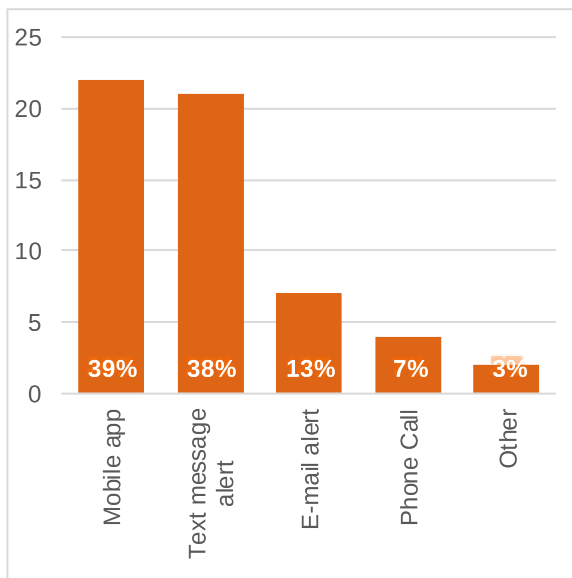


Common Reasons if No:

- It is reliable
- I know the schedule
- I prefer to ask the driver
- I don't use the bus that often

Q8. How would you like to receive information about your bus (when it will arrive, if it will be late, if service stops because of weather)? (select all that apply)

Mobile app	22	39%
Text message alert	21	38%
E-mail alert	7	13%
Phone Call	4	7%
Other	2	3%

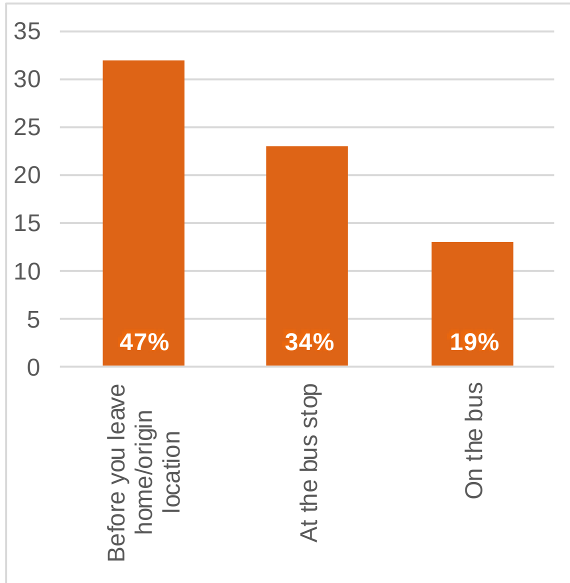


Other Responses:

- Word of mouth
- Website

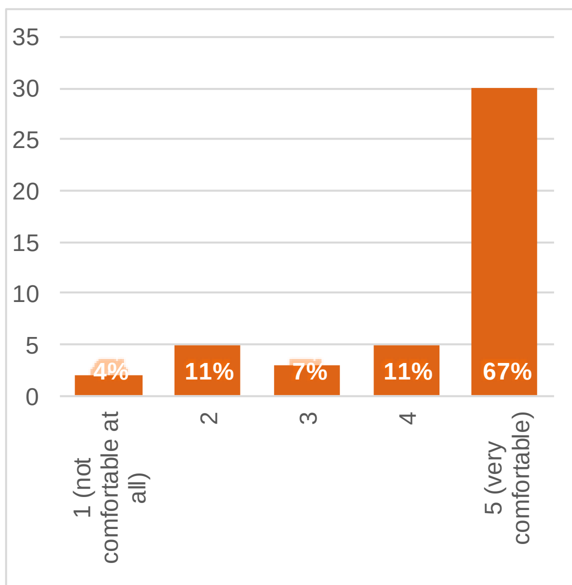
Q9. When would you prefer to receive updates or information about your bus? (select all that apply)

Before you leave home/origin location	32	47%
At the bus stop	23	34%
On the bus	13	19%



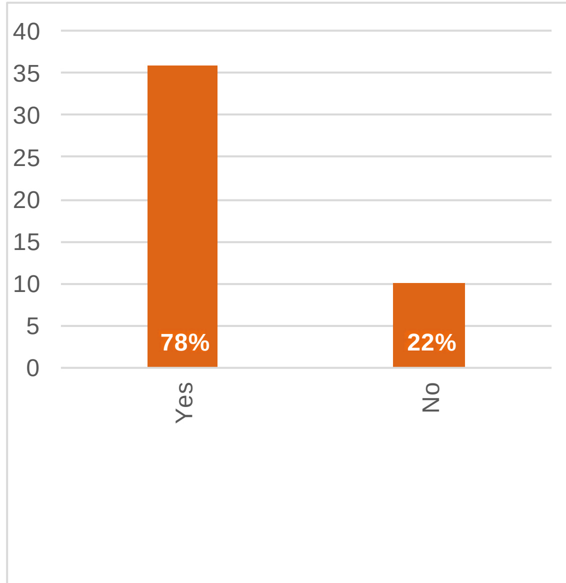
Q10. On a scale from 1 to 5, how comfortable are you with using technology to receive information (smartphone, internet, etc.)?

1 (not comfortable at all)	2	4%
2	5	11%
3	3	7%
4	5	11%
5 (very comfortable)	30	67%



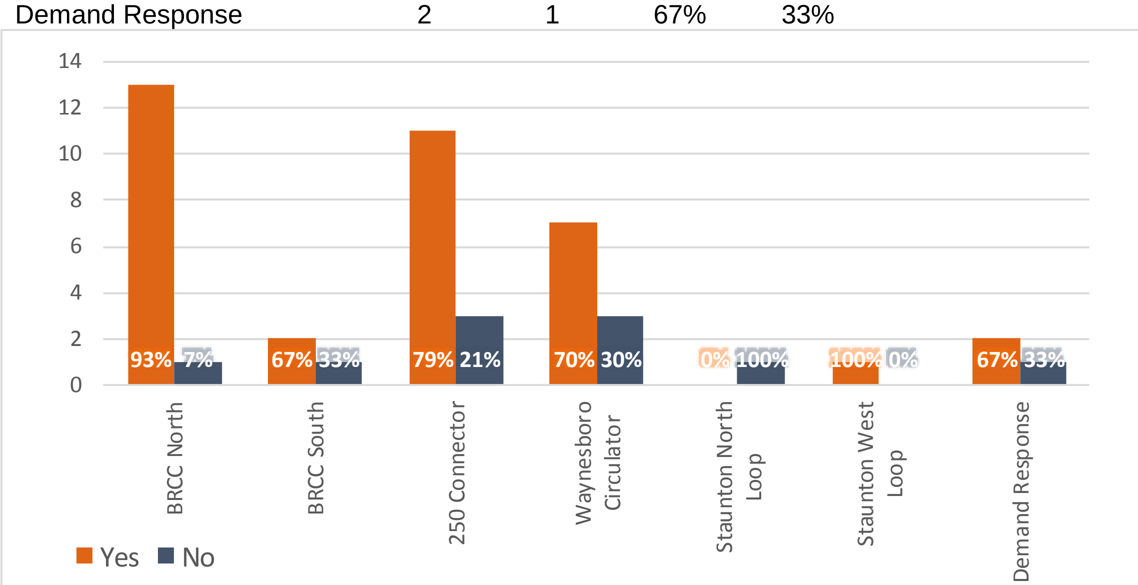
Q11. Do you own a smartphone? (a mobile phone with Internet access)

Yes	36	78%
No	10	22%



Smartphone Ownership by Route Surveyed:

	Yes	No	Yes	No
BRCC North	13	1	93%	7%
BRCC South	2	1	67%	33%
250 Connector	11	3	79%	21%
Waynesboro Circulator	7	3	70%	30%
Staunton North Loop	0	1	0%	100%
Staunton West Loop	1	0	100%	0%
Demand Response	2	1	67%	33%



Q12. Do you have any other suggestions for BRITE for using technology to improve the quality of service? (Optional)

- Provide a map to track where the bus is
- Pay for tickets through an app and scan your phone
- Provide real-time info on when the bus will arrive
- For a disabled person who cannot drive, I would use this service so much more and feel much more independent if it was easier to access
- Provide info on whether both bicycle racks are filled

Other non-technology responses:

- Bigger buses – the BRCC Shuttle is standing room only in the morning
- Provide Waynesboro Circulator service on Saturdays until 5 PM
- The new buses are not really liked; the walkway is too small and the farebox is too low
- Provide weekend service, service east on Hopeman Parkway, and along W Main Street (K-Mart)

Appendix B: Detailed Cost Estimates and Assumptions

Cost estimates are based on the U.S. Department of Transportation ITS Costs Database, discussion with peer agencies and vendors, and engineering judgement. Estimates typically include planning (5 percent), design (12 percent), and project management cost (10 percent) as a percentage of implementation costs. Implementation costs are determined based on unit cost estimates for equipment and software licenses. Each project also has 20 percent of the planning, design, and implementation costs included as contingency. Annual operations and maintenance costs are estimated as 15 percent of this cost as well unless otherwise stated.

P-1: GTFS Data Feed and Integration with Google Transit

Task	Cost Estimate (2017 $)	Notes
Development and Implementation	$1,000.00	Assumes 10 hours at rate of $100/hour
Subtotal	**$1,000.00**	
Project Management	N/A	
Contingency	$200.00	20% of Subtotal
Grand Total (less O&M)	**$1,200.00**	
Annual Operations and Maintenance	N/A	

P-2: Mobile Data Collection System

Task	Cost Estimate (2017 $)	Notes
Planning	$2,200.00	5% of Implementation
Design	$5,200.00	12% of Implementation
Implementation	$43,500.00	Assumes $1,000 devices, $1,500 software, and $400 mounts/cables/power for 15 buses
Subtotal	**$50,900.00**	
Project Management	$5,100.00	10% of Subtotal
Contingency	$10,200.00	20% of Subtotal
Grand Total (less O&M)	**$66,200.00**	
Annual Operations and Maintenance	$7,600.00	15% of Subtotal

P-3: Next Generation Paratransit and Deviated Fixed-Route Scheduling Software

Task	Cost Estimate (2017 $)	Notes
Planning	$6,000.00	5% of Implementation
Design	$14,400.00	12% of Implementation
Implementation	$120,000.00	Assumes $120,000 license fee
Subtotal	**$140,400.00**	
Project Management	$14,000.00	10% of Subtotal
Contingency	$28,100.00	20% of Subtotal
Grand Total (less O&M)	**$182,500.00**	
Annual Operations and Maintenance	$21,100.00	15% of Subtotal

P-4: Real-Time Data Feed for Third-Party Applications

Task	Cost Estimate (2017 $)	Notes
Planning	$1,000.00	5% of Implementation
Design	$2,400.00	12% of Implementation
Implementation	$20,000.00	Assumes $20,000 license fee
Subtotal	**$23,400.00**	
Project Management	$2,300.00	10% of Subtotal
Contingency	$4,700.00	20% of Subtotal
Grand Total (less O&M)	**$30,400.00**	
Annual Operations and Maintenance	$3,500.00	15% of Subtotal

P-5: Next Bus Arrival Text Message Service

Task	Cost Estimate (2017 $)	Notes
Planning	$2,000.00	5% of Implementation
Design	$4,700.00	12% of Implementation
Implementation	$39,000.00	Assumes $20,000 license, $10,000 integration, $60/sign for 150 signs
Subtotal	**$45,700.00**	
Project Management	$4,600.00	10% of Subtotal
Contingency	$9,100.00	20% of Subtotal
Grand Total (less O&M)	**$59,400.00**	
Annual Operations and Maintenance	$7,000.00	$5,000/year service fee and $0.02 per message for 100,000 messages

P-6: Traveler Information Displays at Major Activity Centers

Task	Cost Estimate (2017 $)	Notes
Planning	$1,500.00	5% of Implementation
Design	$3,600.00	12% of Implementation
Implementation	$30,000.00	Assumes $10,000 unit cost for 3 locations
Subtotal	**$35,100.00**	
Project Management	$3,500.00	10% of Subtotal
Contingency	$7,000.00	20% of Subtotal
Grand Total (less O&M)	**$45,600.00**	
Annual Operations and Maintenance	$5,300.00	15% of Subtotal

P-7: Advanced Driver-Assistance System

Task	Cost Estimate (2017 $)	Notes
Planning	$3,800.00	5% of Implementation
Design	$9,000.00	12% of Implementation
Implementation	$75,000.00	Assumes $5,000 per bus for 15 buses
Subtotal	**$87,800.00**	
Project Management	$8,800.00	10% of Subtotal
Contingency	$17,600.00	20% of Subtotal
Grand Total (less O&M)	**$114,200.00**	
Annual Operations and Maintenance	$13,200.00	15% of Subtotal

P-8: Mobile Ticketing

Task	Cost Estimate (2017 $)	Notes
Planning	$800.00	5% of Implementation
Design	$1,800.00	12% of Implementation
Implementation	$15,000.00	Assumes $15,000 in development costs
Subtotal	**$17,600.00**	
Project Management	$1,800.00	10% of Subtotal
Contingency	$3,500.00	20% of Subtotal
Grand Total (less O&M)	**$22,900.00**	
Annual Operations and Maintenance	$24,000.00	$2,000 per month