

Advanced Transportation and Congestion Management Technologies Deployment Initiative Grant Application

Mobile Proximity Fare Collection

Birmingham-Jefferson County Transportation Authority
June 12, 2017

Volume 1 – Technical Application

BJCTA Mobile Proximity Fare Collection	
Eligible Entity Applying to Receive Federal Funding	Birmingham-Jefferson County Transit Authority
Total Project Cost (from all sources)	\$10,855,437
ATCMTD Request	\$5,427,718
Are matching funds restricted to a specific project component? If so, which one?	No
State(s) in which the project is located	The beautiful State of Alabama The Yellowhammer State
Is the project currently programmed in the: <ul style="list-style-type: none">• Transportation Improvement Program (TIP)• Statewide Transportation Improvement Program (STIP)• MOP Long Range Transportation Plan• State Long Range Transportation Plan	Yes – The project is included as part of the Birmingham Bus Rapid Transit Project in the State Long Range Transportation Plan.
Technologies Proposed to Be Deployed (briefly list)	<ul style="list-style-type: none">• Electronic pricing and payment system across transportation modes;• Transportation system performance data collection, analysis, and dissemination systems

Contents

Project Framework.....	3
Context of Our Project.....	3
Project Summary	5
Project Vision	5
Project Eligibility.....	6
Alignment with Federal Program Goals	6
Alignment with Federal Program Priorities.....	6
Description of the Entity that Will Be Entering Into the Agreement with FHWA	6
Real-World Challenges	8
Real-World Challenge #1 – Meeting Current Customer Behaviors.....	8
Real-World Challenge #2 – Changing Customer Behaviors.....	8
Real-World Challenge #3 – Mid-Size Transportation Market Limitations.....	9
Real-World Challenge #4 – Integration in a Rapidly Evolving Technology Market.....	10
Real-World Challenge #5 – Integrating with National Transportation Service Providers.....	10
Real-World Challenge #5 – EBT Use	10
Proposal Partnerships	11
Project Detail Including Transportation Systems	12
Application Planning Considerations	19
Period of Performance and Deployment Plan	19
Federal Involvement.....	24
Model Deployment	24
Proposal Management	25
Description of geographic area or jurisdiction the deployment will service.....	26
Regulatory Issues.....	27
System Performance Improvements.....	28
Quantifiable Safety, Mobility, and Environmental Benefit Projections.....	28
Vision, Goals and Objectives	29
Public Private Partnership Opportunities	29
Leverage existing technology	29
DOT ITS Program Leverage	29

Project Framework

The Birmingham-Jefferson County Transit Authority (BJCTA), branded as MAXTM, is pleased to present this proposal for funding through the Federal Highway Administration's (FHA) Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program.

Context of Our Project

Birmingham, Alabama is currently experiencing a transportation revolution. Long-suffering from geographic transportation choke points caused by limited north/south mobility due to the southernmost ridges of the Appalachian Mountains, both the City of Birmingham and the Birmingham-Jefferson County Transit Authority have developed a shared innovative vision for transitioning Birmingham's automobile culture into a thriving public transit and transportation culture, thereby reducing highway congestion along the critical I-65 corridor.

In response to that vision, the following activities have happened or are already underway:

Renaissance of Birmingham's Urban Core

In response to the mayor's vision, "Birmingham Forward," city planners and private developers have made huge strides in transforming Birmingham's urban core into a transit-friendly environment. The city constructed an award winning downtown baseball park for its AA minor league baseball team (Figure 1). The city developed downtown's largest urban greenspace, Railroad Park, and has leveraged programming to make it the most used public park space in Birmingham. Private developers have invested hundreds of millions of dollars in mixed use developments around the downtown ballpark and in two other concentrated areas that will soon be served by a bus rapid transit route. The city and BJCTA have developed a downtown intermodal facility that hosts the BJCTA central transfer point along with national transportation partners Amtrak, Greyhound and Megabus. Finally, the city has developed an Olympic-class indoor track and field and swimming complex and a primary private developer has begun re-developing major tracts around the complex.



Figure 1. Regions Park

Construction of Birmingham's First Bus Rapid Transit (BRT) Route

The focus of the BRT system is to connect 25 minority and low income neighborhoods containing roughly 20,000 low income residents to 130,000 jobs, of which nearly 70,000 are concentrated in the center of Birmingham. The BRT system is currently being built as a 10-mile system with 19 stations. There are 58,000 residents, consisting of 27% of the city's population, within a half mile of the BRT corridors. One third of the BRT service area residents are low-income, which is double the regional average. The BRT is funded, in part, by a federal TIGER grant.



Figure 2. Bus Rapid Transit Station Design



Figure 3. Recent Mixed Use Development

Development of a Formal Transit Oriented Development (TOD) Program

The focus of the TOD program is to establish necessary systems within the City of Birmingham and BJCTA to empower Transit Oriented Development along the BRT route. This effort is being funded, in part, by an FTA grant and is in partnership with the nation's leaders in TOD, Smart Growth America. This effort is happening amidst an already robust re-development of Birmingham's urban core, and is targeted to focus the continued build-out of the city around TOD.

Transit Route Realignment

The BJCTA has completed Phase 1 of a system-wide route realignment. This effort is focused to support anticipated TOD and the success for the BRT route.

Establishment of Inland Port

The City of Birmingham has formally established a port authority in order to establish an inland port to transfer freight traffic from I-65 to the newly designated maritime highway, M-65.

2021 World Games

With such a grand vision for Birmingham's re-development, the city successfully bid to host the 2021 World Games. This Olympic partner event will bring together 4,000 athletes from more than 40 countries and provides a natural driver to complete the various transportation and re-development initiatives currently enacted. The ATCMTD project is timed to coincide with this deadline, providing a unified electronic payment system in time to showcase it to the world and allow the numerous visitors who are familiar with similar systems across Europe to more easily transit across Birmingham.

Project Summary

The BJCTA is requesting matching funding to develop an electronic payment system, integrating both local and national transportation services into a unified electronic fare collection and payment system, including:

- Local Services
 - REV Birmingham's Zyp Bikeshare program;
 - The Birmingham Parking Authority's city parking decks; and
 - The City of Birmingham's metered curbside parking along key blocks in proximity to the new Bus Rapid Transit system.
- National Services Located in the Birmingham Intermodal Facility
 - Amtrak;
 - Greyhound Bus Lines; and
 - Megabus express bus service.
- Future Services
 - Taxi;
 - Uber; and
 - Lyft.

Project Vision

This project will achieve several critical objectives toward supporting the ATCMTD program vision and goals, including:

1. Develop a technology platform that will provide detailed, user-specific travel data, across transportation modes, including use of public and private transportation systems;
2. Establish a meaningful public transit culture in one of the nation's weakest public transit markets; and
3. Produce detailed metrics on both the project's execution as well as the change in culture, publish project findings and present through national industry-specific platforms to empower other markets facing similar challenges to benefit fully from what is learned through the Birmingham experience.



Figure 4. Birmingham World Games Logo

Project Eligibility

The BJCTA project is eligible under the following project eligibility classes:

- Transportation system performance data collection, analysis, and dissemination systems; and
- Electronic pricing and payment systems.

Alignment with Federal Program Goals

The BJCTA project, through its primary objective to create a strong transit culture in Birmingham, Alabama, and thereby increasing public transit ridership and reducing automobiles on the highway, as well as its objective to develop an advanced data platform that will provide detailed individual user data across all transportation modes, is aligned to support the following Federal program goals:

- Reduced costs and improved return on investments, including through the enhanced use of existing transportation capacity;
- Delivery of environmental benefits that alleviate congestion and streamline traffic flow;
- Measurement and improvement of the operational performance of the applicable transportation networks;
- Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety;
- Collection, dissemination, and use of real time transportation related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services;
- Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair;
- Delivery of economic benefits by reducing delays, improving system performance and throughput, and providing for the efficient and reliable movement of people, goods and services;
- Integration of advanced technologies into transportation system management and operations;
- Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods; and
- Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges.

Alignment with Federal Program Priorities

The BJCTA project is aligned to support the following Federal program priorities:

- Unified Fare Collection and Payment System Across Transportation Modes and Jurisdictions; and
- Infrastructure Maintenance, Monitoring, and Condition Assessment.

Description of the Entity that Will Be Entering Into the Agreement with FHWA

On April 3, 1972, a certificate of incorporation was filed for the BJCTA pursuant to Act 993 of the 1971 Regular Session of the Alabama Legislature, which enabled the formation of publicly operated transit authorities in Alabama. The BJCTA is the public transit operator in Birmingham and is overseen by a nine-member Board of Directors appointed by Jefferson County, the City of Birmingham, and other communities within the service area. The BJCTA is managed by Executive Director Barbara Murdock, a former management consultant who has worked with the United States Department of Transportation on projects for the Federal Transit Administration and the Federal Highway Administration. As a public transit agency, the BJCTA is an eligible organization to compete for funding for the Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD).

The BJCTA depends on local funding, federal funding, mandated funding, and fares to operate. The BJCTA provides fixed route and demand response service to a 200 square mile area with a demand population base of nearly 400,000. The cities within the service area include Birmingham, Bessemer, Fairfield, Homewood, Mountain Brook, Midfield, Tarrant, Center Point, Hoover, and Vestavia Hills. The BJCTA's 38 fixed routes serve an average of 12,000 weekday riders and approximately 3,000,000 annual riders.

The BJCTA is working to improve its transit services and expand its vehicle fleet to achieve its vision for growth. The Downtown Area Runabout Transit (DART) circulatory provides options for travel around Birmingham's downtown and Southside areas. The fleet of vintage trolleys runs six days a week on three interchangeable routes. The BJCTA also sponsors a bike and ride program. The program has advanced with the City of Birmingham's Bike Share Initiative. The BJCTA's fixed route transit vehicles are equipped with bike racks. Additionally, the BJCTA's intermodal transportation facility and key BRT stations will host a Zyp Bikeshare station.

Furthermore, Birmingham is constructing a Bus Rapid Transit (BRT) system focused on connecting many of the city's transportation disadvantaged neighborhoods to employment and education opportunities. The BJCTA is assisting the city with implementation of the BRT system through a memorandum of understanding.

Implementation of the BRT system will create additional demand for buses throughout the region. The introduction of the BRT system to the BJCTA fixed-route service offerings has led the BJCTA to begin optimizing its regular fixed-route bus services. The route optimization program will improve services, enable greater access to geographic locations that were previously not served by transit, and provide greater transportation choices and convenience for residents. These efforts will result in better access to employment opportunities and services to low income and minority areas. The BRT hopes to help accomplish this, in part, through its fare collection system. This will be accomplished through the Mobile Proximity Fare Collection Tool introduced in this proposal.

Real-World Challenges

Although simple in concept, the BJCTA project has numerous real-world challenges that create significant complexity to implementing such a project. It is a reality that systems as large as the Washington Metropolitan Metropolitan Transit Authority (WMTA) have recently halted similar efforts due to several of the challenges inherent in such a project. However, the integration of payment systems among transportation networks is not unheard of, and it is timely for the FHWA to invest in projects beyond the mega-transportation centers to spur development of alternative solutions to what is being proposed by the current transportation technology integrators. The following sections detail the specific real-world challenges we anticipate, and have planned for in our proposal.

Real-World Challenge #1 – Meeting Current Customer Behaviors

When developing any new mass technology initiative, it is important to meet customers where they are. This project already envisions changing customer behavior by driving them toward use of near field communication devices, so it is imperative to make the initial funding of their transportation wallet as accessible as possible. Figure 5 demonstrates the desired payment methods our customers would like to utilize, which methods are currently available for each planned transportation service integration, and which payment options will be available upon full project implementation.































Current State of Transportation System			
Consumer Payment Preferences	Transportation Option	Current Payment Options	Proposed Payment Options
 Cash  App  Digital Wallet  EBT  VISA  Credit Debit  Check  Website  Money Order	 BJCTA		
	 Greyhound		
	 Megabus		
	 Amtrak		
	 Zyp Bikeshare		
	 Deck Parking		
	 Street Parking		

Figure 5. Transportation System

Real-World Challenge #2 – Changing Customer Behaviors

The Washington Metropolitan Transit Authority recently halted a near field communication fare payment rollout due to lack of consumer use. Americans are highly integrating smart phones into their daily lives but certain functionality has not yet become popular. This does not mean the functionality is dead. To the contrary,

Apple has recently established a partnership with leading NFC integrators double-down on its efforts to gain traction for this technology in America. With this level of engagement happening at the national level, the key to local adoption is to engage people to make behavioral changes.

There are two huge behavioral changes the Birmingham payment system project must achieve, (1) trading cars for buses and (2) utilizing NFC. The habit of using NFC is so critical that we have planned for our project to engage a national expert in creating customer/NFC engagement. Figure 6 demonstrates how effective NFC use can become when a deliberate campaign is executed to drive the behavioral change of using NFC technology. In our project, we will engage ten locations along the BRT route, where the highest walking and transit traffic exists, to introduce people to NFC and, ultimately, turn them into NFC-using transit customers.

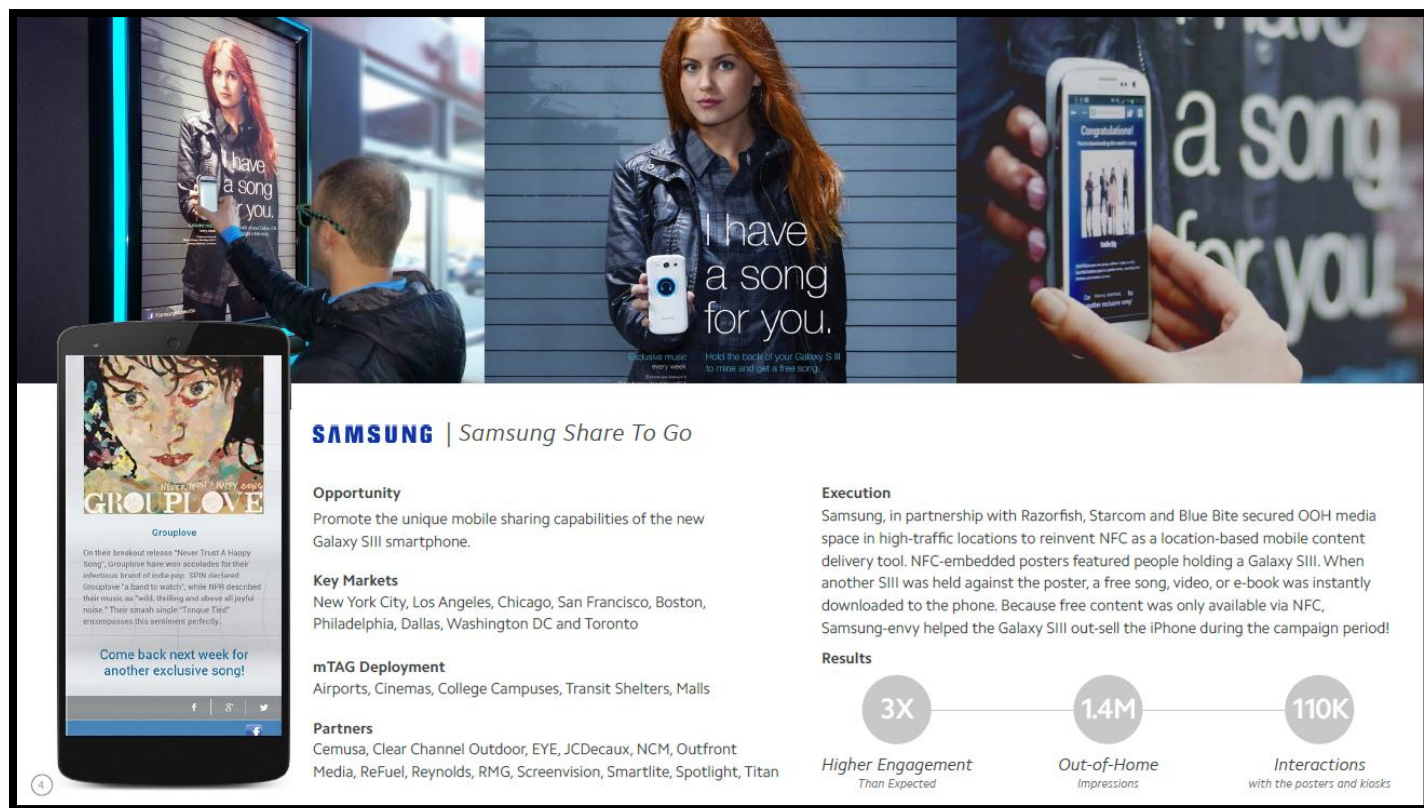


Figure 6. NFC Technology Engagement Campaign Results

Real-World Challenge #3 – Mid-Size Transportation Market Limitations

Although mega-transit markets have the scale to engage the world's leading integrators in developing transportation solutions, markets sized in the Birmingham range have much less volume to leverage significant development and buy-in from leading national and international integrators. We plan to overcome this challenge by engaging fresh companies in the high-tech Huntsville, Alabama region, along with companies in Birmingham's wildly successful technology incubator, Innovation Depot, to develop new and lean integrations that are more agile and affordable than large national consultants can achieve.

Real-World Challenge #4 – Integration in a Rapidly Evolving Technology Market

In researching the various technologies that are utilized for electronic fare payment systems it is clear there is not yet a unified national preference. From NFC to QR codes to Bluetooth, fare payment systems use a diverse combination of solutions. This ATCMTD proposal envisions utilizing all three in a cooperative manner to set up the transportation network for any changes that will occur over the next five-to-ten years in the technology industry. This will allow transportation users to engage their preferred technology at all critical communication points, letting the market determine the ultimate solutions.



Real-World Challenge #5 – Integrating with National Transportation Service Providers

In planning to integrate a unified payment system with national service providers including Amtrak, Greyhound and Megabus, there are natural challenges to engaging their technology departments for support. However, Birmingham has all three providers as tenants in its new Intermodal Facility (Figure 7) which allows for BJCTA to control the physical space within their local footprints. This removes complexity of working with any real estate arms of their operations and, in a worst-case scenario where they would not be willing to coordinate with our effort, would allow us to develop an independent external integration to their web platforms and place it into the intermodal space.



Figure 7. Birmingham Intermodal Station

Real-World Challenge #5 – EBT Use

The Birmingham low income counselors who evaluate and qualify residents for state poverty-assistance programs have repeatedly requested the ability to allow EBT cards to be used for transit purchases. This is a very meaningful integration that we would like to see as part of this project but there are state legal changes that would need to be resolved. Our platform architecture will be established to allow EBT use but it will not be implemented until the Alabama Department of Human Resources resolves their legal and technology challenges.

Proposal Partnerships

Funding for this grant project will come from the BJCTA. However, various transportation partners have been engaged to develop the scope of the grant proposal and are described in Figure 8 below, along with a brief description of the BJCTA, the grant applicant.

In addition to transportation partners this project will engage two other key project partners, the City of Birmingham Information Management Services as well as the University of Alabama at Birmingham Sustainable Smart Cities Research Center (SSCRC).

The SSCRC has a very specific responsibility, to ensure the following key goals of the ATCMTD are achieved:

- Demonstration, quantification, and evaluation of the impact of advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods; and
- Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges.

The SSCRC will focus on assessing the impact of these technologies and to package the project details appropriately to facilitate knowledge transfer to other locations facing similar challenges.

Figure 8. Project Partners

Partner	Description
Zyp BikeShare	Dense network of 40 kiosks and 400 bikes deployed in Birmingham, Alabama in October 2015. Residents and visitors can access 24-hours a day, 365 days a year. Riders can check out bicycles for short rides through annual memberships or by swiping credit cards.
Greyhound	Greyhound Lines, Inc. was founded in 1914 and is the largest provider of intercity bus transportation. Serves more than 3,800 destinations across North America and provides travel to nearly 18 million passengers each year. Offers charter packages for at competitive rates. Operates BoltBus, serving the Northeast and Western regions of the United States. Operates its premium city-to-city service, Greyhound Express, which operates in more than 135 markets across North America. Also operates Greyhound Connect, a service that connects rural communities to larger Greyhound markets and has interline partnerships with a number of independent bus lines.
Megabus	Megabus offers city-to-city bus tickets for travel around North America. Has major North American transportation hubs around the United States and Canada. Serves more than 100 different cities and university campuses. Offers wheelchair accessible, state-of-the-art double decker buses.
Amtrak	The National Railroad Passenger Corporation, Amtrak, strives to deliver high quality, safe, on-time rail passenger service. On an average day, nearly 85,700 passengers ride more than 300 trains. Serves more than 500 destinations in 46 states, the District of Columbia, and three Canadian provinces on more than 21,300 miles of routes. Nation's only high-speed intercity passenger rail provider. On average, 600 daily Thruway schedules with guaranteed connections via buses, vans, ferries, and other modes extend Amtrak service to more than 400 communities not served directly by Amtrak trains in 38 states and Canada.
Birmingham Parking Authority	The Birmingham Parking Authority was formed in 1972 through an act of the Alabama Legislature. Established as a separate entity of the City of Birmingham for the purpose of developing and managing off-street parking facilities. Manages eight parking decks and three parking lots in the downtown area, with a total of 8,353 parking spaces.
City of Birmingham Information Management Services	Provides service to all City of Birmingham Departments through information technology (IT) for greater efficiency in servicing the citizens of Birmingham. Consists of the administrative division, the systems development division, the operations division, the telecommunications/AV/radio division, the IT governance and data analytics division, and the 311 call center.
University of Alabama at Birmingham Sustainable Smart Cities Research Center	Fosters cross-disciplinary research, training, and outreach that integrates health, socio-economic impacts, and infrastructure design for the purpose of developing innovative solutions for sustainable smart cities and communities. Brings together multidisciplinary faculty with diverse expertise to develop tools and methods for sustainable infrastructure design.

Project Detail Including Transportation Systems

The Mobile Proximity Fare Collection Technology will provide a mobile application, to include mobile ticketing, for NFC and Bluetooth enabled devices. The mobile application can provide bus schedule information, next bus arrival information and other data that BJCTA may provide.

The Mobile Proximity Fare Collection Tool will utilize Bluetooth Low Energy (BLE, also known as Bluetooth Smart™) and NFC technology. BLE is a wireless personal area network technology aimed at novel applications such as proposed Mobile Proximity Fare Collection Tool.

As envisioned herein, BLE technology will be installed at each BRT station. As the patron approaches the BRT station, the BLE provides a Bluetooth beacon that “wakes up” a transit patron’s smart phone, and activates the Mobile Proximity Fare Collection Tool. The Mobile Proximity Fare Collection Technology will then automatically provide the patron with the next arrival time of the BRT vehicle or local route serving that particular station. The mobile application will also warn the patron if they do not have enough money in their transportation wallet to cover the transit fare, and if they have the ability to, allows them to purchase additional fare.

As the BRT vehicle and/or local bus approaches the station, the BLE technology onboard the vehicle communicates with the patrons’ phones, identifying them for the system and determining if fare is available. As the patron crosses the threshold from the BRT station platform onto the vehicle, the mobile application activates and deducts the fare from the patron’s transportation wallet. Patrons that do not have adequate fare will have their transportation wallets billed so that the next time it is reloaded the outstanding fare is collected. The bus operator verifies fare payment via an on-board display that accesses an operator specific element of the mobile ticketing app.

The mobile application will allow for trip planning, and enable travelers to see the expected arrival times of other buses that they might be transferring to, as well as their expected arrival time to their destination. The mobile app can record the location, date and time of travelers’ entry to and exit from the bus, providing real time observation of both linked and unlinked trips. Finally, if the traveler has used the mobile app to reserve transportation on another mode, the app can record and provide transportation providers a complete picture of a patron’s travel.

Travelers can electronically manage their transportation wallet either online or through the mobile phone. The mobile application also allows BJCTA access to a new revenue stream, permitting them to sell ad space and allowing local merchants to provide transit patrons coupons and discounts.

In terms of back office operations, transportation fares are received by a clearinghouse and are distributed to the transportation provider like a typical banking operation. Transit fares will be accounted for in normal streamlined and efficient fashion by the BJCTA.

In the back office, the paid fare comes in through a clearinghouse and is accounted for in the normal fashion by BJCTA.

Figures 9 through 12 depict the various architectural requirements that will be met based on the users type of payment, the transaction point, the fare payment method and the service access control points.

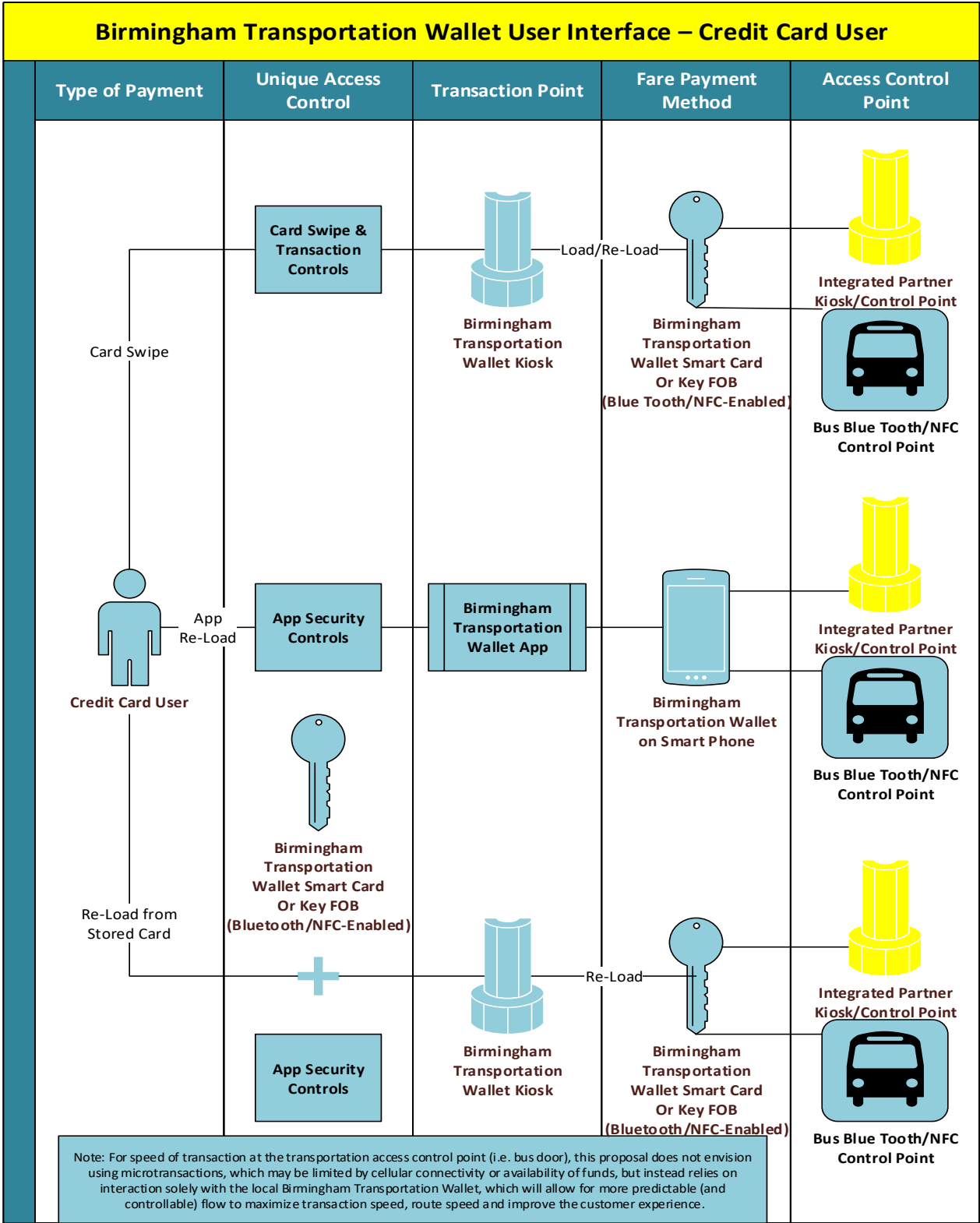


Figure 9. Credit Card User

Birmingham Transportation Wallet User Interface – Digital Wallet User (i.e. Apple Pay)

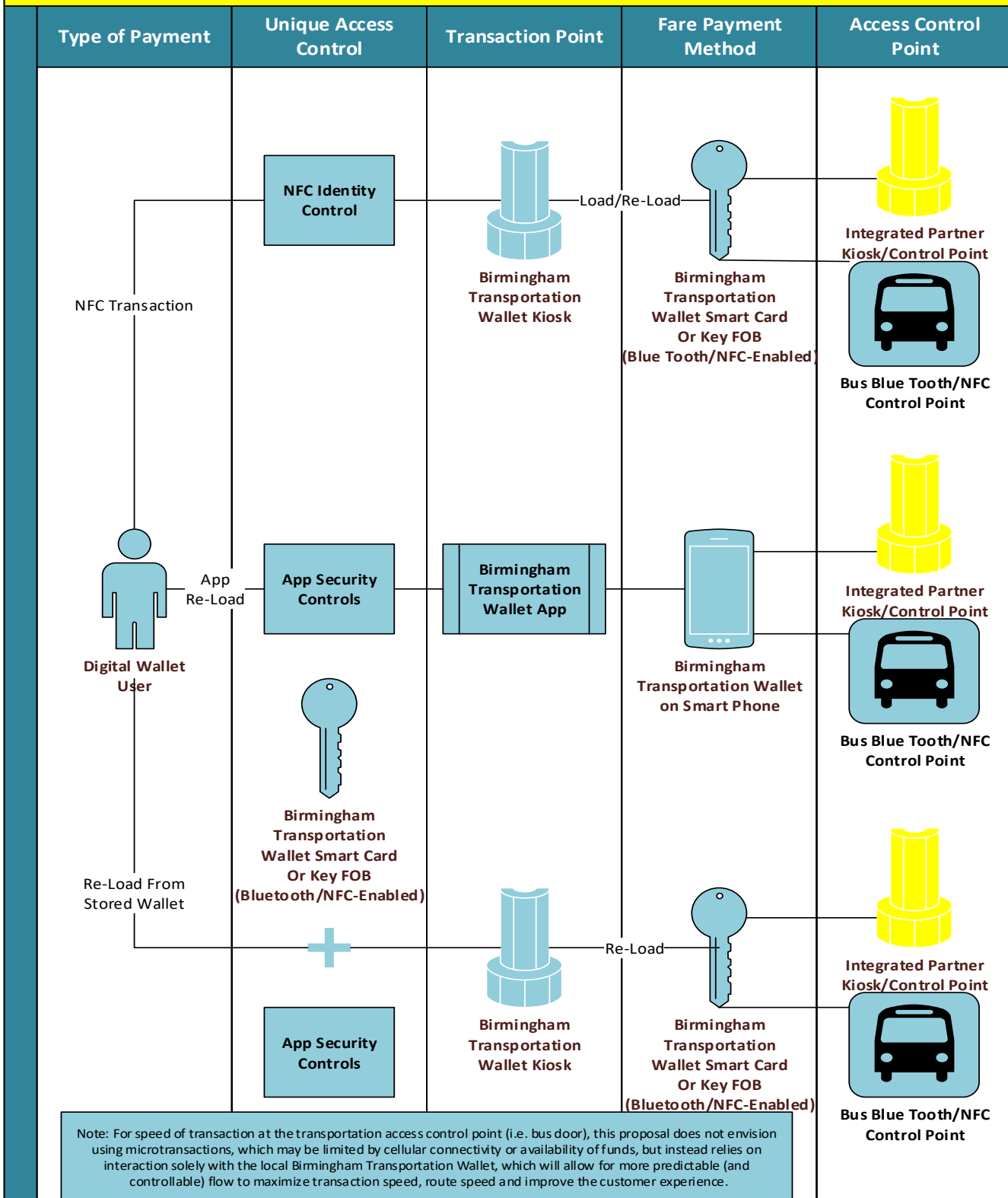


Figure 10. Digital Wallet User

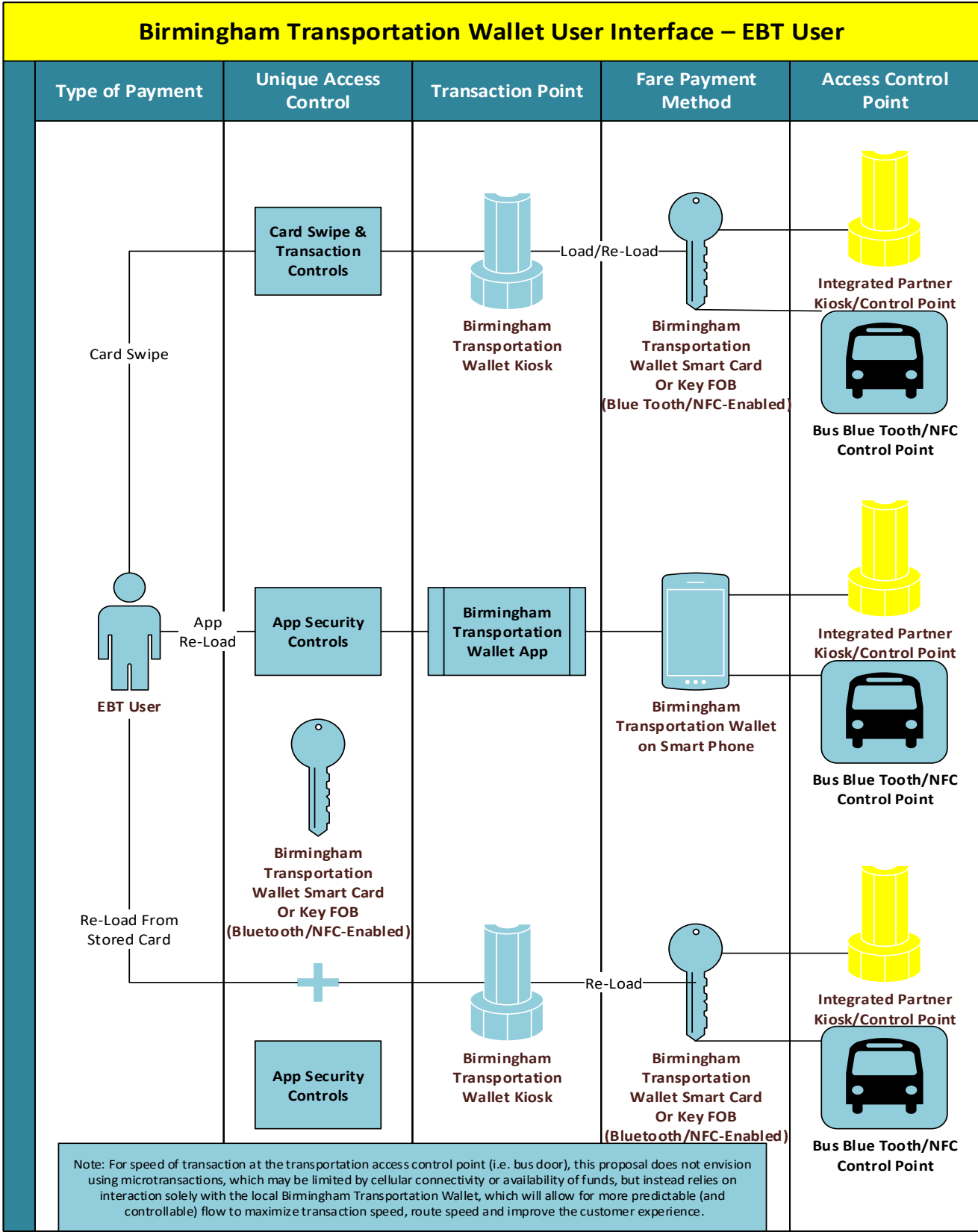


Figure 11. EBT User

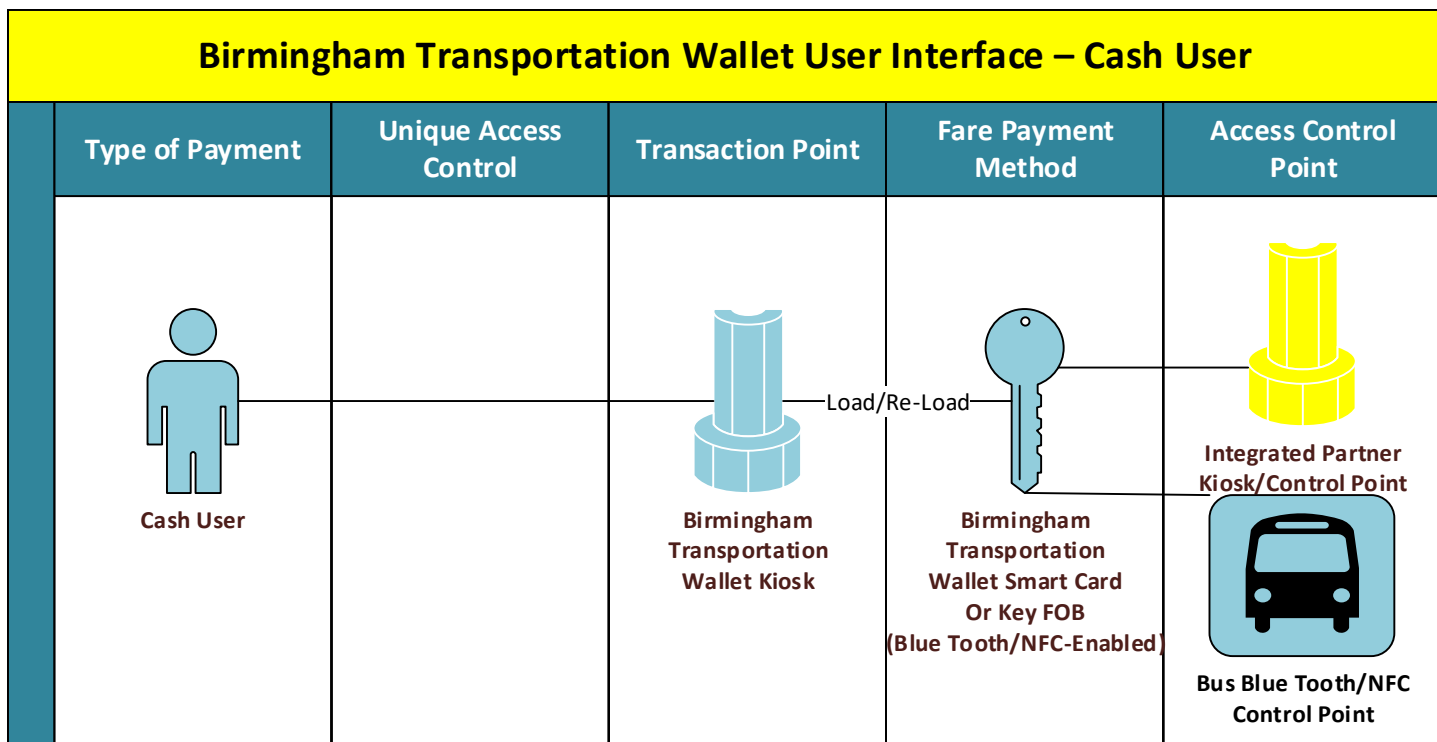


Figure 12. Cash User

The project will require several key architectural designs including the following:

- Bus architecture;
- Intermodal architecture;
- Bus yard architecture;
- BRT route purchase kiosks;
- Cloud-based transportation wallet;
- BRT station architecture;
- Bus stop architecture;
- Partner kiosks; and
- Parking deck/streetside parking architecture.

Figures 13 through 15 depict the typical architectural elements that will be engaged in these integrations:

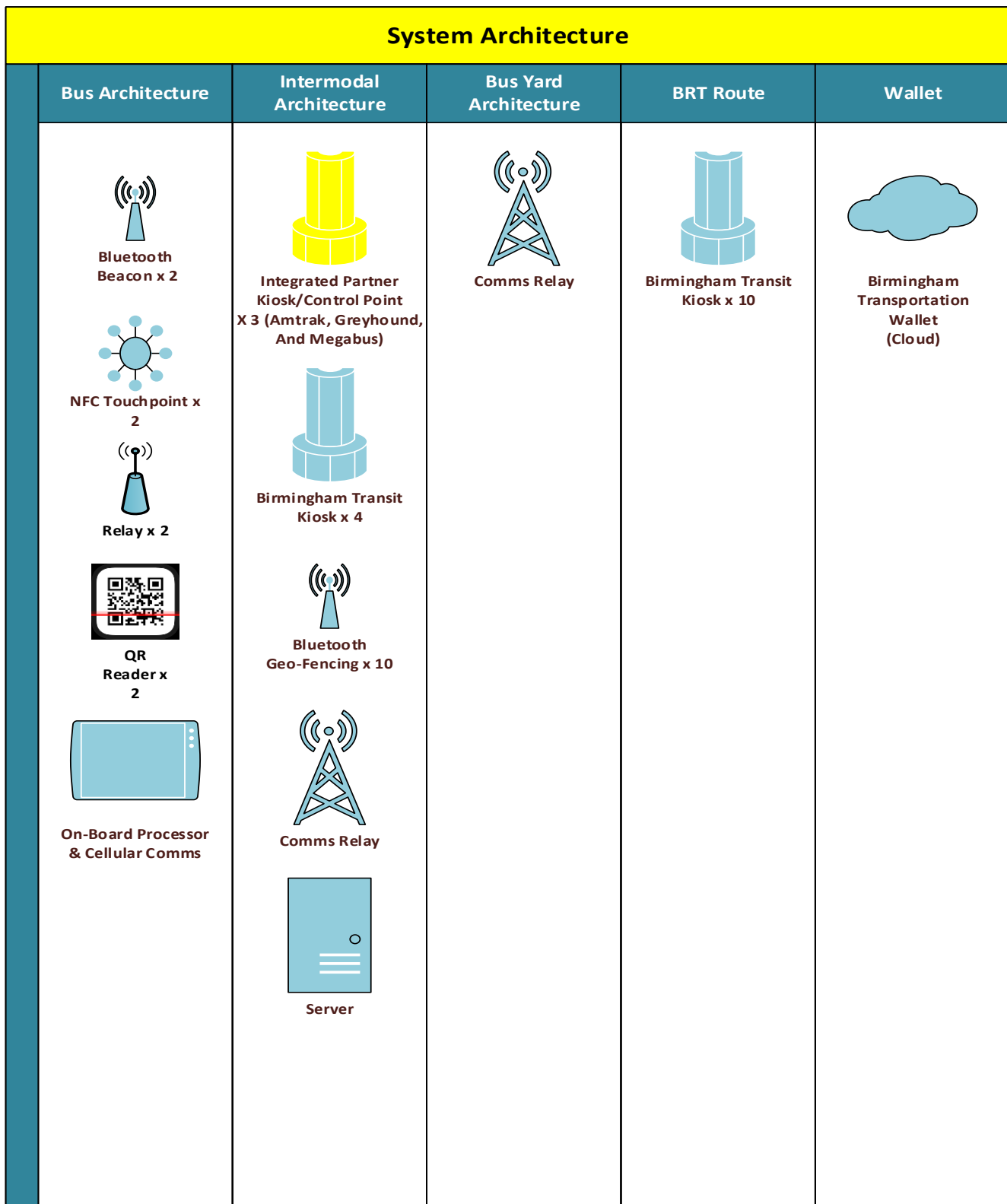


Figure 13. System Architecture

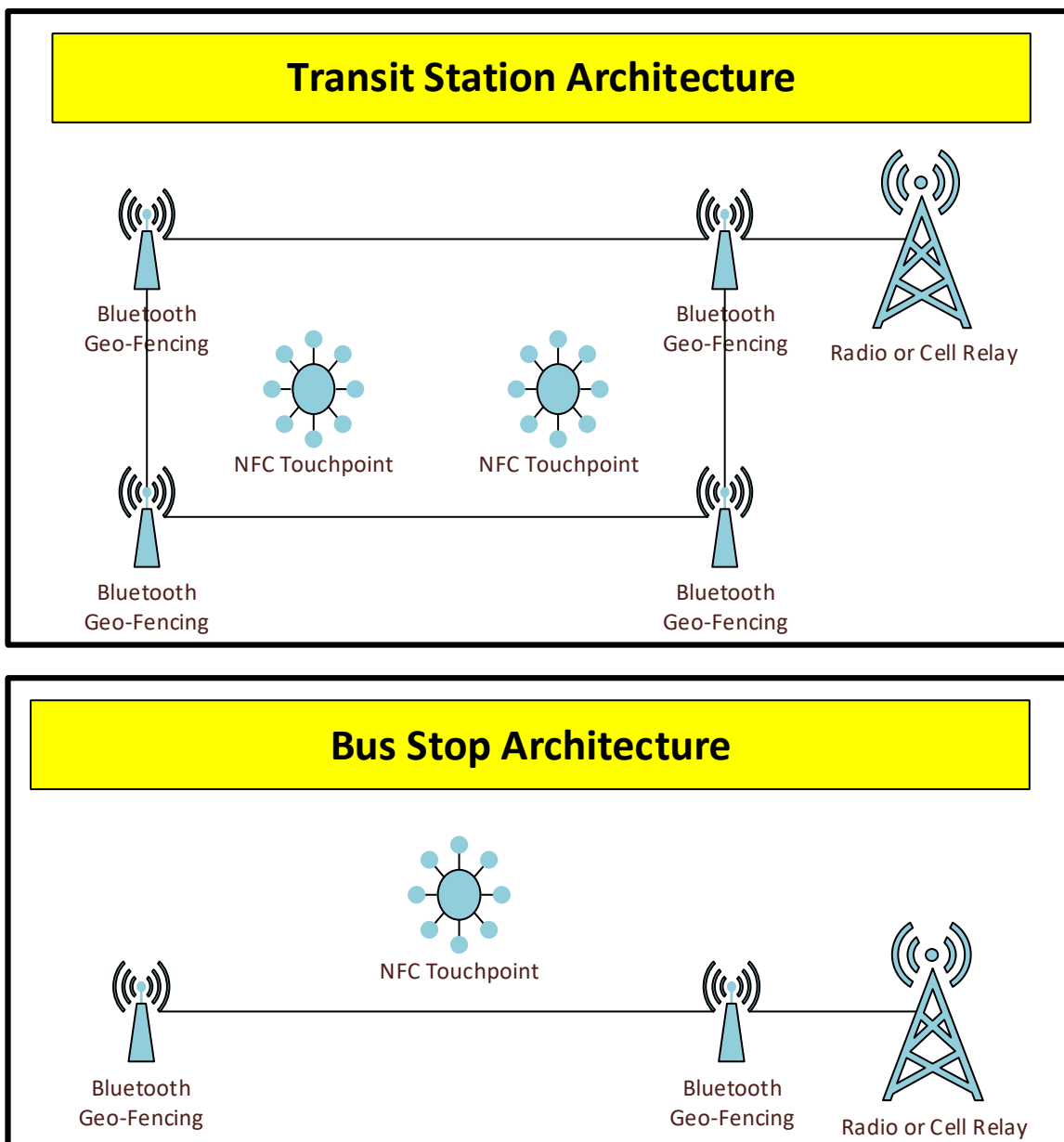


Figure 14. Station and Bus Stop Architecture

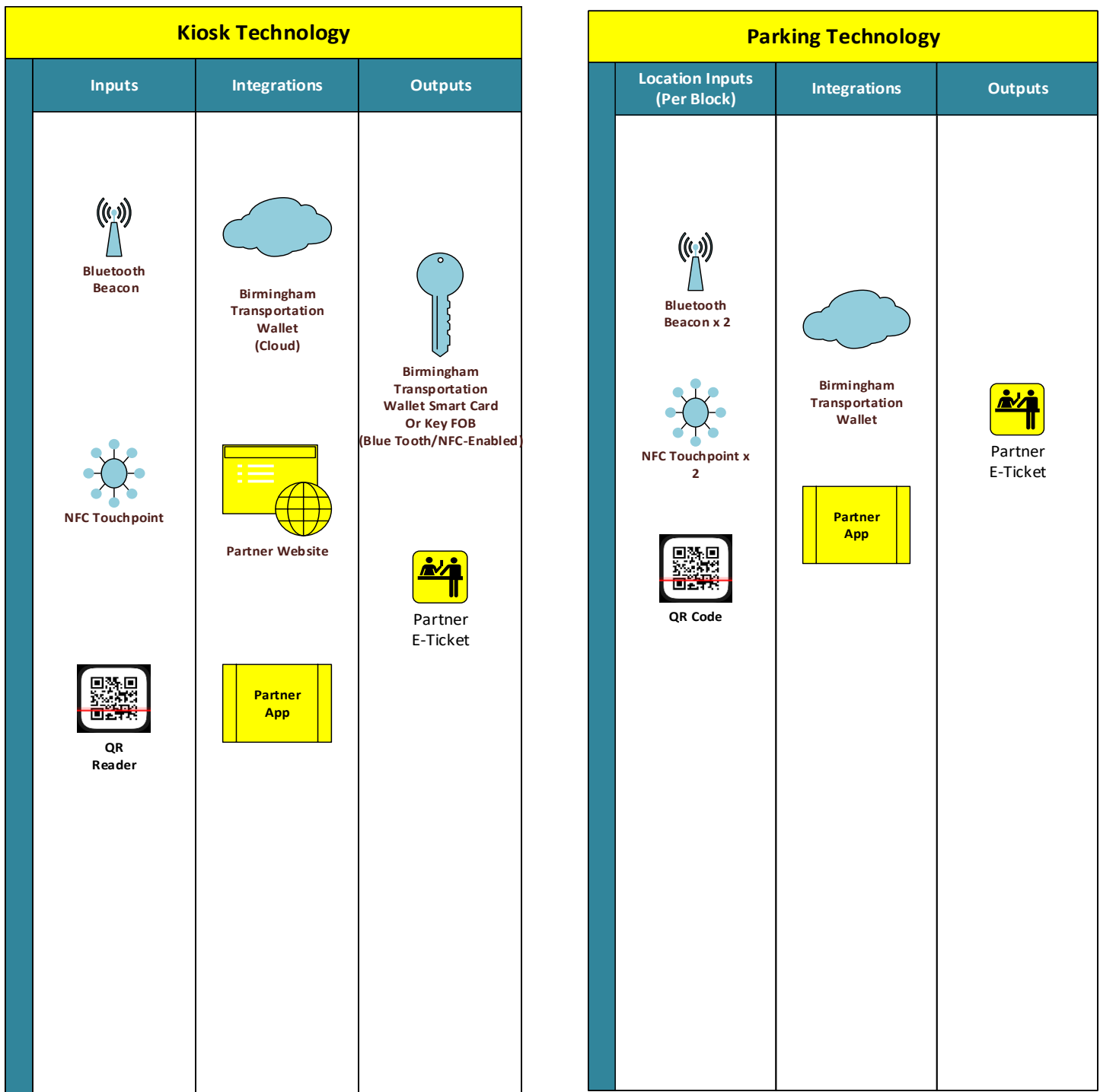


Figure 15. Kiosk and Parking Technology

Application Planning Considerations

Period of Performance and Deployment Plan

The period of performance for this project is planned to begin in 2018 and complete in 2021, with the 2021 calendar year being utilized largely to evaluate the project's implementation and ensure project developers are readily engaged in the 2021 World Games. The project timeline and key activities are captured in Figures 16 through 19.

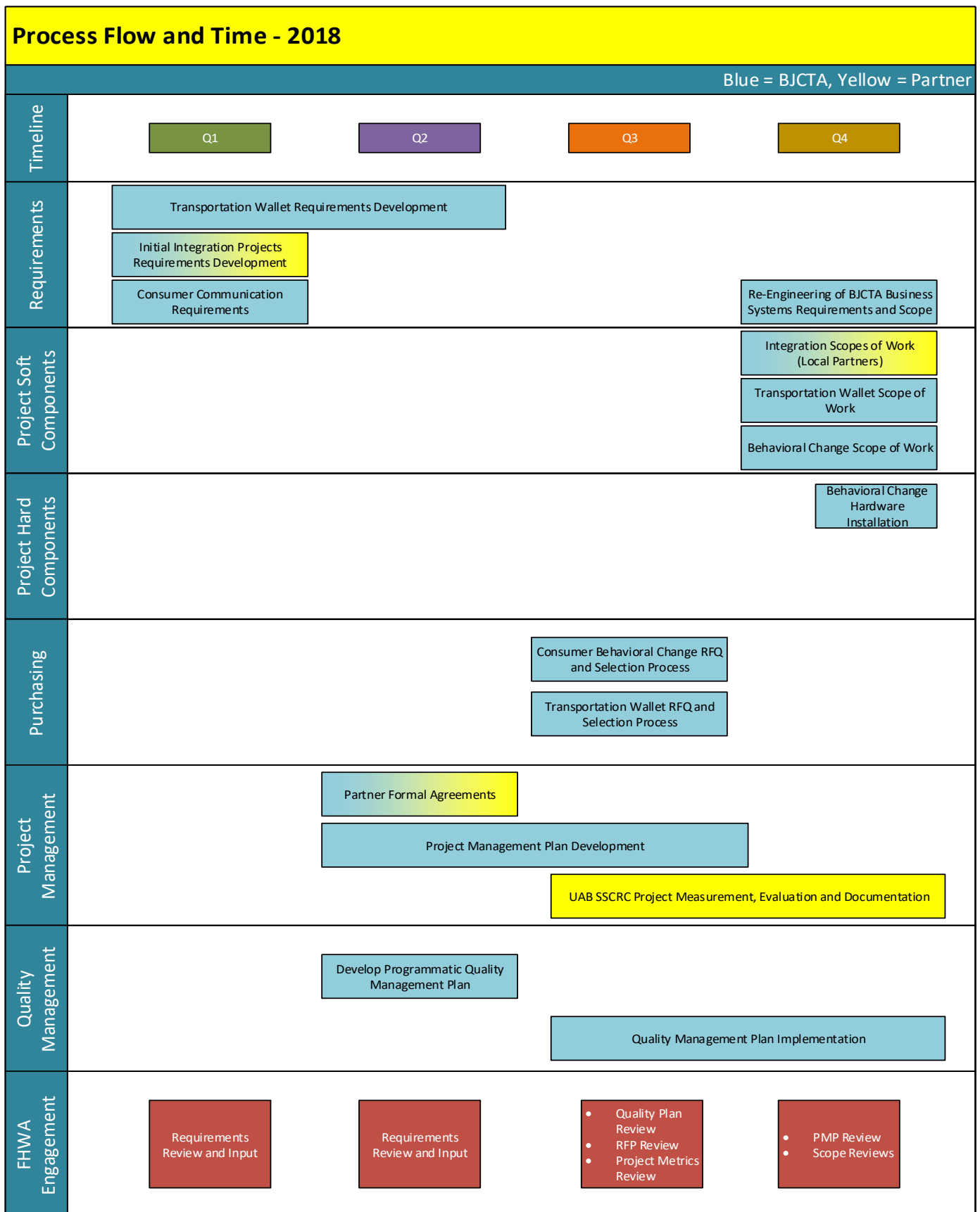


Figure 16. 2018 Process and Flow Time

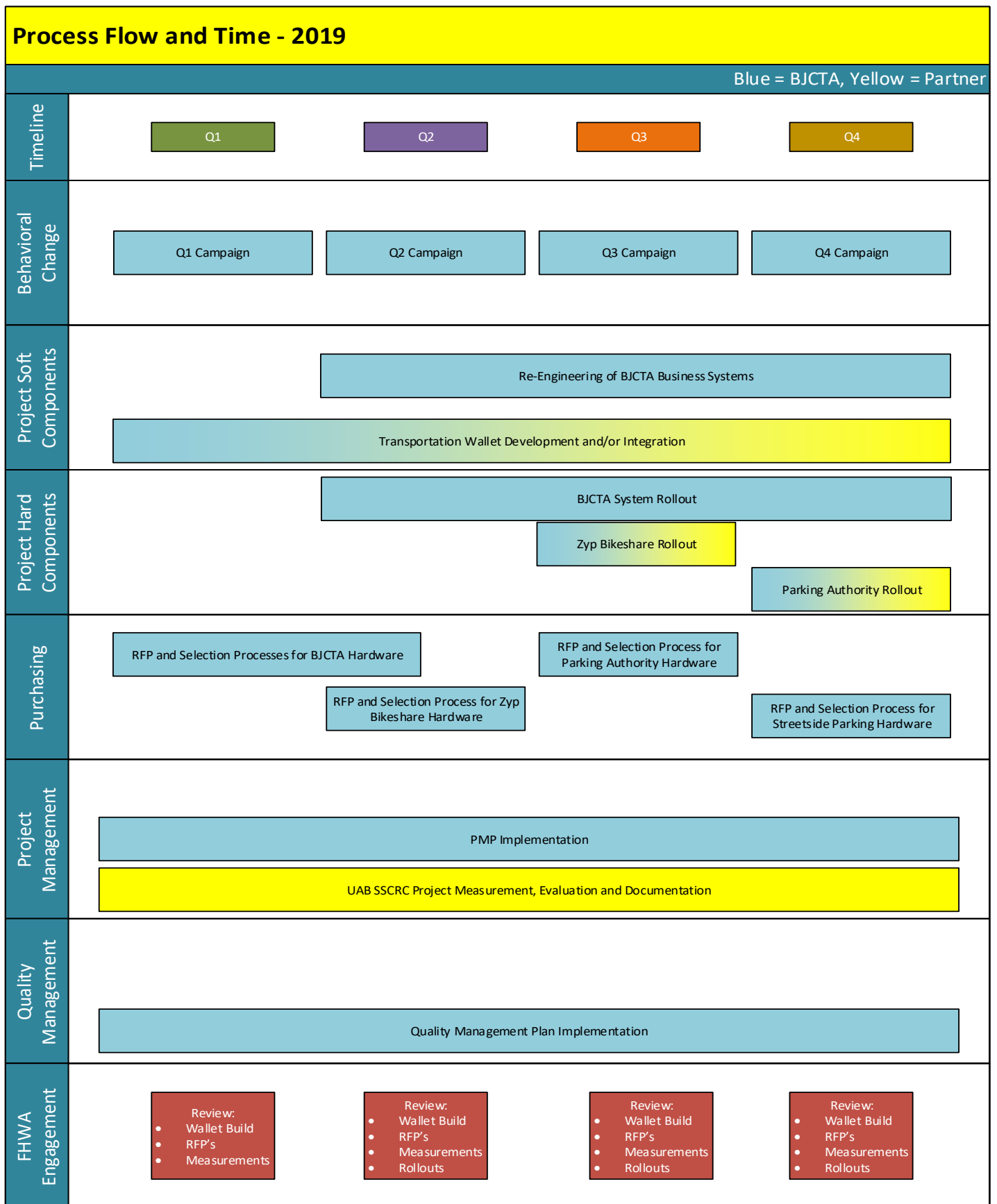


Figure 17. 2019 Process and Flow Time

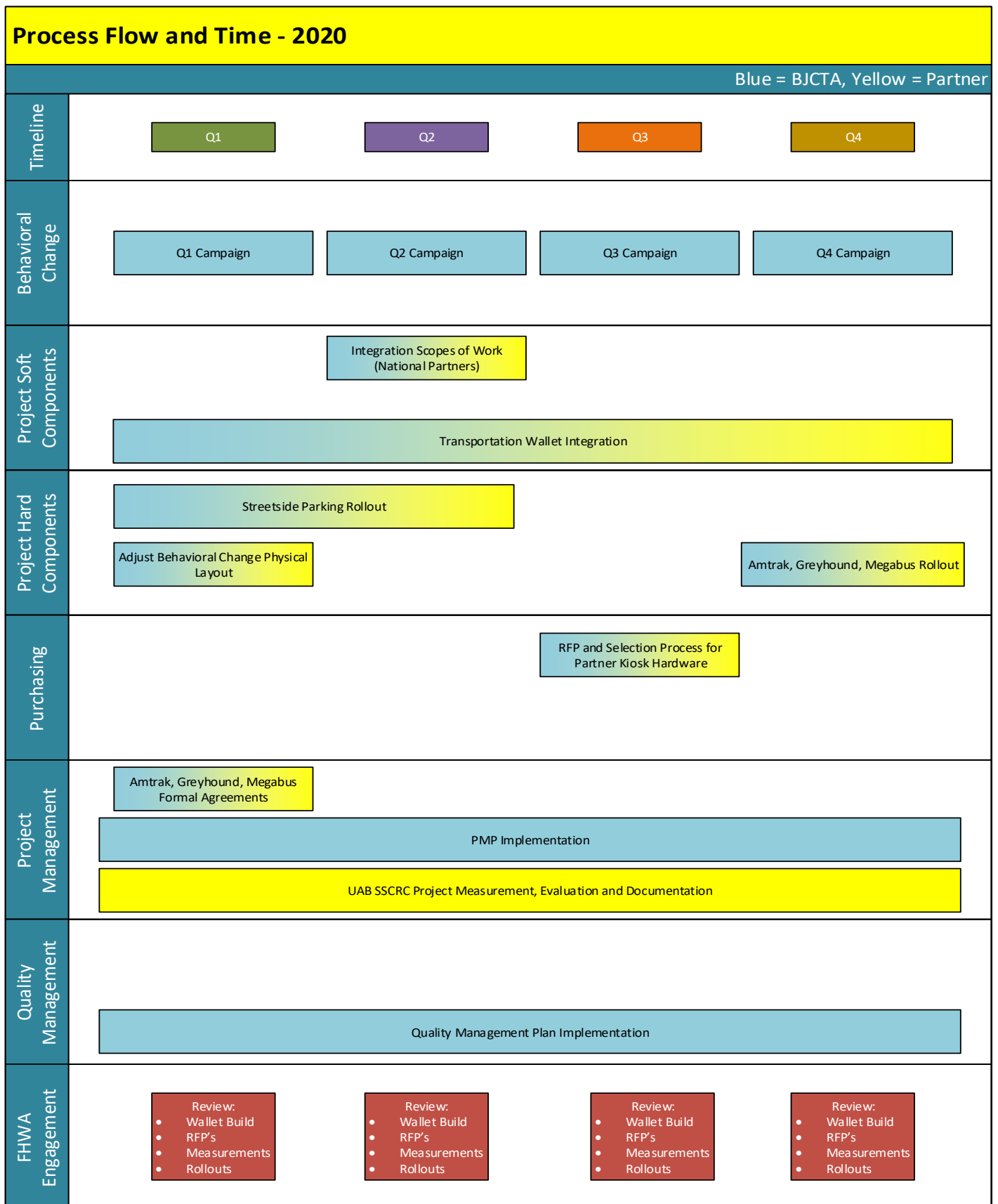


Figure 18. 2020 Process and Flow Time

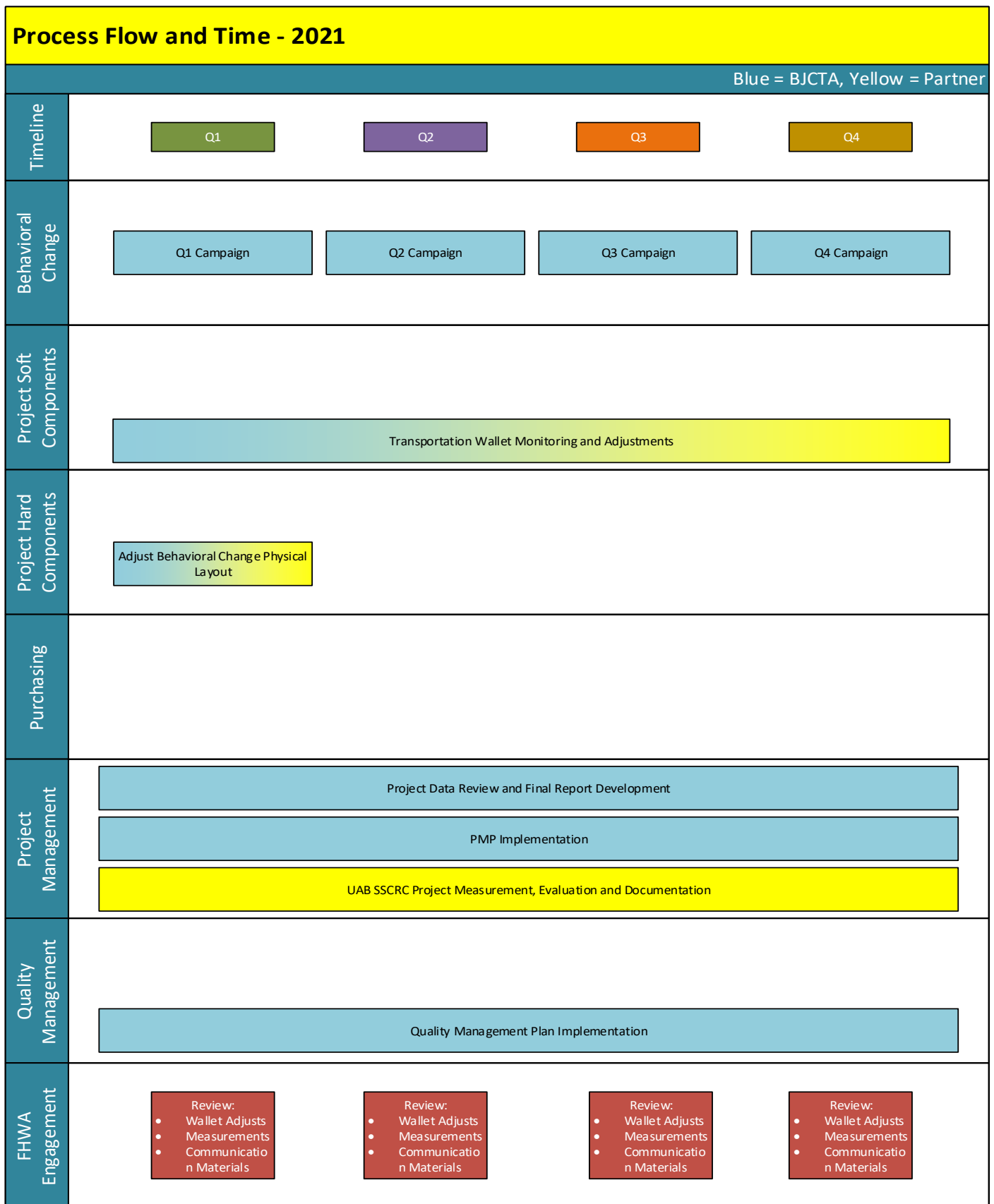


Figure 19. 2021 Process and Flow Time

Federal Involvement

Substantial Federal involvement including technical assistance and guidance is requested. We appreciate that this is a research grant. To support the effective project documentation and evaluation we are proposing to engage a national leader in transportation research, the University of Alabama at Birmingham Sustainable Smart Cities Research Center (SSCRC) to be the primary party responsible for project evaluation and documentation. They will act as an objective, on-site observer for the ATCMTD program staff, ready to engage in any project data requests in a timely and effective manner. The planned interactions are shown in Figures 11-14, delineated as red squares.

Model Deployment

Recognizing that the award is to develop a model deployment site for large scale installation and operations of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment, we have engaged a key partner whose sole responsibility will be to support this critical ATCMTD goal, the UAB SSCRC.

The UAB SSCRC integrates health, socio-economic impacts, and infrastructure design for the purpose of developing innovative solutions for sustainable smart cities and communities. The diverse faculty participating in the program specializes in disciplines that work together to develop tools for sustainable infrastructure design. Sustainable smart cities are environmentally friendly, with reduced costs and an increased quality of life. These areas preserve the natural environment, are energy efficient, provide access to health services, and are economically sound with engaged citizens.

The SSCRC will be a valuable component of this proposed project. Students participating in the Master's Degree program will carefully study the integrated transportation system created by this project. Through their research, these students will evaluate the technologies and applications used to determine the resulting impacts on safety, efficiency, and sustainable movement both along the interstate system and through the public transit system. The research will prove the effectiveness of the mobile application in reducing traffic congestion, increasing the use and ease of public transit, and simplifying the lives of the Birmingham area residents. This research will further demonstrate the economic and environmental benefits of reducing congestion and pollution and increasing the efficiency and reliability of the region's workforce.

Through this research and analysis, students participating in the Master's program will provide reports on their findings that will analyze the impact of this project on the city and surrounding areas. Other cities and communities throughout the country will then be able to utilize such reports to reproduce this technology for their transit systems. The program students will be able to collaborate with partners throughout the country to further develop and utilize this technology across various systems, all while furthering the concept and purpose of both this grant and the SSRC.



Figure 20. UAB SSCRC Logo

Proposal Management

The BJCTA has well-established business systems to manage grant, financial, and compliance management. These systems are subject to Federal Transit Agency Triennial Reviews as well as regular accounting audits. The BJCTA is in good standing and qualifies for continued federal grant funding and had no significant findings in the most recent regular audit.

Mobile Proximity Fare Collection Tool (MPFCT) is a complex application involving many aspects of BJCTA as an agency to integrate the concept into the existing fare collection and bus operations system. The development of the MPFCT will be supported by the services of a technical consultant to be engaged by BJCTA and supported by the City of Birmingham’s Information Management System (IMS) department.

The overall effort for BJTCA will be [REDACTED] [REDACTED] [REDACTED]).

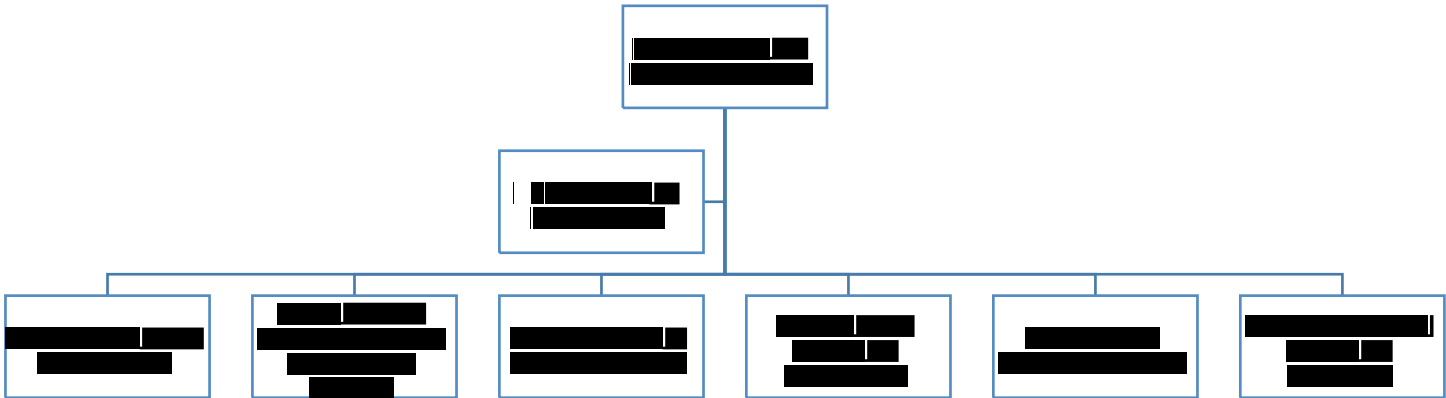


Figure 21. BJCTA Staff

Beyond BJCTA staff, Figure 22 shows key project participants:

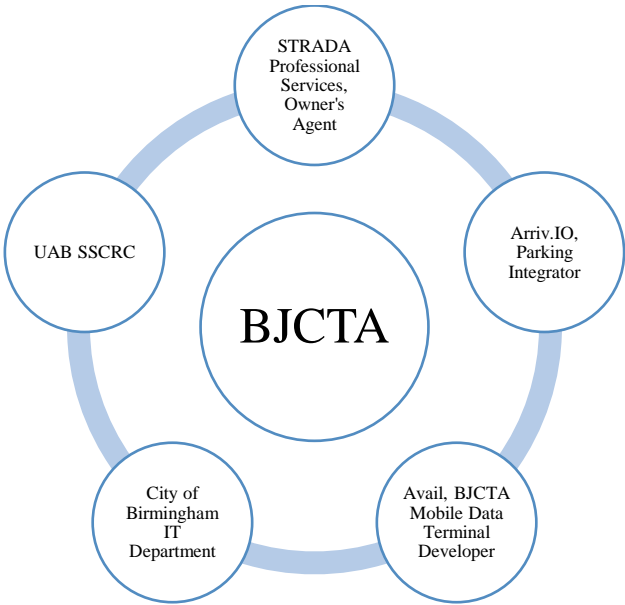


Figure 22. Key Participants

Description of geographic area or jurisdiction the deployment will service

Located in a dramatic physical landscape, Birmingham (Figure 23) is the county seat of Jefferson County and is the largest city in Alabama. Birmingham was founded in 1871 at the crossing of two railroad lines and quickly grew to become the center of industry in the southern United States. As coal, iron ore, and limestone were prevalent throughout the region, it was only natural that the city became known for its iron and steel production. This important piece of infrastructure was, and still is, a key component of the city's development as an industrial powerhouse.

Birmingham is re-emerging as a vibrant southern city where people choose to live, thanks to comprehensive community planning, strong leadership, collaboration, and reinvestment. Revitalization efforts focus on improving quality of life for citizens, protecting and enhancing the unique sense of place, rebuilding the economy with a foundation of diversity and resiliency, and creating an innovative and healthy workforce. The signs of reinvestment and revitalization are occurring citywide. Public and private confidence in Birmingham's future is strong, with the city center growing significantly as reflected through increased opportunities for jobs, education, healthcare, and government services. According to Forbes Magazine, Birmingham is among the fastest emerging downtowns in the nation.

Birmingham is the southern hub of America's expanding automobile manufacturing footprint. Interstate 65 is the main freight corridor for the nation's entire automotive industry. Furthermore, Birmingham is the largest population center on the M-65 marine highway corridor, which is the only marine highway that can provide direct relief to America's most trafficked marine highway, the M-55 Marine Highway Corridor.

Interstate 65 in the Birmingham region is a major freight corridor, with more than 8,500 trucks per day and 50 million tons annually traveling the corridor. This interstate demands continual flow to support the automotive industry's just-in-time supply systems that deliver parts and materials around the clock. Mountains, creating a cost prohibitive obstacle by the reality that Birmingham, as in Birmingham's geographic expansion over of the city center. The population in the Future expansion has been funneled into Figure 17 illustrates the project scope and

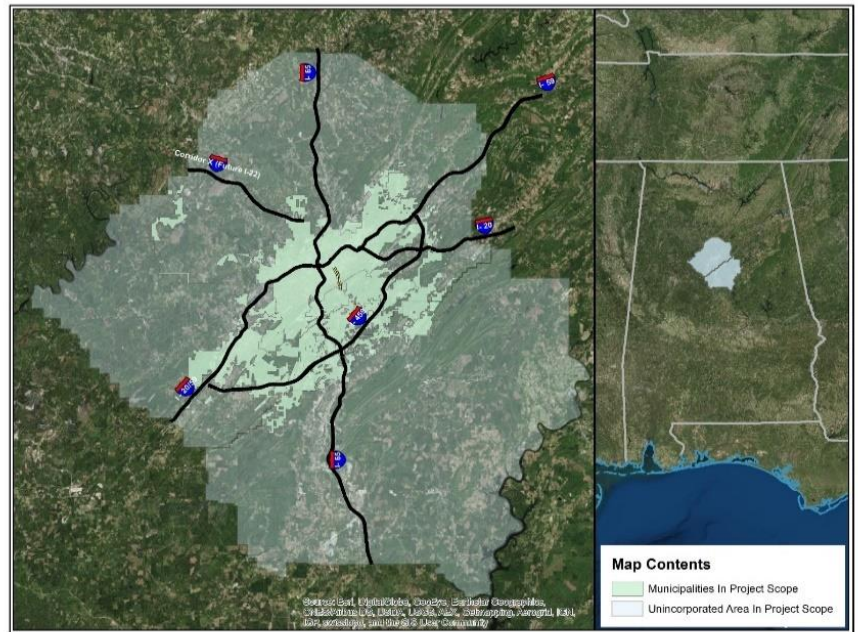


Figure 23. Scope Area

parts and materials around the clock. Interstate 65 travels through five different ridges of the Blue Ridge Mountains, creating a cost prohibitive obstacle to highway expansion. Interstate 65's congestion is exacerbated by the reality that Birmingham, as most southern cities, does not have a public transit centric culture. Birmingham's geographic expansion over the past three decades has increasingly moved along Interstate 65 south of the city center. The population in this region has increased to equal the entire population of Birmingham. Future expansion has been funneled into the already congested five passes through the Blue Ridge Mountains. Figure 17 illustrates the project scope area.

Birmingham has recently emerged from a United States Environmental Protection Agency designated air quality maintenance program. Increases in automobile traffic would further this problem. Birmingham has also recently established the Birmingham-Jefferson County Port Authority and is working to establish port facilities and a public-private partnership to reduce both interstate traffic and M-55 Marine Highway Corridor traffic.

Birmingham is continually investing in the city to create a public transit culture through the BRT system, and the city is creating redevelopment downtown through mixed-use development. The BJCTA continues to realign its route network through its Transit Development Plan to improve on-time performance and increase route frequency. In conjunction with the Transit Development Plan, the city continues to rebrand key routes to appeal to a new generation of residents in professional careers and who are technologically savvy.

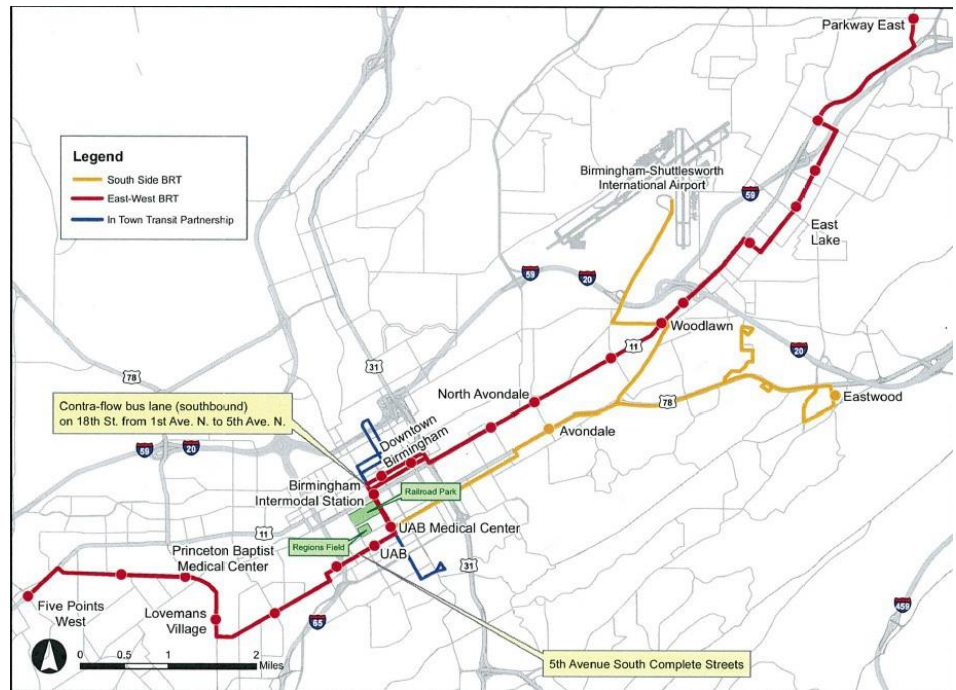


Figure 24. BRT

This project will be implemented within the BJCTA service area and will focus on the BRT system routes shown in Figure 24, with a focus on the east-west and south routes and the airport express routes. Select local bus routes may also be included as the BRT system is refined. The airport express routes will allow utilization by riders who have a choice in how they will travel and could serve to encourage further use by this travel market segment. This project will provide a showcase to the transit industry and firmly establish Birmingham and its state of the art technology as a pioneer in the industry.

Regulatory Issues

The Mobile Proximity Fare Collection technology does not present any regulatory issues at any level. The existing system of fare collection, the magnetic strip card, will continue to be available in its present form. The Mobile Proximity Fare Collection Technology system will supplement the existing fare collection system. The Mobile Proximity Fare Collection Technology meets ADA compliance for similar reasons. The app's mobile ticketing application will utilize travelers' existing smart phone, tablet, or compatible mobile device. These devices would likely be already consistent with user needs.

Mobile Proximity Fare Collection utilizes existing technology that is readily available and able to be connected by custom mobile applications in order to provide a product that meets identified needs. It will provide a safe and affordable way for transportation challenged individuals and households to easily and conveniently gain access to transportation services, without bank or credit accounts.

There are two key issues that will be important to implementing the Mobile Proximity Fare Collection technology that are not part of the BJCTA's staff capabilities, but consultant services could be engaged to assist in resolving them. First, inherent in Mobile Proximity Fare Collection is a linkage to banking and fund transfers. Secondly, the agreements of various types may be negotiated with private transportation providers and retail vendors. These services, while not part of the primary Mobile Proximity Fare Collection Technology application, could provide substantial convenience to the transit patrons.

System Performance Improvements

The Mobile Proximity Fare Collection technology is focused on improving access to transportation services, particularly for the transportation disadvantaged. The system will broaden payment options and substantially improve convenience. Ideally, fare evasion will be reduced, as well as financial security through the reduction of cash accounting. The overall accounting and financial systems should be considerably more secure as transit patrons migrate to cashless systems.

One of the key performance measures for any transit system is on-time performance. That is, the buses are consistently on time. The Mobile Proximity Fare Collection Technology will speed the loading of the buses at each stop. This will improve the speed of the bus along the route, and enhance their on-time performance. Universally, most every bus operator suggests that collecting cash fares is a key cause of delays in route performance. The mobile ticketing app is designed to reduce cash payments at the farebox, and optimize efficiency in fare collection.

Mobile Proximity Fare Collection Technology will ideally reduce fare evasion, reducing the opportunity for theft of services and embezzlement. Both the electronic fare collection system and the vehicle operator will be aware of each discrete boarding, and will be able to advise transit patrons' if their fare have not been paid. In addition, by reducing the amount of cash that must be accounted for in the office, the opportunity for accounting errors will be substantially reduced.

Quantifiable Safety, Mobility, and Environmental Benefit Projections

The use of the Mobile Proximity Fare Collection technology will substantially improve the average vehicle speed along the BRT route system, and increase on-time performance by reducing one of the key contributors to delay for transit vehicles; use of cash for fare payment. System operational performance will be tracked before and after implementation of the mobile ticketing application. Improvements will be identified and issues resolved, resulting in an overall enhancement of system speed.

Transit use will also be measured and evaluated. The Birmingham market presents a unique research opportunity for FHWA by evaluating the potential for increased transit ridership when a city makes a multi-pronged commitment to increasing transit ridership (BRT, TOD, Intermodal and Electronic Payment), driven by a burning imperative (2021 World Games). To establish precise metrics the UAB SSCRC will be engaged so that peer-reviewed-quality research is conducted as part of this project.

Cashless systems are inherently safer and more secure. The fare collection system will be significantly more resilient through the provision of two parallel systems: a non-smart phone NFC card system, and the mobile ticketing application. Mobile Proximity Fare Collection Technology will also be significantly more convenient for transit patrons. Transit patron focus groups of travelers using both local and express transit routes will be developed, and used to help identify the requirements for the Mobile Proximity Fare Collection Technology and the accompanying app. Focus group interviews will be followed up with statistically significant fare survey that will be administered prior to development and implementation of the mobile ticketing application. Following implementation of the Tool and the associated applications, additional surveys will be administered with the purpose of gauging customer reaction and refining the system.

Vision, Goals and Objectives

BJCTA's Transit Vision, Goals and Objectives are embodied in the agency's 2008 Comprehensive Transit Development Plan. BJCTA's vision is:

"... to become a transportation system that is seamlessly connected, offering safe, affordable, reliable and accessible services that improves mobility, flexibility and choices for all users, while supporting the social, economic and physical health of the region's communities."

BJCTA goals for the mobile ticketing technology application are:

- To develop a fare payment system that maximizes the ability of all system patrons to pay fares in the most convenient and efficient way possible.
- To ensure that the fare payment system continues to afford the opportunity to use cash as necessary, but the cash fare payment system is minimized to the greatest extent possible.
- To reduce accounting and administrative costs.
- To develop strong data, that includes but is not limited to origin-destination information, and trip/tour data in order to improve system planning and route efficiency.
- Provide an incrementally scalable and expandable fare collection system.

Public Private Partnership Opportunities

Mobile Proximity Fare Collection Technology offers multiple opportunities for partnering with both private entities and other public sector agencies. As the patron approaches the transit stop they could receive coupons and/or discounts from various merchants located along the route. Negotiations for the distribution of and on the use of the coupon could result in non-transit revenue for the BJCTA. Through the transit wallet concept, travelers could utilize the application to procure other transportation services. This could be either public or private entities, and includes, but is not limited to: intercity bus, bikeshare and traditional bicycle rental services, ridesharing services, car-sharing services, structure, surface, and on-street parking, or taxis. The potential exists for further enhancing the application to link it to WIC, SNAP and other EBT services provided by social service agencies. The patron could have all of their services and payment options located on their phone, easily accessible.

Leverage existing technology

BJCTA has just implemented Automatic Vehicle Locator (AVL) technology on the transit system. This technology could be linked to the mobile ticketing application to identify the schedule for the next bus.

DOT ITS Program Leverage

The Mobile Proximity Fare Collection technology can be developed and applied consistently with the development of the Birmingham BRT system. The four-year schedule assumes a grant award in the fourth quarter of 2017. The BRT system is anticipated to be operational in the third quarter of 2020. Deployment and testing of the mobile ticketing application will be consistent with the construction of the BRT system in late 2019 and early 2020.