Regional Transit Technology Integration Plan

December 2019

Prepared for

GO FORWARD
A COMMUNITY INVESTMENT IN TRANSIT

Prepared by

WSP

GO Cary   GO Durham   GO Raleigh   GO Triangle   GO Wake ACCESS

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Executive Summary

We are living in a time of unprecedented change: rapid growth, an explosion of new technology options, and new people moving into the Raleigh-Durham region. These changes provide the GoForward regional partners – GoCary, GoDurham, GoTriangle, GoWakeAccess – and other regional transportation providers an opportunity to transform the region by making it more navigable, sustainable and welcoming.

The way people use transit and, to some extent, the role of transit as a mobility provider in the region are rapidly changing. Technology is providing new ways to pay for transit – and to get the best value without purchasing an expensive pass. It's also spawning powerful new planning and management tools for customers and agencies alike. These new functions can enhance the customer experience, grow ridership and provide management tools, data and analytics to help make the transit service more effective, responsive, targeted and efficient.

With these changes in mind, the GoForward partners have drafted a new Regional Transit Technology Integration Plan. The Plan includes technology innovations that will improve, simplify and streamline the customer experience by integrating trip planning, fare payment, wayfinding, and trip guidance. It will help reduce trip times and increase on-time performance while it improves safety and operating efficiency.

A constellation of technologies powers the Plan. It includes new and updated Automatic Fare Collection (AFC) systems, Computer Aided Dispatch and Automatic Vehicle Location (CAD/AVL) systems, Real Time Bus Information (RTBI) systems, Automatic Voice Annunciation (AVA) systems, Passenger Information Display Systems (PIDS), Collision Avoidance Systems (CAS), and Traffic Signal Priority (TSP) systems. These systems will help the regional partners provide a more integrated and efficient regional transit network that can more easily integrate with other mobility providers and modes of transport. They underpin a Plan that will lead to providing faster, more cost-effective, comfortable, convenient, safe, and reliable transit service.

Roadmap

The Regional Transit Technology Plan was developed by the GoForward partners to ensure that they would optimize future technology investments. The Plan includes a technology roadmap that will help the partners ensure that technology investments are

- aligned with regional and agency goals and objectives
- reflect best practices and industry trends
- consider agency priorities and available resources,
- identify synergies and opportunities to capture greater value, and
- consider opportunities for early wins

As they were developing the roadmap, the agencies considered regional goals and objectives for Wake, Durham and Orange counties. For example, the plan was developed to be aligned with the four 'big moves' those noted in the Wake County Transit Plan – connecting the region, connecting communities, creating frequent, reliable urban mobility, and enhancing access to transit. Both the Durham and Orange Transit Plans are currently being revisited and will be updated as the Durham Orange Light Rail project is no longer moving forward.

These regional goals are echoed in the partner agency plans including GoTriangle's 2017-2021 Strategic Plan. They are to improve mobility in the region; assure high-quality customer service through direct operation and partnerships; and encourage sound growth patterns.

The partners also considered best practices and industry trends for both AFC and ITS technology components of their roadmap. Aside from leveraging technology to maximize efficiencies, AFC and ITS systems are benefiting from significant innovation from firms in related sectors such as manufacturers of both heavy-duty and light-duty vehicles. These firms are investing in the sector and commercializing valuable new technologies. Ever more cost-effective services and greater system integration capabilities are simplifying and speeding installation.

A summary of the key alignment considerations for the Regional Transit Technology Integration Plan is shown below in Table 1:

Table 1: Key alignment considerations for the Regional Transit Technology Integration Plan

	Agency and Regional Goals	Best Practices and Industry Trends	Agency Priorities	Opportunities for Early Wins
AFC	New fareboxes and mobile ticketing application can offer new functionality to enhance customer experience	Open payments, and fare capping included in new offerings	AFC is an agency priority to improve customer experience. The roadmap is based on agency readiness, but offers opportunities for acceleration	New fareboxes and mobile ticketing application can offer new functionality and convenience for customers
CAD/AVL	New, integrated CAD/AVL systems are key ITS building blocks that can enhance customer service, and improve regional coordination	New CAD/AVL systems are central to bus operations and are moving toward more complete integration with other AFC and ITS systems	New CAD/AVL systems are a priority for most of the partners and a new system is being implemented at GoRaleigh	Identifying funding to accelerate CAD/AVL systems across the partners would facilitate regional coordination and mobility
RT Bus Info	Real Time Bus Information systems that provide accurate information across routes and systems improves the customer experience and facilitates regional mobility	Many new CAD/AVL systems are based on the Real Time General Transit File Specification (GTFS-RT) and provide real time information	Ensuring continuity of real time bus information is a priority for the agencies.	The partners are developing a strategy to maintain service despite loss of vendor support in mid-2020
PIDS	Passenger information display systems improve the customer experience and facilitate mobility	Some agencies are having success with firms that fund and operate PIDS that include advertising	Agencies consider customer information, services and amenities a high priority	The partners may wish to consider a pilot project with interested vendor(s)
CAS/VSS	Collision avoidance systems and vehicle security systems make systems safer and more effective, reducing delays and improving service	Collision avoidance systems are becoming more sophisticated with expanding coverage and greater speed and functionality	Agencies consider CAS/VSS top priorities for risk management and savings	Several partners are installing CAS/VSS and should consider evaluating more sophisticated systems
TSP	The region will be deploying transit signal priority systems to speed service on new Bus Rapid Transit routes which will create more frequent, reliable transportation as they connect the region	Transit signal priority systems are becoming more cost-effective as their adoption increases	GoRaleigh and GoDurham have been evaluating TSP and believe it will be a valuable tool to reduce trip time and improve performance	New BRT activities will facilitate further development of TSP systems

The figure below shows the current five-year regional technology integration roadmap for the region. The current roadmap includes technologies that the partner agencies have identified as critical to realizing regional goals and objectives including Wake County's "four big moves." The roadmap is constrained by agency resources – both available funds and their resources available to deliver significant new technology projects. Additional funding could help improve regional alignment and expedite implementation of key technologies such as new CAD/AVL and vehicle radio systems that would yield additional opportunities for "early wins."

Figure 1: Five-Year Technology Roadmap

Roadmap	2020	2021	2022	2023	2024
Automated Fare Collection					
Bus Fare Collection					
GoCary		▇			
GoDurham					▇
GoRaleigh					
GoTriangle	▇	▇			
GoWake				▇	
Gen2 Mobile App					
GoCary			▇		
GoDurham			▇		
GoRaleigh			▇		
GoTriangle			▇		
GoWake			▇		
Business Intelligence					
BI System					
GoCary				▇	
GoDurham				▇	
GoRaleigh				▇	
GoTriangle				▇	
GoWake				▇	
Intelligent Transportation Systems					
Automated Passenger Counters					
GoCary		▇			
GoDurham					
GoRaleigh			▇		
GoTriangle		▇			
GoWake					
Computer Aided Dispatch / Automated Vehicle Location					
GoCary		▇			
GoDurham	▇				
GoRaleigh					
GoTriangle	▇				
GoWake				▇	
Collision Avoidance System					
GoCary		▇			
GoDurham					
GoRaleigh	▇				
GoTriangle				▇	
GoWake					
Real Time Bus Information					
GoCary	▇				
GoDurham	▇				
GoRaleigh	▇				
GoTriangle	▇				
GoWake	▇				

The Regional Transit Technology Integration Plan presents recommended action strategies over the next five years with an estimated capital funding range of $25 to $50 million. The Plan builds a pathway for the region to follow over the next five years and beyond.

Figure 2: The technology roadmap is estimated to require between $25 and $50 million in capital investment over the next five years. Estimated ranges for AFC, ITS and Business Intelligence systems are shown above.

Recommendations and Next Steps

The technology roadmap provides an overview of the key systems and technologies that will help the GoForward partners and their partner agencies in the Research Triangle to realize their strategic objectives. The following recommendations and next steps will facilitate further development and implementation of the regional strategy:

• Implement a program to guide, encourage and govern regional technology investments to help realize optimal benefits

- Develop a regional enterprise architecture for strategic technologies that ensures integration and accommodates partner agency plans, capabilities and project delivery capacities

- Consider accelerating implementation of radio and CAD/AVL and AFC system upgrades using available funding resources. CAD/AVL and AFC systems are the foundations for improved customer service – including many customer amenities like onboard WiFi and integrated trip planning, payment, and guidance.

- Continue to leverage regional procurements and develop a strategic regional sourcing plan to optimize value and minimize implementation delays

- Include provisions to require system integration in vendor agreements

- Consider PIDS systems that are partially or wholly funded by advertisements

Introduction

The GoForward regional partners (GoTriangle, GoRaleigh, GoDurham, GoCary and WakeACCESS) retained WSP to help develop a regional plan to integrate technologies that support transit operations. The partners will use the plan to improve customer service and enhance operational performance across the three-county region.

Project Understanding

The regional partners are interested in developing a regional technology integration plan to help them identify steps that may be taken by the transit agencies jointly and individually to advance the strategic business objectives of the five partner agencies and the three-county region as a whole. The partners would like the plan to help them align the technology assets that support fixed-route, on-demand and paratransit services and improve them according to industry trends and best practices. The study should focus on technologies that support key transit functions such as

- Automated fare collection (AFC)
- Customer information and experience management
- Service planning
- Vehicle dispatch and communications
- Vehicle monitoring and security
- Vehicle and facility operation and maintenance, and
- Resource planning and management

The Partners would like the plan to foster regional integration but acknowledge the requirements and priorities of the individual regional partners. It should highlight standards and practices that will facilitate integration while affording flexibility in deployment. The plan should also identify risks that could affect technology deployments as well as strategies to mitigate them.

Reference Documents

2040 Cary Community Plan

Central Durham Transportation Study (movedurham.org)

Chapel Hill Short Term Transit Plan

Durham County Bus Rail Investment Plan

Durham County Transit Plan

GoTriangle Strategic Plan 2017-2021

GoTriangle Short-Range Transit Plan

Orange County Transit Plan

Wake County Fare Integration Study

Wake County Transit Plan

Western Wake Comprehensive Operational Analysis
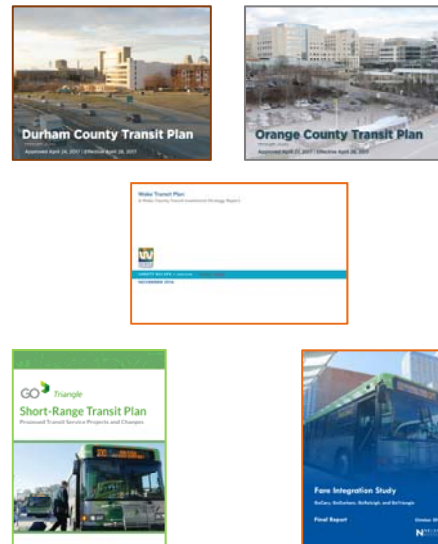
Approach

The Regional Partners set out to develop a regional technology integration strategy that

- Helps the partners and the region advance their strategic goals and objectives
- Leverages industry trends and best practices
- Includes opportunities for near-term wins
- Is embraced by both customers and stakeholders

Report Contents

This report summarizes the recommended framework that will help the regional partners leverage their technology assets to provide better service to the region and operate more effectively. It is the culmination of the work of the inter-agency study team that worked closely together to identify alignment opportunities based on regional goals, distill priorities based on business objectives, highlight potential benefits and balance them against resource requirements and available capacity. The report provides an overview of key transit technologies, summarizes how they might be aligned for optimal regional results, and provides a roadmap along with recommendations to help the three-county region and the partner agencies move forward.

Glossary of Terms

Application Programming Interface (API): an interface or communication protocol between a client and a server.

Automated Fare Collection (AFC) Systems: enable transit agencies to collect, process and manage revenue collection activities.

Automated Passenger Counter (APC): electronic device that is available for installation on transit vehicles that accurately records boarding and alighting data.

Automated Voice Annunciation (AVA): a system on transit vehicles that provides an audible announcement of transit information, such as the approaching stop, during the trip.

Bus Rapid Transit (BRT): high-quality bus-based transit that delivers fast and efficient service. BRT systems may include dedicated lanes, traffic signal priority, enhanced stations, off-board fare collection, etc.

Commercially off the shelf (COTS): used to describe products that are ready-made and available for sale to the general public.

Collision Avoidance Systems (CAS): a system that uses radar, LiDAR, or some other detection method and is designed to prevent or reduce the severity of collisions.

Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL): the use of computers and Global Positioning Systems (GPS) in dispatching and tracking a fleet of transit vehicles. CAD/AVL systems usually result in added costs of operating and maintaining additional computer equipment, but agencies benefit from improvements to customer service through real-time information.

Driver Control Units: functions as an interactive communication platform for the bus and its equipment.

General Transit Feed Specification (GTFS): a common format for public transportation schedules and associated geographic information.

Intelligent Transportation Systems (ITS): a variety of technology-based systems, techniques, and methods used to relieve congestion, improve road and transit safety, and increase economic productivity.

LiDAR: an acronym for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges.

Microtransit: a form of Demand Response Transit (DRT) that offers flexible routing and/or scheduling of minibus vehicles.

Mobility as a Service (MaaS): describes an idea of combined transportation services from private and public providers through a unified gateway that creates and manages the trip, such as a smartphone application, which users can pay for with a single account. MaaS is a concept that characterizes the shift away from personally-owned modes of transportation and towards mobility provided as a service.

National Transit Database (NTD): a federal reporting program for transit agencies receiving Federal Transit Administration funding that serves as the primary repository for all transit-related data and statistics in the United States.

Paratransit as a Service (PaaS): similar to MaaS, Paratransit as a Service combines transportation services offered by private and public providers for people with disabilities or who cannot use regular, fixed route transit.

Passenger Information Display System (PIDS): automated system for supplying users of public transportation with information about the nature and state of a public transportation service.

Pedestrian Warning Systems (PWS): a system that alerts pedestrians of the presence of the vehicle moving slowly in either drive or reverse using an audible warning player from a speaker mounted on the vehicle.

Predictive Maintenance Systems: techniques used to determine the condition of in-service equipment in order to estimate when maintenance should be performed.

Radio Frequency Identification (RFID): uses electromagnetic fields to automatically identify and track tags attached to objects.

State of Good Repair: an asset is considered to be in a state of good repair if it is in a condition sufficient for the asset to operate at a full level of performance.

Traffic Signal Priority (TSP): also referred to as Transit Signal Priority, includes a set of operational improvements that reduce dwell time of transit vehicles at traffic signals by holding green lights longer or shortening red lights.

Ticket Vending Machine (TVM): an electronic vending machine that allows riders to purchase single fares, add value to fare media, or generate proof-of-payment tickets from passes.

Zero Emission Bus (ZEB): buses that operate strictly on electricity powered batteries and not gasoline or overhead wires.

Background

The regional technology plan is intended to reflect regional objectives and priorities as well as partner goals, business objectives, and priorities. These key components were arrayed against the partners' current technologies and technology landscape. The partners then considered industry trends, best

practices along with opportunities and challenges, before highlighting alignment opportunities and developing a technology roadmap.

Agency Goals, Business Objectives, and Priorities

The WSP team met individually with each of the regional partners to discuss, understand and document their short and long-term business goals and objectives. Each agencies goals and objectives were revisited at the October 2019 road mapping workshop and are summarized below. As the process moved forward it became abundantly clear that each partner agency shares the common regional goals that include increasing and improving mobility, enhancing customer service, and improving regional coordination.

The partner agencies share three goals:

1. Improve Mobility

2. Enhance Customer Service

3. Improve Regional Coordination

GoTriangle

GoTriangle is building a transit network that will offer an even more convenient, seamless way to travel across the region. In doing so, GoTriangle is dedicated to access to transit in the Triangle.   Key priorities are the expansion of bus service, improvement to bus stops and shelters and implementation of a new 37-mile commuter rail system. Technology priorities are noted to be the upgrade of voice communications and dispatching, and procurement of new CAD/AVL and fare collection systems.

GoWakeACCESS

GoWakeACCESS key objectives are to provide new service to rural areas not served by existing fixed-route transit service, improve customer service for their passengers (new resources at Customer Service Center), and to create a centralized or inter-operable call center for scheduling and dispatching. The agency is open to exploring opportunities to use a common scheduling software to assign trips based on cost and demand rather than transit operator, and development of a Wake County travel training program to encourage use of the fixed-route network. Providing the customer more ownership of their ride, i.e. greater visibility into the timing of their vehicle's arrival and exploring Paratransit as a Service (PaaS) are areas the agency wishes to explore.

GoRaleigh

The agency is focused on the introduction of new Bus Rapid Transit services under the Wake Transit Plan in addition to other services such as connections to Garner, Rolesville and Knightdale. GoRaleigh has ongoing programs for a GoRaleigh/GoWakeACCESS ADA shared maintenance facility, and East Raleigh and Midtown Transit Centers, and are improving shelters for new and existing bus stops. Key technology priorities are implementing mobile ticketing and fare capping, improving real time bus information, and implementing collision avoidance systems.

GoDurham

GoDurham's long term objectives are to provide greater transportation options, positively impact traffic congestion and air quality and support local development policies. Some key programs are service quality improvement, improving on-time performance and reducing over-crowding on vehicles. Technology priorities for GoDurham are to remove cash from on-board the vehicles, provide an Origin to Destination mobility app, integrate parking and transit mobility, improve real time bus information,

introduce a traffic signal priority system for transit vehicles and improve the effectiveness of their paratransit system.

GoCary

GoCary wishes to increase the service and frequency of their fixed route service and improve reliability and the efficiency of interconnections with other transit services. The agency seeks to provide best-in-class transit services and is working on bus stop improvements. Major capital projects include a feasibility study for a Downtown Cary Multi-Modal Transit Center and a new Bus Operations and Maintenance Facility. Technology priorities include an improved fare collection system, implementation of an integrated and connected ITS system, improved customer services in the area of the call center and providing customer information, improved efficiency of paratransit services and improvements to the business management information systems.

Regional Objectives and Priorities

The Triangle region is one of the fastest growing metropolitan regions in the United States and this growth has precipitated a move to improve and expand transit services in the region. Among the region's key goals are those noted in the Wake County Transit Plan, which are described as four 'big moves':

- connecting the region

- connecting communities

- creating frequent, reliable urban mobility

- enhancing access to transit.

GoTriangle's regional goals in its 2017-2021 Strategic Plan echo those in the Wake County Transit Plan. They are to improve mobility in the region; assure high-quality customer service through direct operation and partnerships; and encourage sound growth patterns.

Figure 3: Key regional goals and objectives

The Durham County Transit Plan, adopted in 2017, states that goals are to 'continue to develop an exceptional public transportation system … that provides greater transportation options for Durham residents and employers, positively impacts traffic congestion and air quality and supports local development policies.'

The Orange County Transit Plan, also adopted in 2017 and developed in coordination with the Durham County Transit Plan describes goals as 'improving overall mobility and transportation options, providing geographic equity, supporting improved capital facilities, encouraging transit supportive land use and providing positive impacts on air quality.'

Both the Durham and Orange Transit Plans are currently being revisited and will be updated as the Durham Orange Light Rail project is no longer moving forward.

Industry Trends, Best Practices

Transit ITS (Intelligent Transportation Systems) and Automated Fare Collection (AFC) technologies are evolving at an increasing pace. The following section provides an overview of some of the key practices and industry trends for both ITS and AFC technologies.

ITS Practices and Trends

Transit ITS technology involving communications, data collection and control and improved customer experience continues to advance, taking advantage of many light duty automotive based systems which are some of the drivers of innovation in this field. Heavy duty trucks are another area where advances lead to innovation and standards for communication, data, and compatibility. All of this will drive the ability for multiple platforms to integrate with other provider's technology seamlessly for use by the transit industry. Many systems will provide the same or similar services now, but the speed of communication and the ability, availability and types of data storage will advance as the market and technology grow.

Bus manufacturers have departments devoted to new technology and the customer demands, integration, and testing including support, training and warranty.   The APTA bus procurement guidelines have sections dedicated to the individual systems (TS 45 for bus data communications, TS 76 for farebox, TS 86 for communication APC, Radio, Security Cameras etc.) which will aid in the procurement of regionally compatible systems.

Most systems have some level of continuing system/data recurring costs on a monthly or yearly basis (such as cellular plans at a minimum) and this practice will continue. These costs can be rolled into service contracts with component suppliers, service providers or bus manufacturers. Review of the contract language will be critical to identify and plan for recurring monthly and yearly fees. Yearly software license fees, fees for hosting software, maintenance, changes and support of AVA stops, as well as subscriptions for service can be costly and must be planned for.

Most new ITS systems have the capability to interface with other vendor hardware and software using open architecture and open automatic programming interfaces (APIs). These open systems provide system owners with greater hardware and software options which can also make systems more cost effective. Specifying open systems in future procurements will provide the partners with more flexible systems.

AFC Practices and Trends

Innovative technologies are emerging which will allow each agency in the region to partner together and provide a coordinated transit service to residents in the Raleigh/Durham region. Today these direct trips often overlap are not coordinated regionally. Each transit agency has different route fare and transfer policies. There is no single regional value pass or fare media to encourage passengers to take advantage of the multiple transit service opportunities.

Almost all agencies have purchased Genfare fareboxes over the past decades and now strive to maximize the customer experience while minimizing dwell time with this aged equipment. This region has a unique opportunity to carefully plan a regional fare system that will benefit all partners, especially transit passengers. Fare systems that support automated fare collection practices are becoming the

norm. These technologies include new forms of fare system architecture (account-based systems) and fare media (such as smart cards, mobile phone applications and near-field communications).

The next generation of fare system in the Raleigh/Durham region should be a non-proprietary open architecture system; have an expandable and flexible design that can evolve as needs and technology change; be simple for customers to use and for the regional agencies to manage; be stable and compliant with security standards; and use leading, yet proven technology for fare payment that maximizes fare media already held by customers. All fare products and value loaded by customers should be stored in the account- based backend and all validation should be equipped with real-time communications.

Opportunities and Challenges

The GoForward partners recognize that the region faces both opportunities and challenges as it adopts, implements, operates and maintains technology solutions. The opportunities include implementing new automated dispatching solutions (CAD/AVL) that significantly improves information available to both customers and managers; realizing additional benefits to regional customer service (the region has already achieved benefits from regionalizing the customer call-center); and planning ahead for the next generation of mobile ticketing and its greater capabilities and cost efficiencies.

The challenges facing the partners include supporting and maintaining new technologies; ensuring that there is adequate funding for them; encouraging technological innovation, coordinating planning, implementation and operation through an effective governance structure; and procuring, implementing, and acclimating to systems before the industry is ready to replace them.

Technology Alignment

In the process of developing the Regional Technology Integration Strategy, the GoForward partners identified opportunities for technology alignment. These alignment opportunities are based on regional and agency goals, objectives and priorities; best practices and industry trends; as well as current plans and capacity to fund and deliver projects. Alignment opportunities for each major technology opportunity are summarized below.

Voice and Data Communications

The Current Voice and Data Communications Environment
Communication technologies are heavily dependent on the available infrastructure and devices that are used to transmit voice and data. Communications infrastructure is critical to the planned integration and implementation of transit ITS technology being considered by the regional partners. It supports the exchange of critical information – both audio and data – between drivers, dispatchers, emergency responders, and supervisory personnel. It can also support WiFi access for passengers.

GoCary uses a cellular system to communicate with its drivers and provides WiFi access to passengers. This works well for GoCary but limits its capability to quickly communicate with groups of GoCary drivers or with other partner agencies.

GoDurham recently upgraded its radio system to the APX6500 hand-held model and has no reported problems. WiFi on GoDurham buses is heavily used by passengers and has reported issues with bandwidth throttling during periods of high usage.

GoRaleigh has updated the voice and data communication systems in most of its buses, which are equipped with Motorola APX4500 radio systems. Data is transferred using the Verizon cellular system, which also provides cell service to passengers. Not all buses are equipped with WiFi for passengers, but the service works well on those that are equipped.

GoTriangle's current radio network suffers from signal dropouts in certain areas and its aging equipment is beyond its useful life and will no longer be supported by the manufacturer. Its APX4500 and hand-held APX6500 have reported communication problems with other regional transit partners resulting in missed connections. GoTriangle uses a Verizon based cellular network for data communication.

GoWakeAccess uses Motorola XTL2500 radios on one channel and its system is working effectively. Data is transmitted using tablet computers on the Verizon cellular system and tablets. Voice and data are currently not integrated nor a component of a CAD/AVL system. GoWakeACCESS does not provide WiFi access for its passengers.

The GoForward partners would like to improve their ability to communicate and transmit data. Agencies like the GoForward partners are moving from analog to digital based radio voice and data communication. Connected vehicles are sharing data with each other (like google traffic or WAVE). Voice over Internet Protocol (VOiP) is available through almost all cellular providers. Talk to text and canned communication is a common means of communication and CAD systems provide additional features which utilize this option

Cellular based communication using data terminals, text, talk, WAN and focused broadcast messages to buses and support operations is available in a variety of configurations and can be scaled for use by the individual partners. Some will only utilize a simple hand-held radio for communications while others will require data and voice capability.   New ITS systems have significant capability to transfer video, audio, location, and number of passengers on a vehicle in real time or near real time with the use of a buses AVL system. Current 4G technology is adequate for existing data and voice communication and future systems will be faster with the implementation of 5G service. As 5G becomes more prominent, route-planning technology, especially for buses can be greatly enhanced. A reduction in wait times and real-time updates, for example, will make transit systems more efficient and easier for the everyday traveler to navigate.

Partner Plans and Priorities for Voice (and Data) Communications/Radio Environment

Planned replacement of older CAD/AVL systems will greatly enhance the capability to transfer data and voice communications using cellular channels. The features inherent to the latest models of CAD/AVL systems provide user friendly and intuitive means of transfer of data, texts and emergency broadcasts. Specifications for new ITS systems should emphasis open architecture and open API for future expansion and flexibility. Data used to generate real time passenger information will be provided these same systems.

GoTriangle is seeking funding to replace the existing radio system which will not be supported by the end of 2019. They are comparing options for either the State or County system for purchase of new equipment including a base station. New radios combined with the planned new CAD/AVL system will provide better coverage and communication capabilities.

GoCary expressed a desire to move away from push to talk communication systems for their vehicles. Better abilities for regional communication was reported as a priority. They will be transitioning to a new operator contract (MV) in the near future and will negotiate a contract at that time.

GoDurham recently upgraded their system and will likely maintain the APX6500 system for 4-5 years. GoRaleigh and GoWakeACCESS did not report any changes to their current equipment in the near future.

Radio systems remain in use by many agencies as a backup for cellular communications and for the ability to communicate with service vehicles not equipped with cellular systems. There are options for replacement radio systems using either the State or County contracts for interoperability among agencies.

Alignment Benefits, Challenges
Alignment of voice and radio communications strategies will provide potential Operational cost savings through adherence to schedules, communication with other Partners, and real time information sharing. Safety and emergency situations can be addressed more easily and with a more focused approach using cellular based systems. GoTriangle has reported problems with wide area broadcasting of calls and would like to be able to communicate with specific buses without all other buses being involved and able to hear the broadcast.

Automated Fare Collection (AFC)

The Current AFC Environment
Four bus system operators (GoCary, GoDurham, GoRaleigh and GoTriangle) utilize Genfare validating fareboxes. GoRaleigh recently installed Genfare's Fast Fare fareboxes which is the current technology manufactured by the vendor, and the remaining three bus operators utilize Genfare Odyssey fareboxes which relies on several components that are no longer manufactured or supported. Fareboxes are largely mechanical pieces of equipment carefully calibrated sets of plastic gears, belts, sensors and circuit boards that pull in cash and coins deposited by cash-paying customers. With so many moving parts, the margin for error is small. Just like any other mechanical failure on a bus, fareboxes that break down while in service can cause a bus to be replaced or revenue not collected.

The fareboxes are in constant use with high rates of failure. Signs of excessive wear on the units are apparent. The Ticket Reader/issue Machine (TRiM) units within the fareboxes contain many moving mechanical components and have a high failure rate. In addition, the counting room vaults at many bus depots are dated technology. GoWakeACCESS utilizes a Routematch program which calculates the fare and cash payment is given to the driver.

The Genfare Odyssey fareboxes at GoCary, GoDurham and GoTriangle are near the end of their useful life and need to be replaced with new fareboxes. GoWakeACCESS does not use fareboxes, but if they want to automate the reconciliation of their revenue, they will need to install validating fareboxes. GoRaleigh is using the latest farebox technology and does not need to make any investment in fareboxes in the near future.

Partner Plans and Priorities for AFC
Improving revenue collection with new technologies and options presents tremendous opportunities to better engage and inform passengers and improve the efficiency and reliability of the regions' services. Experience from other regions suggests that a well-designed and implemented system based on

electronic fare payments can provide increased customer satisfaction, greater revenue accountability, improved data for service planning and operations, and enhanced service, especially when transitioning away from on-vehicle cash collections.

Mobile ticketing technology has become more relevant now than ever. The regional partners are pursuing a regional approach to mobile ticketing to help achieve their goal of using technology to enhance the passenger experience. Mobile ticketing can be a cost-effective technology improvement which can accommodate fare capping and other discount programs. While relatively new to the transit marketplace, this technology is proving to be an important factor in increasing rider adoption and improving efficiency in transit operations. Mobile ticketing is allowing public transportation to appeal to an entirely new audience that doesn't utilize public transit, as well as their current riders that are willing to ride more frequently.

Fareboxes need to be replaced with new technologies that are account-based, open-payment and open-architecture systems. This will provide greater security and flexibility, forward-compatibility with developing technology, ability to interact with a variety of payment sources, opportunity to replace equipment available from several suppliers, and provide a long life-span and lower life cycle costs.

Many of the Genfare Odyssey fareboxes are near the end of their useful life and need to be replaced with new fareboxes. An account based open architecture specification should be developed which will allow for greater system expandability. An open architecture will lay the foundation for potential integration with trip planning, rider sharing, and other services. Open architecture will also allow for the ability to share technology, applications, and payment media across the region.

Developing a robust transition plan will not only ensure a smooth transition for each agency and customers, it will also help guide the procurement process and implementation plan. The degree to which the region chooses to maintain, upgrade, or replace existing system elements will determine the scope of a new system procurement. While a full system replacement can provide more advanced features, it can cost a significant amount in cost and time. Leveraging legacy systems can extend the useful life of existing investments, and still provide core improvements and upgrades. The region should develop a comprehensive transition plan prior to the development of a technical specification.

Given the significant investment devoted to the existing fare system, and the high cost and potential risk associated with a full system replacement, a strategic upgrade analysis and detailing the results in a Concepts of Operations (ConOps) is recommended. ConOps have been developed and recommended as a best practice by several peer agencies and industry vendors. It can be used a living document that describes several critical aspects of the regions fare collection technology, procurement and operations. By understanding and discussing each of these aspects prior to procurement, the regional agencies can minimize risk.

The key decisions made in the development of the ConOps will impact the overall cost of the fare collection system. In addition to considering the costs of a single system integrator, additional cost scenarios should be developed for a strategic upgrade option as well as a split procurements approach. Updating the capital cost estimate is a key component of the ConOps.

Alignment Benefits, Costs, Challenges
Based on experience of other regions, full implementation of a regionally integrated fare payment system takes a significant amount of coordinated agency effort and funding and could take up to five years. The fare collection projects identified in this Technology Plan identify some near-term fare

coordination efforts that could help advance regional fare integration goals as well as prepare the region for capturing the benefits of a regionally integrated fare payment system.

Innovative technologies are emerging which will allow each agency in the region to partner together and provide a coordinated transit service to residents in the Raleigh/Durham region. Today these direct trips often overlap are not coordinated regionally. Each transit agency has different route fare and transfer policies. There is no single regional value pass or fare media to encourage passengers to take advantage of the multiple transit service opportunities.

Almost all agencies have purchased Genfare Odyssey fareboxes over the past decades and now strive to maximize the customer experience while minimizing dwell time with this aged equipment. This region has a unique opportunity to carefully plan a regional fare system that will benefit all partners, especially your passengers. Fare systems that support automated fare collection practices are becoming the norm. These technologies include new forms of fare system architecture (account-based systems) and fare media (such as smart cards, mobile phone applications and near-field communications).

The next generation of fare system in the region should be a non-proprietary open architecture system; have an expandable and flexible design that can evolve as needs and technology change; be simple for customers to use and for the regional agencies to manage; be stable and compliant with security standards; and use leading, yet proven technology for fare payment that maximizes fare media already held by customers. All fare products and value loaded by customers should be stored in the account-based backend and all validation should be equipped with real-time communications.

It is critical that the region follow best practices when implementing fare systems as careful attention should be made to the system design. The system design refers to the overall technical functional aspects of the system. This covers a broad cross section of elements from the fare media to the customer service support software. It is important to address policy issues in advance of system design, organize agencies to get involved early to ensure their specific needs and constraints are addressed, organize to reflect conflict as a governance approach should be developed, and clearly define the functional requirements of the system and the scope of services of the system contractor, including interfaces with other systems, customer use, and the agency responsibilities. Focus on functional requirements and avoid proprietary design.

CAD/AVL/AVA Systems

The Current CAD/AVL/AVA Environment
The Partners have a wide range of Computer Aided Dispatch/Automated Vehicle Location (CAD/AVL) systems – from newly installed systems with full functionality to older, end-of-life systems with waning functionality and support.

GoRaleigh has installed new ITS systems on its buses including a full suite of advanced functions including CAD/AVL, and Automated Voice Announcement (AVA) systems. Updated CAD software will allow better reporting, visibility of buses in service, review of performance parameters in addition to more accurate dispatch and operations support.

GoTriangle has a system which will not be supported by the manufacturer in the near future. Accurate bus location information is not available, reports are limited and dispatch of buses is done manually. GoTriangle is using APC data for scheduling and planning due to the existing problems with their AVL capabilities.

The GoCary CAD/AVL system is not functioning properly and is a maintenance burden which is providing limited use. Many features associated with the AVA are not integrating with the older hardware and software. GoCary is considering maintenance agreements to continue operational capabilities of the existing system.

GoDurham indicated their system needs replacement in 2021. The current ITS is functional, but with limited capabilities. Better tracking and reporting features are a major desire in addition to the ability to generate real time information.

GoWakeACCESS offers unique service and requires limited CAD/AVL features, but they are using an older computer tablet-based system which was listed as a priority for replacement to aid in dispatch and real time information.

Partner Plans and Priorities for CAD/AVL/AVA

During discussions with the different agencies, integration of the various ITS features into a functional system which provides the necessary data, communication and connectivity is crucial. GoRaleigh is in the final stages of a fully integrated CAD/AVL system which provides accurate data for AVA required stop announcements, GTFS in real time for passenger information and back office reporting capabilities.

Just as in the case with replacement of the fare collection systems, developing a plan for new CAD/AVL systems will not only ensure a smooth transition, it will also help guide the specification development, procurement process for each agency and implementation for the region. A replacement of the CAD/AVL system requires an understanding of the features and functions desired as the individual agency, and as a regional partner as well.

GoTriangle is in immediate need of replacement systems and GoDurham and GoCary need to plan for replacement ITS in year 2021. The systems in use were stated as not providing real time data, not having a capable cellular system and are an Operational burden. During interviews with the Partners and at the Roadmap workshop, real time passenger information was listed a priority by all agencies. Generating the data to support a real time information system requires a CAD/AVL system with cellular communication technology.

GoWakeACCESS requires limited ITS capabilities due to the nature of its service but would benefit from specific new CAD system features with AVL for dispatch and to aid in generating real time data. Their service still needs to have visibility of the individual vehicle location which a cellular connected AVL system offers. Their dispatch will require careful consideration of a CAD system coupled with the AVL to accommodate the dispatch and scheduling requirements of their operations.

Alignment Benefits, Costs, Challenges
CAD/AVL systems are the backbone of the ITS functionality. The hardware and software monitors the data flow, knows the vehicles real-time location, provides schedule adherence tracking, meets ADA requirements, as well as adding convenience for all customers by providing "Next Stop" announcement systems through the AVA system and the mobile cellular system. Newer CAD/AVL systems will benefit the regional partners through the sharing of accurate data, generating useful reports, and assisting with the timing of bus arrival information. Some of the goals for the new CAD/AVL systems include the following: improving on-time performance by disseminating continuous, real-time information to drivers, improving dispatch reliability and efficiency, improve scheduling and planning by providing more accurate data and reducing the schedule preparation time and staffing, improving scheduling and planning, and improving data management and reporting by automating data collection and improving

the accuracy and accessibility of the data. A regional procurement would help reduce costs, improve vendor support and improve contract terms.

Real time passenger information was mutually agreed as the area most in need of alignment to provide accurate information to the customers. Accurate bus location information and use in a variety of web and application-based programs would improve such areas as the riding experience for the public, provide agencies with the visibility needed to support each other at regional transit centers, possibly reduce costs. New CAD/AVL systems with cellular communications will provide this capability.

All five partners use Verizon as their cellular provider and should consider a unified business approach for pricing and service level efficiencies and maximum bandwidth allocations. This may be another valuable topic for the agencies to discuss.

Real-Time Bus Information

The Current Real Time Bus Information Environment
The GoForward partners were early adopters of the TransLoc system, which still provides bus arrival information for customers. The system worked relatively well for many years and initially it contributed to a reduction in calls to the customer service center. Over time the TransLoc system degraded and the information provided by it became less accurate. In addition, the system will no longer be supported by the vendor after June 2020. To complicate matters further, the accurate data needed to provide real time information is not available from several of the Regional Partners due to the age and capability of their CAD/AVL systems. GoRaleigh is installing a new CAD/AVL system which is expected to provide the information required, but the other partners will continue to rely on a static GTFS feed for predictive arrival information.

Partner Plans and Priorities for Real Time Bus Information
All of the regional partners believe it is a priority to provide accurate, valuable arrival and status information to their customers. They would like the new system to be more efficient – better integrated with their automate dispatching systems and based from the beginning on industry standards like GTFS-RT (General Transit Feed Specification – Real Time). They would also like to ensure that the system is more accurate and capable – for example, that it enables customers to see where their bus is and when it will arrive, even if it is currently completing another route before it begins their route.

The GoForward partners have established a working group to address the loss of service in 2020 and develop a bridge strategy to ensure continuous operation while a longer-term strategy, such as replacement and alignment of CAD/AVL systems, can be implemented.

Alignment Benefits, Challenges
The benefit of accurate travel data will result in fewer missed rides, fewer complaints, possibly increased ridership and regional connectivity as transit users are able to make their travel plans better. During interviews and discussions, real time data was ranked as one of the most important issues by the Regional Partners. Several of the partners will require new or updated CAD/AVL systems that will generate real time bus information. A unified approach, which specifies the functional and technical requirements for not only the agency, but the region should be carefully considered by the working group.

Vehicle Safety Systems / Collision Avoidance Systems

The Current Vehicle Safety/Collision Avoidance System Environment

Collision Avoidance Systems (CAS) such as RADAR, LiDAR, cameras and proximity sensors are used in various combinations to detect and warn of potential threats. Pedestrian Warning Systems are used to detect and warn pedestrians of a vehicles movement such as turning near crosswalks. Past pilot testing on passenger warning systems resulted in complaints due to the noise emitted from the buses to warn passengers when the buses were in residential areas.

Partner Plans and Priorities for Vehicle Safety/Collision Avoidance System

GoRaleigh conducted pilot testing of the most advanced Mobileye system which continuously monitors the road ahead and analyses the risks of forward collisions, unintended lane departures, tailgating, and pedestrian and cyclist hazards. GoWakeACCESS and GoCary use the camera-based Mobileye system which is mounted to the windshield for forward detection and warning. GoDurham and GoTriangle do not use Collision Avoidance Systems but will make it a priority in the near future.

Alignment Benefits, Costs, Challenges

A regional approach for the specification and procurement of vehicle safety systems such as collision avoidance will improve driver performance while reducing potential collisions. All partners recognize the inherent safety benefits to passengers, pedestrians and employees from the use of CAS as drivers grow accustomed to the alerts and anticipate them. Therefore, drivers naturally begin to keep a safer following distance or stop earlier in anticipation of the warning. Operational costs are also reduced as collision costs are steep, from replacement parts and vehicle down- time to late delivery charges, increased insurance premiums and more.

Automatic Passenger Counting (APC)

The Current APC Environment

APC systems are electronic machines that count the number of passengers that board and disembark at every bus stop. The accuracy of counting passengers from new APC systems is approaching 98 percent. Detection units can be located in multiple locations on the vehicles including using a variety of detection methodologies and the detectors are rugged and dependable. Data is capable of real time transfer through the AVL system and coordination with GPS location information and fare collection for data reconciliation and reporting. Together with AFC systems, this forms the technologies that many transit systems have. In systems that have them, they replace the schedule checks that previously collected ridership information manually and do not have rely on farebox data reporting which could be troublesome. When the Federal Transit Administration is satisfied the APC systems are calibrated correctly, ridership information can be used to fulfill National Transit Database (NTD) reporting requirements.

All agencies with the exception of GoWakeACCESS are utilizing APC technology to various degrees of success. GoDurham has 100 percent of their fleet operating and the system is providing extremely good accuracy. GoCary is in the process of certifying their APC data so it could satisfy NTD reporting requirements. GoTriangle is not as far along as their APC data cannot be used for scheduling and planning due to AVL problems. In addition, the APC system is not used to reconcile passenger counts from the Genfare fare system.

Partner Plans and Priorities for APC

The partners in the region would like to integrate their APC system with their AVL and AFC systems at some point in the future, but it is not a priority at this time. Prior to implementing a new APC system

the agencies should establish a data collection procedure that meets each agencies' needs, avoid unnecessary customization, and clarify the responsibilities from several departments within each agency as the working relationships could change because of this new technology.

Customer Amenities and Customer Service

The Current Environment for Customer Amenities and Customer Service
The Regional Partners currently provide various customer amenities including on-board WiFi and in the case of GoRaleigh, onboard device recharging. The partners planning to provide new and improved tools to help customers with trip planning, payment and real time guidance.

Partner Plans and Priorities
The partners are not only focused on amenities, like improved WiFi and a new mobile payment application, but they are also interested in improving the customer experience by streamlining the way people plan and pay for their trip. They are also interested in strengthening customer relationship management through their regional customer call center.

Customer Service
The major requirements for establishing and operating a Back Office System (BOS) which supports a regional call center consist of account management (e.g., customer account functions, customer communications, customer disputes, customer applications and user guides, customer statements, credit card notices, report capability, and credit card processing security), financial management (e.g., accounting features, credit card clearing house, and report capabilities), interface with a record management system and telecommunications which provide software for customers to communicate with the BOS.

A proper, well-designed project management approach is key to planning each task effectively and within tight time constraints. The management approach should be straightforward yet highly effective. All activities should be thoroughly planned before work begins, then diligently following the plan, monitor progress, and fine-tune the plan as necessary. The result of this common-sense approach consistently achieves high-quality output within agency budgets and schedules. Proper equipment and training manuals are also critical elements in achieving a long BOS life. These materials should be provided with significant information on the operation and components of the system. As these will probably be the only materials in hand, it would be imperative that the materials be made available as quickly as possible after completion of the design review. This will ensure the documents reflect the design agreements and that sufficient information is included to provide agencies with the necessary system component and software information.

In addition, as training will normally be provided once by the BOS Integrator, training requirements should be designed to provide audio/video support as well as subsequent refresher training. A well-defined testing plan is just as important as any other element of the BOS program. When designed properly, tests can identify critical difficulties and system problems well in advance of production or installation. Design testing should be performed upon fabrication of the initial item of each type of equipment and or software. This will vary depending on the design element and function of the BOS to ensure that it operates properly. Once all the hardware and software are tested, integration and acceptance testing should be performed. The system vendor's test plan and test scripts should be reviewed to ensure that no critical functionality is overlooked. The implementation schedule should be reviewed to confirm that adequate time has been allocated for testing and there is time in the schedule

for re-testing if required. Participation in factory, field and operational testing of the BOS should also be included.

Alignment Opportunities

Call centers should be viewed as a universal shared service, much as finance or human resources are services shared across an organization. Call centers are the hub of the customer experience and where more than 50% of all customer interactions take place. There are operational benefits attainable through call center technologies and after people, technology is often the second largest cost in operating a call center. Today call center technologies are many, varied and often complex. With telephony platforms, niche or point solutions for email, chat, interactive voice response (IVR) and short message service (SMS), customer relationship management (CRM) and back office systems. Many of these systems are integrated and tied together so that changing or upgrading a single technology can have impacts on others.

Of course, each center has different needs, goals and objectives for their center, so each regional call center is unique and based upon each agency's functional, operational and financial objectives. The optimal solution utilizes commercial off the shelf software and which utilize conversational natural-language capabilities and blend artificial intelligence (AI) to provide exceptional service to agency's customers. Personas based on demographics or customer preference further personalize the customer experience. By combining self-service with personalization, agencies can transform their call center system into a valuable asset for building customer relationships. Improving the customer experience with automation and AI-based innovations enable our voice and digital self-service system to understand the real meaning behind a question and then deliver only relevant answers. When an agent is needed, AI seamlessly transitions the customer, along with all their relevant information and context, to the right agent at the right time. This will serve up a better experience, reduce call volumes and improve first contact resolution. The technology solution should reflect best practices in business processes and gets the microapps up and running quickly. Using microapps with automatic support across voice and digital channels, including web chat, Facebook and mobile, allows us to design and personalize the whole customer journey in a single process. An open-access approach lets each call center system fully integrate with other third-party data sources including natural language processing and AI engines to create conversational self-service business process automation or intelligent apps. Built in service analytics gives us full visibility into how your customers move through their self-service journeys. Because it's easy to understand these journeys you will see significant savings in time customers spend on your system and it will be improving the customer experience through continual optimization. When customers contact call center agents, having context from previous voice and digital interactions creates a better experience.

The optimal technology solution should leverage public APIs which provide interaction into other agency systems that require integration. This will save each agency and its vendor valuable time and cost in designing, developing, testing and implementing innovative solutions. Payment card industry data card security standard (PCI DSS) compliance is a very important issue. The technology solution which allows customers to pay bills with a payment application that is used during an assisted expert interaction with your agents must be protected through PCI compliance. Data breaches are becoming more sophisticated, frequent and expensive; thus, the risk of reputation damage is at an all-time high. The PCI DSS is there to protect both agencies and their customer's data. When a customer makes a payment over the telephone, the sounds made by the key tones using dual tone multi frequency are masked so the agent can stay in contact with the customer throughout the entire call. As agents are on hand at every step of the payment process, any changes or errors can be dealt with instantly, which greatly improves customer satisfaction and reduces the number of abandoned calls.

The ultimate measure of how the regional call center operation is performing is through customer satisfaction surveying. A customer survey should be offered to all customers/all interactions. This is facilitated through the phone system. Post-contact surveys are supported by phone system and configurable; all reporting available within system and part of dashboards (Phone via IVR, Email link, and SMS/chat (once queue is active). Primary key indicators measured include customer satisfaction, first call resolution, and net promoter score. These measures could be used to incentivize and reward employees throughout the agency.

Opportunities and Challenges
Modern call centers have moved away from the traditional role of handling phone calls to providing a one-stop shop for customer relationship management. The goal is to provide a seamless customer experience at the lowest price point. Vendors offer all-in-one solutions for inbound, outbound, and omnichannel contact centers. Powered by cloud-based technology and AI capabilities, their software integrates with most modern CRM platforms such as Salesforce and ZenDesk.   In 2019, vendors offered plans ranging from $75 to $140 per month for each agent.

Mobility-as-a-Service

As transportation has evolved over the past several years, ride-hailing companies and shared mobility companies, including carsharing (Zipcar, Car2Go), bike sharing (Jump, Lime), scooter sharing (Bird, Lime, Razor), have spread the idea that mobility (provided by public and private entities) could be packaged together and provide a viable alternative to owning a car. The concept of combing the information, trip planning, and payment for mobility has been called Mobility-as-a-Service (MaaS).

Increasingly, most people do not make distinctions between public and private transportation options; rather, they assess modes by cost, convenience, comfort and travel time. Many people are comfortable taking a bus to work and then hailing an Uber or Lyft to go to dinner. However, today, you might have to consult several different smartphone apps to compare options and prices, and it can be difficult to combine modes for a single trip. MaaS offers an opportunity to make the overall transportation network more efficient and user-friendly by providing the ability to plan, book and pay for trips on a variety of modes using a single interface helping to improve access, convenience, while providing cost-effective travel options.

MaaS offers transit agencies the ability to create increasingly attractive incentives to take transit by providing more information on first/last mile access modes and more transparent information on things such as traffic congestion and parking costs. One day, it could be possible for transportation agencies to change fares/fees in real time in response to traffic congestion, emergency access needs or major travel demand changes. This would allow the transportation system to be used more efficiently by sending price signals for people who can switch to modes that have less of an impact on the system's capacity (e.g., taking transit or a bike rather than riding in a car).

Paratransit-as-a-Service

Paratransit provides a critical mobility service to some members of the Triangle region who otherwise cannot ride on the fixed-route network. However, paratransit is a relatively expensive and inefficient service. As technology improves, there is the potential to provide Paratransit-as-a-Service (PaaS) which includes a better customer interface and at a lower cost, either through new partnerships with service providers or better technology integration.

PaaS cam improve paratransit by improving the reservation system with more modern technologies which allow for spontaneous reservations, vehicle tracking and other customer-friendly benefits. An

improved reservation system could increase the number of rides offered per day which would reduce the cost per trip. While further exploration would be required, many transit agencies have successfully reduced their paratransit costs by partnering with a wider variety of service providers. For example, not all transit patrons require a wheelchair-enabled vehicle or direct door to door services. In these cases, less cost services can be procured through taxis or ride-hailing services reserving the more specialized services and vehicles for those who need a higher level of service.

Signal Priority

In a corridor that experiences frequent delays from traffic congestion that often puts buses behind schedule, there are agencies around the country implementing smart traffic signal technology. Traffic Signal Priority (TSP) is an operational improvement that uses technology to reduce time at traffic signals for transit vehicles by holding green lights longer or shortening red lights. When a bus is approaching an intersection, the intersection can detect the bus and modify the traffic signal timing to reduce the delay for the bus. Equipped with camera, the signals are designed to monitor the intersections and reprogram their own timing to respond more quickly to changing traffic conditions.

This technology employs artificial intelligence to coordinate traffic lights based on traffic conditions, which improves traffic flow and reduces average travel times. According to the National Association of City Transportation Officials (NACTO), 20 to 30 percent of bus travel is wasted sitting at signals or in congestion.

While it is not imperative for the region's transportation agencies to have the same signal vendors, the systems need to be compatible and coordinated. Without interoperability and coordination, the systems will not work efficiently and may induce traffic backups. If done right, smart signal systems are relatively inexpensive pieces of infrastructure that could provide a tremendous upgrade from the current, conventional, static signal systems, which operate according to set timing plans based on average volume of traffic expected during a given period time.

Technology Roadmap

The Regional Transit Technology Plan was developed by the GoForward partners to ensure optimization of future technology investments. The Plan includes a technology roadmap that will help the partners ensure that technology investments are

- aligned with regional and agency goals and objectives

- reflect best practices and industry trends

- consider agency priorities and available resources,

- identify synergies and opportunities to capture greater value, and

- consider opportunities for early wins

As they were developing the roadmap, the agencies considered regional goals and objectives for Wake, Durham and Orange counties. For example, the plan was developed to be aligned with the four 'big moves' those noted in the Wake County Transit Plan – connecting the region, connecting communities, creating frequent, reliable urban mobility, and enhancing access to transit.

These regional goals are echoed in the partner agency plans including GoTriangle's regional goals in its 2017-2021 Strategic Plan echo those in the Wake County Transit Plan. They are to improve mobility in the region; assure high-quality customer service through direct operation and partnerships; and encourage sound growth patterns.

These regional goals and partner agency plans were applied to the alignment opportunities developed by the regional partners. The alignment opportunities described earlier in this report provided a lens through which the partners could identify options to integrate and optimize technology investments that furthered their objectives.

The partners also considered best practices and industry trends for both AFC and ITS technology components of their roadmap. Aside from leveraging technology to maximize efficiencies, AFC and ITS systems are benefiting from significant innovation from firms in related sectors such as manufacturers of both heavy-duty and light-duty vehicles. These firms are investing in the sector and commercializing valuable new technologies. Ever more cost-effective services and greater system integration capabilities are simplifying and speeding installation.

Prioritization Methodology

With regional and agency goals and objectives as well as best practices and industry trends, in mind, the regional partners conducted an initial prioritization of key AFC and ITS technologies under consideration for the next five to ten years. The partner's priorities technologies based on five prioritization elements: their ability to improve the customer experience, improve operations, enhance safety and reduce risk, their ability to increase capacity, and their ability to reduce cost. Representatives from each agency scored potential technologies from 1 to 5 with five being the highest. Scores were collected and are presented below. These are initial results intended only as a first step toward refining the roadmap and affirming the general trajectory of the roadmap.

Prioritization Results

The results of the initial prioritization exercise are summarized in the table below. CAD/AVL was a top priority in three of the five categories and one of its by-products; real time bus information was the top priority in a fourth category. Other key priorities include VSS/CAS, communications systems and AFC improvements.

Table 2: Technology Priorities

Benefit Category	Top Technology Priorities
Customer Experience	Real Time Bus Information, Customer Service Center enhancements, Automated Fare Collection improvements, additional customer amenities
Operational Improvements	CAD/AVL, Real Time Bus Information
Safety and Risk Reduction	VSS/CAS, Voice/Radio
Potential Capacity Enhancements	CAD/AVL, MaaS/PaaS
Cost Reduction	VSS/CAS, CAD/AVL

The charts below illustrate the scores for the technologies under consideration within each benefit category. The bars show the range of scores registered with the midpoint shown as values.
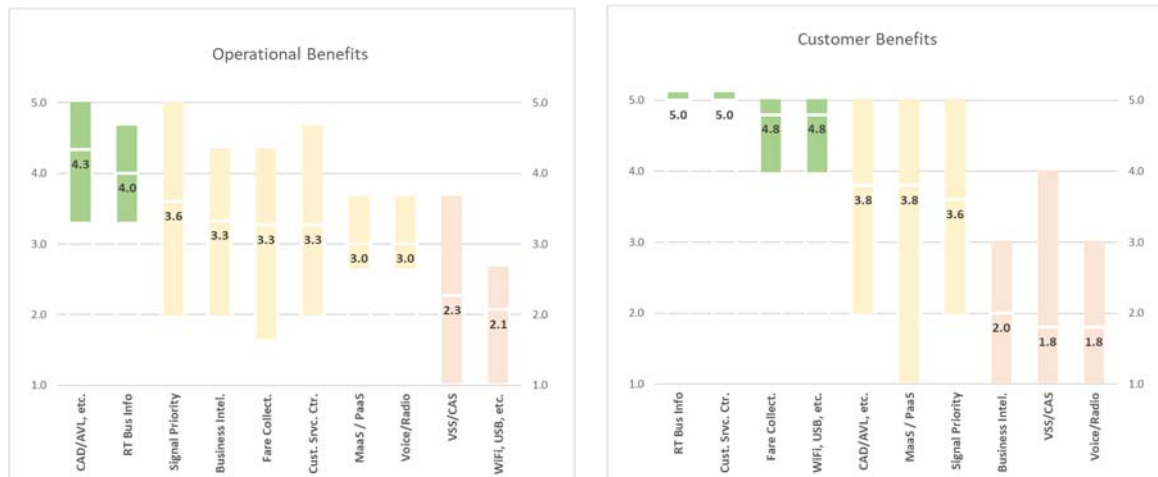
Figure 4: Five Year Technology Roadmap

Roadmap

The table below shows the current five-year regional technology integration roadmap for the region. The current roadmap includes technologies that the partner agencies have identified as critical to realizing regional goals and objectives including Wake County's "four big moves." The roadmap is constrained by agency resources – both available funds and their resources available to deliver significant new technology projects. Additional funding could help improve regional alignment and expedite implementation of key technologies such as new CAD/AVL and vehicle radio systems that would yield additional opportunities for "early wins."

Figure 5: Technology Roadmap

| Roadmap	2020	2021	2022	2023	2024
Business Intelligence					
BI System					
GoCary				■	
GoDurham				■	
GoRaleigh				■	
GoTriangle				■	
GoWake				■	
Intelligent Transportation Systems					
Automated Passenger Counters					
GoCary		■			
GoDurham					
GoRaleigh			■		
GoTriangle		■			
GoWake					
Computer Aided Dispatch / Automated Vehicle Location					
GoCary		■			
GoDurham	■				
GoRaleigh					
GoTriangle	■				
GoWake				■	
Collision Avoidance System					
GoCary		■			
GoDurham					
GoRaleigh	■				
GoTriangle				■	
GoWake					
Real Time Bus Information					
GoCary	■				
GoDurham					
GoRaleigh					
GoTriangle					
GoWake					

The Regional Technology Integration Plan presents recommended action strategies over the next five years with an estimated capital funding range of $25 to $50 million. The Plan builds a pathway for the region to follow over the next five years and beyond.

Figure 6: The technology roadmap is estimated to require between $25 and $50 million in capital investment over the next five years. Estimated ranges for Automated Fare Collection, Intelligent Transportation Systems and Business Intelligence systems are shown at right.

Technology Roadmap - Capital Investment
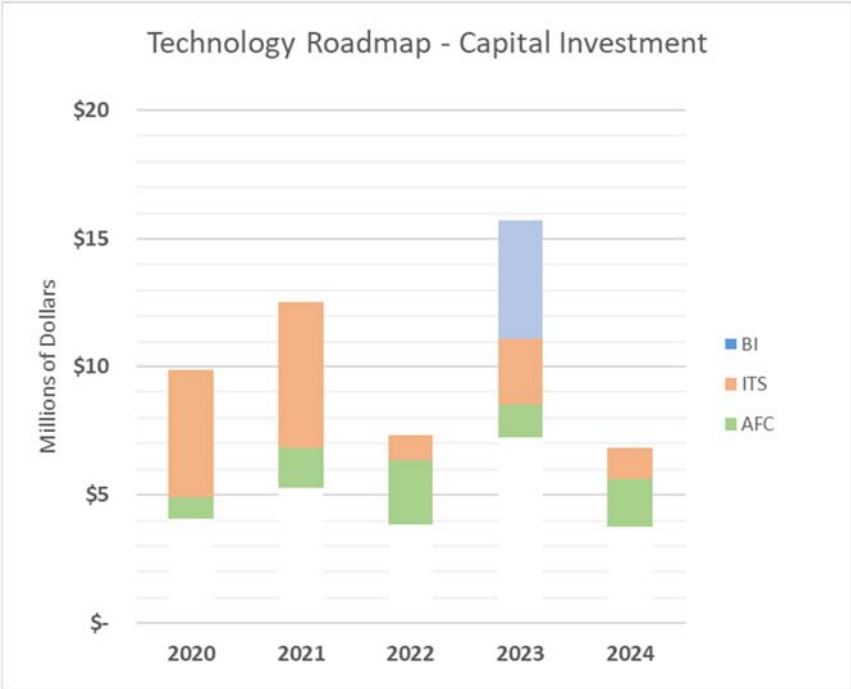
Funding

The Regional Technology Integration Plan outlines the vision for expanding technologies to current and future demand which may not be currently fully funded in the Wake County Transit Plan. There are a wide range of funding requirements over the next five years. When and how much additional funding will become available in the future will dictate the speed and extent to which technology improvements can be made.

The primary action item in this plan is to conduct a funding study to identify a dedicated and permanent funding source. The funding study will explore options for ongoing funding as well as improvements to the fare structures. While the final funding source or combination of sources will be determined through a process, the adoption of new sources of dedicated technology funding will trigger a need to revamp current organizational responsibilities.

Governance

Many public entities find that governing technology programs can yield significant benefits. These benefits include better alignment, more cost-effective technology investments and a suite of systems that provide real value to the enterprise. Well governed technology programs reduce the probability of implementing systems that are under-utilized and insufficiently supported.

Barriers to Adoption of New Technology

Organizational Barriers – It is often difficult to access IT staff and/or technical resources from each agency. This usually means that the agency must rely on its limited resources, identifying someone who is most interested but not necessarily appropriately trained to provide IT direction and support. This model has frequently led to the emergence of pockets of IT resources outside of the primary IT environment.

Past Practices – Perhaps the single biggest barrier to the effective acquisition and deployment of technology resources in transit is the condition of being wedded into past practices. The primary mechanism for moving to computerization has been to automate existing manual processes. Although transit agencies are more alike than different, a whole host of unique manual processes have developed at individual agencies over time. The business approach in the transit agency represents a major barrier to acquiring commercially off the shelf (COTS) technology to support primary functions and make transferability difficult across transit agencies of similar size despite significant commonality.

Training – Lack of training in existing hardware/software and related technologies and inadequate education regarding new developments in technology are critical barriers to success. Training needs to occur at two levels in transit agencies: training and development of IT staff where they exist and training and education of user department personnel in appropriate technologies.

Funding – Funding is a problem in two areas of transit: a lack of funding to acquire, update, and maintain critical technology and new technologies and specific funding opportunities that create uneven or inappropriate investment in particular technologies. Because most technology is acquired through capital grant funding, which is often dictated by particular events and timing, projects in this area do not always conform to strategic need.

Management Architecture

Coordinated investment in technology is a valuable, but often elusive, objective. A common issue at many transit agencies is that various units – such as operations, planning and finance – choose and secure their own technology, and wait until acquisition is complete to request IT support. The result of this management philosophy has been the evolution of an uneven, disparate, inequitable technology infrastructure without adherence to agency-wide standards or architectures.

The resulting technology environment in transit consists of IT staff that exercises control mainly over the corporate systems and independent departments operating a variety of technology to support their individual and specific needs. Different agencies performing the same functions often have different technology to perform the same tasks. Very little control is exercised in the acquisition of technology, training, maintenance and support for these systems.

Duplication of information, lack of standardization in technology and insufficient control over the development of technology projects results in significant inefficiency and ineffectiveness at transit organizations and inequities in technology investments between individual departments within agencies as between regional agencies.

To provide appropriate centralized technology services and support an organization within an agency is created that can take the lead in developing a unified deployment strategy for an agency's technology environment. This approach could also be utilized to create a regional technology advisory committee.

Technology Governance Committee

There are two independent actions necessary to move a region's technology strategies into a position to fully support management information, technology investment, and the region's overall mission, goals, and objectives.

1.   Establish a technology investment process that reviews and approves the recommendations of the Technology Advisory Committee at the General Manager/senior staff level.

2.   Establish a Technology Governance Committee (TGC) of key staff from primary functional areas from each agency to recommend which technology investment decisions are best for the region. This committee would operate as the region's single focal point for developing recommendations for the acquisition and deployment of technology and establish and oversee regional technology policies and standards.

Figure 7: Technology Governance Committee Process

At least one person on the committee should be a technology expert who should operate as a peer at the senior management level. The expert's job is to challenge entrenched in-house thinking. He or she should not think negatively of technology-averse cultures and must be a skilled communicator who does not hide behind technology jargon or talk down to committee members. The expert should help the committee avoid dwelling on the difficulties of the work and emphasize instead the opportunities.

Conversations should focus on the big picture: technology strategy can be hard to distill and can be discouraging if the committee gets dragged down into technical detail. The technology expert must have not only a solid grounding in the regions' overall business needs, but also a holistic view of the agencies and its systems architectures. This is particularly important if the regional agencies choose to outsource any of its functions and connect multiple vendors across a regional network. The expert must also thoroughly understand the underlying dynamics governing changes in technology and their potential to alter each agency's economic outlook.

Generally speaking, the technology expert serves much the same function as the certified financial expert on an audit committee. As chair of the TGC, he or she helps balance the regions short-term business needs with long-term technology investments.

Many transit agencies lack skilled, business-oriented technology strategists. In the absence of such a person within the GoForward community, a technology consultant who can help sort out technology issues would be valuable, or perhaps, a General Manager or Chief Operating Officer who is actively managing technology.

The study team recommends that the TGC maintain a close relationship with the audit function at each agency. Technology systems involve many issues of critical concern including confidential information, financial accountability, data retention and disaster recovery.

Establishment of a Technology Oversight Committee (TOC) is also recommended. The TOC would include the General Manager and other senior staff from participating agencies as well as a senior manager with audit experience/responsibility. The purpose of the TOC is to provide oversight, advice and coordination of the development and implementation of strategic initiatives and related technology projects recommended by the TGC. The charter of the TGC should explicitly describe its relationship to

the TOC and audit function, as well as its organization, purpose, oversight responsibilities, and meeting schedule.

The Capital Area Metropolitan Planning Organization (CAMPO) in partnership with the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHCMPO), the North Carolina Department of Transportation (NCDOT), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA) developed Intelligent Transportation System (ITS) Strategic Deployment Plan for the Triangle Region in 2010 with an update in 2019. It is recommended that the TGC foster a relationship with the governance apparatus for the Regional ITS Deployment Plan to coordinate on regional ITS solutions that include transit but operate in a space beyond the bus. It is recommended that a liaison with traffic engineering and extensive ITS implementation and regional coordination experience be identified to attend TGC meetings on an as needed basis.

The TGC establishes the proper linkage between each transit agency's management and their technology support staff. This committee represents key functional areas of each agency that use and/or need technology tools and will foster and promote region-wide technology ideas and solutions. The charter and responsibilities of this committee clearly establishes it as distinct from, but operating in an advisory capacity to, other committees/departments. Depending on the strategic interests and technology needs of the region, this committee has the authority to provide some or all of the following functions:

- Recommend a process and a cost-benefit methodology for the evaluation and prioritization of all technology projects.

- Develop a list of all technology projects based on all capital project submissions and review and evaluate all ongoing and proposed technology projects on an annual basis, within this context.

- Provide executive agency management with the information necessary to properly evaluate technology projects and investments.

- Recommend specific objectives and develop a Service Level Agreement process for technology.

- Link to each agency's annual budget process.

A specific TGC charter defines technology and delineates the minimum technologies over which the TGC has authority. It is important that the TGC and all the regional agencies adopt a definition of technology that is sufficiently broad and consistent with evolving contemporary standards. For example, the definition of technology, includes all those technologies that are information-based generate data that have application across the region, and/or involve standard computing platforms running on common communications infrastructures.

The overall intent of the Technology Investment Process is to set policy, prioritize the investment in information-related technologies, and help ensure that technology investment is in the best long term strategic interests of the region. As part of the process of overseeing technology investment, the TGC has the initial and principal responsibility to develop recommendations that would be reviewed and approved by the General Managers and senior management. The primary functions of a TGC are to:

- Advise senior management on policy for technology. This would include helping establish mission, goals, objectives, and technology standards for each agency and the region.

- Establish cost-benefit methodology and standards for all technology investment.

- Prioritize, schedule, and monitor all technology projects.

- Assure the conformity of project development with the program budgeting process.

- Arbitrate disputes between agency departments and IT support staff.

Table 3:   Technology Investment Process

Step 1 Annual Budget Process - Identify Mission, Goals and Objectives
Step 2 List all Technology Projects
Step 3 Prioritize Projects based on Mission, Goals and Objectives – Cost Benefit Analysis
Step 4 Project Management Process – Establish Manager and Team
Step 5 Performance Monitoring Process – Specific Manager and Team
Step 6 Project Completion – Assess additional project requirements

Strategic Sourcing Alignment Opportunities

The Technology Governance and Oversight committees can also assist the region to advance a more strategic approach to procurements.   Regional procurements may yield greater value to the partners and the region in the form of consistent and advantageous terms and conditions, improved support, and better pricing. The TGC can help coordinate technology requisitions identified by each agency and work with agency procurement personnel and IT support staff for appropriateness, consistency, and adherence to the agency's standards and architectures, the following approach may be applicable.

• The TGC can help establish a list of generic technology standards appropriate for different types of staff and usage, emphasizing interoperability between agencies as well as interoperability with other ITS technologies where appropriate.

• The Committee can support Procurement and the IT support staff as they work together to establish vendor relationships and term contracts for these items. It can also create a "catalog" to facilitate hardware and software purchases.

• The agencies may elect to require that technology-related requisitions for noncatalog items require TGC agency review and approval prior to acquisition.

Suggested TGC Bylaws

The following suggested bylaws may be used as a guide when the TGC is created:

Committee Chair
The technology expert will serve as Chairperson of this committee. In the event the Chair is unable to attend a committee meeting, the Chair must designate an alternate from the committee members to run the meeting.

Members
Each Technology Governance Committee member will be appointed by the General Manager or other senior executive on advice of their respective senior staff. In the event a committee member can no longer serve on this committee, the respective senior will advise the General Manager or other senior executive on who should replace the committee member.

Invited Guests
With consent of the Committee Chair, committee members may invite guests from different areas of the agencies to attend advisory committee meetings. Guests can be any employee, contractor, or consultant and will not have voting rights.

Meeting Frequency
All meetings will be held on a monthly basis. Committee members should expect to commit approximately 3 hours per month in addition to the meeting time independently reviewing materials related to requests and other matters.

Meeting Structure
The Committee Chair will poll the membership and develop an agenda for each meeting which will be published at least one week before the meeting.

Voting
Each voting member will cast one vote towards a recommendation for each reviewed technology project request or for any other matter the Committee Chair seeks guidance on. The Chair will have the authority to decide quorum and cast a tie-breaking vote.

Project Request Reviews
This committee will review project requests on an ad-hoc basis and will make a recommendation for approval or disapproval to Executive leadership. As required, the Committee Chair will present voting results and recommendations on project requests to Executive leadership.

Special Projects
The Committee Chair may use appropriate discretion to approve special projects that are critical to the region for Governance Committee review.   A special project is a project that requires new funding and is requested by one of the agencies. Internal agency technology projects do not require governance approval.

Support
All regional agencies IT departments will provide support to this committee as needed.

Next Steps

This report summarizes the work that the Regional Partners have initiated to coordinate and guide their efforts to ensure that technology investments are aligned for the benefit of the region. The Partners have laid the groundwork for their vital efforts to ensure that technology investments support regional and agency goals, improve mobility, enhance the customer experience and make the region an ever better and more productive place to live, work and play.

As the partners move forward, they should revisit the regional technology strategy to refine their prioritization of key technology investments, as well as the scope, schedule and estimated cost of the systems. These refinements will improve cost estimates and provide a better sense of when and how much funding will be required from agencies, the region and external sources (such as state and federal grant programs).

The partners should also consider formally adopting and implementing the Technology Governance and Oversight committees to encourage innovation, action and alignment of technology investments. These committees can help advance technology investments rationally and expeditiously.

The Technology Governance and Oversight committees can also assist the region to advance a more strategic and aligned approach to procurements.   Regional procurements may yield greater value to the partners and the region in the form of consistent and advantageous terms and conditions, improved support, and better pricing.