King County

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

KING COUNTY

Signature Report

December 13, 2016

Motion 14769

Proposed No. 2016-0292.1 **Sponsors** Dembowski

A MOTION relating to public transportation; presenting the first-ever Strategic Technology Roadmap for Transit, as required by the 2015/2016 Biennial Budget Ordinance, Ordinance 17941, Section 129, Proviso P4.

WHEREAS, in November 2014, Ordinance 17941 adopted the 2015/2016 King County Biennial Budget, and

WHEREAS, Ordinance 17941, Section 129, Proviso P4 requires the executive to transmit the Strategic Technology Roadmap for Transit ("Roadmap") and a motion that approves the Roadmap and the motion is passed by the council before expending or encumbering $25,000 in funds on capital project 1124887 authorized by Ordinance 17941, and

WHEREAS, the transit division has prepared the required Roadmap and the executive has transmitted the Roadmap as set forth as Attachment A to this motion to the council;

NOW, THEREFORE, BE IT MOVED by the Council of King County:

The King County council hereby approves the first-ever Strategic Technology Roadmap for Transit, Attachment A to this motion.

Motion 14769 was introduced on 6/20/2016 and passed by the Metropolitan King County Council on 12/12/2016, by the following vote:

Yes: 9 - Mr. von Reichbauer, Mr. Gossett, Ms. Lambert, Mr. Dunn, Mr. McDermott, Mr. Dembowski, Mr. Upthegrove, Ms. Kohl-Welles and Ms. Balducci
No: 0
Excused: 0

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

J. Joseph McDermott, Chair

ATTEST:

Melani Pedroza, Acting Clerk of the Council

Attachments: A. Strategic Technology Roadmap for Transit

14769

King County

FINAL REPORT

Strategic Technology Roadmap for Transit

Prepared for King County Metro Transit
by IBI Group
with N-Squared Associates and DKS Associates
March 21, 2016

Document Control Page

CLIENT:	King County Metro Transit
PROJECT NAME:	Strategic Technology Roadmap for Transit
REPORT TITLE:	Strategic Technology Roadmap for Transit
IBI REFERENCE:	
VERSION:	V2.0
DIGITAL MASTER:	[File Location]
ORIGINATOR:	Erin King
REVIEWER:	Jill MacKay, Nancy Neuerburg
AUTHORIZATION:	Paul Lavallee
CIRCULATION LIST:	Steering Committee
HISTORY:	Preliminary Report Outline: approved by Council June 16, 2015 V1.0 – Internal (Steering Committee) Draft V1.1 – Interim Internal (Steering Committee) Draft Submittal V9 – Interim Internal (Steering Committee) Draft Submittal V11 – Interim Internal (Steering Committee) Draft Submittal V17 – Draft Report for Transit Technology Oversight Meeting V18 – Draft Report for Submittal V2 – Draft Final Report to Council

Table of Contents

List of Appendices

1 Introduction

The Strategic Technology Roadmap for Transit (STRT) was developed to guide the strategic technology planning process for new or changing technologies within King County Metro Transit (Metro, Transit, or Metro Transit), while also defining the five-year plan for the initiatives that are necessary to achieve Metro Transit's business needs, goals, and objectives. It delivers a planned, integrated, and forward-looking understanding of Transit's technology needs. As the business needs of transit and the technology industry change continually, this STRT will be a living document that regularly evolves.

> *"This aligns with our belief that there are no 'technology' projects, only 'business' projects that leverage technology to improve business results."*
> King County Strategic Technology Plan

King County Metro Transit has long been a national and regional leader in the delivery of quality transit service and the strategic application of transit technology. As the breadth and depth of applications has grown, the agency is facing a number of strategic issues in how the technology program is developed and managed, such as:

- Ensuring that technology is deployed to meet specific strategic goals, not "technology for technology's sake."
- Balancing spending between maintaining existing investments, while continuing to innovate and meet expectations for "new" technology services.
- Partnering with King County Information Technology (KCIT) as the IT service provider for the organization.
- Getting ahead of market trends and drivers to mitigate vulnerability resulting from changes in the information technology and telecommunications industries, as well as customer-facing technologies.

With this Strategic Technology Roadmap development effort, supported by the King County Council and the Executive Department, Metro has a unique opportunity to assess its current environment; identify key forces impacting this environment; develop a new vision, goals, objectives, and strategies; and develop a Roadmap for moving forward.

"Developing a roadmap has three major uses: ① it helps reach a consensus about a set of needs and the technologies required to satisfy those needs, ② it provides a mechanism to help forecast technology developments, and ③ it provides a framework to help plan and coordinate technology developments."[1]

[1] http://en.wikipedia.org/wiki/Technology_roadmap

1.1 Purpose

The purpose of the STRT is to articulate:

- Critical factors affecting the planning, deployment, and maintenance of technology at Metro Transit, including market trends and internal and external drivers.
- An attainable vision for King County Metro Transit's technology program, with associated goals, objectives, and strategies, which is congruent with King County and Metro Transit's strategic plans and supports Metro Transit's primary mission of delivering transit service.
- A process for assessing and prioritizing Metro Transit's desired technology initiatives that considers the current technology environment; related major initiatives, plans, and projects; and trends and best practices in the technology industry.
- A programmatic Roadmap of priority initiatives, timelines, and planning-level costs for the next five years that demonstrates alignment with County and Metro Transit goals.

1.2 Scope

The STRT specifically identifies how technology needs from internal and external customers will be categorized, prioritized, and translated into a high-priority, near-term project list that goes forward into the biennial budget process, with new projects being submitted for Council approval.

The STRT is intended to focus on initiatives that are in the realm of Transit's control without being short-sighted to the realities of shared services and infrastructure within the County. Resultant STRT initiatives could therefore include mitigation activities necessary to address changes in the broader King County operating environments (County website, financial systems, telecommunications infrastructure, etc.), along with those more fundamentally owned by Transit.

1.3 Methodology

In 2014, Metro initiated a Transit Technology Oversight effort to provide a forum for evaluating and prioritizing requests for new or modernized technology. This effort is supported by a Technical Review Committee (TRC) comprised of managers from King County Metro and KCIT, who are chartered with providing recommendations to the Transit Technology Oversight Steering Committee (TTOSC), which serves as Metro's technology investment board. The TRC directly guides and implements Metro's technology program, and the STRT has been developed collaboratively with many members of the TRC as its Steering Committee. The Steering Committee and the consultant team liaised periodically with Council staff to confirm that the approach and content of the STRT were progressing as expected. Additionally, they interviewed other technical and project management staff regarding the vision, objectives, and needs of Metro and its technology program.

Existing King County, KCIT, and Metro Transit strategic plans were assessed to determine the larger planning framework within which the STRT would need to fit. An environmental scan was performed to document market trends, technology issues within Transit, and internal and external drivers that may affect Metro's technology program. The assessment of the planning documents and the environmental scan were used to guide the development of a vision, goals, objectives, strategies, and proposed projects.

The analyses and planning work was supported by extracts from existing Metro Transit databases of existing and anticipated needs, and Metro's Enterprise Architecture Model, which contains inventories and

information about its applications, databases, and other components of its technology environment. The STRT project provided time and resources to look at potential technology issues and investments from a variety of perspectives, enabling strategic combinations of needed improvements and requests for services, and resulting in potential efficiencies and the ability to leverage technology investments.

1.4 Organization

Document Structure

The remaining sections of the document are structured as follows:

Section 2: Planning Environment and Context – This section describes the existing planning landscape within King County and Metro Transit and how the STRT fits in to that landscape. Specifically, it discusses how the Roadmap will fit within the King County planning framework and be guided by existing County planning goals and objectives.

Section 3: Transit's Technology Environment – This section briefly describes Metro's technology environment, including the organizational drivers and market trends impacting the formation of the Transit technology program.

Section 4: Strategic Technology Vision, Goals and Objectives – This section presents a vision, goals, objectives, and strategies for the technology program that are grounded in the principles espoused by the planning framework described in Section 2.

Section 5: Strategic Technology Roadmap – This section provides the Strategic Technology Roadmap, guided by the vision, goals, and strategies. The Roadmap lays out the path forward for the technology program's initiative identification and priority setting, general timelines, and planning-level costs.

Section 6: Moving Forward – This section identifies Metro's approach for maintaining its technology investments and addressing financial considerations. The section also includes a set of recommendations for moving forward with the near-term program and refining the Roadmap for the later years in the planning window, as well as a general approach for updating and maintaining the STRT as a living document.

2 Planning Environment and Context

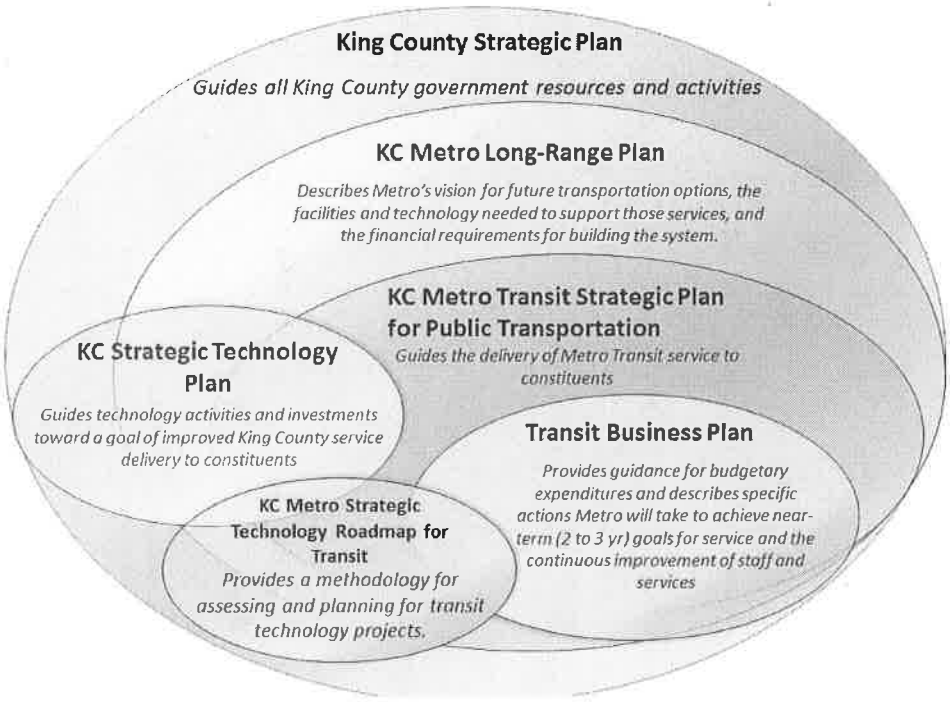
King County, KCIT, and Metro Transit have developed extensive strategic planning documents that recognize the increasing role of technology across the organization and touch on many of the STRT's target issues at various levels. This section describes how King County's planning framework and existing County planning goals and objectives have guided the development of the STRT. The intent of this section is to illustrate how the STRT does not exist in a vacuum; rather, it is shaped by, and supports, the strategic direction of the larger organization.

2.1 Relationship to Existing Plans

Metro Transit's technology program, through the STRT, must be guided by the existing King County strategic planning framework. In addition to King County's Strategic Plan, which creates a countywide planning framework to guide subsequent plans, there are a number of strategic documents that guide County activities in key areas, such as countywide technology and IT activities, and Metro Transit activities. The plans that were reviewed include the following:

- King County Strategic Plan 2010-2014
- King County Metro Strategic Plan 2011-2021
- Metro Transit 2015/2016 Business Plan
- Metro's Long Range Transit Plan (draft plan currently under review)
- King County Strategic Technology Plan (STP) 2013-2015

The relationships between these documents are shown in the diagram below. All of these strategic documents inform and guide King County's Transit technology program.



Relationship of the Planning Documents and the STRT

Specifically:

- The goals, key objectives, and strategies of King County's Strategic Plan guided the development of the King County Metro Strategic Plan, which then guided the development of the STRT.
- Early work on Metro's Long Range Plan (LRP), which looks out to 2025 and 2040 was reviewed, as its development is coincidentally overlapping with the development of the STRT. The LRP has a much longer timeline than the STRT, but the STRT is informed with an awareness of the future expectations of technological capabilities that Metro as an agency will need to be able to deliver over the longer time frame.
- Many of KCIT's technology objectives and strategies from the King County Strategic Technology Plan are very applicable to Metro's technology program and have been incorporated in the STRT.
- In addition to the plans shown in the figure above, which influenced the STRT, the King County Executive's report titled, The Transit Integration Report: Getting There Together, was reviewed for potential issues, strategies, and projects to consider while developing the STRT.

Appendix A, Review of Existing Plans, discusses in more detail how the development of the STRT was supported and influenced by this strategic planning framework.

King County Strategic Goals

What

- *Justice and Safety*
- *Health and Human Potential*
- *Economic Growth and Built Environment*
- *Environmental Sustainability*

How

- *Service Excellence*
- *Financial Stewardship*
- *Public Engagement*
- *Quality Workforce*

King County Metro Transit Strategic Goals

1. *Safety*
2. *Human Potential*
3. *Economic Growth and Built Environment*
4. *Environmental Sustainability*
5. *Service Excellence*
6. *Financial Stewardship*
7. *Public Engagement and Transparency*
8. *Quality Workforce*

Inform Transit Technology Projects

The King County and King County Metro Transit strategic goals will inform the Strategic Technology Roadmap for Transit project prioritization process

3 Transit's Technology Environment

This section provides information on Metro Transit's technology environment, including background information on Transit's technology program and descriptions of both the internal and external drivers that influence Transit's technology program. In addition, a subsection is included that highlights key technology and market trends affecting the availability, selection, implementation, and maintenance of Metro's needed technologies.

3.1 Background on Technology at Metro Transit

Metro uses technology to deliver, manage, and improve nearly every aspect of its business, such as to increase efficiency, provide more accurate and consistent service, improve safety and security, and provide information for improved decision making and performance monitoring. To that extent, however, quantifying the value of Metro's investment in technology is not straight-forward, as 'technology' is not a category of investment that is maintained in the fixed asset system. Specifically, software investments are currently valued at $112 million as of the 12/31/2014 financial statement[2]. Other technology investments are included in the categories of Transportation Equipment and Other Equipment, which have a combined value at 12/31/2014 of almost $1 billion (but only a portion of which would relate to technology). KCIT's recent budget for supporting technology operations, maintenance, enhancement, and new projects development for Transit was approximately $15 million annually.

The next section highlights some of the uses of Metro's investments in software and supporting technologies.

Technology's Relationship to Metro Transit's Goals

The following table maps the King County Metro Transit Strategic Plan goals and objectives to examples of specific supporting technologies as a way of illustrating the extent to which technology is critical to Metro Transit's operation. Many of the technologies identified here are those for which Metro must plan for their ongoing maintenance, enhancement, and eventual replacement.

How Metro's Use of Technology Supports Transit Strategic Goals and Objectives

Metro Transit Goal	Objective	Supporting Technologies
Safety	Keep people safe and secure	Technology is used to increase passenger and employee safety and security on vehicles and at stops, and to make facilities more secure. Some examples include: video surveillance systems, radio, computer aided dispatch, safety tracking, security tracking, and safety training.
		Technologies such as the Transit radio system and automatic vehicle location are used to expedite incident management and coordinate with first responders.

[2] 2013-14 audited financial statements for the King County Public Transportation Enterprise Fund

Metro Transit Goal	Objective	Supporting Technologies
Human Potential	Provide public transportation products and services that add value throughout King County and that facilitate access to jobs, education, and other destinations	Technology is used to help create Transit service and distribute all the information about that service within the agency and to customers. Many of Metro's business systems and staff use this core information to manage operator work assignments and administer labor contract provisions; dispatch and maintain vehicles; produce timetables, websites and other customer information; and to manage Transit facilities. Technology is also used to create system data and performance measures to help design new products and services tailored to meet diverse market and mobility needs. It enables products such as the Trip Planner, the ORCA system, annunciators, and real-time information.
		Technology systems support the effective dispatching and management of Metro's Access services, customer eligibility, and a wide variety of specialized public transportation services and supporting amenities at bus stops.
Economic Growth and Built Environment	Support a strong, diverse, sustainable economy	Ridematch and VanPool software are two examples of technology tools that help provide alternatives to driving alone, in addition to bus and rail options, and that help provide integrated, multimodal transportation systems that link a range of destinations to education and employment centers. The significant ridership increases with RapidRide shows clearly that customers will respond when offered more efficient service with improved travel times and customer amenities, all of which are realized through the deployment of technologies such as off-board fare payment and transit signal priority.
	Address the growing need for transportation services and facilities throughout the county	Technologies, such as trip planners and real-time information signs make it easier for people use transportation services and to maximize travel options. Geographic information system (GIS) tools and other automated planning tools are used to design new routes and services for the region.
Environmental Sustainability	Minimize Metro's environmental footprint	A range of technologies support this goal, including systems to manage fuel, assets, energy usage, HVAC systems, facilities, efficiently running vehicles, etc. These systems help to ensure that Metro's infrastructure is running efficiently and allow monitoring of energy usage to identify areas for improvement.

Metro Transit Goal	Objective	Supporting Technologies
Service Excellence	Improve satisfaction with Metro's products and services and the way they are delivered	Technology plays a critical role in improving transit speed and reliability through systems such as scheduling, dispatch, automatic vehicle location, transit signal priority, and GIS tools. Customer satisfaction is also increased by technology-enabled apps and fare products.
	Improve public awareness of Metro products and services	New and existing technologies allow Metro to increase public awareness and improve communications via web pages, Customer Relationship Management (CRM) system, trip planning tools, mobile apps, service alerts, and regional coordination of customer information.
Financial Stewardship	Emphasize planning and delivery of productive service	Many technologies and the data they collect and manage improve the planning and delivery of transit services. For example, maintenance management, scheduling, and dispatch systems help optimization service delivery. Schedule data from the scheduling system, automatic passenger counting data, on-time performance data from the onboard systems, and fare data are some of the many data sets that are analyzed and used for performance measures, planning, and decision making. A planned new data infrastructure will help with timely planning and delivery of productive service.
	Control Costs	Enterprise architecture, asset management, fuel management, and vehicle maintenance systems are used to schedule and perform regular maintenance and upgrades and to keep Metro's fleet and facilities in good repair and support efficient, safe, and reliable transit operations.
Public Engagement and Transparency	Increase customer and public access to understandable, accurate, and transparent information	Transit continues to pursue innovative ways to report to and inform the public, whether by delivering new information-related products, or facilitating third party developers to create new apps by making transit service data more accurate and easily accessible.
Quality Workforce	Attract and recruit quality employees	A range of technology applications, such as systems to facilitate attracting and hiring staff, do training administration, and provide modern training, makes Metro a more attractive employer and cultivates a skilled labor force. New generation staff members often expect a different technology toolset than older, more traditional Transit employees. New KCIT and Transit initiatives, such as improving mobile access, help address this issue.

Technology Success Story: Customer Communications and Contacts (C3)

The recently-completed C3 process analysis and system implementation is a highly successful example of how a careful business analysis, combined with the right technology tools, can have wide-ranging improvements for Metro Transit staff and customers. The customer service team designed a system that, combined with process improvements, cut the time it takes to receive, investigate, and respond to a customer complaint or comment by two-thirds. Remarkably, they achieved these gains while handling a 28 percent increase in customer contacts amid record ridership numbers.

And that's not all. The same group also launched an automated lost-and-found system that lets customers submit online inquiries 24/7. The system automatically searches a database of lost items, sends a response, and emails the results of follow-up searches if the lost item isn't found immediately.

A Challenging Environment

Even without technology, transit is an inherently complex business. It is no surprise then, that the technology environment, which automates and enables larger transit agencies like Metro, has its own particular complexities.

The core business of Metro is moving people. Metro moves close to 400,000 people every day, operating approximately 12,000 weekday trips on 174 routes with a fleet of 1,448 buses. This fleet is distributed across seven operating bases, and is comprised of 20 different vehicle types, each of which serves a specific purpose in Metro's diverse route network. In addition to buses, Metro has the largest public VanPool fleet in the nation, an extensive paratransit service, and other transportation products. Behind the operation of Metro are the people, processes, data, applications, and technology infrastructure elements that make it possible.

Data and applications are needed to plan and track vehicles that move in time and space and with operators who also operate in time and space and within union rules. Ideally, both planned and actual data is collected for comparison and validation purposes. The planning of products and services is complicated by the moving target and ever-changing needs of its current and potential customers.

The internal systems required to manage and deliver these services are transit specific. Much of the same information that drives these internal systems must be communicated daily to the internal users and stakeholders who operate the service, as well as the public customers who use Metro's services.

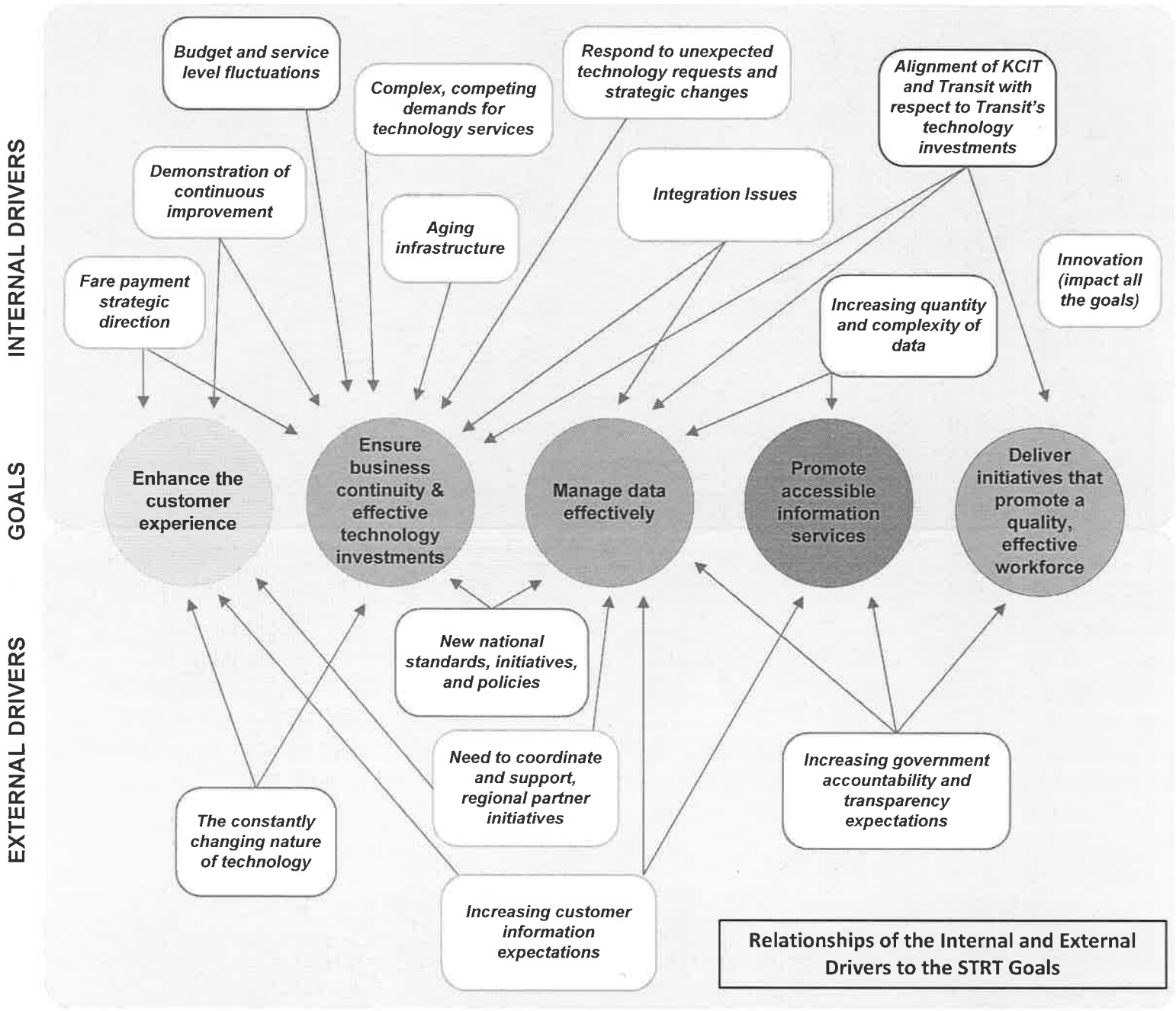
Transit's systems are a significant part of King County's overall information technology environment and create unique challenges for KCIT and Metro. For example, KCIT extends the King County WAN on over 100 miles of roadways with over 1,500 mobile connected networks on Metro's fixed route fleet. Approximately 300 applications and interfaces are maintained by Transit and KCIT staff.

While Transit relies on standard countywide enterprise systems (EBS, PeopleSoft, Outlook, etc.), there are also many functions specific to transit where vendors have developed purpose-built applications with features that are not applicable to other general government functions. An example of this is Metro's HASTUS scheduling system. HASTUS uses sophisticated mathematical logic for scheduling trips and making efficient vehicle assignments, which then allows for cost-effective operator assignments to be made, that comply with labor contract requirements. The market for these transit-specific software products is very small, in world-wide terms, so the number of viable vendor products to choose from is similarly small. However, despite the specialized and relatively small nature of the industry, the product itself is a major investment and requires significant training to shift fundamental concepts about transit schedules and the way that transit service data is modeled, managed, and distributed.

More information on the role and breadth of technology at Metro Transit is included in Appendix B - Expanded Summary of Metro's Technology Environment.

3.2 Internal and External Drivers Relative to STRT Goals

Transit's ability to implement, operate, and maintain technology is affected by a number of environmental factors. Both internal (inside the organization) and external (outside the organization) drivers affect transit. Technology drivers are considered to be factors influencing the identification, prioritization, selection, operation, and maintenance of technologies. An example of an external driver that might affect Metro's technology choices would be changes to Federal Transit Administration requirements for "state of good repair" that may require changes to existing technologies or the generation of new ones. Other significant influences on Transit's technology options stem from key technology and market trends, which are constantly evolving. The internal and external drivers described in the next two subsections have influenced the identification of STRT goals and objectives (described in Section 4), as highlighted in the figure below. Innovation is a key internal driver that helps Transit meet all of its goals.


INTERNAL DRIVERS
GOALS
EXTERNAL DRIVERS
Budget and service level fluctuations
Complex, competing demands for technology services
Respond to unexpected technology requests and strategic changes
Alignment of KCIT and Transit with respect to Transit's technology investments
Demonstration of continuous improvement
Aging infrastructure
Integration Issues
Fare payment strategic direction
Innovation (impact all the goals)
Increasing quantity and complexity of data
Enhance the customer experience
Ensure business continuity & effective technology investments
Manage data effectively
Promote accessible information services
Deliver initiatives that promote a quality, effective workforce
New national standards, initiatives, and policies
Need to coordinate and support, regional partner initiatives
Increasing government accountability and transparency expectations
The constantly changing nature of technology
Increasing customer information expectations
Relationships of the Internal and External Drivers to the STRT Goals

3.3 Internal Drivers

The following table lists and assesses internal drivers or factors that originate within King County government and impact Metro's technology environment. The internal drivers were identified through several stakeholder sessions with Metro Transit staff, the project Steering Committee, and the planning documents reviewed.

The purpose of identifying and documenting drivers as part of the STRT is to better understand the many competing factors that can impact technology-related decision making. The STRT goal setting and prioritization process takes into consideration the many important impacts and implications of both internal and external drivers.

STRT Internal Drivers[3]

INTERNAL DRIVER	IMPLICATIONS
Innovation	Metro is driven to find and apply practical, innovative processes and technologies to improve the agency's products, services, and internal operations in a cost effective manner. Being aware of innovative advances, being creative, and where appropriate, implementing pilot projects, all support valuable innovation.
Alignment of KCIT and Transit with respect to Transit's technology investments	KCIT services and support are integral to Transit's ability to deliver its services on a daily basis. The alignment of KCIT and Transit, with respect to Transit's technology investments, can drive what technologies are implemented, their effectiveness, how much they cost, their maintainability, their implications for the ongoing operation of the business, and what standardization occurs. Alignment is not a one-time event. It entails ongoing, joint decision making through the life of a project, during maintenance and ongoing operations, and during end-of-life planning.
Budget and service level fluctuations	The management of technology always takes place within a larger context. The budget uncertainties in recent years make it challenging to manage changes in the scale of Metro's operation. Cost management is always a factor that must be considered. Reliance on technology generally requires continued investment to ensure service delivery. Service additions, when they occur, can present significant challenges, particularly when tied to fleet expansion. Onboard devices such as driver displays, ORCA readers, mobile routers, and vehicle logic units may be toward the end of their life cycle, and not readily available from the original suppliers. Extraordinary measures may be required to obtain additional equipment, and to move equipment between old and new fleets.

[3] The first four items in the table below are adapted from the Business Plan.

INTERNAL DRIVER	IMPLICATIONS
Aging infrastructure	Metro's information technology infrastructure is aging. The need for investment continues to grow as major portions of the system age in parallel and require significant investments at similar points in time, resulting in systems that are "too big to fail." yet whose costly replacement may trump other needed maintenance or required policy mandates. This problem is compounded as Metro's technology dependencies continually increase as more systems that are critical to the basic operation of the organization are identified. Technology modernization is a key priority of KC's Strategic Technology Plan. As a result of the analysis producing the STRT, Transit and KCIT will be collaborating more closely on prioritizing the continuous refresh of Transit business systems and technologies.
Increasing quantity and complexity of data and information	Data complexities, and the large volume of real-time data from vehicles, drive the need to design and implement a robust and flexible enterprise-wide transit data and information architecture. Metro Transit's increased service analysis needs, including enterprise-wide initiatives to modernize Metro's data architecture and grow data availability, require robust, flexible and standardized data. Initiatives such as the Long Range Plan and process improvement efforts are driving the need for "business intelligence" tools. These modern suites combine data from multiple sources and formats into a digestible format and provides sophisticated analytics, along with tools for visualization and reporting. New procedures and tools for storing, accessing, and analyzing the increasing volume of image and video data are needed.
Demonstration of continuous improvement	As King County supports the development of a Continuous Process Improvement culture, Metro and other agencies will increasingly rely on visual management tools and the rapid availability of data and metrics to demonstrate progress. These processes require increased capabilities for measuring productivity, which in turn often means using existing tools and metrics with more focus than previously, or even creating new metrics. New initiatives will need to demonstrate improvement over the current state to move forward. When life cycle replacements occur, Transit and KCIT will leverage consistent and measurable rules to evaluate the affected systems and business processes, and look for opportunities to streamline and improve the business.
Complex and competing demands for technology services	The growing demands for technology support will likely result in increased requests for new projects and system upgrades being presented to decision makers. For example, agency staff need better access to real-time data to assist with planning and operations. To support this decision making process, the STRT's technology assessment and prioritization process will need to be followed on a regular basis.

INTERNAL DRIVER	IMPLICATIONS
Integration issues	The need for thoughtful, integrated infrastructure planning and data integration has grown as Metro's technology environment has become more complex. Transit customers and decision makers want richer, more accessible information that requires integration at various levels of Metro's technology architecture, such as databases and/or analysis tools, as well as physical devices. As Metro installs new technologies, enterprise architecture and integration considerations should be part of the planning and design process. KCIT and Metro are still managing the repercussions of early "siloed" technology implementations, common throughout the transit industry, where purchased applications were designed and implemented relatively independently. Even today, some vendor products have inherent, silo-like characteristics or limits in their technologies. The risk of purchasing products with these limitations, if they are the best option, will be mitigated by careful architecture planning and requirements development.
Unexpected technology requests and strategic changes	Unexpected technology requests or strategic changes have the potential to alter the sequence, priority, and general mix of technologies that Transit deploys. Examples include: 1. The ORCA LIFT Reduced Fare Program – This major new policy initiative was introduced outside the standard technology planning process and, subsequently, required very rapid reprioritization of resources within KCIT and Transit. It resulted in the successful delivery of a truly innovative, industry-leading product. 2. The City of Seattle's new RapidRide lines – The City's decision to add seven new RapidRide lines to last year's ballot measure is an example of a new initiative with significant technology resource requirements.
Fare Payment strategic direction	Any strategic direction established for fare payment, such as a move toward cashless technologies, can drive different technology options and operating scenarios. In parallel with the preparation of this Strategic Roadmap, Metro Transit is developing a separate document on future fare collection directions, and the potential policy choices that will be presented to decision-makers.

3.4 External Drivers

While the previous section identified internal drivers affecting the Transit technology program, Metro Transit is also affected by external drivers, originating from other governmental organizations as well as the broader technology industry. As with the internal drivers, external drivers were identified through stakeholder meetings that included Metro Transit staff and the project Steering Committee, industry documents, and the King County planning framework reviewed in Section 2.1.

Two key themes must be kept in mind when considering external drivers and their impacts, namely that technology is in a state of continuous evolution and that transit operates in an inherently complex environment.

Continuous Evolution of Technology

The continuous evolution of technology presents a serious and ongoing challenge to agencies such as Metro Transit that are heavily dependent on technology to manage and deliver core services. The agencies must balance technology investments against other budget obligations for delivering service, such as purchasing buses; paying operators and other staff; and building and maintaining operating facilities.

Historically, processing capabilities have doubled every 18 months, driving the entire IT industry through continuous cycles of innovation and competitive change. New hardware capabilities open up new software capabilities; and new software capabilities require faster and more capable hardware. In turn, these changes drive additional innovations in network management, data storage, data management, analytics, security, and other IT capabilities.

In the face of these competitive pressures, the economic reality is that many, if not most, vendors do not have a strong financial incentive to make their products last as long as possible. They may not be able to provide the extended support they would otherwise wish to provide for products they have previously sold. They must therefore maintain a balance between supporting existing customers while increasing profitability through new products and new customers. The timeliness of the industry's decisions to retire or halt support on a particular (and frequently highly-specialized) technology often does not dovetail with the agency's plan for the same.

All these changes act with and against each other to put an agency at risk as portions of its connected technology architecture are forced into obsolescence. To protect information technology assets and business continuity, it is necessary to stay abreast of these changes, monitor changing risk levels, and make balanced assessments as to the best long range solution for the agency.

STRT External Drivers

EXTERNAL DRIVER	IMPLICATIONS
Constantly changing nature of technology	The rapidly changing technology marketplace poses both issues and opportunities for Metro and KCIT, such as: • Changes to vendor product offerings, such as Software as a Service (SaaS), pose design, selection, and integration issues. Purchasing systems in the form of service contracts or subscriptions has budgeting and contracting implications, since a hosted solution may not provide the agency with a physical asset when the project is completed. • Changes in technology create new training needs, impacting both the skill types and levels needed by County staff to assess, implement, and maintain technology solutions. • Changes to technologies also offer opportunities for improving customer service. For example, improved wireless communications speed and coverage will allow Transit to move from a card-based to an account-based system with Next Generation ORCA.

EXTERNAL DRIVER	IMPLICATIONS
Need to coordinate with, and support, regional partner initiatives	Metro has regional partnerships with a wide range of other agencies, including Sound Transit, other transit agencies in the region, cities in King County, and the Washington State Department of Transportation. The partnerships may address data and revenue sharing, use of similar technology applications, shared communication networks, and other facets of technology in the region. As a result, Metro cannot make some technology decisions in isolation, resulting in the potential for decision making to become slower. Further, some of the partnership needs may raise issues and challenges for standardization within King County. Seattle's initiative for seven new RapidRide lines will significantly expand the use of transit signal priority, real-time information signs, off-board fare payment, and possibly other intelligent transportation systems (ITS) features. Planning for these new lines will need to align with the upcoming replacement of the ORCA system, along with other system lifecycle activities.
Increasing customer information expectations	Customers desire real-time information and integrated, location-aware information via their preferred media, pushing an expectation for near-immediate responsiveness and availability of information. The third-party developer community's interest in transit data can help to offer new services in this regard, but still puts a burden on agencies to continuously provide the "open" data. The current Real Time Information Improvements project is intended to address a fundamental internal challenge – that the information being sought does not currently exist in a shareable format.
Increasing government accountability and transparency expectations	More data sets and information pieces are expected to be available, creating additional needs for guidelines for information storage and easy access, plus a need for additional tools and resources to make more information available.
New national standards, initiatives, and policies	New national standards, initiatives, and policies periodically impact Transit's technology environment. National transit data communication standards have encouraged vendor software upgrades that impact a transit agency's data architecture. In September 2015, the Federal Transit Administration (FTA) issued a proposed rule that would require public transportation agencies to monitor and manage their capital assets to achieve and maintain a state of good repair. As the FTA issues more details on how transit agencies must comply, Metro may have to modify asset management procedures and/or reporting. Technology advances with respect to connected vehicles have been moving relatively quickly, accelerating the need for discussion with regional partners on standards. Metro Transit, with a suite of regional partners, recently participated in pursuing a USDOT Connected Vehicle grant.

3.5 Key Technology and Market Trends

Emerging technologies and market trends are profoundly impacting the transit industry. They are changing how service is provided and offering new and updated methods for connecting with customers. Technology trends and resulting customer expectations can impact technology priority decisions.

This section describes some of the key trends that will likely affect Transit, and their potential implications.

Data and Information

The creation, management, and propagation of data and information are undergoing significant change. Most industries, including transit, have to deal with the relatively recent explosion of data, which has been called the challenge of "Big Data." The transit industry is also constantly wrestling with the growing demands of customers to receive more information in new and different ways. Customers want to use smart phones for different purposes related to transit, such as accessing real-time bus arrival information or paying fares.

Three key data and information trends are :

- **Data generation and communication for "smart" vehicles:** A vast amount of data is being generated and transmitted from technology-equipped "smart" vehicles in the field, including continuously-updated information about vehicle location, health, passenger counts, fares, onboard video, and more. What this means is that agencies like Metro Transit are, and will continue to be, investing resources in accessing and storing this data, interpreting it to make better business decisions, supporting real-time passenger information programs, and fulfilling the various reporting requirements for federal and other public funding mechanisms. The transit industry is asking how they can better manage and integrate their various data sources, including the huge volumes of new data. Metro's Real Time Information Improvements project, scheduled to start in 2016, will address part of this issue. The STRT goals, and several of the Roadmap projects, are also responsive to this issue (see Section 5.2 for project descriptions of the *Transit Business Intelligence Resource Database (T-BIRD)* and the *Transit Video Cameras and Video Management* projects).
- **Public information expectations:** The desire for "personalized information" and the public's growing expectations of better information from transit agencies are issues pressuring Metro. New technologies make it possible for people and organizations to interact and share information with a frequency and ease that has not previously been possible. Metro Transit faces the challenge of being a large organization with many legacy systems that cannot react with the same nimbleness as a small start-up to changing customer expectations.
- **Third party development and open data:** One means of making large public agencies appear more "nimble" are open data initiatives, using application programming interfaces (APIs) and standard format data feeds such as General Transit Feed Specification (GTFS). Open data encourages creative development by independent developers that meets customer needs for innovation with relatively little agency investment. Metro Transit has taken this step already through the publishing of its GTFS and RSS alerts data, and spotlighting third-party apps in its App Center.

Information Technology (IT) Trends

As transportation technologies become more complex, intelligent transportation systems (ITS) begin to look more like traditional information technology systems, rather than "transportation" projects, and correspondingly must adopt IT standards and practices. For example:

- At Metro Transit and other agencies, the onboard vehicle architecture resembles a miniature office network, with a mobile gateway router (MGR) acting as the hub for the various onboard technology systems. The implication is the changing skill set that is required to install and maintain these systems, particularly with a fleet as large and diverse as Metro's. When vehicles are retired, plans must be made for uninstalling and re-purposing any of this equipment that still has useful life. The communications infrastructure required for these vehicles to remain connected wirelessly back to a central base must also be maintained, managed, and prioritized for eventual replacement.
- Cloud-based and software-as-a-service (SaaS) offerings are becoming more pervasive – so much so that smaller transit agencies are using SaaS Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL)-like systems for dispatching, and cloud-based business intelligence tools. For Metro Transit, this means that upgrades to cloud-based systems can be more complicated, as these have their own set of risks that must be explored and mitigated.
- "Open data" is a current topic of the IT industry. Providing data that anyone can access, use, or share via APIs and standard data feeds raises questions related to legal, technical, privacy, and other issues with public or third-party hosting. Publicly-shared data offers an opportunity, but staff time is still required to plan, manage, and reduce risks to the agency.
- Evolving technologies not only change the products that are offered, but how they are maintained. A mix of locally and remotely-hosted products are offered, and transit agencies must assess the costs, risks, and their own internal skill sets in determining the model that is the best fit for their needs. Unfortunately, the specialized nature of many transit applications can result in limited choices within the industry.

Fare Collection

Many of the pioneering smart card systems of the early 2000s, such as ORCA, are now at, or nearing, end-of-life. The timing of this, however, coincides with new payment options from smart phone and credit card companies. With this growth also comes increasing security requirements for fraud reduction and personal information protection, which are reflected in evolving Payment Card Industry standards, the deployment of chip-enabled cards, and shifting business models for operating these systems. The expansion of payment options, including mobile payment, offer significant opportunities to integrate with other transportation-related payments such as tolling, parking, bike rentals, and bike lockers.

Metro Transit is at the forefront of fare collection evolution as it participates in the Next Generation ORCA replacement and spearheads the first mobile ticketing application in the region.

In addition to mobile ticketing, Metro is considering options for expanding the use of off-board fare payment, which has been shown to be effective in speeding passenger boarding and alighting at busy stops. The need to keep transit moving will become increasingly important as bus service leaves the downtown Seattle transit tunnel (DSTT), downtown corridors become increasingly congested, and as Metro expands its frequent service network.

Wireless Communications

In addition to the robust land mobile radio (LMR) communications systems in use at most transit agencies, there is increased adoption of wireless communications systems that include commercial cellular data to support capacity requirements, and in response to dropping costs for government agencies. Agencies are also exploring the use of Voice-over-IP (VoIP) – consistent with King County changes associated with Lync.

Wireless communications are currently critical to Metro Transit, and are likely to become even more so as the technology environment changes. Metro Transit, with KCIT, is in the thick of this evolution as it charts its path forward in the replacement of the 4.9 GHz wireless network through the Transit Next Generation Wireless (NGW) project described in more detail in Section 5.

Connected Vehicles

The Federal Transit Administration has been supporting significant research on connected vehicles. A connected vehicle is considered to be one that is equipped with wireless communications capability to exchange information with the roadside environment, other vehicles, centralized data repositories, and personal devices. Many connected vehicle applications are focused on collision avoidance. The ultimate connected vehicle would be fully autonomous and require little or no operator interaction to safely operate.

Metro Transit's upgraded transit signal priority (TSP) through RapidRide is one form of connected vehicle technology in terms of advanced vehicle-to-roadside communications. The exploration of safety and accident avoidance systems that can communicate with, and alert, wayward vehicles and pedestrians could potentially reduce accidents and claims. However, these are emerging systems that will warrant further development prior to any plans for adoption. Metro Transit will continue to stay engaged with possible opportunities to participate in pilot or test bed projects that can showcase Metro Transit's commitment to innovation without taking on undue risk. One opportunity would be remote vehicle monitoring, also known as vehicle telematics, which provides real-time information to maintenance and dispatch personnel about the vehicle's health and operating status.

4 Strategic Technology Vision, Goals and Objectives

The goals, objectives, and strategies for Metro Transit's technology investments have been developed to help achieve the vision described below. The body of work is strongly influenced and guided by the Planning Framework in Section 2. The goals and objectives are further derived from the information-gathering and priority-setting sessions with stakeholders, and include consideration of the business and technology drivers affecting Transit discussed in Section 3. To improve the effectiveness of the STRT, a range of strategies are provided to help facilitate the achievement of Transit's vision and goals, and to trigger considerations when developing projects.

4.1 Vision

The vision statement is intended to be a big-picture, forward-looking (ten-year) statement of what the technology program at Metro Transit will do and become, through the implementation of the STRT.

Metro's technology program supports Transit's goals and meets business needs by providing secure, reliable, flexible, and cost-effective technology solutions that measurably demonstrate continuous improvement; are intuitive for end-users; deliver accurate and accessible data for a wide range of users and uses; and are integrated with regional transit initiatives.

4.2 Goals, Objectives, and Strategies

Goal A: Enhance the Customer Experience

Supports: Service Excellence

Objective A-1: Provide the information riders want, when they want it; provide customers with accurate, reliable, and timely access to transit information

STRATEGIES

a. Consolidate multiple customer alert and notification processes to create a consistent stream of data for use by customer-facing systems.

b. Provide a variety of communications channels (including various social media applications) with enhancements to provide information the way customers want it.

c. Implement tools to track and analyze customer feedback and identify trends and priorities.

d. Solicit customer involvement in the development of new projects with customer-facing elements.

e. Increase customer satisfaction with the accuracy of real-time service information.

Objective A-2: Make it easy for customers to seamlessly travel on transit throughout the region

STRATEGIES

a. Offer a variety of fare payment options, including off-board payment, to speed boarding times and provide convenient options for customers.
b. Leverage regional partnership opportunities to offer a greater range of integrated services and information.
c. Support regional efforts to improve the ORCA program.
d. Provide real-time information routinely as part of corridor and facility improvements, through the installation of real-time information signs; with priority given to regional transit hubs, transit centers, major corridors, and transfer points.
e. Continue to expand transit signal priority along selected corridors.

Objective A-3: Make it easy to receive and respond to feedback from customers

STRATEGIES

a. Improve products and processes for customers to provide feedback, including social media platforms.
b. Improve internal processes so that staff can be more responsive to customers.
c. Track customer requests and suggestions for new features, and make them a key element in prioritizing system updates and enhancements.

Objective A-4: Improve data and technologies that enhance safety and security

STRATEGIES

a. Improve safety and security related data and systems.
b. Expand and improve security monitoring capabilities on transit vehicles and at facilities.

Goal B: Ensure business continuity and effective technology investments

Supports: Financial Stewardship

Objective B-1: Properly maintain existing and new systems

STRATEGIES

a. Improve technology asset management practices to protect investments and develop a proactive maintenance program.
b. Maintain systems to ensure that system availability meets business needs for recovery point/recovery time objectives (RPO/RTO). Develop operating and maintenance plans for all systems.
c. Improve processes and procedures to ensure that the appropriate hand-offs occur between project implementation and ongoing operations.
d. Continue to mature change management approaches to minimize system disruption.

Objective B-2: Efficiently manage and apply technology investments and resources

STRATEGIES	**a.** Link resource requirements to development and maintenance activities to better plan, predict, and budget resource needs. **b.** Use an enterprise architecture approach and the Transit Enterprise Architecture Model to improve the management of technology assets and ensure efficiencies through appropriate integration of technology elements. **c.** Invest in modernization as appropriate to maintain critical assets and ensure reliable operations. **d.** Establish and monitor service level agreements with vendors for critical systems to ensure uninterrupted operation. **e.** Leverage the efficiency and capabilities of existing "enterprise class" systems and applications by extending their use and integration with the business. **f.** Evaluate system requests and purchases to ensure compliance with standards and to ensure that systems can be maintained. **g.** Utilize a "cost of ownership" approach when evaluating system alternatives. **h.** Look for opportunities to reduce the variety of supported databases, software languages and utilities, and applications, eliminating "one-off" cases whenever possible.

Objective B-3: Strategically plan for modernization and replacement of aging systems

STRATEGIES	**a.** Efficiently plan and manage asset refresh and replacement as part of an overall lifecycle management approach for the agency's technology assets. **b.** Maintain an updated inventory of information technology assets. **c.** Conduct assessments of systems and other assets as part of a lifecycle review process in preparation for each biennium, to identify upgrade and replacement needs for prioritization. This includes evaluating current approaches and whether or not systems are meeting customer and employee needs. **d.** Develop maintenance plans that include migration to vendor-provided upgrades at intervals that make sense for the business. **e.** Minimize system customizations in order to more efficiently implement and maintain the system. **f.** Seek interim upgrade/enhancement opportunities that extend the system's useful life.

Goal C: Manage Data Effectively

Supports: Service Excellence

Objective C-1: Provide high-quality data and information services that meets internal and external customer needs

STRATEGIES	
	a. Work with regional partners to integrate data and to reduce inconsistencies in data being provided to customers.
	b. Seek opportunities to expand regional data sharing.
	c. Provide data and analyses that support performance measurement and reporting throughout the agency for decision makers and others.
	d. Strategically address internal and external information needs.

Objective C-2: Reduce error, rework and data inconsistency

STRATEGIES	
	a. Minimize duplicative data entries.
	b. Eliminate "workarounds" and "side" systems by thoroughly identifying and incorporating business requirements into system design.
	c. Reduce paper records and manual record-keeping in support of King County's record management initiative.
	d. Provide automated tools to eliminate manual processes. Develop strategies to use existing data sources more effectively, such as through improved interfaces or better data access.

Objective C-3: Improve internal data and information sources

STRATEGIES	
	a. Implement strategies and tools for effectively managing the increasing volumes of information, including storage, access, and analysis of data, documents, images and video.
	b. Improve available decision-making resources by combining and integrating data from multiple internal and external sources.
	c. Look for opportunities to develop a common data dictionary and language that allows individuals to identify data elements needed for reporting, development, and implementation.
	d. Incorporate USDOT Intelligent Transportation System and other common standards to ensure that data can be easily integrated with others.
	e. Effectively utilize business intelligence, the Enterprise Architecture, SharePoint, and other strategies to better meet business needs.

Objective C-4: Use information technology to support County goals for environmental sustainability

STRATEGIES

- **a.** Promote transit mode choice through improved information delivery to customers.
- **b.** Implement tools that support data collection and reporting for environmental goals (fuel usage, emissions, etc.).

Goal D: Promote Accessible Information Services

Supports: Human Potential

Objective D-1: Deliver information and services that support equity and social justice (ESJ)

STRATEGIES

- **a.** Incorporate assessment of ESJ impacts into initiative prioritization, requirements, and alternatives analysis.
- **b.** Ensure that customer-facing applications meet current accessibility standards for screen readers and related features.
- **c.** Seek opportunities to expand multi-lingual service offerings.

Objective D-2: Support alternative services

STRATEGIES

- **a.** Identify approaches to addressing the need for alternative services in areas with poor communications coverage.
- **b.** Incorporate geographic data features to provide location-aware information and services, and to evaluate and expand service provision based on customer and regional demographics.
- **c.** Consider partnership opportunities with alternative mobility service providers, potentially for "last mile" trips.

Goal E: Deliver Initiatives that Promote a Quality, Effective Workforce

Supports: Quality Workforce

Objective E-1: Continue to strengthen partnerships with internal and external (contracted) service providers to improve technology solutions

STRATEGIES

- **a.** Work together with service providers to identify and define a common set of solutions and platforms.
- **b.** Leverage Transit-specific technological advancements that support County strategic direction and the KCIT enterprise technology strategy.
- **c.** Provide a venue for training that incorporates Transit-specific technology (both IT employees as well as Transit employees).
- **d.** Develop service level agreements and contracts that clearly document expectations and provide clear roles and responsibilities.
- **e.** Identify and understand resource needs and constraints relating to:
  - i. Resource requests
  - ii. Availability
  - iii. Budget implications
  - iv. Work intake (incident, work requests)
  - v. Change management
- **f.** Develop a collaborative requirements development process that aligns business, functional, and technical requirements for projects and services.
- **g.** Work together cooperatively to ensure long-term alignment between Transit's needs and the County's information technology service delivery plan.

Objective E-2: Identify and promote initiatives that help employees with job performance and satisfaction

STRATEGIES

- **a.** Leverage service level objectives for internal customers, including metrics to set expectations and measure success.
- **b.** Provide a venue for employees to identify opportunities for improvements and provide tools to develop business cases and benefit expectations.
- **c.** Ensure that the appropriate level of resources is provided to support employee-initiated improvements.
- **d.** Foster innovation and provide opportunities for employees to share learning from industry groups and other agencies that may be providing leading edge technologies.

5 Strategic Technology Roadmap

In addition to providing a strategic Roadmap of technology projects and initiatives, this section includes an overview of the assessment and prioritization process used to develop this Strategic Technology Roadmap for Transit. The list of projects and technology initiatives in the Roadmap is in two parts: a near-term list of projects to be developed and assessed further as a part of the 2017-2018 King County business planning and budget development process, and a longer-term set of potential project initiatives for moving Metro Transit into a proactive position to attain its long-term vision.

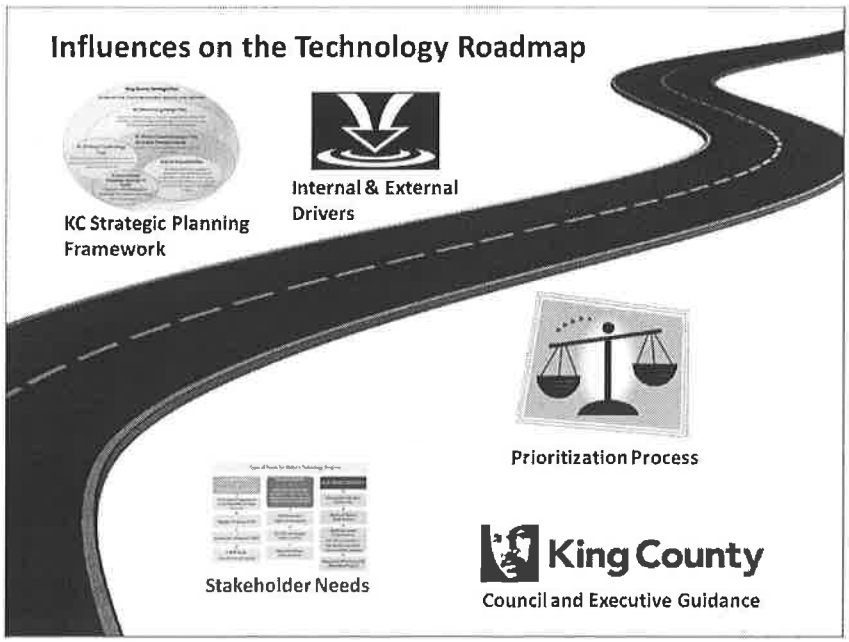
5.1 Assessment and Prioritization Process for Future Technology Initiatives

The STRT development effort provided Metro with a dual opportunity to take a fresh look at stakeholder requests for technology services, while also looking across the elements of its enterprise architecture, including the business, applications, data, and technology layers for additional needs, dependencies, and opportunities for integration and leveraging investments. As ongoing analysis, it provides Metro a method to assess its technology needs, prioritize them, and begin determining how best to meet those needs.

5.1.1 Summary of Influences on the Roadmap

The figure below identifies the key influences on development of the STRT. Metro has a wide range of stakeholders who generate technology needs and requests for technology support. For example, the KC Strategic Planning Framework identifies technology needs and guides technology's role in the organization. Internal and external drivers identified in Section 3, along with Council and Executive guidance, also influence the development, processes, and priorities of the Roadmap.

Key influences on the development of the Strategic Technology Roadmap for Transit



5.1.2 Technology Needs Identified and Addressed in the Roadmap

Before any projects could be placed on Metro's technology roadmap, potential technology needs had to be identified, assessed, and prioritized. Key steps to this process include:

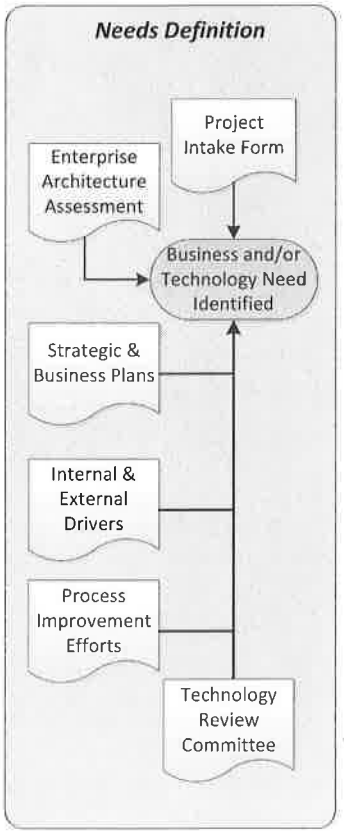
- Establishing how the initial set of technology needs were identified
- Determining how the needs were to be initially categorized to facilitate further analysis
- Conducting a preliminary prioritization of the needs
- Defining an initial process, which will be refined over time, to analyze Critical and Important needs to find commonalities, overlaps, patterns of needs, possible vulnerabilities in the technology architecture, potential efficiencies or possibilities for leveraging efforts, opportunities for eliminating duplication of effort, and to identify possible related groupings of the needs to:
  - Create an efficient, integrated list of technology projects and initiatives that will help Metro achieve its STRT and business goals
  - Identify the estimated timing of potential new projects

Before Metro's technology needs were prioritized, they were first identified by a variety of information gathering and analysis processes, and then categorized into three "types of needs" categories that would align with, and support, Metro's business planning and budgeting processes.

Identification of Potential Needs

Metro's potential technology needs were identified through a diverse range of information collection and analysis processes. Both top-down and bottom-up perspectives were employed, as well as the use of existing agency tools and lists. Listed below are the main sources of the initial set of technology needs.

- A review of the KC Strategic Planning Framework documents for strategic directions and business tactics that require additional technology support
- Technology support requests submitted by Transit staff on Project Intake Forms (2014), starting with a broad solicitation and incremental additions in 2015 and 2016
- KCIT's recommended enhancements of Transit's technologies
- STRT Steering Committee member interviews, with follow-up interviews as needed with other key Transit stakeholders
- An assessment of the internal and external drivers to determine potential technology implications and needs



- A preliminary assessment of the list of applications in Metro's enterprise architecture to identify the following:
  - Systems that bring significant risk to Transit because they no longer adequately and/or efficiently meet business needs
  - Systems at risk from technology obsolesce, where either
    - The system was at the end of its life cycle, or
    - The system depended on another technology component that was obsolete

The transit industry has been gearing up to become more effective at managing its assets in a "state of good repair," including better life cycle management and asset reporting. On September 30, 2015, the U.S. Department of Transportation's Federal Transit Administration (FTA) officially issued a proposed Rule that would require public transportation agencies to monitor and manage their capital assets to achieve and maintain a state of good repair. Metro Transit is in the process of improving its life cycle management of its technology investments through the use of an enterprise architecture model. As a part of this STRT needs identification effort, Transit staff did a preliminary review of over 200 Transit applications included in the enterprise architecture to identify systems at the end of their life cycle that should be considered for replacement.

- A high level review of Metro's current Enterprise Architecture Model, which includes information on four architecture layers (Business, Applications, Data, and Technology Architecture) and some of their interdependencies.
- Known and potential process improvement efforts that need technology support.
- Countywide technology initiatives from KCIT were reviewed to consider potential impacts on Transit systems, resources, and timing of projects.

Preliminary Categorization of the Types of Needs

The types of technology-related needs, brought forward for consideration as part of the STRT development process, fall into three categories: Maintenance, Enhancement of Existing Investments, and New Project Requests. The definition of these three categories align with, and support, Metro's business planning and budgeting processes, and have been refined and more clearly defined through the development of the STRT:

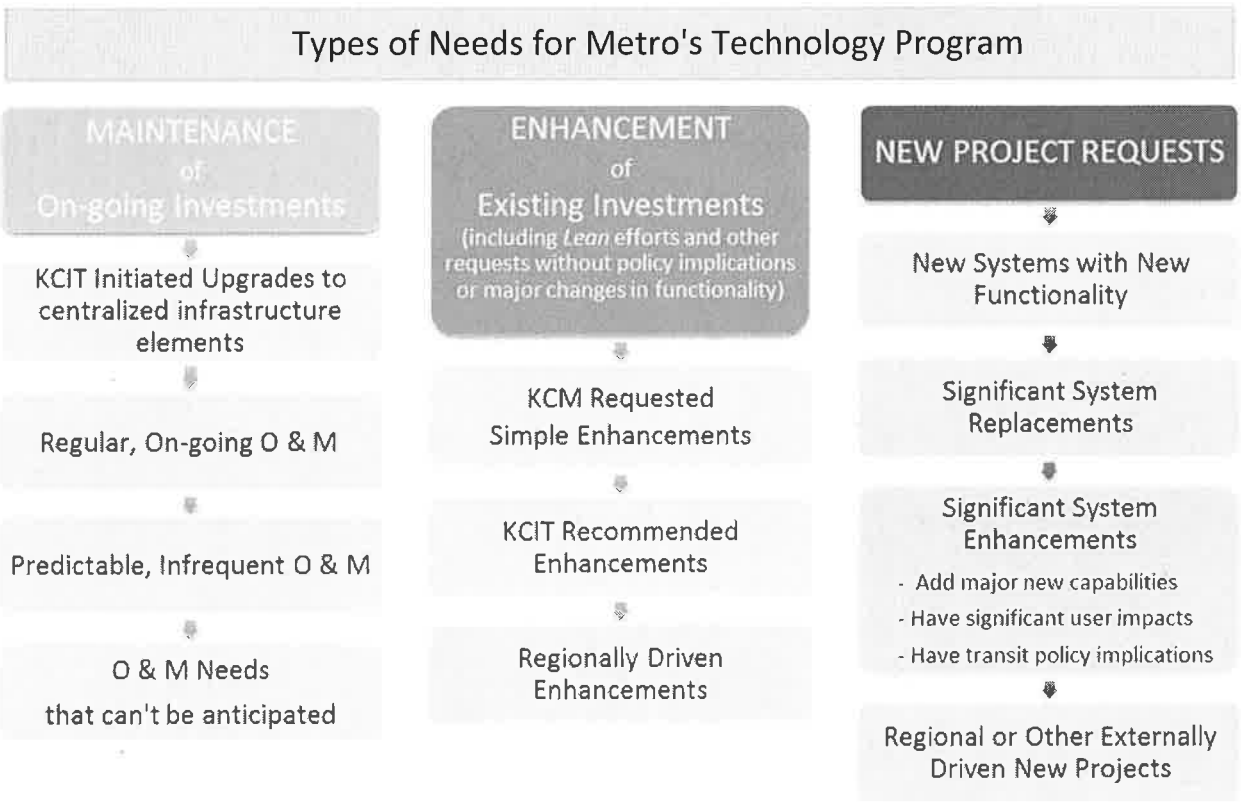
- **Maintenance** refers to repairs, replacement of parts, and other activities needed to keep an investment in good working order.
- **Enhancements of Existing Investments** includes requests to enhance existing systems to support business process improvement efforts and other minor system enhancements that leverage its investment, but have no policy implications. Often, this is closely related to the Maintenance category.
- **New Project Requests** refer to new systems with new functionality and may include significant system replacements or enhancements.

Technology needs that were initially identified were often presented as a request for a new system, or as a request for maintenance, enhancement, or replacement of an existing system. Significant replacements of

systems were deemed New Projects. Needed replacements of small desktop software systems were considered Predictable, Infrequent O & M in the Maintenance Category.

As part of the STRT process, the categorization of these technology needs provides an overall view of Metro's technology needs to help with prioritization. Second, activities in these categories can be related; therefore, it is ideal to avoid overlaps during the process of trying to improve integration of Transit data and applications, while leveraging existing technology investments wherever possible. Third, because requests for technology services can come from many different stakeholders, there may be related requests that should be coordinated or combined. For example, there may be little point in enhancing a system that is due for replacement.

The figure below elaborates on the types of needs that fall into each category.



5.1.3 Prioritization and Analysis Process

After the technology needs were identified and given a preliminary categorization, they were further examined for strategic fit, value contribution, feasibility, and interdependencies. A high-level overview of the process is provided below, along with a discussion of the evaluation criteria.

The figure below provides an overview of how the STRT will guide the prioritization of needs to be carried forward as implementable projects and initiatives. The upper box illustrates the prioritization and analysis process that is influenced and guided by the STRT. To improve the quality of this prioritization process, technology needs will be assigned to one of the following proposed transit technology-related Program Areas, where Metro and KCIT staff with knowledge of those areas can determine priority, interdependencies, and other issues and/or solutions:

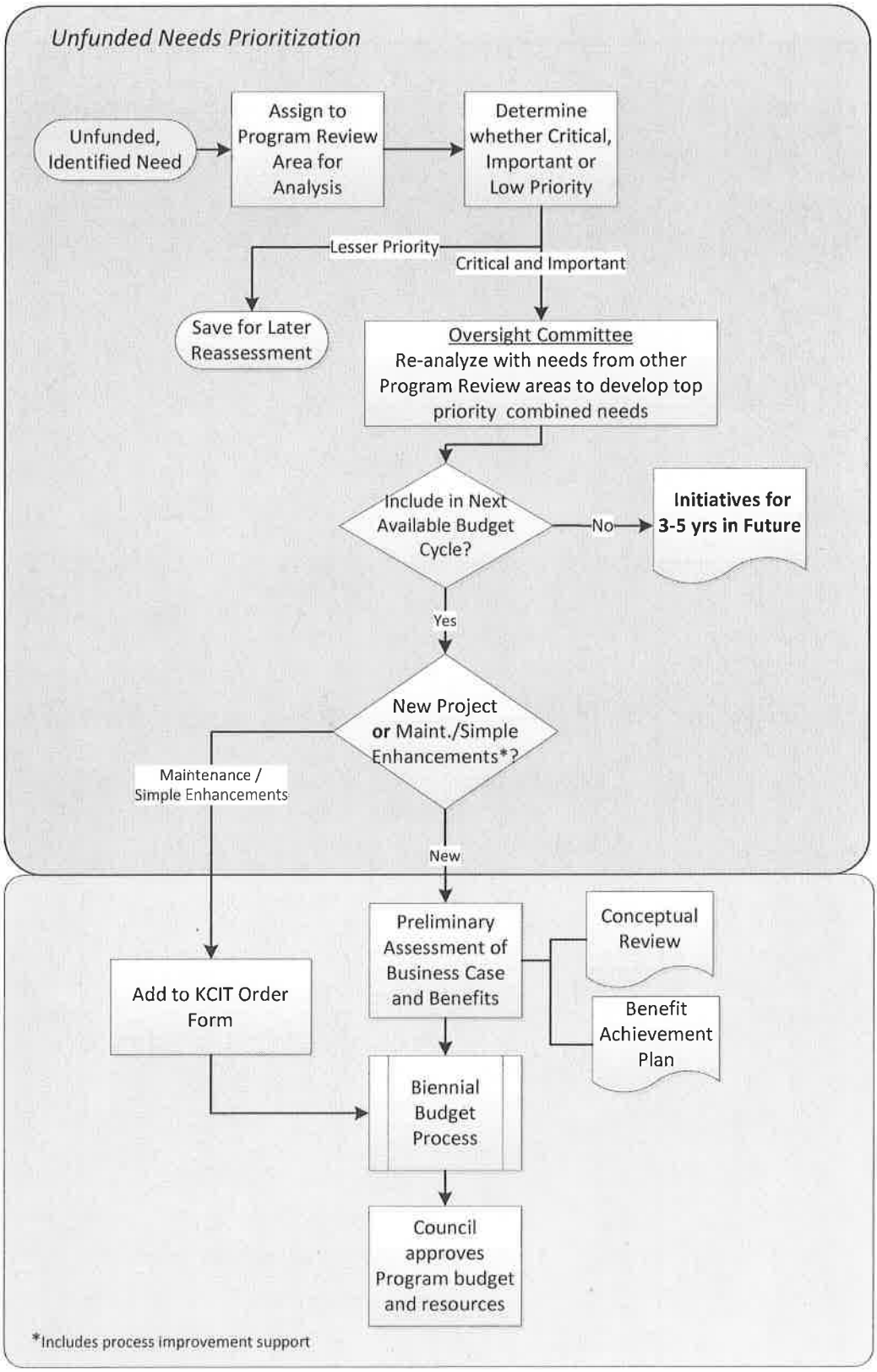
- Asset Management
- Customer Management
- Data Analytics & Reporting
- Fare Collection
- Financial Management
- Human Resources
- Incident Management
- Networks / Communications
- Paratransit
- Transit Operations

High priority, critical, and important needs are considered within the context of related technology needs. Needs may be combined within and across Program Areas to create more integrated projects that serve a broader set of needs and stakeholders.

As the Program Area owners develop a broad understanding of the business processes, applications, and data across their programs, they will be able to identify interdependencies and potential efficiencies, which should enable better prioritization of needs among the requested enhancements and new projects within the program. Often, minor enhancements can be addressed within existing resources, assuming concurrence between Transit and KCIT on resource availability and prioritization. The management teams of the two groups are engaged in ongoing discussions about how to effectively collaborate, track, and communicate status and progress of these efforts. This process may identify the need for improved tools and data to support this work.

The top priority projects for the next business planning and budget process then flow down into the Budget Process, as shown in the figure below.

Transit Technology Program Prioritization Process



The use of the STRT prioritization process will allow the Technical Review Committee to weigh proposals against the STRT strategic framework as part of its recommendations to the Transit Technology Oversight Steering Committee (TTOSC), which itself reflects the goals and objectives of King County, Metro Transit, and KCIT.

Evaluation Criteria for Setting the Priority of Technology Needs

The following evaluation criteria are used in combination to guide Metro in assessing identified needs to carry forward as proposed priority initiatives for funding. Many of the evaluation criteria are supportive of Metro's commitment to financial stewardship.

How does the Need Further STRT Goals and Objectives?

First and foremost, the need must be assessed for its strategic fit to determine whether its implementation will advance the technology program's attainment of its vision and goals to support Metro's success. The need must support at least one of the following goals:

- Enhance the Customer Experience
- Ensure Business Continuity and Effective Technology Investments
- Manage Data Effectively
- Promote Accessible Information Services
- Deliver Initiatives that Promote a Quality, Effective Workforce

Does the Need have Equity and Social Justice (ESJ) Implications?

If the need does have equity and social justice implications, it should be flagged and ensured that the ESJ implications are included in the discussion of the need and solutions, as appropriate.

What is its Level of Need?

Part of determining a need's value contribution is looking at its level of need. Characteristics of a critical need would include the following:

- Mandated or required by law
- Avoids critical failures in important parts of the business
- Essential for maintaining business continuity.
- Critical investment to maintain security of systems, networks, and people
- Must be completed before another critical initiative can move forward

In contrast, lower priority needs could be described as "nice to have," convenient rather than critical, and having a business case that is weak compared to other needs.

What are the Benefits to the Organization?

An additional part of determining a need's value contribution is assessing the "payoff" or benefits expected from doing the work, such as:

- Improves the quality or quantity of services provided to the public
- Improves internal operations, including the quality or availability of internal services
- Maintains service levels by replacing or upgrading older technology
- Reduces cost or cost avoidance to produce services
- Offers a positive return on investment, provides new revenue to the County, or leverages grant or other external funding
- Reduces future expenditures and/or improves productivity
- Improves internal or external access to County records, services, or resources
- Integrates existing systems, enhances system reliability, or improves data accuracy, security, or quality
- Supports tracking of long-term outcomes, use of data in decision-making, or transparency

What is the Feasibility / Risk Assessment?

The technology needs were assessed as to their general feasibility and level of risk, considering both the business as well as the technological side. In terms of risk, the higher priorities generally were those where the business faced a high risk if no action were taken, due to aging or obsolete technology. Feasibility considered the resource commitments required to move forward, as well as the state of the marketplace.

What is the Cost / Benefit Ratio?

At this step in the STRT prioritization process, a high level assessment of the cost/benefit ratio is performed. The concept can then be used to identify higher and lower priority projects. For projects designated to move forward into the budgeting process, this assessment is completed more thoroughly.

5.1.4 Areas of Focus

While Transit relies on standard countywide enterprise systems (EBS, PeopleSoft, Outlook, etc.), the focus in the STRT is on a Transit-specific technology program that has been assessed within the context of a countywide technology program. As Transit technology needs and systems were assessed, different ways of meeting those needs were considered. Rather than propagating countless new systems in response to requests for technology assistance, ways to leverage existing platforms and systems were considered. The solution to many requests was judged to be a minor enhancement to an existing system (e.g., King County's EBS or Transit's Enterprise Asset Management system), or used for possible

requirements for a new platform such as the proposed Transit Business Intelligence Resource Database (T-BIRD) project, which itself consolidates many smaller data systems.

An overview of all the technology needs identified highlights the following key focus areas, which fit well under the STRT goals and objectives:

- Improved **data access, management, and reporting** were common requests. The review of Transit's enterprise architecture showed that many different reporting tools are used in Transit. The wide variety of reporting tools adds complexity and risk to Metro's and KCIT's IT support processes. A number of the reporting software packages have been procured as part of a transit vendor package. Although data analytics and reporting is proposed as a discrete program area, each of the other program areas also has specific data access, data management, and reporting needs. These will be evaluated in a strategic manner to reduce duplication and to facilitate effective data ownership and management.
- More **out-dated, at-risk systems** were identified than can be upgraded or replaced within this STRT timeframe, due to staffing and budget constraints. Outdated systems are considered to be those that use unsupported, end-of-life technologies. The highest risk systems are addressed through the projects proposed in Section 5. Other specific high-priority systems for modernization are identified in Appendix C. In addition, Metro and KCIT intend to improve the processes for identifying at-risk systems and developing end-of-life plans.
- **Fare collection improvements** were deemed to be a high priority because of the amount of revenue at risk and the number of customers and other agencies this may affect. ORCA Replacement Planning and Implementation, as well as Metro's desire to reduce onboard cash fare collection in order to improve transit speeds, particularly through Seattle's Central Business District, will be a continued focus of technology planning efforts. The increased use of ORCA Lift, and customer acceptance of mobile ticketing options, will help the ORCA Replacement project further refine the fare collection landscape and options for that project.
- **Safety and security related systems** were a focus area because of a range of issues, such as similar functionality in different systems, multiple systems at end-of-life, un-met business needs, process improvement opportunities, poor or missing interfaces, and possibilities for better integration with other King County applications. Further, an ongoing Safety System Program Review will likely identify other issues that may have a technology component.
- **Customer-focused investments** are a continued high priority. Metro continues to incorporate customer feedback in application enhancements, such as updates to Metro Online and the Puget Sound Trip Planner app.
- Better **access to real-time information** is wanted, which will be addressed in the existing Real-Time Information Improvements project and the Real-Time Information Signs (RTIS) project.
- **Coordination with regional partners** supported a number of technology needs. RapidRide line expansions, Sound Transit's regional initiatives, and the Center City Mobility

Plan support efforts such as transit signal priority, next generation wireless communications, fare-related system improvements, and a future assessment of the Trip Planner.

Continuing forward, this initial review of needs and resulting focus areas will provide a running start for the Program Area owners to continue the translation of needs into prioritized, actionable projects with timeframes and resource estimates.

5.2 Metro Transit Project Roadmap

This section presents the technology projects and initiatives proposed to help Metro Transit achieve the STRT's vision, goals, and objectives. These projects and technology initiatives will inform the 2017-2018 business planning and budget development process, and describe potential technology initiatives for the 2019-2021 time period.

The STRT looks at the period from 2016 to 2021, presenting:

- Currently funded projects that will be active during part of the 2016-2021 time period
- The anticipated follow-on phases of existing projects that will begin in the 2017-2018 period
- Proposed new projects for the 2017-2018 biennial budget process
- Proposed new technology initiatives for the 2019-2021 time period that will undergo additional analysis and development work

The Roadmap includes currently funded Transit projects to show the anticipated breadth of technology-related work that Metro staff will be engaging in, helping to plan, oversee, and implement. The list of current, funded projects is also included because a number of those projects are part of the discussion about project dependencies and integration points in Section 5.2.6. Section 5.2.6 also provides a timeline showing the duration of the various projects and initiatives.

In addition, Transit staff resources will be affected by, and may need to work with, KCIT as they implement a number of important near-term King County enterprise-wide technology projects. These KCIT countywide projects are listed in Appendix D. Two of the projects, the SharePoint Conversion and the Electronic Records Management System (ERMS), will require active participation by Transit staff for a successful implementation. Transit and KCIT staff have numerous forums for identifying opportunities and potential needs with respect to countywide projects.

At the time of this report (March 2016), coordination and alignment of resources and priorities between Transit and KCIT continues to present some challenges to the management teams of both groups. The overall complexity of the program, plus the number of existing and proposed new projects, represents an ambitious effort with many interdependencies. The teams are engaged in ongoing discussions about improving tools and processes for managing, tracking, prioritizing, and communicating effectively across the many dimensions of this program.

5.2.1 Currently Funded Projects

Metro Transit has a solid roster of ongoing technology projects that are either currently underway, or are approved for funding. It is important to acknowledge and incorporate these projects into the STRT for the following reasons:

- The STRT must seek opportunities to leverage and build on these important investments.
- The STRT must consider resource constraints and programmatic dependencies related to the current technology deployment efforts.

The table below includes currently funded projects that are underway or beginning in 2016.

Currently Funded Metro Transit Technology Projects

PROJECT NAME	STATUS AS OF MARCH 2016	DESCRIPTION OF CURRENTLY FUNDED PROJECT
Capital Management and Reporting System	Underway	The Capital Management and Reporting System (CMRS) will provide Transit project managers with a single, transit-wide repository of relevant, up-to-date capital project data, including scope, schedule and budget. CMRS will assist project managers with consistent project management planning, executing, reporting, and budget tracking.
Customer Information Systems	Underway	The Customer Information Systems project is a multi-faceted effort to replace or upgrade aging legacy systems that provide important customer information, such as trip planning, real-time bus location information, and customer resource management (CRM).
HASTUS Upgrade	Underway	King County Metro Transit has relied upon the HASTUS system for the scheduling of bus routes for over 20 years. This upgrade of the critical HASTUS system will assist in ongoing compliance with the 2009 Transit Performance Audit recommendations for development and maintenance of schedule efficiency tools, and the use of systematic, effective data analysis.
HASTUS Employee Performance Module	Not Started	The HASTUS Employee Performance Module (EPM) will enable Transit Operations to pull all relevant operator data into a single database where it can be queried, tracked, and viewed at very specific or very general levels, as needed, to identify trends and issues.
HASTUS Planning Module	Not Started	This new HASTUS module will be used primarily by the Service Planning group to develop and evaluate route and transit network concepts, including the associated costs. The module will be customized by the vendor specifically for Metro's operations.
Mobile Ticketing Pilot Project (aka Cashless Fare Technologies)	Underway	This project will pilot the implementation of mobile ticketing technology (payment via smartphone) for use throughout the Metro system, using up to 10,000 participants for a period of six months and extensible by another six months. There will be an assessment following the Pilot that will include evaluating the fare collection approach as to its suitability for a cashless operating environment.
On-Board Systems (OBS) / Communications Center System (CCS)	Underway	The On-Board Systems/Communication Center System (OBS/CCS) Project combines upgrades to two separate, interrelated systems into one project. The OBS portion of the project replaces an obsolete vehicle tracking system with a modern GPS based system. The CCS portion of the project updates the computer aided dispatch/automatic vehicle location (CAD/AVL) system to one that provides more efficient call processing to an essential life-safety system.

PROJECT NAME	STATUS AS OF MARCH 2016	DESCRIPTION OF CURRENTLY FUNDED PROJECT
ORCA Replacement Planning	Underway	The existing ORCA smart card fare collection system was deployed in 2009 and is now used for nearly 65% of all fares collected on King County Metro service. The vendor support agreement ends in 2021. This ORCA Replacement Planning project will conduct detailed planning and scoping to replace the existing ORCA system and ensure that Metro Transit can continue to collect transit fares beyond 2021.
P&F Timekeeping via EAM	Underway	The objective of the project is to move from using the existing, outdated, separate time-keeping system, ETTS, to using an embedded time-keeping system that can exist within the Enterprise Asset Management Software (EAM). The project will result in a one-stop timecard entry process automated through EAM, and will eliminate the need for employees to manually fill out a redundant timecard every day.
Real-Time Information Signs (RTIS)	Substantially Complete	The purpose of this project is to procure and install real-time customer information signs at select high ridership stops along five RapidRide corridors (A Line through E Line). These signs display the estimated next bus arrival time, as well as dynamic messaging to waiting customers.
Real-Time Improvements Project	Not Started	The purpose of this project is to improve the quality of real-time information for customers and Transit's planning and operations staff. An implementation plan will be based on a detailed analysis of the many systems and processes involved in creating, managing, delivering, and displaying real-time transit information. This project will simplify or eliminate redundant data systems and processes to deliver more consistent, timely, and accessible real-time information to transit customers and staff.
Regional Fare Coordination Enhancements	Underway	This project provides enhancements to the existing ORCA fare system. The purpose of the project is to implement additional functionality designed to meet King County-specific business needs in the areas of sales, customer service, business accounts, and operations. The scope also includes ORCA enhancements that benefit all of the ORCA Transit agency partners as a group, per an inter-local agreement.
Replacement of 4.9 Network and Mobile Access Routers	Underway	This project will implement a replacement for the 4.9 GHz wireless network that provides onboard connectivity and communications. This planning phase will gather requirements and conduct a market survey to determine what technologies are available. The project will also take a more strategic approach to assess other data communications needs that are not supported by the current 4.9 GHz network.
Rider Information Systems - Bus Tracker	Substantially Complete	The purpose of this project is to ensure that the legacy bus tracking application, Tracker, continues to provide Transit customers with real-time bus information while the system providing data to the application is being replaced.
Rider Information Systems - TABS Replacement	Underway	This project will replace the outdated legacy systems that generate the schedule strips for transit stops, as well as the information and layout of the bus timetables that go to the printer.

PROJECT NAME	STATUS AS OF MARCH 2016	DESCRIPTION OF CURRENTLY FUNDED PROJECT
Transit Data Infrastructure Replacement	Underway	This project will design and implement a new transit data infrastructure that will be the foundation for most of Transit's core information systems. The new structure will incorporate industry-standard concepts, enable simpler integration, reduce data distribution cycle times, extend customer information, and address data integrity issues.
Transit Signal Priority (TSP) System Replacement Conceptual Design and Specification	Underway	This project is the first step in replacing the existing, aging, TSP system. This first phase develops a Concept of Operations and solution architecture in conjunction with the Replacement of 4.9 GHz Network and Mobile Access Routers project, as well as a system/equipment specifications for procurement of a new TSP system.
VanPool Information System Modernization	Underway	This project will migrate the VanPool Information System and Vanshare desktop client-server applications to a single browser-based application that can be easily maintained by KCIT.
Vehicle Maintenance Dispatch Replacement	Underway	This project will implement the new vehicle maintenance dispatch system developed by the current vendor, AssetWorks, and retire the existing one.

5.2.2 Follow-on Phases to Existing Projects - Proposed to Start in 2017-2018

A time-critical effort in the development of this STRT was the identification of the new projects that would likely be brought forward for inclusion in the 2017-2018 budget.

In the prior section, several of the currently ongoing projects identified are in their initial phases for planning and/or requirements definition. Pending the success of these precursor efforts, the logical next step would be to pursue the next phase, which would typically be implementation. These projects are listed below:

Planned Follow-on Phases to Ongoing Transit Technology Projects for the 2017-2018 Business Plan

PROJECT NAME - PHASE	DESCRIPTION
Next Generation Wireless - Implementation	Metro will implement the recommended, and approved, wireless network solution developed in the planning and design phase of the current project, *Replacement of 4.9 GHz Network and Mobile Access Routers*. The project will implement a wireless network solution that can be supported by KCIT and that serves Transit's long term business needs for on-board connectivity and communications. The new data communications network will support the transit fleet, operating bases, and service corridors and provide business continuity for the systems and processes that use the network.
ORCA Replacement Project - Implementation (Next Generation ORCA)	This project provides funding for participation and support for the next phase of the ORCA replacement, after the current ORCA Replacement Planning phase is completed.

Transit Signal Priority (TSP) Replacement - Implementation	The current *Transit Signal Priority (TSP) System Replacement Conceptual Design and Specification* project will develop a Concept of Operations and specifications for procurement of a new TSP system. This next phase will fund the procurement and implementation of the replacement system.

As another ongoing effort, Metro Transit will continue to monitor the aging first-generation ORCA equipment. The onboard equipment has reached its end-of-life and the final device purchases have been made. Metro must continually monitor the agency equipment requirements against the available quantities. If new devices are needed prior to the launch of ORCA 2 in 2021, it is expected that new software would be required. This is not listed as a project, since its necessity has not been established, and it is expected that cost for the new software would be covered by the Regional Fare Coordination Enhancements project.

5.2.3 New Projects for the 2017-2018 Biennial Business Plan

The next category of projects in the STRT Roadmap is "new projects" that Metro intends to present for consideration as part of the 2017-2018 Business Plan. These projects would implement a new system that combines or replaces other aging systems, and/or delivers new, needed functionality. These near-term projects support the STRT goals and will help Transit meet its core business needs more effectively.

The proposed new projects are listed in the following table.

New Transit Technology Projects Proposed for 2017-2018 Biennium

PROJECT NAME	DESCRIPTION OF NEW PROJECT
Transit Business Intelligence Resource Database (T-BIRD)	The Transit Business Intelligence Resource Database (T-BIRD) project will create an integrated, multi-purpose reporting database combining data from onboard systems, the ORCA fare collection system, and other related data sources. This new system will replace outdated reporting tools and a number of at-risk systems that use those data sources. It will provide advanced analytical tools, further satisfy findings from the 2009 performance audit, and support Transit's revised performance indicator reporting process. This project was initially proposed for 2015-2016, and the STRT development process has reaffirmed its need.
Transit Video Cameras and Video Management	Many different groups in Metro collect and use video for a range of purposes such as planning, incident management, training, security, etc. A comprehensive system is needed for acquiring, managing, viewing, analyzing, and archiving transit video from vehicles, facilities, and other sources. Tying in with this system would be the expanded installation of camera systems at Transit facilities and on vehicles, including support for remote monitoring.

Comprehensive Safety and Security Technology Assessment and Enhancement	Metro has a number of small- to mid-sized safety and security systems, many of which support incident and risk management and are at, or approaching, their end-of-life. These include applications for managing VanPool accidents, security incidents, Transit safety, etc. King County also has related systems that support risk management. The project would look comprehensively at the range of safety and incident management systems and determine an appropriate plan for life cycle replacements. The results of this project should include leveraging existing King County enterprise platforms, improving needed data sharing between systems, and reducing complexity and learning curves for maintenance and operation.
Vehicle Telematics	Major advances in vehicle telematics have occurred and continue to occur, providing tools to assess vehicle health, and provide driver monitoring information, location, conditions, and diagnostics. The ability to manage vehicles remotely will allow Transit to improve efficiencies and reduce costs in fleet management and repairs. New Flyer Connect™ is one product that is currently available in the transit marketplace, and other products are available in the overall vehicle marketplace. This project would include a pilot phase, followed by an evaluation, and a plan for an expanded implementation of vehicle telematics capabilities.

Both the T-BIRD project and the Comprehensive Safety and Security Technology Assessment and Enhancement project will consolidate and replace aging and partially redundant systems, reduce the number of independent reporting platforms, reduce associated learning curves, facilitate faster ad hoc reporting, and deliver needed new functionality. The Vehicle Telematics project will support improved safety, and fleet maintenance and utilization. The Transit Video Cameras and Video Management Project supports improved safety, security, risk management, training, as well as provides operating efficiencies. These projects are shown relative to the STRT goals in Section 5.2.5.

Continuing into Spring, Metro will be refining the above projects and preparing the necessary documentation and analysis needed for inclusion in the budget packages.

Potential Additional Projects for the 2017-2018 Time Period

Other potential new projects may be proposed when more information becomes available. For example:

- King County's Fleet Administration Division is exploring and assessing options for automating vehicle use data to help better utilize County vehicles. Should a countywide solution be proposed, which would support automatic vehicle location for key non-revenue fleets, Metro would benefit from participating in the project. It would greatly improve Metro's ability to manage and dispatch field support during incidents and emergencies, as well as for major events such as adverse weather and civic events.

5.2.4 Anticipated Initiatives for 2019-2021

Longer term, Metro has identified the following as anticipated initiatives for 2019-2021. As "initiatives" rather than projects, these are considered areas where Metro is aware of a need to be addressed, and will

be working towards further refining and scoping these needs into projects for a future (anticipated 2019-2021) budgeting process.

Metro Transit's Anticipated Technology Initiatives for 2019-2021

PROJECT NAME	DESCRIPTION
Mobile Ticketing Continuation	As more and more customers adopt electronic methods of fare payment, Metro may reach a point where it is no longer cost-effective to continue to collect cash fares. The Cashless Fares Business Plan provides a range of strategies to enable this migration. Mobile Ticketing and Self-Serve TVMs are addressed as separate projects. A Mobile Ticketing Pilot project to test an approach for reducing cash fares will be evaluated in 2017. Depending on the results, and depending on the availability and feasibility of new cashless fare technologies, Metro may start testing other cashless fare technologies and/or continue the Mobile Ticketing Pilot.
New Farebox Needs Assessment	Metro will need to decide whether or not to replace its existing fareboxes with new fareboxes. The decision must be made early enough that a Farebox Replacement project can be successfully completed before farebox end-of-life issues compromise the operation of the fareboxes and impact revenues. This decision is dependent upon policy direction regarding a cashless fare system. Planning work for the farebox replacement will begin in 2017-2018, and will include assessing the policy implications around cashless fares.
Regional Trip Planner	Regional efforts to offer customers a consistent trip planning experience may trigger the need to replace Metro's Trip Planner with a new product. Whether regional compatibility becomes an issue or not, Metro's Trip Planning software will need to be assessed in five years to determine if it needs a life cycle replacement.
VanPool Information System Replacement	Metro operates the largest public sector VanPool fleet in the United States, and it is continuing to grow. The VanPool Information System (VIS) operates in conjunction with a number of smaller, older, related systems. The VIS will be reaching the end of its extended life in five years. The system has not kept up with the expanded needs of the VanPool program, particularly in terms of dealing with the higher volume of VanPool activity since the system was first implemented, leading to staffing and business inefficiencies. This project will include a needs assessment, requirements development, alternatives analysis, and system implementation.
On-Board Systems/Communication Center System (OBS/CCS) Replacement Planning	The existing on-board system (OBS) installation was completed in 2012. However, its technology dates back several years further and will be rapidly reaching its end-of-life within this timeframe. Part of this replacement planning effort will be to tie in with the Next Generation ORCA design in order to develop integration requirements that can best accommodate the potential system replacement.

At this point in time the initiatives listed above are judged to be the most likely to be developed in the 2019-2021 budget. Since technology changes so rapidly, other projects will likely be proposed. From a technology planning perspective, it is challenging to keep up with the rapid pace of change, and to determine which applications will provide the highest operational and safety benefits to Transit.

For example, Metro is currently in the process of evaluating different safety applications, such as pedestrian warning systems. The bus vendors are also investigating technologies that may be included as options in future bus builds. Although the results of these evaluations will not be available in time for incorporation into the STRT, Metro does expect to continue investigations into this area, and most likely will carry some proposals forward, with budget timing to be determined.

5.2.5 Projects and Initiatives Mapped to STRT Goals

Metro Transit's new proposed technology projects and initiatives are mapped in the table below to the STRT goals they support. All the goals are supported by multiple projects.

New Proposed Transit Technology Projects Mapped to the STRT Goals

PROJECT NAME	STRT GOALS				
	Goal A – Enhance Customer Experience	Goal B – Ensure Business Continuity	Goal C – Manage Data Effectively	Goal D – Promote Accessible Information	Goal E – Deliver Initiatives that Promote a Quality Workplace
NEW PROJECTS					
Transit Business Intelligence Resource Database (T-BIRD)		✓	✓		✓
Transit Video Cameras and Video Management	✓	✓	✓		
Comprehensive Safety and Security Technology Assessment and Enhancement	✓	✓	✓	✓	✓
Vehicle Telematics		✓	✓		✓
FOLLOW-ON PROJECTS					
Mobile Ticketing Continuation	✓	✓		✓	
Replace 4.9 network & Mobile Access Routers (NGW) Implementation		✓	✓	✓	
ORCA Replacement Project - Implementation (Next Generation ORCA)	✓	✓	✓	✓	
Transit Signal Priority (TSP) Replacement - Implementation	✓	✓	✓		

PROJECT NAME	STRT GOALS				
ANTICIPATED NEW PROJECTS					
New Farebox Needs Assessment	✓	✓			
Vanpool Information System Replacement	✓	✓	✓		✓
Regional Trip Planner	✓		✓	✓	✓

Metro's current, on-going technology projects were also examined with respect to the new STRT goals and mapped, as shown, in the following table.

Current Transit Projects Mapped to the STRT Goals

PROJECT NAME	STRT GOALS				
	Goal A – Enhance Customer Experience	Goal B – Ensure Business Continuity	Goal C – Manage Data Effectively	Goal D – Promote Accessible Information	Goal E – Deliver Initiatives that Promote a Quality Workplace
CURRENT PROJECTS					
Capital Management and Reporting System			✓		✓
Customer Information Systems Refresh	✓	✓	✓	✓	
Data Infrastructure Replacement		✓	✓		✓
HASTUS Upgrade		✓			
HASTUS Employee Performance Monitoring (EPM)					✓
HASTUS Planning Module			✓		
Mobile Ticketing Pilot (aka Cashless Fare Technologies)	✓	✓		✓	
On-Board Systems (OBS)/ Communications Center System (CCS)	✓			✓	
ORCA Replacement Planning (Next Generation ORCA)	✓	✓	✓	✓	

PROJECT NAME	STRT GOALS				
P&F Timekeeping via EAM					✓
Real-Time Improvements	✓		✓	✓	✓
Real-Time Information Signs (RTIS)	✓			✓	✓
Regional Fare Coordination Enhancements	✓		✓		
Replace 4.9 network & Mobile Access Routers (NGW)		✓	✓	✓	
Rider Information Systems – Bus Tracker	✓	✓	✓		✓
Rider Information Systems – TABS Replacement	✓	✓	✓		✓
Transit Signal Priority System Replacement Conceptual Design and Specification	✓	✓	✓		
Vanpool Information System Modernization	✓	✓	✓		✓
Vehicle Maintenance Dispatch Replacement		✓			✓

5.2.6 STRT Projects Timeline and Dependencies

Analysis of the STRT's new and current projects identified a number of dependencies and relationships between projects. This section highlights key dependencies from a high level planning perspective. An overall project timeline has been developed to look at the proposed active project portfolio across time.

STRT Projects Timeline

The *STRT Projects and Initiatives Timeline* shown on the next page shows Transit's currently funded projects, proposed new projects, and proposed new technology initiatives, which are expected to occur within the 2016 to 2021 time period. It should be noted that these timelines are planning-level schedule estimates, and are subject to change throughout the life of the projects.

Time Dependencies

The timeline also shows a number of time dependencies between the projects, particularly for the projects that will be moving from planning phases into implementation phases, such as the following three projects:

- ORCA Replacement Project - Implementation (Next Generation ORCA)
- Transit Signal Priority (TSP) Replacement - Implementation
- Next Generation Wireless – Implementation

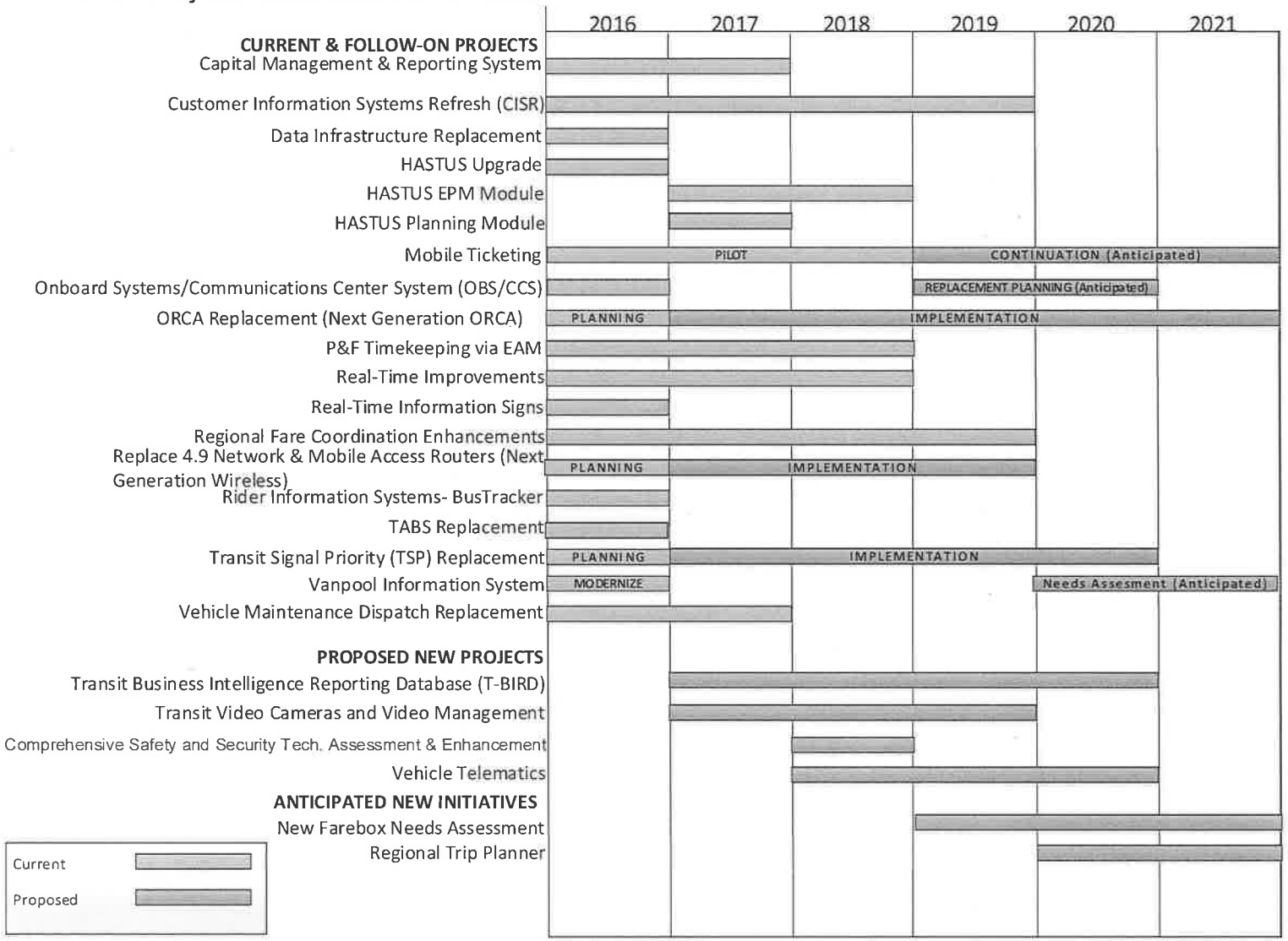
Beyond moving from planning to implementation phases, other timing relationships between projects exist, such as the Next Generation ORCA and TSP projects requiring a wireless network to be in place that

meets their needs. Parts of the T-BIRD project will require elements from the Data Infrastructure Replacement project to be completed.

Maintain Driver Functionality Dependencies

The functionality of a bus operator's work space on a vehicle is dependent on two of the proposed projects in the STRT: *Next Generation ORCA* and *OBS/CCS Replacement.* The transit operator's work area has grown more complex in recent years with electronic fare payment, ADA stop announcements, and the increased complexity of vehicle functionality. It is essential that these systems, and the requirements for operator interaction, are designed to minimize distraction, and continue to enable the operator to deliver service in a safe and efficient manner.

STRT Projects and Initiatives Timeline



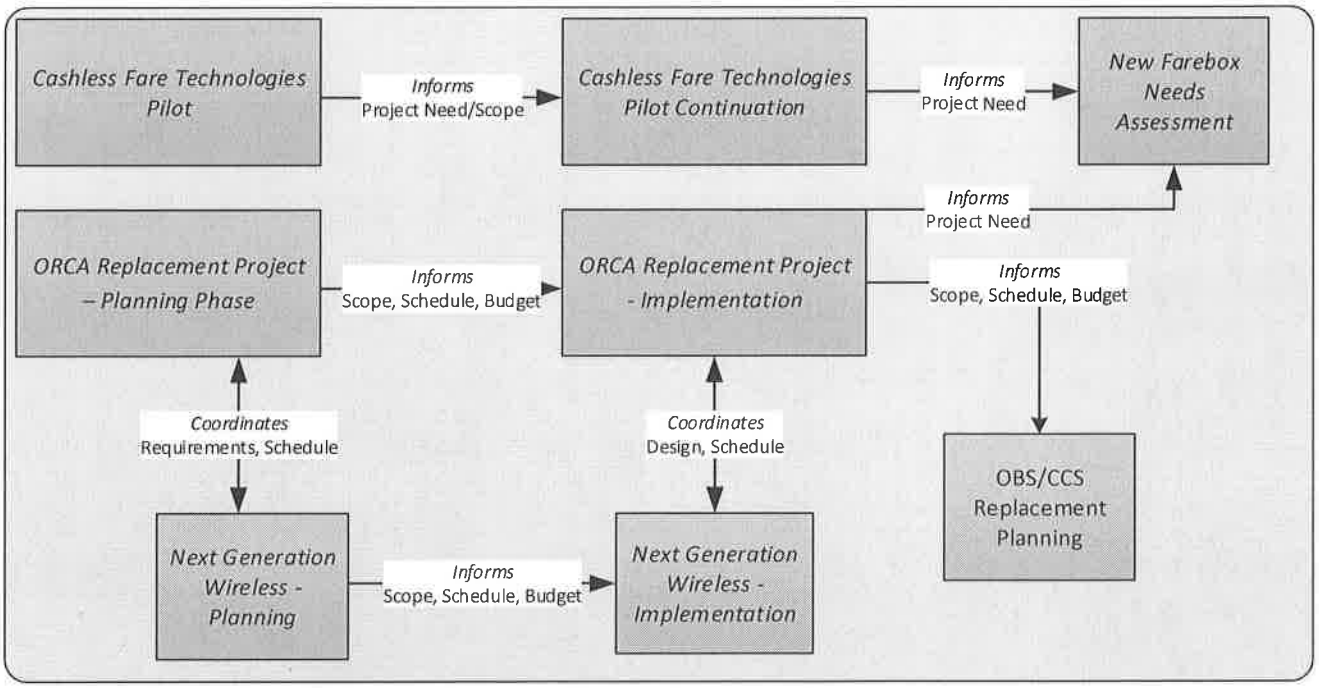
Program Area Dependencies and Relationships

As shown in the timeline on the previous page, there are many projects at various levels of implementation in any given year. With the exception of the multi-phase projects that have a firm finish-start relationship, the other projects' direct dependencies are more nuanced. Examples of the inter-relationships between projects and systems include the following:

- Coordinates: This is typically a two-way relationship where the design, requirements, and schedule of one project is coordinated with another project.
- Shares Information: This is typically a two-way relationship where information flows between two systems, generally implying a communications connection or integration.
- Informs: This is typically a one-way relationship where the output or outcome of one project is an input to another project.
- Evaluates: This is typically a one-way relationship where an element of one project includes evaluating an aspect or condition of another.

The figure below shows some of the high level relationships of Fare Collection program projects:

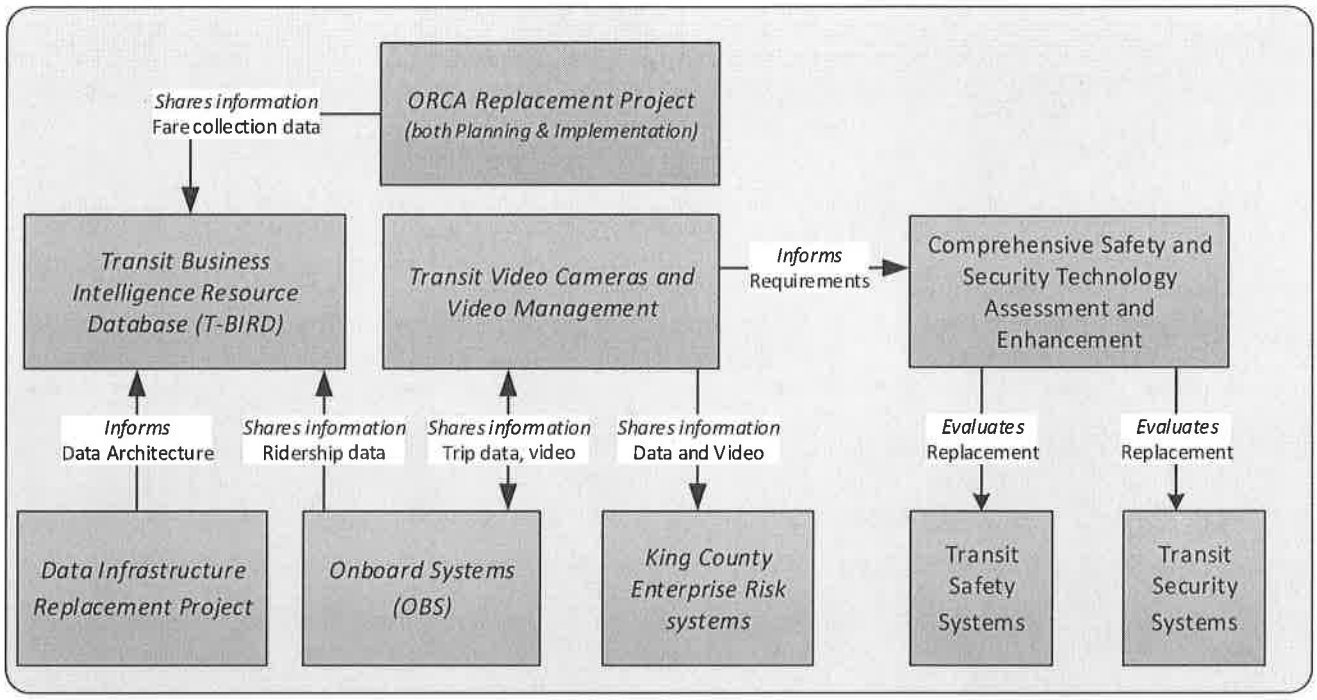
Fare Collection Project Relationships



Both the ORCA Replacement Project (Next Generation ORCA) and Cashless Fare Technologies project will inform the New Farebox Needs Assessment. Next Generation ORCA will also inform the OBS/CCS replacement. The Next Generation ORCA and Next Generation Wireless projects are currently scheduled with parallel implementation phases, and will require close coordination for design, requirements analysis, and implementation scheduling.

The following figure shows the new projects in the Data Analytics and Reporting area and their key relationships to other new, ongoing, and previously implemented applications. There are many small to mid-sized inter-related systems in the safety and security business areas. Many, but not all (to be determined in the assessment), of the systems will need to be replaced and/or enhanced, or have a better interface developed. King County also has related systems to be considered in the assessment.

Data Analytics and Reporting Project Relationships



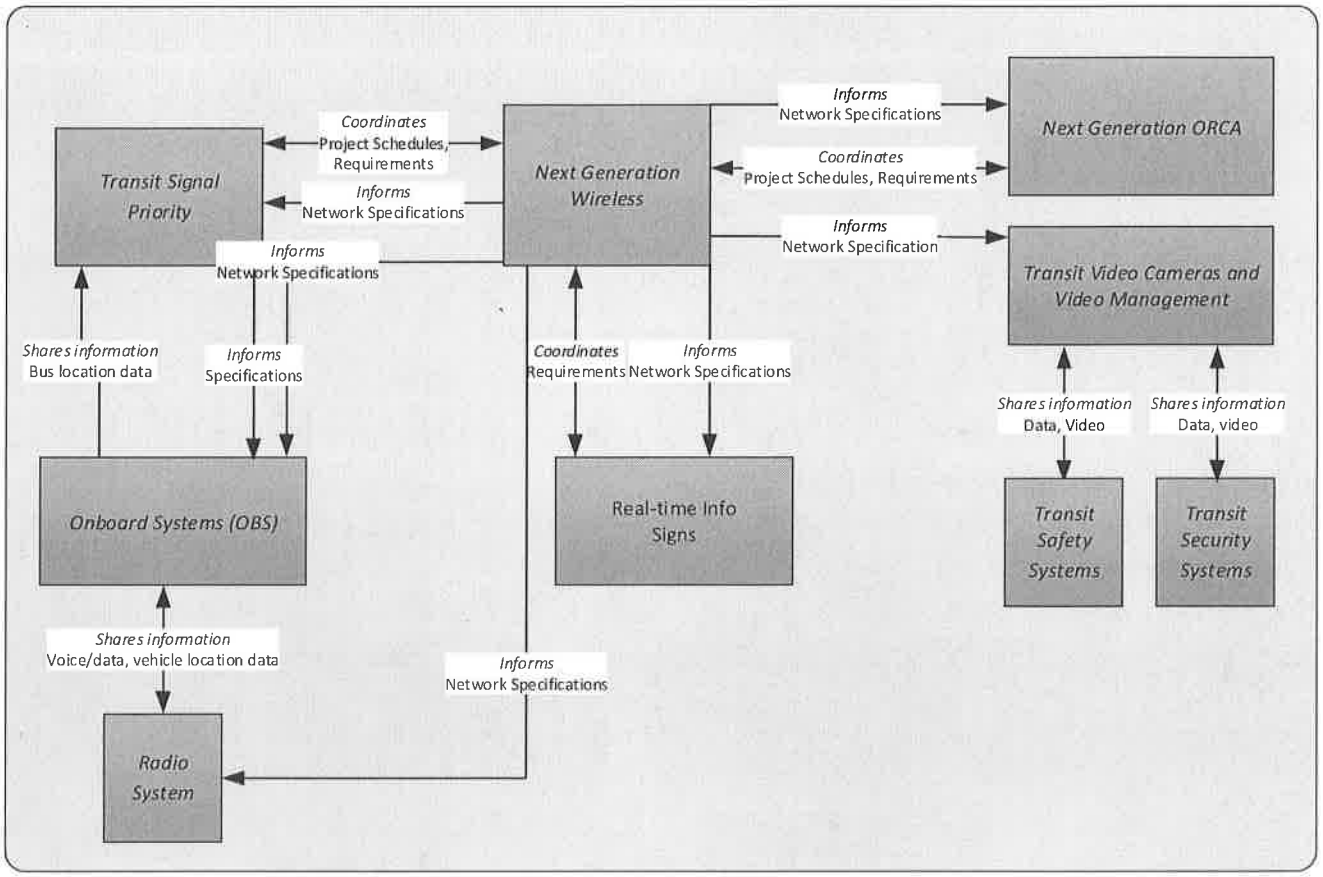
As would be expected, there are many information-sharing relationships in this program area. The current Data Infrastructure Replacement Project will develop the data architecture that will form the basis for the new T-BIRD project. T-BIRD will be implemented in parallel with Next Generation ORCA, and will eventually receive significant amounts of data from the new fare system, as well as other onboard systems. The existing transit video cameras and video management system will inform requirements for the new Comprehensive Safety and Security Technology Assessment, which will in turn be evaluating potential replacements of other safety and security systems.

Finally, the Data and Communications program area is possibly the most complex, with the Next Generation Wireless project touching many key systems and parallel projects. As part of the current phase, the Next Generation Wireless project has been gathering requirements from the technology projects that will rely upon it. However, the challenge has been that many new and replacement projects are not yet far enough along to provide definitive requirements. The project plans to undertake an additional round of requirements gathering prior to going out for bid on the new system, to ensure that the requirements are as relevant as possible. However, an outcome of the Next Generation Wireless project

will be a transit-wide network specification that all forthcoming projects or systems will have to comply with in order to use.

The figure below shows a high level representation of the new projects in the Network and Communications program area and their main integration points.

Networks and Communications Project Relationships



5.3 Cost and Resource Planning for 2017-2018

The table below shows the current rough order of magnitude cost estimates, using the STRT cost categories, of the new technology projects and new project phases that are being proposed for 2017-2018. These estimates will be further refined as part of the budget development process, and then again in each project's initial planning phases. A number of the new projects being proposed will require a significant amount of effort to establish requirements and alternatives, which impact cost.

	ESTIMATED PROJECT BUDGET			
NEW PROJECT NAME	<$1M	>$1M & <$5M	>$5M & <$10M	>$10M
Transit Business Intelligence Resource Database (T-BIRD)		✓		
Transit Video Cameras and Video Management		✓		
Comprehensive Safety and Security Technology Assessment and Enhancement		✓		
Vehicle Telematics		✓		
Next Generation Wireless - Implementation				✓
ORCA Replacement Project - Implementation (Next Generation ORCA)				✓
Transit Signal Priority (TSP) Replacement - Implementation			✓	

6 Moving Forward

This section identifies recommendations for moving forward with the near-term program of work that aligns with Transit's Roadmap, maintaining Transit's technology investments, and establishing the STRT as a living document.

Section 6.1 addresses Metro's approach for maintaining its technology investments. Section 6.2 discusses considerations and approaches pertaining to sourcing sustainable funds for Metro's technology program. Finally, Sections 6.3 and 6.4 discuss next steps for implementation and an approach for updating and maintaining the Strategic Technology Roadmap for Transit as a living document.

6.1 Maintaining the Investment

A wide range of technologies are required to safely, efficiently, and effectively operate large transit agencies, such as King County Metro. As a result, the maintenance of the agency's systems is as important as maintaining its buses and facilities. For example, maintaining a properly operating automatic vehicle location system is essential for supporting operator and passenger safety, as well as for providing service quality and customer information. The maintenance of technology investments supports nearly all of Metro's goals; however, it is particularly important to the goals of Financial Stewardship, Safety, and Service Excellence.

Transit is an industry where assets such as buses and bases have relatively long lives. Good maintenance practices for assets such as vehicles are understood and expected. Further, the relationship between safety and good maintenance practices is also understood. Metro is taking steps, outlined below, to raise the level of knowledge about the maintenance requirements of its technology investments and to ensure a disciplined and cost effective approach to meeting those maintenance needs.

The Changing Maintenance Environment

Fifteen years ago, technology maintenance was described in terms of hardware and software. Today technology categories have changed by an order of magnitude, requiring specialized training and the ability to navigate among multiple technology layers. Services may require multiple physical and virtual hardware platforms, middleware, communications services, application types, data architectures, etc.

Understanding the requirements for technology maintenance and its implications, including impact of integration with other technology, is challenging. Key factors that have increased the challenge in the planning and providing of technology maintenance services include the following:

- Increased complexity and number of products needed to provide a robust technology environment.
- More product and platform interdependencies that are difficult to untangle and track, as more vendors provide products that rely on the existence of embedded products and licenses from other companies.

- The rapid speed that technologies and vendor products evolve.
- New vendor approaches to selling systems and maintenance services.

The rapid rate of technology change, and the factors listed above, pose challenges for planners, funders, system architects, vendors, and other agency staff to understand maintenance needs and quickly develop appropriate maintenance strategies and procedures. As a result, Metro has developed a number of approaches with KCIT to effectively maintain its technology investments moving forward.

Approach for Maintaining Technology Investments

As maintenance options and issues change, Metro and KCIT staff have partnered in ongoing discussions to tune strategies and procedures to help constrain maintenance costs and improve operating performance. They work together to oversee the selection and performance of vendors who provide maintenance services and/or provide integrated maintenance activities. Further, they use tools to facilitate their maintenance planning and execution, such as a life cycle model planning tool and the Enterprise Architecture Model. For the purposes of this Strategic Roadmap, high level maintenance strategies and activities are discussed in general, and within the context of three generic project stages (planning, implementation, and operations/maintenance).

General Considerations

Metro Transit's general approach for the maintenance of its technology investments is to:

- Plan and manage maintenance within the framework and guidance of the Strategic Roadmap.
- Use a life cycle model, considering operations and maintenance costs and implications at all the stages of a system's life, from initial planning through operations and maintenance to end-of-life planning and replacement. The goal is to acquire maintainable technologies and then wisely maintain them throughout their life cycle.
- Strive to achieve quicker implementations and refresh of technologies to ensure Metro is not out of step with hardware, database software, and other technology layers' maintenance and upgrade requirements.
- Have KCIT and Metro staff stay vigilant, aware, and informed of best practices for maintenance, as technologies and maintenance models change to ensure an adequate understanding of new technology requirements, options, and trade-offs.
- Actively work to align KCIT's and Metro's maintenance priorities based on business needs and strategic direction.
- Practice preventative, predictive, and corrective maintenance activities.
- Ensure resources are allocated for operations, maintenance, and asset replacement, and use new funding models where appropriate to obtain cost effective maintenance services.
- Ensure appropriate training for both business and KCIT staff to operate and maintain new and existing transit-related technologies. This includes providing information and education to build an understanding of the integration of Transit's technologies, data, and

business processes, as they support the inter-related movement of customers, employees, and equipment through time and space for a wide range of services.

Replacement Planning Stage

Capital costs for a new system have historically been a high, one-time cost that attracted much review and consideration. Operations and maintenance (O&M) costs are ongoing and accumulate, so they also need careful consideration, planning, and review. Similarly, any incoming system must be assessed in terms of its status as a likely entity in perpetuity or uniqueness at implementation. Each consideration impacts O&M as well as any possible replacement opportunity. In the planning stages of a project, Metro ensures that:

- Cost benefit analyses for new systems take into account the estimated life span of the proposed system and the ongoing operations and maintenance costs.
- As new systems are developed, or major upgrades, are implemented, the new system will eventually need to transition to the O&M portion of its life cycle. Roles and responsibilities for the transition and the operation and maintenance of the system are defined early in the project's life cycle, ideally during planning. This is essential to ensure resources are available, trained, and equipped when the new system goes live.
- Maintenance representatives are involved in the selection of the new technology. The purpose of this involvement is to enable early identification of potential maintenance issues and trade-offs. Engaging maintenance staff also helps keep them aware of, and prepared for, any resultant changes in processes and procedures.
- KCIT's architectural review process is followed.
- The Systems Engineering process is followed whenever appropriate.

System Implementation Stage

In the Systems Implementation stage, Metro strives to:

- Establish clear business ownership of systems and processes.
- During the testing and acceptance stages of system implementation, the following tasks will be completed to improve the ongoing maintenance of a new system:
  - Acceptance testing to provide a baseline and a clear shift from the implementation stage to the ongoing O&M stage.
  - Development of operations and maintenance procedures.
  - Development of system health monitoring tools and procedures.
  - Development of ongoing system effectiveness assessment tools procedures.
  - Integration of the system into the Transit production environment.
- Develop, test, and refine adequate, accessible documentation.
- Train support staff on the new system.

System Operations and Maintenance Stage

Once a system is implemented, it is important to support the anticipated O&M needs, such as software bug fixes or upgrades, as well as any further fine-tuning or fixes necessary to support effective operations. While testing phases during the implementation offer opportunities to interact with the new system, often additional needed fine-tuning and fixes cannot be identified until a certain period of ongoing operations has elapsed. Throughout the life of the system, issues occur and new requirements are identified. Therefore, after transitioning to the O&M stage, Metro focuses on the following to keep the investment operating and properly maintained:

- Ensuring alignment between the business and KCIT staff when considering any change, from a simple bug fix to a large-scale software upgrade.
- Supporting a thoughtful, cost-conscious approach that is sensitive to business disruptions, and is risk-aware and adapts to changing business needs.
- Using the Enterprise Architecture Modeling tool to maintain up-to-date inventories and to periodically assess both the business and technical fit of the items in the inventory, such as user applications, database tools, report writing tools, servers, etc.
- Ensuring availability of trained staff who bring a specialized knowledge of transit business, technology, and IT specialty to support the new system
- Maintaining the platform and other general infrastructure elements needed by the transit technology.

Finally, from the outset of a new project, and as part of the assessment approach, Metro Transit will work to ensure that all systems have an end-of-life plan. The plan will be reviewed by a team with a broad perspective and range of knowledge that looks at business impacts, all system users, and integration implications. Plan development and review is supported by the information and tools in Metro's Enterprise Architecture Model. Metro also utilizes industry standard change management, which engages end-users, stakeholders, and management to assess the impact of, and plan for and communicate, changes to the system.

6.2 Financial Considerations

This section discusses some of the financial issues facing Transit's technology investment program and how Metro intends to address them. A number of financial considerations play a key role in the successful funding and provision of the technology services needed by Metro. At the heart of Metro's approach for financing its technology investments is a strong commitment to achieving its goal of Financial Stewardship, while also accomplishing its other goals (e.g., Service Excellence, Safety, etc.).

6.2.1 New Issues

Three relatively new issues are facing Metro and KCIT during the time period covered by this Strategic Roadmap, which may impact budget planning, staffing assignments, accounting, and performance reporting.

First, KCIT has implemented a new service delivery model with a selection of different services that they offer, such as business solutions, IT project management, and network, server storage, and databases. Staff in both KCIT and Metro Transit must refine their skills needed to identify which services are needed, estimate the resources needed, and schedule their availability. Critical to the success of Metro Transit's ongoing operations is the effective bundling and management of those diverse services from different parts of KCIT to ensure that the final technology solutions are efficiently integrated within Transit's technology architecture.

The second issue is that both Transit and KCIT have recognized that more planning is needed in the development of project concepts and new project proposals. The continued maturation of the conceptual review process has highlighted the need for much more analysis in the definition of project concepts, including more explicit analysis of project assumptions, proposed alternatives and technical approaches, and expected benefits and outcomes. The need for increased planning at these early stages presents a resource challenge to both groups, since the proposed projects are not yet funded at this stage. All stakeholders agree that more explicit definition of scope and assumptions will help reduce project risk and increase the likelihood of project success. However, the increasing planning needs are not necessarily covered by existing resources. The maturation of this process will require ongoing attention and collaboration between the Transit and KCIT.

The third issue is that vendors are developing new product delivery and funding models. One of the biggest changes is that not all vendors are offering software and other technology solutions with a pricing model that allows the investment to be capitalized. Now a range of evolving service and financing models are being presented, such as software as a service (SaaS) that is paid for by an ongoing operating fee, rather than by a one-time capital cost. Given that Metro is dependent on the service and financing models offered by vendors, these new models can have impacts that will likely:

- Require a new assessment approach.
- Affect the decision to use capital versus operating dollars.
- Impact skill sets needed by staff.
- Require new methods to evaluate vendor pricing options against other options.
- Affect how project implementation and maintenance funding accounting occurs.
- Have significant impacts on existing cost of service performance indicators for Transit. If major technology investments are no longer capitalized and considered one-time costs, but are added to ongoing operating expenses, it could significantly skew historical analyses of performance indicators, such as Hourly Cost of Service or Cost per Passenger Mile. Metro Transit already has one of the highest cost per hour rates in the nation and there is constant pressure to become more cost efficient. The dynamic of more operating costs to support the same level of technology will become challenging to manage and communicate.

6.2.2 Ongoing Issues

A number of ongoing considerations affect Metro's approach to financing its technology program, such as the following:

- Balancing too many requests for technology services and not enough resources (human capital and financial).
- Identifying a sustainable level of service when some funding is from highly volatile sources.
- Changing availability of traditional grant funding and allotted Federal resources.
- Aligning funding across several regional agencies and projects may take a significant amount of financial planning and oversight, as there can be many pots of money and resources involved.
- Estimation challenges to determine the "True Cost of Ownership" of legacy systems to help with prioritizing systems for replacement.
- Increasing the agility and speed of implementing technology solutions while managing risk – low risk items should be able to move forward faster.

6.2.3 Approach for Addressing Financial Considerations

Metro has developed STRT goals and a multi-faceted approach to ensure an effective and well balanced technology investment program to support its delivery of transportation products and services to the region. The key elements are highlighted below:

- Commitment to Financial Stewardship.
- Improvement of processes to assess and prioritize potential investments.
- Development and maintenance of a "living" Strategic Technology Roadmap for Transit.
- Partnership with KCIT to implement the new services delivery model and improve ways to understand costs.
- Awareness of market trends and impacts on financing.
- Flexibility to adapt to changes.
- Seeking additional funding sources.
- Leveraging funding through a variety of mechanisms, including the formation of public and/or private partnerships.
- Monitoring and managing risks.

Some of these approaches are discussed in more detail below.

Improvement of Processes to Assess and Prioritize Potential investments

Metro has been refining its processes to assess and prioritize potential technology investments. As the processes are used, they will continue to be refined and made more efficient, including the mechanism for better identifying potential future impacts of changes and needs.

Seeking Additional Funding Sources

Metro has a long history of finding other sources of funds to help pay for its technology investments and will continue this practice of searching for and acquiring other funding to help pay for investments. Funding sources to watch and pursue, if available, include government-related funding, public/private partnerships, regional projects, grant sources, and transportation industry organizations such as the American Public Transportation Association (APTA) and the Transit Cooperative Research Program (TCRP).

Examples of government-related funding sources that will be explored include FTA, FHWA, the state Department of Transportation, local governments, and other Federal agencies, such as the Department of Homeland Security (DHS), Department of Defense Advanced Research Project Administration, and the Department of Energy. Federal funds have been provided in the past through formula and discretionary grant programs. Periodically, a state government will use special funds to support transportation initiatives such as congestion management, livable communities, and sustainability projects.

Leverage Funding

Examples of areas where funding for Transit's technology needs can be leveraged include:

- Using the Regional ITS Architecture to find potential partners or stakeholders willing to contribute funding.
- Developing public-private partnerships, where appropriate.
- Using the Enterprise Architecture to determine where projects can combined or coordinated.
- Supplementing agency funds with Federal, State, and local grants funding resources.
- Exploring other funding mechanisms such as bond funding.

Monitoring and Managing Risks

Metro Transit's commitment to successful Financial Stewardship includes monitoring and managing a range of risks. Economic risks will be considered, such as the extent to which pledged revenues may not provide an adequate income stream. Legal risks will be managed, such as the potential to violate Federal and state statutory provisions relating to construction and operation of the system and relating to the taxable and/or tax-exempt financing being applied. Project management risks will be monitored and managed through Metro's and King County's technology governance processes.

6.3 Next Steps for Implementation

This first Strategic Technology Roadmap for Transit is a starting point for Metro to move forward in early 2016 to prepare budget packages for the 2017-2018 Business Planning and Budget Development process. Proposed projects listed in this document can be further planned and analyzed to refine the projects' proposed scopes, schedules, and budgets, in preparation for the budget development and review processes.

In support of the business planning process, as well as an ongoing strategy to deliver on KCM's vision, the STRT team identified major program areas and aligned them with existing systems, applications, and

proposed Transit technology projects. The program areas will define technology programs headed by the owners of the proposed projects and will provide a venue for detailed analysis of each project to determine the best approach for providing comprehensive, integrated technology solutions that reduce the number of systems to be operated, monitored, and maintained.

In 2016, Metro intends to advance the initial assessment work completed in this STRT to a more refined level. Some of the areas that Metro needs to further assess and plan for include the following:

- Further refinement of the program area concept. Transit's Technology Oversight Committee will confirm the organization and composition of the program areas. They will identify program owners and take the necessary steps towards implementing the supporting communications and processes to move forward. The program owners will take a stronger role in managing all of the existing applications and data, business processes, and new projects in each program. More resources may be needed to provide program areas with an appropriate level of analysis and support to enable effective decisions.
- Continued assessment and planning for maintaining Transit's information technology assets. The analysis completed for the STRT revealed that Metro has many systems and applications that need to be updated or replaced. The highest priority systems for replacement are listed in this STRT. The next tier of priorities need to be identified from the Transit Enterprise Architecture and assessed for approach. This life cycle evaluation process will need to be refined and updated in an iterative manner.
- Development of recommended approaches for reducing the number of technology platforms.
- The technology project prioritization process will likely need further refinement following its use for the 2017-2018 Business Planning and Budget Development process.

6.4 STRT Updates and Maintenance

The STRT is a living document that will be updated over time to reflect the changing environment affecting Transit's business requirements, goals and objectives, Business Plan, and the resultant STRT goals and objectives. The STRT's strategic planning context will undergo a significant review biennially, with interim updates as needed. This approach will position the STRT as a tool that encourages early preparation for the budget process. Project lists and significant issues will be reviewed and updated more frequently.

A strategic plan has the most value when it is actively consulted and followed. Metro's relatively new Enterprise Architecture Model and modeling tools provide an opportunity to forge a new, strong, active link between the STRT goals, objectives, strategies, projects, and the project development world of Metro and KCIT project managers and technical staff.

In order to make effective use of the STRT as a planning tool, Metro intends to focus on updates to the STRT during the "off" years, between biennial budget processes. The updated STRT can then be used as an overarching reference during business planning and budget development. As an example, the STRT would next be updated during 2017, and then be used as a guide in 2018 for preparing the 2019-2020 business plan. The intent is that the STRT will provide a planning framework for the biennial business plan; however, it is recognized that new initiatives and urgent business requirements may arise and need to be prioritized and addressed between these updates.

Appendix A – Review of Existing Plans

Introduction

This appendix supplements Section 2.1 by providing a more detailed discussion of the existing strategic and business planning documents that were reviewed to guide the development of the Strategic Technology Roadmap for Transit. The plans that were reviewed include the following:

- King County Strategic Plan 2010-2014
- King County Metro Strategic Plan 2011-2021
- Metro Transit 2015/2016 Business Plan
- Metro's Long Range Transit Plan
- The Transit Integration Report: Getting There Together
- King County Strategic Technology Plan (STP) 2013-2015

The reviews focused on goals and objectives, as well as key strategies, to determine key guidance and elements to include in the STRT.

King County Strategic Plan 2010-2014

The King County Strategic Plan provides the basis on which King County will make decisions about how to improve and navigate a path to a better future. The plan provides important goals, sets specific directions, and clarifies policy and budget priorities. The plan sets forth specific goals for what King County government will deliver and how it will deliver those services. For each goal, the Strategic Plan identifies key objectives and strategies that will be utilized to accomplish these goals.

The Strategic Plan influenced the development of the STRT in the following ways:

- The goals, key objectives, and strategies of the Strategic Plan guided the development of the King County Metro Strategic Plan, which then guided the development of the STRT.
- The goals, objectives, and strategies of the Strategic Plan were examined with respect to Metro Transit's technology program to assist with the planning.

The Plan sets forth specific goals for what King County government will deliver and how King County government will deliver those services:

The "what we deliver" goals are:

- **Justice and Safety**. Support safe communities and accessible justice systems for all.
- **Health and Human Potential**. Provide equitable opportunities for all individuals to realize their full potential.
- **Economic Growth and Built Environment**. Encourage vibrant, economically thriving and sustainable communities.
- **Environmental Sustainability**. Safeguard and enhance King County's natural resources and environment.

The "how we deliver" goals are:

- **Service Excellence**. Establish a culture of customer service and deliver services that are responsive to community needs.
- **Financial Stewardship**. Exercise sound financial management and build King County's long-term fiscal strength.
- **Public Engagement**. Promote robust public engagement that informs, involves, and empowers people and communities.
- **Quality Workforce**. Develop and empower King County government's most valuable asset, our employees.

For each goal, the King County Strategic Plan identifies key objectives and strategies that will be utilized to accomplish these goals. The key objectives and strategies that have application to the transit technology program were taken into consideration in the development of the STRT.

King County Metro Strategic Plan 2011-2021

Metro Transit's Strategic Plan, guided by King County's Strategic Plan, charts a path into the future, addresses internal and external challenges, and lays out a framework for making both near- and longer-term policy and resource decisions. The goals in Metro Transit's plan build on, and align with, those in the King County Strategic Plan.

Goals, Objectives and Strategies in the King County Metro Strategic Plan

Metro Transit Goal	Objective	Strategies
1. SAFETY	Keep people safe and secure	• Promote safety and security in public transportation operations and facilities • Support regional emergency response and homeland security efforts
2. HUMAN POTENTIAL	Provide public transportation products and services that add value throughout King County and that facilitate access to jobs, education, and other destinations	• Design and offer a variety of public transportation products and services appropriate to different markets and mobility needs • Provide travel opportunities and supporting amenities for historically disadvantaged populations and others with limited transportation options
3. ECONOMIC GROWTH AND BUILT ENVIRONMENT	Support a strong, diverse, sustainable economy	• Provide alternatives to driving alone that connect people to jobs, education, and other destinations essential to King County's economic vitality
	Address the growing need for transportation services and facilities throughout the County	• Coordinate and develop services and facilities with other providers to create an integrated and efficient regional transportation system

Metro Transit Goal	Objective	Strategies
4. ENVIRONMENTAL SUSTAINABILITY	Minimize Metro's environmental footprint	• Adopt technology that has the least impact on the environment and maximizes long-term sustainability
5. SERVICE EXCELLENCE	Improve satisfaction with Metro's products and services and the way they are delivered	• Improve transit speed and reliability
	Improve public awareness of Metro products and services	• Use available tools, new technologies, and new methods to improve communication with customers
6. FINANCIAL STEWARDSHIP	Emphasize planning and delivery of productive service	• Manage the transit system through service guidelines and performance measures
	Control costs	• Provide and maintain capital assets to support efficient and effective service delivery
7. PUBLIC ENGAGEMENT AND TRANSPARENCY	Increase customer and public access to understandable, accurate and transparent information	• Explore innovative ways to report to and inform the public
8. QUALITY WORKFORCE	Attract and recruit quality employees	• Make Metro an employer of choice and cultivate a diverse and highly skilled applicant pool

Each of these goals, objectives, and strategies summarized in the above table will directly inform not only the goals, objectives, and strategies for this Roadmap, but also the prioritization efforts for the proposed projects and initiatives. Furthermore, grounding the Roadmap specifically in the King County Metro Transit Strategic Plan (and Business Plan discussed below) highlights a vital cornerstone within the foundation of all of the effective planning that has come before—namely that all technology decisions for transit must be driven by the strategic and business needs of transit.

Metro Transit 2015/2016 Business Plan

Metro Transit's Business Plan charts a path into the future, addresses internal and external challenges, and lays out a framework for making both near- and longer-term policy and resource decisions. As described above, Metro Transit's Strategic Plan, grounded in King County Strategic Plan's guiding principles of accountability, customer service, fairness, partnerships, and efficient and effective delivery of products and services, identifies the agency's overarching priorities. Building upon Metro Transit's Strategic Plan, the Business Plan describes the actions that will be taken in the next two to three years to move toward the objectives in Metro's Strategic Plan. The plan also identifies trends and forces that affect Metro's ability to provide quality service, along with changes that will drive future budget decisions.

Technology investment decisions should be driven by Metro Transit's business needs and operating environment rather than the desire for new technology. Therefore, the following key action items in the Business Plan that impact technology decisions will be carried forward in the Roadmap:

- **Continuous improvement**. Efforts in this area include the following:
  - Stop-based scheduling, a new system that is changing how we manage data used to locate vehicles and how we manage bus zone and shelter information.
  - Base automation, which is bringing technology to the maintenance floor in Vehicle Maintenance. By giving mechanics and other staff the ability to record information directly online, fewer staff members are needed for data input.
  - Revising system interfaces, such as those between our maintenance work order system and our electronic business system, will result in more efficient operations. Standard system functionality can be used to perform inventory calculations, thereby assisting Vehicle Maintenance in its efforts to improve inventory management.
  - Eliminating redundant systems such as the timekeeping system used by Power and Facilities. This will allow time to be entered into the Enterprise Asset Management System, which will feed it into PeopleSoft as well as provide information on the cost associated with asset maintenance.
- **Safety and security**. Metro Transit will be developing the long-term strategy for the use of onboard cameras on transit vehicles.
- **Improve project delivery**. The plan budget supports an initiative to improve project delivery to better meet business needs and reduce costs.
- **Reduce fare payment and passenger boarding times**. The plan includes the proposed projects that would help Metro increase the speed of boarding, especially on crowded routes

Furthermore, as the "living document" Roadmap is carried forward, reviewing technology initiatives against the current Business Plan should be a key step in the process of evaluation and assessment. In addition to carrying forward the items discussed above, a number of the trends and forces identified in the Business Plan ("Change Drivers") also impact technology and have been included in the STRT's discussion of drivers in Section 3.

Metro's Long Range Plan

Coincidentally overlapping with the development of the STRT, Transit is developing a long-range transit plan which will identify Metro's role in providing mobility to those who work, live or play in King County through 2040.

The Long Range Transit Plan (LRTP) will identify a service network concept and supporting capital and operating investments needed to implement King County Metro Strategic Plan for Public Transportation and to promote the goals of the King County Strategic Plan and King County Comprehensive Plan. The LRTP will describe Metro's role in public mobility across King County and identify a system of public transportation options that are financially responsible, meet the regional transportation goals as defined in the Puget Sound Regional Council's Transportation and Vision 2040 plans, and reflects the local values of the communities Metro serves now and in the decades to come. The service concepts in the LRTP include significant uses of technology for improved service quality, better customer information, and increased efficiency.

The LRTP has a much longer timeline than the STRT, but the STRT is informed with an awareness of the future expectations of technological capabilities that Metro as an agency will need to be able to deliver. Following formal adoption of the LRTP, Metro will begin the incremental process of building the expanded transit networks envisioned for 2025 and 2040. Updated to the STRT will anticipate and incorporate the incremental addition of the capabilities needed to achieve the long-range goals.

Getting There Together

In addition, The Transit Integration Report: Getting There Together was reviewed. The report addresses how the Puget Sound transit agencies, WSDOT and state ferries, Puget Sound Regional Council and local jurisdictions work together continually to ensure effective regional mobility. The report reminds decision makers and planners of both existing and future needed regional transportation coordination and identifies some needed regional technology initiatives such as a Regional Trip Planner and the ORCA fare payment system.

King County Strategic Technology Plan (STP) 2013-2015

The King County STP was developed by the King County Department of Information Technology (KCIT), which is the central IT organization for the government of King County. KCIT customers include King County departments and agencies, such as Metro Transit, that deliver county services directly to the public.

As detailed on the KCIT website, the county has established the following four goals that illustrate its long-term values regarding use of technology to serve the public and the county agencies:

1. Efficiency,
2. Public access and customer service,
3. Transparency and accountability for decisions, and
4. Risk management.

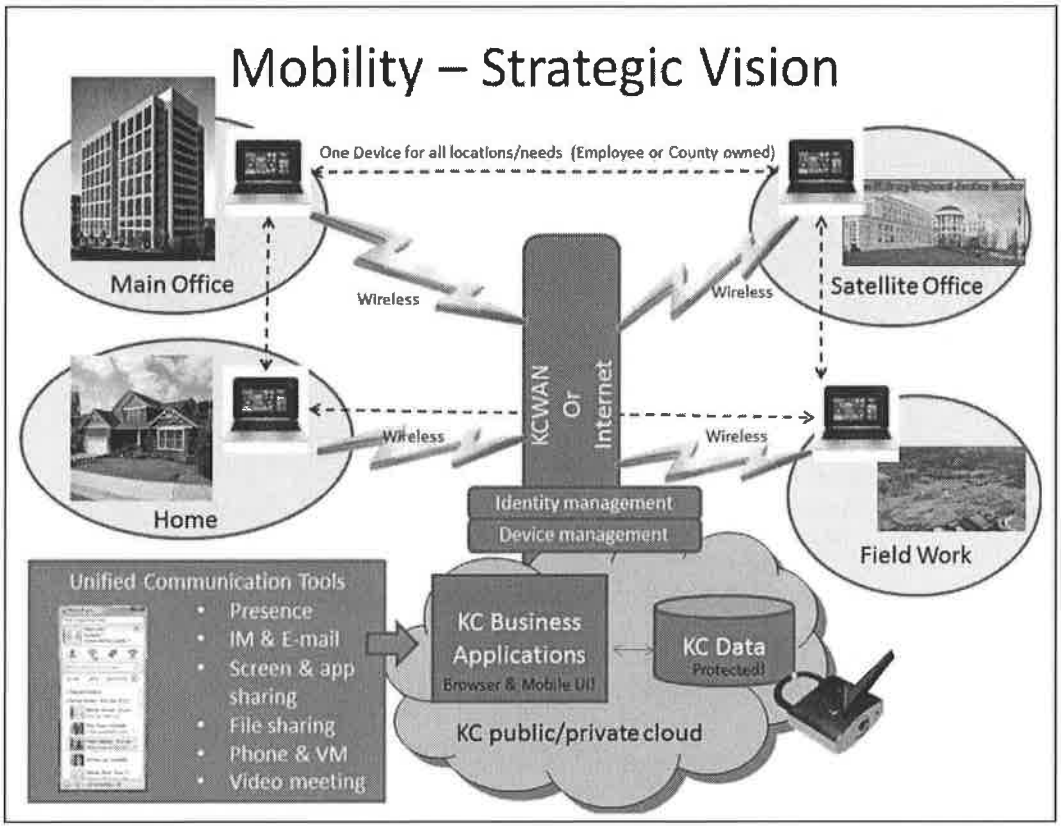
KCIT also identifies that, because of its significance and pervasiveness through all the other themes, the fifth theme area, Information Assurance, is not called out separately. Rather, it is included as an integral part of each of the other four.

Therefore, KCIT's vision states that "all county information and information-based services [should be] cost-effective and easy to access and use by the public, private companies, and internal [county] staff through web-based technologies with appropriate security and privacy controls," which "aligns with [KCIT's] belief that there are no 'technology' projects, only 'business' projects that leverage technology to improve business results."

The goal of the STP in particular is to align technology activities and investments with business strategy and goals, resulting in improved King County service delivery to the public. A key objective to support these goals is leveraging technology to improve the business results to achieve the goals identified in King County's Strategic Plan. By leveraging technology, King County service providers can improve the value, convenience, and ease of use of each of the services they provide directly to the public. Specific STP objectives carried forward in the Roadmap include:

- **eGovernment**. Improve service delivery to and interaction with King County customers by leveraging web and related social media technologies. Increase online service delivery and improve public engagement.

- **Mobility**. Free employees and citizens to interact and transact business when and where most appropriate and convenient. Improve mobile capabilities with wireless connectivity. The diagram below illustrates how this objective will be supported by the technology infrastructure highlighting how a technology initiative maps back to strategic goals and objectives while remaining grounded in business need.



This diagram from the STP illustrates the vision for how employee mobility will be supported by the IT infrastructure and technologies.

- **Technology Modernization**:
  - **Applications**. Enable flexible, timely, and dependable business solutions by pro-actively evolving modern application technologies and processes.
  - **Infrastructure**. Empower flexible system solutions by providing current technology platforms, components and frameworks on which applications can operate and continuously improve.
- **Service Maturity**. Increase the value to customers from IT services by maturing our service delivery processes and improving our services to better anticipate and match customer needs and expectations.

Appendix B – Expanded Summary of Metro's Technology Environment

Metro's technology environment can be viewed from a simple Enterprise Architecture (EA) framework, which covers the following four architecture layers, Business, Applications, Data, and Technology.

Metro's Business Architecture layer identifies Transit's many stakeholders and the business processes needed to run the agency and provide its products and services. Transit's broad stakeholder groups are shown in the figure below. Associated with each of the stakeholder groups are data sets and automated systems that support reporting requirements or facilitate the delivery of products and services.

Metro developed a basic Applications Architecture in its Enterprise Architecture Model (created and stored with EA modeling software). The EA Model includes an inventory of applications software that is used by KCM staff and/or is needed to operate transit. Some applications that Metro uses are maintained by other organizations such as KCIT, Sound Transit, or the Federal Transit Administration.

Applications have come into use at KCM in many different ways. They have been:

- Built either by KCIT or transit staff
- Bought as Commercial Off-The-Shelf (COTS) software and possibly heavily customized

- "Shrink wrap" software (e.g., Excel and Access Database used as an application development platform usually in a business area
- Provided by other organizations such as the State of Washington (e.g., Ridematch software) or FTA (e.g., the National Transit Database).

Currently, the EA Model has an applications and interface inventory of over 300 items. The applications inventory was used to help develop the STRT. In particular, it was used to identify systems that were past their end-of-life and introduced risk to Transit.

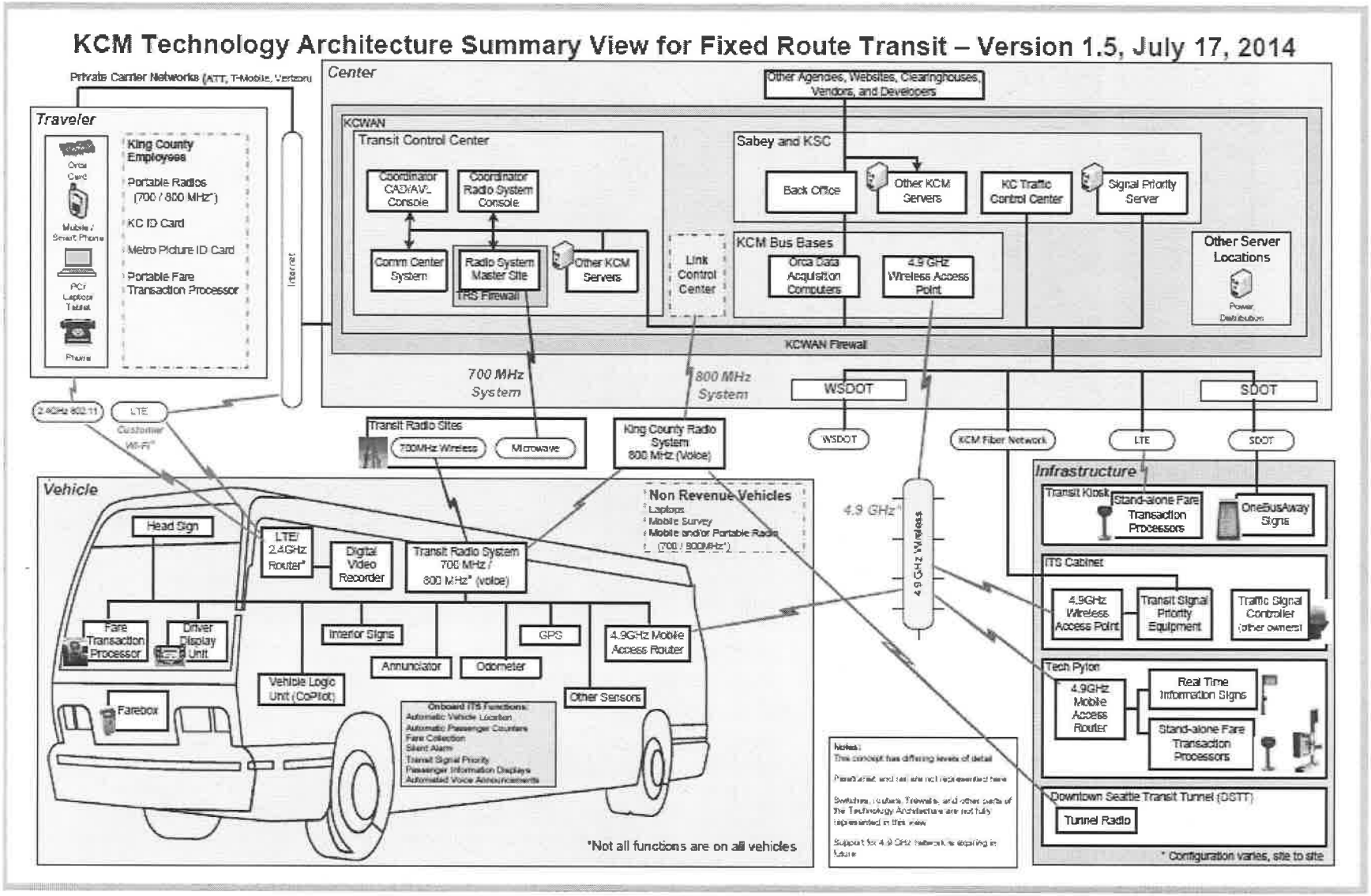
The review of the EA Model also highlighted the large number of reporting tools in use at Metro. The wide variety of reporting tools adds complexity and risk to Metro's IT support processes. The proposed T-BIRD project will help with this issue, by reducing the number of platforms and learning curves needed.

Technology Architecture

As shown in the figure on the next page, Technology Architecture Summary View, KCM's Technology Architecture is complex, but provides effective connectivity between centers, field, vehicles and travelers. Unlike other more traditional businesses, transit has technology components in buildings, in the field at intersections and bus stops, on vehicles, and in the hands of customers and employers. Looking at the diagram, KCM must work with two radio systems, multiple carrier networks, and a Digital Video system that is not connected to the bus network.

The 4.9 GHz Wireless Local Area Network (WLAN) system that supports ORCA, Onboard Systems, Real-Time Information Signs and the Transit Signal Priority system is supported by hardware that is obsolete and no longer manufactured by the sole vendor. The vendor has announced an end-of-life date in 2017, for security patches and software support.

Part of Transit's technology architecture resides on vehicles. Vehicles may have radios, APC sensors, video recorders, annunciators, etc. These ITS hardware assets have a different life cycle than the vehicles on which they reside. As vehicles are retired, these hardware components are often moved to newer vehicles. Existing processes should be reviewed and improved for managing these assets, including their versions, end-of-life issues, replacement needs, ownership, and other relevant issues.


KCM Technology Architecture Summary View for Fixed Route Transit – Version 1.5, July 17, 2014
Private Carrier Networks (ATT, T-Mobile, Verizon)
Traveler
King County Employees
Portable Radios (700 / 800 MHz*)
KC ID Card
Metro Picture ID Card
Portable Fare Transaction Processor
Orca Card
Mobile / Smart Phone
PC / Laptop / Tablet
Phone
Internet
2.4GHz 802.11
LTE
Customer Wi-Fi*
Center
Other Agencies, Websites, Clearinghouses, Vendors, and Developers
KCWAN
Transit Control Center
Coordinator CAD/AVL Console
Coordinator Radio System Console
Comm Center System
Radio System Master Site
TRS Firewall
Other KCM Servers
Link Control Center
Sabey and KSC
Back Office
Other KCM Servers
KC Traffic Control Center
Signal Priority Server
KCM Bus Bases
Orca Data Acquisition Computers
4.9 GHz Wireless Access Point
Other Server Locations
Power Distribution
KCWAN Firewall
700 MHz System
800 MHz System
WSDOT
SDOT
Transit Radio Sites
700MHz Wireless
Microwave
King County Radio System 800 MHz (Voice)
WSDOT
KCM Fiber Network
LTE
SDOT
Vehicle
Head Sign
LTE/ 2.4GHz Router*
Digital Video Recorder
Transit Radio System 700 MHz / 800 MHz* (voice)
Non Revenue Vehicles
Laptops
Mobile Survey
Mobile and/or Portable Radio (700 / 800MHz*)
Fare Transaction Processor
Driver Display Unit
Interior Signs
GPS
4.9GHz Mobile Access Router
Annunciator
Odometer
Vehicle Logic Unit (CoPilot)
Other Sensors
Farebox
Onboard ITS Functions:
Automatic Vehicle Location
Automatic Passenger Counters
Fare Collection
Silent Alarm
Transit Signal Priority
Passenger Information Displays
Automated Voice Announcements
*Not all functions are on all vehicles
4.9 GHz*
4.9 GHz Wireless
Infrastructure
Transit Kiosk
Stand-alone Fare Transaction Processors
OneBusAway Signs
ITS Cabinet
4.9GHz Wireless Access Point
Transit Signal Priority Equipment
Traffic Signal Controller (other owners)
Tech Pylon
4.9GHz Mobile Access Router
Real Time Information Signs
Stand-alone Fare Transaction Processors
Downtown Seattle Transit Tunnel (DSTT)
Tunnel Radio
* Configuration varies, site to site
Notes:
This concept has differing levels of detail
Redundant and test are not represented here
Switches, routers, Firewalls, and other parts of the Technology Architecture are not fully represented in this view
Support for 4.9 GHz network is expiring in future

Appendix C – Proposed Modernization Efforts

Based on a review of the systems in Transit's Application Architecture in its Enterprise Architecture Model, the following existing Transit systems were identified as *high priority candidates for modernization* by Metro and KCIT. These systems were selected because they are at risk from being dependent on out-dated technologies and being at end-of-life, resulting in performance issues for the users.

Initial research identified proposed approaches for modernizing these systems, which in many cases, leveraged existing or proposed technology platforms. As further research and planning is done, these proposed approaches may be refined and/or changed.

System Name	Description	Proposed Approach
All Trips	Extract from scheduling data in Transit Enterprise Database for all trips, for analysis, tracking of hours and miles.	Functionality of the new T-BIRD project
APC Ad Hoc Reporting Databases	The APC Ad Hoc Reporting Suite ((APC Analysis Suite for Users) is an interrelated, large set of Access databases used to store, clean-up, distribute and analyze APC data. Some of the databases are for the Master User, some for advanced users, and many for basic users. Many of the databases have forms, reports, and links to tables associated with them. The data is initially downloaded from Mobile Statistics by running an Init script.	Functionality of the new T-BIRD project
APC Reliability Research	APC Reliability Research is the database for recording and analyzing APC data. The data may come one of both of the following: onboard verification of boardings and alightings or counts from reviewing onboard security camera data. This analysis of the "goodness" of the APC data is required by FTA for the National Transit Database reporting.	Functionality of the new T-BIRD project
AVL Data Acquisition Project On-Time Reporting	This legacy module (misnamed as the project to implement it) is still in use for on-time reporting since the INIT solution is not adequate yet for on-time reporting.	Functionality of the new T-BIRD project
Commute Trip Reduction	CTR Database contains information on employers and worksites in King County that are affected by the Commute Trip Reduction law including address, contacts, employee counts and status history within the CTR program. It's used to track worksite compliance and progress with the laws survey and program reporting processes as well as outreach to worksites on commute programs. Its tables have been published to the KCDOT SharePoint site as SharePoint lists. Users, both internal to King County and our external partners, access the database via one of four front end databases specific to the functions and level of access needed. There is no data in the actual application, only links to the SharePoint lists.	Research option of modernizing via Customer Relations Management (CRM) platform

System Name	Description	Proposed Approach
HR Payroll Action Reporting System PARS	System that tracks payroll transactions for Operations	Possible enhancement to existing payroll system
HR PI. Audit & OSHA Compliance	System to manage and track Principal Investigator Audits and Occupational Safety & Health Administration regulatory compliance.	Possible enhancement to existing HR system
HR Service Quality Payroll System	System for tracking payroll of Service Quality staff.	Possible enhancement to existing payroll system
Incident Management Program-Safety Accident Tracking	Accident Tracking stores records of all accidents involving transit vehicles	Functionality of the new Comprehensive Safety and Security Technology Assessment and Enhancement project
Paratransit-Vanpool Issue Tracking System	A system that Rideshare Operations uses for Accident tracking of their commuter pool programs.	Functionality of the new Comprehensive Safety and Security Technology Assessment and Enhancement project
Transit Operations Program-Layover	Compute location of layover and availability of space at time of use.	Needs additional research
Lotus Notes - VM Contract Management	Vehicle Maintenance Bus Procurement Contract Management, tracking contract inspection work when inspecting new buses being considered.	End-of-life desktop system replacement, part of Infrequent, Predictable Maintenance
Ridership Forecasting Model	Software used by transit to forecast short term ridership. The Ridership Forecasting Model includes a number of assumptions that can be adjusted to develop different ridership forecasts for different potential anticipated scenarios.	End-of-life desktop system replacement, part of Infrequent, Predictable Maintenance

Appendix D – Near-term King County Enterprise Projects from KCIT

This list of countywide projects from KCIT is included to show some of the other technology efforts that will impact Metro Transit in the 2016 to 2018 time period. To fully achieve the beneficial impacts of some of the projects, Transit will have to allocate staff resources. In particular, the SharePoint migration will require Transit assistance and the Electronic Records Management System will bring significant benefits to Transit after carefully planning and records conversions.

Objective: Modernization

Name	Description	When
Legacy SharePoint	Migrate Transit SharePoint 2007 sites to SP 2013	2015/16
Outlook PST	Replace Outlook Personal Storage Files with Email Archives	2015/16
Office 365	Upgrade Microsoft Office and email hosting	2016
Windows	Upgrade to Windows 10	2017/18
EBS BI	Replace Financial reporting tool	2016
IP FAX (digital)	Replace existing analog faxing	2016
Desktop Virtualization	Provide a virtual desktop solution	?

Objective: Service Improvement and Standardization

Name	Description	When
AnyConnect	Replace GoToMyPC and SSL VPN (F5) with AnyConnect	2015/16
Onboarding	Provide a consistent onboarding experience for KC employees	?

Objective: New Services

Name	Description	When
Self-service Account Management	Establish security questions and answers for self-service Account Management	9/2015
311	Implement public service information hotline for citizens	2017/18

Objective: Compliance

Name	Description	When
ERMS	Electronic Records Management System will implement records management processes and procedures	2015/16
Application Portfolio	Catalog and document all applications and systems	2015/16
Moves	Provide technology support during staff moves	Ongoing

Appendix E – Acronyms and Glossary

Acronym or Term	Definition
AA	Applications Architecture
APC	Automatic Passenger Counter. An onboard function that counts passenger boardings and/or alightings.
API	Application Programming Interface. An API is a set of routines, protocols, and tools for building software applications
Application	A self-contained program that performs a well-defined set of tasks. Applications in the KCM EA Model include software used by KCM staff or needed to operate transit.
AVL	Automatic Vehicle Location. A means for determining the location of a vehicle and transmitting this information to a point where it can be used.
BA	Business Architecture
CAD	Computer Aided Dispatching. A method of dispatching transit vehicles, field service technicians, emergency services or other mobile assets by computer. It can either be used to send messages to a mobile data terminal (also called an MDT) and/or used to store and retrieve data (i.e. Radio Logs, Field Interviews, Client Information, Schedules, etc.)
Connected Vehicle	Connected vehicle applications provide connectivity: Among vehicles to enable crash prevention • Between vehicles and the infrastructure to enable safety, mobility, and environmental benefits • Among vehicles, infrastructure, and wireless devices to provide continuous real-time connectivity to all system users. See: http://www.its.dot.gov/connected_vehicle/connected_vehicle_research.htm
Control Center	Control Center activities include the dispatching, monitoring, controlling, and managing transit operations in real-time (most activities involve interactions between the CAD/AVL and other fixed business systems and transit vehicles)
COTS	Commercial Off-The-Shelf [software]
DA	Data Architecture
DIRP	KCM's Data Infrastructure Replacement Project
EA	Enterprise Architecture
FTA	Federal Transit Administration
GIS	Geographical Information System. A business system that organizes and processes information based on geographical coordinates as well as other attributes.

Acronym or Term	Definition
GTFS	General Transit Feed Specification
IT	Information Technology
IT/ITS	Information Technology / Intelligent Transportation System
ITS	Intelligent Transportation System
KCIT	King County Department of Information Technology
KCM	King County Metro Transit
MDT	Mobile Data Terminal. A component with a key pad and a screen on a transit vehicle to allow the vehicle operator to exchange information with onboard components and systems.
O&M	Operations and Maintenance
ORCA	One Regional Card for All. The *ORCA* card is used to pay fares on buses and trains in the Puget Sound region.
RSS	RSS (Rich Site Summary; often called Really Simple Syndication), uses a family of web feed formats to publish frequently updated information such as news headlines, alerts
RT	Real Time
SaaS	Software as a Service. SaaS is sometimes referred to as "on-demand software." It is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.
STRT	Strategic Technology Roadmap for Transit
TA	Technology Architecture, sometimes called the Infrastructure Architecture
TRC	Technical Review Committee in Metro Transit that reviews and provides recommendations on Transit's technology program
Transit Signal Priority	A business function related to obtaining preferential treatment for public transit vehicles at signalized intersections.
TSP	Transit Signal Priority
TTOSC	Transit Technology Oversight Steering Committee , which serves as Metro's technology investment board
VAN	Vehicle Area Network. A data communications network within public transit vehicle, usually conforming to SAE standards
WAN	Wide Area Network