Phase 1 System Requirements Specification (SyRS)

CALACT ITS4US Deployment Project

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COMPLETE TRIP
ITS4US

U.S. Department of Transportation

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16. Abstract

The California Association for Coordinated Transportation (CALACT) ITS4US project aims to address the need for riders who use demand-responsive services, rural riders, and riders with disabilities to have equal access to real-time trip planning technologies already available for fixed-route transit and by Transportation Network Companies. The System Requirements Specification (SyRS) report for the CALACT Phase 1 ITS4US project details the technical specification needed to address with User Needs identified in the Concept of Operations. The SySR provides a summary of the system changes proposed in the Concept of Operations and details each system requirement necessary to accomplish those changes.

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1. Introduction

This System Requirements Specification (SyRS) for the CALACT Phase 1 ITS4US describes the technical specifications of a proposal for a new system of technology governance meant to increase access to online and mobile transit trip planning. The research and development for this project has been performed by a broad team of technology and transit experts in collaboration with stakeholders including transit operators and riders, and builds from the ongoing work of the community of rural and specialized transportation technology practitioners over the last decade.

The intended audience of this document is the CALACT team, including its subcontractors and stakeholder subcommittee chairs and members, as well as the USDOT program management team. Academic and practitioner stakeholders who may find this document useful are considered as well.

1.1. System Purpose

The CALACT project identifies over 100 user needs in the Concept of Operations (ConOps) document that the proposed system of the project aims to meet. Every user need identified by the project must have at least one correlating technical requirement, or system requirement. This document details the system requirements that all system components collectively must fulfill to answer the project's user needs. If any of the proposed system components cannot fulfill a user need's system requirements, then either the proposed system component is not an adequate solution for that need, or the user need is out-of-scope and should be removed. Thus, the system requirements will serve as a litmus test for whether:

- the project's proposed system components are viable solutions to each identified user need, or
- fulfilling the identified user need with available technology is unviable and the need must be removed.

In the subsequent report, proposed system components have been identified which are capable of meeting each system requirements defined in this report. While user needs remain subject to further review and refinement, none have been removed after the development of this report due to finding no viable solution technology.

1.2. System Scope

Many transit riders benefit from a level of technical functionality in trip planning tools not currently attainable by certain underserved transit riders. The CALACT ITS4US project has identified user needs that reveal this disparity in the transit rider application ecosystem. The user needs of underserved riders could be fulfilled by improving this ecosystem with a variety of interoperating technical, administrative, and regulatory tools. The end result is a system of user-centered tools

that brings an accessible and complete trip planning experience to any rider within the tri-state region–accessible because the system will comply with all regional accessibility guidelines, and complete because the rider will have the opportunity to plan, book, and pay for their trip through the proposed system, regardless of service mode and regardless of location. Embedded in this system are also various customer service components that will allow users to seek the transit information they need in the format that works best for them, whether that is speaking with a human representative, browsing on a website, or using a commercial trip planning smartphone app.

The proposed subcomponents for the new system are based on facilitating the finalization of proposed extensions to the GTFS data specification, new data standards related to booking integration, new open-source software applications tailored to provide easy tools for regulators and other users to analyze transit agencies and their services, and intergovernmental governance and coordination processes to ensure that ongoing investments effectively maintain and improve data, data specifications, and software applications. The proposed approach defines new responsibilities for state DOTs that improve data outcomes from transit agencies and their software vendors, creates a standardized interface for assessing key transit service data, provides a feedback loop that improves the quality and accessibility of essential data on an ongoing basis, and integrates demand-responsive transportation services into the GTFS data ecosystem that currently serves fixed route transit. The CALACT project proposes the following system components (each detailed later in Section 2.3):

- Transit Data Enhancements
    - Enhanced GTFS
    - GTFS-Realtime
    - GTFS-Flex
    - GOFS
- New State DOT Responsibilities
    - Data and Procurement Guidelines
    - System Coordination Committee
    - Official List of Transportation Services
- New System Coordination Committee Responsibilities
    - Directory/Analysis Frontend
    - Knowledge Base/1st Tier Support
    - Accessibility, Mapping, Payment, Eligibility, and Wayfinding Coordination
    - Engineers' Guide to Inclusive Transit
- Transit Operator Software Applications

- Brokerages (desired)

1.3. Definitions, Acronyms, and Abbreviations

Accessibility – Accessibility is used in this document to indicate the ability all riders—especially people with disabilities, Limited English Proficiency, or who faces other barriers to access transit—to use transit and transit technologies in a way that best supports those users' individual experiences with transit. A service or technology may be "accessible" as defined by the ADA, but may also present "accessibility barriers" which this project seeks to help riders manage, in order to make the service or technology "more accessible".

ADA – Americans with Disabilities Act

API – Application Programming Interface

B2C – Business to consumer

B2G – Business to government

BAA – Broad Agency Announcement

CA – State of California

CA PATH – California Partners for Advanced Transit and Highways

CAD/AVL – Computer-Aided Dispatch/Automatic Vehicle Location

CALACT – California Association for Coordinated Transportation

Caltrans – California Department of Transportation

CCPA – California Consumer Protection Act

CDL – Concept Development Lead

ConOps – Concept of Operations

Deep link – A link within a mobile application which directs the user to another mobile application, rather than to a website.

Demand-responsive transit – Transit services which provide trips at a location and/or time that is requested by a rider. Generally, any transit service that is not Fixed-route is considered a type of Demand-responsive transit for the purposes of this document, including general public DAR, ADA paratransit, and other transit models.

DOT – Department of Transportation

Fixed-route transit – Transit services that provide service to the general public through vehicles which stop at designated locations (stops and stations) at designated times.

Freemium – Business model in which a company provides a basic level of service for free but additional, optional features are available at a premium.

Geocoding – Geocoding is the process in which a geocoder consumes addresses and transforms them into latitude and longitude coordinate points. Geocoders are often maintained and customized by local parties as generic geocoders often fail to account for nuances in a local area and rarely perform well in more sparse areas such as rural farms.

GPS – Global Positioning System

GTFS – General Transit Feed Specification

IEEE – Institute of Electrical and Electronics Engineers

Internationalization – Often shortened to i18n, refers to the technical preparation of a software application to handle translations. i18n involves wrapping all text that is used in interfaces and needs to be translated with markup tags and unique ids so that a translation can be mapped to individual tags and users can quickly toggle between supported languages. Internationalizing an application helps rapidly support additions on new translations.

IRB – Institutional Review Board

Low income riders (LI) – Public transit users who may qualify for reduced or free fares. Low income riders may also use public transit because it is the most affordable transportation option available to them.

NEMT – Non-Emergency Medical Transportation

NIST 800-53 – National Institute of Standards and Technology

PII – Personally Identifiable Information

PLC – Project Leadership Committee

PML – Project Management Lead

PMO – Project Management Organization

PMP – Project Management Plan

PMT – Project Management Team

ODOT – Oregon Department of Transportation

Older adult riders (OA) – Public transit users who carry eligibility status based on their age as defined by a given transportation service. Older adult riders may also use public transit because they are unable to access other forms of transportation due to their age.

OR – State of Oregon

OS – Operating System

Riders with hearing disabilities (DH) – Individuals who either take public transit because it is the safest transportation option for a person with a hearing disability or for whom riding transit is difficult because of that disability.

Riders with intellectual and developmental disabilities – Persons who, because of their intellectual or developmental disability, use public transit. They may also qualify for specialized forms of public transit such as paratransit or Dial-A-Ride service.

Riders with limited English proficiency (LEP) – Public transit users who, because of their limited English proficiency, do not have access to all the information related to their journey. They may also have difficulty communicating with drivers, scheduling technicians (for demand responsive-services), and other passengers.

Riders with mobility disabilities (DM) – Persons who, because of their mobility disability, use public transit. They may also qualify for specialized forms of public transit such as paratransit or Dial-A-Ride service.

Riders with other safety concerns, e.g. women, riders of color, riders with children, recently incarcerated riders (SI) – Public transit users who must consider and be aware of additional safety aspects of their journey relating to one or more of their identities being the target of harassment, violence, intimidation, or other unsafe situations.

Riders with vision disabilities (DV) – Persons who, because of their vision disability, use public transit. They may also qualify for specialized forms of public transit such as paratransit or Dial-A-Ride service.

Rural riders (RT) – Public transit users who live in low-population density areas typically with limited transit options.

SCC – System Coordination Committee

Screen-reader – Software applications that can read for visible text on a screen and non-visible markup or metadata (such as paragraph sections) and speak the content aloud to a user.

SDL – System Development Lead

SEMP – Systems Engineering Management Plan

SyRS – System Requirements Specification Document

TBD – To Be Determined

TTS – Text-to-Speech

TNC – Transportation Network Company

UI – User Interface

Veteran riders (VT) – Public transit users who carry veteran eligibility status as defined by a given transportation service.

Voice user interface – Voice user interfaces reference to user functionality that provide spoken aloud content or interactive spoken content for example Google Maps pedestrian walking navigation or Amazon's Alexa. These interfaces are becoming increasingly common and in some cases replace the need for a screen readers as the entire interface is voice based.

WA – State of Washington

WBS – Work Breakdown Structure

WSDOT – Washington State Department of Transportation

WSTA – Washington State Transportation Association

1st Tier Support – Service provided to users of the technical components of the system. 1st Tier Support may provide help with specific problems or questions related to the system or use the system to answer basic, quickly searchable questions on behalf of the user.

1.4. References

CALACT Phase 1 Concept of Operations (ConOps), FHWA-JPO- 21-858

1.5. System Overview

The CALACT ITS4US project will create a system of technology infrastructure that coordinates organizations across the three-state region of California, Oregon, and Washington. The purpose of the system created through this project will be a new level of equitable technology service available to all transit operators and other rideshare providers in the region. Access to high quality trip planning will be more available to riders with disabilities, rural and low-income riders, those with limited-English proficiency, and veterans. These riders will be able to plan their trip, book their seat, and coordinate payment for their ride, even if that ride includes ADA paratransit, a rural dial-a-ride service, or a local community transportation non-profit serving rides to veterans. By connecting this demand-responsive trip planning into current fixed route trip planning, the full public transportation network will become available to riders from these underserved communities, and the network available to current fixed route riders will be expanded. The combined outcome will be a seamless transit experience, at reduced cost to taxpayers and more effectively reported to the state DOTs.

Achieving this outcome will be a coordinated effort between transit agencies, DOTs, technology vendors, technical non-profits, trade associations, and technology companies. The project will augment the flow of data from transit operators to riders by developing a system of governance and coordination between the state Departments of Transportation (DOTs) in the region, which maintains transit data quality and aggregates that data on an ongoing basis. The DOTs are the primary project sponsors and will lead a System Coordination Committee (SCC) which governs the content of procurement guidelines required and supported by each state DOT. After the initial development of GTFS data extensions by project partners, these guidelines will ensure that high-quality transit data continues to be available throughout the life of the system, which will be aggregated in a transit directory system based on official lists of transportation services maintained by each DOT. The transit directory system will provide basic information regarding

transit services to all users, such as social service agencies or employers that may need information regarding the transit services available. The SCC will also administer functions to publish best practices for the development of third-party rider applications, coordinate technical working groups on accessibility, eligibility, payment, and wayfinding coordination to support operators, and support a first-tier support desk function that helps all users interact with the directory system. A diagram of the proposed system and further description of each subcomponent is provided in Section 2.1 of this document.

2. General System Description

This section is a review of the system introduced in the ConOps to provide the necessary context for discussing its system requirements. It is intended to provide the reader with a high-level overview of the system's function, its components and subcomponents, and how those components interoperate. For a more extensive detailing of the proposed system, readers should refer to the ConOps.

2.1. System Context

The proposed system aims to provide an improved trip planning experience to people who use public transit, especially demand-responsive transit. Users of these kinds of transit services are often members of underserved communities and thus have transportation needs apart from those that are met by standard fixed-route bus/rail service trip planning systems. For example, a rider with a mobility disability may need to know what kinds of services exist in their area that can offer door-to-door service. They may also need to know whether the vehicles operated can accommodate their mobility device and whether it has a lift, the weight capabilities of that lift, and if a wheelchair securement area will be available. However, the ways in which these various needs are met by a given operator are not made clear in the current trip planning environment. In fact, these services are not typically represented through online trip planners at all.

The CALACT ITS4US project aims to close this gap in the transit trip planning environment by extending existing data standards, developing data pipelines for standardized data sets, assisting operators in creating necessary data within the deployment region, and lastly by enacting various governance functions to manage newly formed relationships surrounding these data and standards of data quality. Focusing on the needs of specific underserved riders as identified within the ConOps, the intended result is that these system components work in concert to bring complete and accurate transit information to third-party trip planning applications so that underserved riders can also experience the full benefit of those tools.

The goals of the project are met through the establishment of the following proposed system, as illustrated in Figure 1 on the next page. System component functions are described at a high level in Section 2.3.

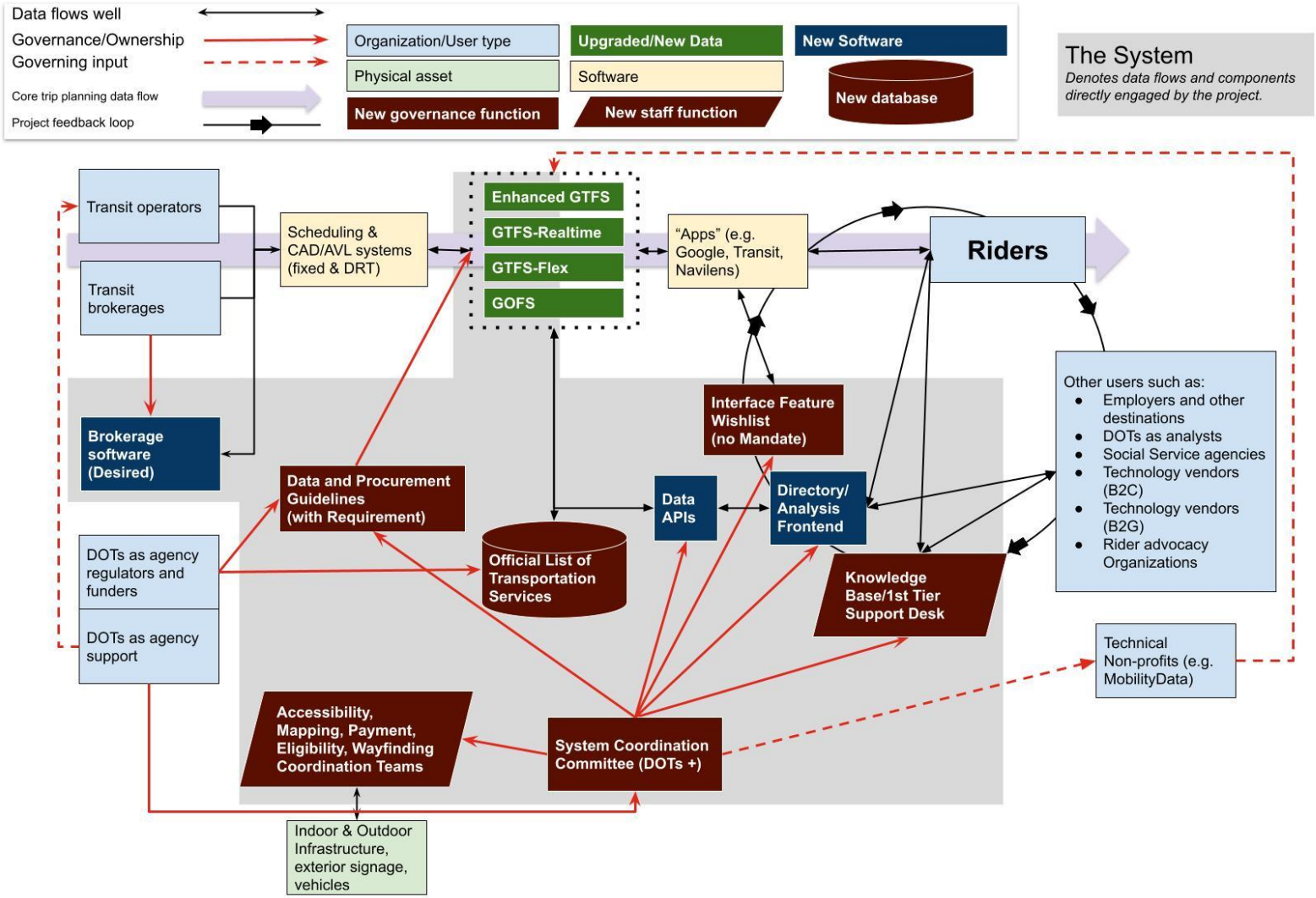

Figure 1. Detailed System Context Diagram

2.2. System Modes and States

This section expands upon Section 5.5 of the ConOps. The modes and states of the system are explained in further detail.

The following table describes varying levels of functionality of the proposed system and the outcomes of that functionality under four different Modes of Operation: Normal, Degraded, Failure, and Transitory. The proposed system is designed to increase the quality of normal operations under the current system (classified by Normal in Table 1), rather than the degraded or failing operations that characterize the current system. As the system supports more and more agencies in providing data, there may be an intermediate period wherein parts of the proposed system are deployed (Transitory). In the current system, there are no consistent processes or policies in place to remedy present degraded/failure modes of operation due to the complexity of the system failures and number of different stakeholders involved.

Table 1: Mode of Operation of Proposed System Descriptions and Outcomes

Mode of Operation	Description	Outcome
Normal	**Transit Data Enhancements**: Agencies within each deployment area have fully representative data for their transportation services. The data is publicly available for download, up-to-date, accurate, and complete. Data is accessible to all parties that need it, whether that be regulators, developers, trip planner end users, or the agencies themselves. The data includes demand-responsive services as well as accessibility-focused information such as text-to-speech, pathways, and translation information. Agency data is used by online trip planning and other transit information tools to inform riders about transit services. **State DOT Responsibilities**: Reasonable procurement requirements for regional agencies are included in funding agreements to guarantee high data quality and coverage. **System Coordination Committee Responsibilities**: System components managed by the committees enshrine multilateral communication pipelines between agencies, regulators, vendors, and riders, resulting in a feedback loop wherein voices from every stakeholder group are heard. This feedback loop serves as an input to improve the system overall. **Transit Operator Software Applications (desired)**: Agencies save resources through better coordination of demand-responsive rides with neighboring agencies. The brokerage software is operated, maintained, and governed by transit operators locally, allowing them to benefit from open data specifications and shared development, without encroaching on local agency operations.	Riders are able to rely on accurate online information about all transit services and travel accordingly. Agencies and regulators are able to conduct analysis with good data. Rider applications are able to deliver a reliable service to their end users. The information provided to users is generally all of the information needed for users of any abilities to discover and use the best trip to suit their needs.

Mode of Operation	Description	Outcome
Degraded	**Transit Data Enhancements**: The transit agency has data representing services, but it is out of date, inaccurate, or incomplete. Online transit information tools therefore paint an incomplete picture of the agency's services and in some cases may contradict ground truth (for example, a stop's location or arrival times may not match). Representative data may not be fully accessible to all parties that need it and is likely not publicly available. **State DOT Responsibilities**: Procurement requirements for regional agencies are included in funding agreements, but some of those requirements are either not robust enough to guarantee high data quality and coverage or are too onerous for agencies to fulfill. **System Coordination Committee Responsibilities**: System components managed by the committees establish some interoperability, but not all necessary voices may be heard. The deployment of components managed by these committees may be incomplete, lacking features that would otherwise facilitate a complete feedback loop. **Transit Operator Software Applications (desired)**: Some agencies save resources by coordinating and sharing demand-responsive rides, but ride balancing may be unevenly distributed, causing more of a burden on one or a small number of agencies over the rest. The brokerage software is accessible locally, but it may be harder for some agencies to manage due to in-house technical capacity not matching what the tool requires. Agencies may be shut out from some functionality as a result.	Riders have access to online information regarding transit services, but it may not be as helpful as it should, and in some cases, may mislead them as they make travel decisions. Agencies and regulators can conduct analysis with the data, but only in broad strokes, as more granular data is less reliable. Rider applications can consume transit data but would need to mitigate the promotion of unreliable data, and therefore may not publish it. In degraded conditions, additional support from state DOTs and the other system subcomponents providing technical assistance are applied to help the agency improve their transit data.

Mode of Operation	Description	Outcome
Failure	**Transit Data Enhancements**: The transit agency operates without any representative data for online transit information tools. In this mode of operation, there are key tools that have not been adopted by the agency, or those tools are not being utilized effectively. **State DOT Responsibilities**: There are either no new procurement requirements established as part of regional agencies' funding agreements, resulting in no guarantee of high data quality and coverage, or those requirements are too onerous for agencies to feasibly meet. **System Coordination Committee Responsibilities**: The deployment of components managed by these committees are incomplete and ineffectual due to the lack of interoperability. Pipelines necessary for the transfer of information are severed, resulting in an inability for users of the system to solicit customer service. **Transit Operator Software Applications (desired)**: The brokerage software is either not built or of a technical complexity that agencies are unable to manage it due to in-house technical capacity. Agencies are thus unable to efficiently and effectively rebalance their rides with neighboring agencies.	Riders have no access to standardized online information, so they must manage to make sense of physical and online materials to discover and plan transit trips. Agencies and regulators do not have access to schedule and service data that is clearly defined, organized, easy to analyze. Rider applications cannot publish the agency's services, reducing their utility to end users.
Transitory	The transit agency operates in a fashion that has certain components of the new system but has not implemented all features.	Riders have access to information available during Normal operations of the current system, and some but not yet all information available during Normal operations of the proposed system. Transitory operations may be different in different regions as the technologies to be deployed will vary.

2.3. Major System Capabilities

The new capabilities of the proposed system can be grouped into four categories, each representing one or more system components: Transit Data Enhancements, New State DOT Responsibilities, New System Coordination Committee, and Transit Operator Software Applications.

Transit Data Enhancements

The General Transit Feed Specification (GTFS) is a data standard that was developed to define public transit schedule information. Evolving and gaining adoption since 2005, the standard is now in use by thousands of operators in the United States and is compatible with the GTFS Realtime specification to accurately describe real-time location of service vehicles. The rapid adoption of the standard was driven by consumer demand with riders often using third-party commercial trip planning applications such as Google Maps, Transit app, Apple Map, Rome2Rio, Navilens, and many others. However, this demand and its response focused investment on riders with smartphones in urbanized areas. This project's proposed transit data enhancements focus on enhancements and extensions to the data ecosystem to serve riders of demand-responsive service and improve essential information for underserved riders on fixed-route services. The enhancements fall into four categories:

Enhanced GTFS

Enhanced GTFS includes the GTFS-Pathways, GTFS-Text-to-Speech, GTFS-Translations, GTFS-Vehicles, and GTFS-Fares v2 extensions.

The GTFS-Pathways extension describes the physical environment of a stop or station as it relates to pedestrian (either walking or using a wheelchair or other mobility device) navigation and accessibility. This extension is well-developed and Pathways data is already present in some communities. Pathways data is especially necessary for more complex stop locations such as subway stations with multiple entrances but with fewer elevators than entrances. This project will focus on collecting the necessary pathways data within the deployment area.

For many of the fields present in GTFS and GTFS extensions there is a Text-to-Speech (TTS) field—for example 'tts_stop_name' corresponds to the field 'stop_name'. These TTS fields are meant to include the same information as the primary field, but with improved notation for applications such as voice user interfaces and screen-reader applications (for example, a stop name like "Stop 'n Save @ NE C. Chávez Blvd").

The GTFS-Translations provides text in multiple languages for information found in a GTFS dataset. This extension has already been adopted into the GTFS, and defines the translations.txt file. By providing translations within the data specification, third-party applications that are internationalized can immediately consume and display information in the user's target language when the appropriate translation has been provided. This project will work with operators to support all languages in GTFS that the operator serves in their jurisdiction per state and federal guidelines.

The vehicle information in the GTFS specification is limited, allowing for two simple fields trips.wheelchair_accessible, and trips.bike_allowed. However, we know these fields are insufficient to support the needs of riders travelling with mobility devices. The proposed GTFS-

Vehicles extensions describes additional fields to support riders with mobility devices including information on which vehicle doors are accessible for boarding with a mobility device.

The existing implementation of fares data in GTFS is limited and only supports very basic fare types. The proposed GTFS-Fares v2 extension addresses many of the limitations present in the current specification and allows for the description of complex transit fare systems, including fare capping, zone or route-based fares, and fare discount programs.

Some of the GTFS data (Pathways, Text-to-Speech, Translations, Vehicles, and Fares v2) will be created for the deployment area by the CALACT ITS4US project team with minimal staff hours contributed by operators. These labor and technology services will be provided to agencies in order to support the completeness of coverage across the deployment region. For agencies where data is developed, a long-term maintenance plan or transition plan to agency-maintained data will be developed to capture the expected long-term operational costs of the system. The production of some data sets directly through project staff resources will not be a permanent feature of the system, although the continued capacity for the system to manage and deploy such services as needed will be. The purpose of building and maintaining some data sets in the short term during system development and deployment is to support smaller agencies which are less likely to have the technical capacity to adopt new technology solutions, and also to persuade vendors within the technology marketplace to comply with the new data and procurement guidelines.

Some of these extensions, including Pathways and Text-to-Speech, are already incorporated into the GTFS specification and could be used in applications currently. Others, such as Fares v2, are well-defined proposals and are in the process of being implemented in third-party applications. None, however, are widely adopted. Where standards are even less developed, such as GTFS-Eligibilities and GTFS-Capabilities, the project team will participate in standards development efforts as appropriate to support project goals.

GTFS-Realtime

GTFS-Realtime is an API specification that provides alerts regarding transit services and also allows for the update of arrival times and vehicle locations. While it is not feasible for the CALACT ITS4US project to produce arrival time or vehicle location updates for individual agencies, as these must be calculated automatically with GPS or other location information from the vehicles, it is feasible both to produce alert information for agencies and also to encourage the adoption of GTFS-Realtime by agencies through their own vendors. This would support the fulfillment of user needs identified in stakeholder research, such as to know when stops or trips have cancelled service.

GTFS-Flex

GTFS-Flex is a proposed extension of GTFS that incorporates demand-responsive services for the purpose of service definition, trip discovery, and trip planning. The first large-scale deployment of GTFS-Flex data launched in 2018 in Vermont, when the VTrans FTA Mod Sandbox project began publishing GTFS-Flex data for each agency in that state and incorporated the data into a statewide trip planner. GTFS-Flex v2 is an updated version of the proposed extension released in 2020 that incorporates lessons learned during that process and subsequent deployments in Northwest Oregon and Central California. In 2020, an additional extension, GTFS-Eligibilities, synchronized with GTFS-Flex v2 was developed to describe the eligibility

restrictions of transit services and is currently being enhanced through an FTA Mobility4All grant led by project partner agency ODOT. The CALACT ITS4US project will create or facilitate the creation of data aligning with these proposed extensions to describe every public or private non-provide demand-responsive service within the three-state region.

General On-Demand Feed Specification (GOFS)

General On-Demand Feed Specification (GOFS) is the name given to the MobilityData working group currently convening to define a specification and roadmap to allow not only discovery, but also the booking of and payment for services within trip planning apps. GOFS would be similar to the GTFS-Realtime specification, but focus on supporting an end-to-end ride for users of flex-route and demand responsive service. The workgroup is focusing on accelerating the adoption of a suite of existing proposed GTFS extensions that would support these riders with changes to GTFS which are compatible with previous versions of GTFS (the proposed changes include GTFS-Flex v2, plus further additional changes necessary to present on-demand services). The CALACT ITS4US project is a member of this working group and will support adoption and implementation of these specifications in the deployment area.

New State DOT Responsibilities

The proposed changes call for new approaches to data quality assurance and procurement at the state level and better alignment with other DOTs through participation in a new combined governance body.

Data and Procurement Guidelines

The CALACT ITS4US project would coordinate the development of data quality guidelines which specific the data to be provided as well as establishing a process to assess data quality. As existing standards and proposals are complex and broad, requirements to produce GTFS data must be supplemented with guidelines on how to produce quality data meeting the needs of regulators, operators, vendors, transit riders, and other stakeholders. Procurement guidelines, developed in partnership with operators to be inserted into agreements with vendors to govern data quality, would assist operators in procuring software systems that could produce the complete and accurate data required to meet data guidelines. By providing both data assistance and procurement guidelines as a resource to operators, the project can help ensure the improvement in quality of data used in third-party trip planning applications and thus improve outcomes for riders. State DOTs would be essential in their local roles to encourage agencies within their jurisdiction to adopt the guidelines in their vendor agreements.

System Coordination Committee

The System Coordination Committee (SCC) is a long-term governance function that defines and evolves the advisory data and procurement guidelines to keep them practical in light of the current status of the GTFS ecosystem. During the course of the CALACT ITS4US project, this committee would be made up of the Project Management Team (PMT, including the key persons on the CALACT team and representatives of each participating state DOT), with advice from the Project Leadership Committee (PLC, including all project partners and stakeholder representatives). The SCC would hire a Project Management Organization (PMO) to implement and manage the components of the system governed by the SCC, as well as to provide training and technical support to DOTs in the development of technical capacity for their roles within the

project. The SCC would continue to function after Phase 3 of the project, although whether a PMO would continue to support the SCC or if DOT representatives would assume operations will not be defined until Phase 3 after project evaluation begins. The state DOTs will be central decision-making participants in the SCC, making up the core members of a consortium approach to aligning data regulation across the three states, through commitments detailed within an MOU drafted before the end of Phase 1.

Official List of Transportation Services

Each state DOT will maintain a list of all transportation services operating within their states. Exactly which transportation services are included will be defined by the SCC. This definition may change over time, but will include at least all shared-ride public transit services. This list will be integrated into the Data APIs component, and is separate and distinct from a list of all operators. Official lists will have a standardized process that can ensure a regional list of all operators can be coordinated and in sync with the other non-ITS4US lists of all transit services.

It is expected that the SCC will define the data fields for the list as well as appropriate metadata. Transportation services is meant to be broader than a list of transportation operators. This list will be a subset of the information included in the Data APIs and published via the Directory/Analysis Frontend. There is no known existing data standard for describing a list of transportation services that meets the project's needs, however it’s expected that many of the necessary fields may be pulled from GTFS feeds.

New System Coordination Committee Responsibilities

The proposed changes call for a combined approach to governance across the three-state region. Combined governance allows for reduced overhead in supporting the creation of new guidelines and better outcomes for all stakeholders by creating consistent expectations for participation and quality. Collectively the new governance body will oversee administration of the tasks described below.

Data APIs

The Data APIs are a database and backend software application which ingests GTFS data from operators and provides to other applications a series of APIs that expose useful data elements from the GTFS feeds as well as aggregations, calculations, and abstractions from those GTFS feeds which are necessary to support user needs. The Data APIs would be a software application with a shared approach to licensing, development, code, and hosting that allows for centralized and/or decentralized deployment to support the state DOTs. The Data APIs should be maintained through a shared licensing and financial model across the three states.

Directory/Analysis Frontend

The Directory/Analysis Frontend would be a web application where users are able to view, search, and filter for basic transit operator data, such as contact information, a list of routes and stops, demand responsive services and their service times and areas, fares, and GTFS downloads. Additional analytical features and data downloads may be available for some users. The Directory/Analysis Frontend would be a software application with a shared approach to licensing, development, code, and hosting that allows for centralized and/or decentralized

deployment to support the state DOTs. The Directory/Analysis Frontend should be maintained through a shared licensing and financial model across the three states.

Knowledge Base/1st Tier Support

The Knowledge Base and Support Desk would provide "1st-tier" educational resources and answers in response to user questions. It is expected that this system component will be a consolidated interface for the user across the deployment site regardless of what transportation service they are using. This system includes staff responding through multiple modes (i.e.: chat, phone, etc.) and would include tracking question topics for feedback into improving its own operations or that of other system components. Staff are expected to use the Data APIs and Directory/Analysis Frontend, or commercial mobile applications such as Google Maps, Transit App, Navilens, in their own workflow, and to also provide support to other users of those applications. It is expected that a management team would support the creation and implementation of standard operating procedures (SOPs) pertaining to this system component.

Accessibility, Mapping, Payment, Eligibility, and Wayfinding Coordination Teams

During the course of the ITS4US project, complete inter-state/inter-agency standardization of Accessibility, Mapping, Payments, Eligibility, and Wayfinding coordination is unattainable and not necessarily desirable. Each individual state and agency may continue to use local tools and policies that should still be interoperable and coordinated, along with oversight of accessibility features not governed directly by data standardization.

The SCC will oversee the creation of one or more technical working groups to address these four areas as well as the staffing of technical support teams for operators focused on improving these four areas. Both the working group and technical support teams will focus on solutions to user needs that are not supported directly through transit data enhancements required by new procurement and data guidelines.

Engineers' Guide to Inclusive Transit

Many stakeholder interviews identified desired application features or needs that are not fulfilled by rider-facing transit apps today. The scope of this project does not include designing and building new interfaces for rider-facing transit apps such as trip planning applications. However, the marketplace at large is good at scoping and building effective user interfaces. This system component will provide a comprehensive introduction to existing regulations, requirements, and user needs as known to the project for third-party application developers. For example, an overview of applicable federal and state guidelines for web accessibility, multiple language support, and common definitions such as fixed-route and on-demand. This guide will improve rider outcomes by providing information that is difficult for developers to find and incorporate into their work.

Transit Operator Software Applications

The CALACT ITS4US project does not envision developing software directly for transit operators except for a potential targeted software approach to fulfilling one important agency user need.

Brokerages (desired)

Brokerage software based on open data standards are a desired (i.e., not required) component of the system. A brokerage is a process or software application that facilitates the exchange of trips between transit operators. Transit operator users expressed a desire to save resources through better coordination of rides with neighboring agencies. Data models exist to exchange information between demand-responsive agencies via brokerages, and could fulfill this use case, but would not be necessary for the other components of the system to fulfill their requirements. A brokerage could be a standalone feature governed through a different model than other system components. If implemented, brokerage software would be built or deployed in partnership but operated, maintained, and governed by transit operators locally. This would allow operators to benefit from open data specifications and shared development without encroaching on local agency operations.

2.4. Major System Conditions, Constraints, Assumptions and Dependencies

Assumptions and Constraints

The system depends on accurate, complete, and standards-based datasets and APIs. The outcome of having a system built around data standards proposed by the project requires that those data standards are interoperable. They must be adopted by data standard communities (which itself likely requires both a producing and consuming entity and then a vote by the community), and ingested by trip planning applications. Ingesting these new data formats would require enhancements like upgrades to user-facing routing software, integration of deep link or in-app capabilities for booking, and TTS. Thus, the development of data standards and the applications that use the data occur together.

API development is also required to make these intersystem connections. To ensure the region has consistent coverage of representative data, a regional effort must be taken to gather accurate information, including information on service schedules, boundaries, vehicle specifications, infrastructure, eligibility, booking, and fares. Such an undertaking requires initial cooperation and active ongoing participation of agencies to develop over time.

Transportation providers, agencies, and regulators already have a complex system of software and data pipelines. A fixed-route operator uses software in network planning and schedule development, Computer-Aided Dispatch/Automatic Vehicle Location systems (CAD/AVL), fare system management, passenger counting, passenger-facing information and trip planning. A demand-responsive operator uses software to receive trip requests, schedule rides on vehicles, dispatch vehicles, and audit trips. The above functions may be served by many different software from different vendors. Given this high degree of modularity, adding new functions and data specifications needs to be done in a way that allows the existing system to continue to operate or be replaced without disruption to riders or high costs to agencies.

Data and API standards, best practices, and guidelines are essential for purchasing agencies to foster interoperability between the systems that they procure and implement. Implementation guidelines will be useful so that traveler-facing applications can deliver information that matches how agencies present their services. Voluntary guidelines would still allow experimentation and innovation among apps.

To enable broad access to travelers and planners, data should be available online under open licenses and in human-readable directories and automated APIs. The system needs interstate governance to build a universal directory of transit data feeds for the three states, which this project is positioned to provide.

Data on the movement of vehicles is sometimes linked with data for an individual person's trips. A record of point-to-point demand-responsive trip may not be linked to an individual identity, but the origin or destination may be at a home, workplace, social service, which could be used to link the trip to an individual identity and even build a profile of travel behavior. Therefore, any data that could reveal travel behavior needs to be protected as a matter of user privacy.

The prevalence and availability of demand-responsive transportation will increase in the coming years as technology allows more efficient booking and routing, and expectations continue to be shaped by ride-hail in a post-pandemic world. It is expected that more demand-response services will be offered over the course of this program.

Support Environment

A broad and diverse support environment is already in place for the proposed system and includes operational processes, physical infrastructure, and software, hardware, and data technologies. It also differs depending on the local context of the users. Some transit agencies and riders have complex ITS infrastructures and operate in urban environments with physical infrastructure specifically built to augment that ITS infrastructure. Other transit agencies and riders have little technology to work with other than vehicles and commercial cell phones and operate in rural environments where even the roadway infrastructure is not up to a modern standard. Additionally, fixed-route services operate with an entirely different technology stack than demand-responsive services, and sometimes these technologies are combined to deploy a deviated-fixed-route. The current system operates within this diverse environment, but only effectively for some users – generally those more technologically advanced and in urban settings.

Typical technologies that support the current system are

- Scheduling systems: Software that operators use to generate bus schedules, which typically produces GTFS data
- CAD/AVL systems: On-board technology that allows dispatch centers to monitor and manage their vehicle fleet in real-time.
- GPS devices: On-board signaling hardware that produces the coordinates of a vehicle
- Telephone systems: Systems, on-board or in-office, that allow riders to call in to transportation services to request pickup
- Customer service call centers: Service for riders to call with questions about a transportation service
- WiFi devices: On-board hardware that allows operators to conduct online functions of their services like mapping, communication, and scheduling

- Cellular networks: Both riders and agencies use the cellular phone and data networks to exchange information to and from the transit vehicle and other locations.

- Consumer mobile phones, smartphones, and other computers: Riders use their own mobile devices to access SMS, websites, and native applications through cell or WiFi networks

- Station/bus stop infrastructure: Infrastructure and accommodations for riders at or around boarding locations. This could include signage displaying traveler information, a bench, a power outlet, a trash can, a stairway, or other things that can be either amenities or barriers for riders.

- Fare kiosks and vending machines: Stations where riders can pay for their bus fare. These may accept cash, card, contactless payment, or any combination of these methods

- Agency websites/online documentation: Online source of information for riders

- Data validators: Programs that evaluate GTFS data for accuracy/correctness

- Transit data analysis tools: GTFS-based software that enables regulators to conduct various high-level analysis tasks of a transit network

- Online trip planning applications: Online tools in which a user can input an origin-destination pair, as well as a few other trip parameters, and return potential transit trip itineraries

- Online map interfaces: Manipulatable map display on which trip directions are overlaid in many trip planning apps.

Operational Policies and Constraints

Negative effects of many operational policies and constraints on the system will be mitigated by the proposed system components. Other policies and constraints that limit the field of applicable solutions that can be applied in the proposed system have been accounted for in system components to support system success within those constraints. There are some new relevant policies and constraints related to the system which should be considered as they relate to the standardization of data and transit agency processes outside of the three-state region of this project.

Significant resources from state DOTs and agencies are dedicated in the “current system” (which lacks any organized coordination between various US public entities) to discuss and plan for how to adapt shared data resources like GTFS and related standards to the needs of multiple agencies and coordinate divergent but related projects that leverage those standards. The SCC will support more efficient use of these resources by ensuring that each state DOT and other stakeholders are aware of other ongoing projects, by providing a central venue where DOTs can coordinate other ongoing specification enhancement projects. The same resources can be used to advance transit data, but greater improvement will be realized by reduced overlap between the multiple agencies working with GTFS and other specifications.

In the development of shared software resources, the IT policies and capacities of different organizations involved, especially the central state DOTs must be considered. These organizations do have very distinct IT policies, capacities, and roadmaps for how those policies are expected to change over the coming years. Most of the specific IT policies in effect at these agencies are too numerous to recount here, and not necessary to consider at this stage of system design. However, the general framework of the proposed system has been designed to allow for the best management of local IT policies and reduce the risk of conflict between system design and IT policies and capacities. The distinction between the official list of transportation services and the directory/analysis frontend is of critical importance to this consideration. The frontend itself is only broadly defined, and could be made up of multiple technical subcomponents (for example, database, API, and website). The separation of the official lists of transportation services from the frontend allows for the DOTs to maintain their own core data product in a form that best fits agency policies, while allowing the shared software tools that make up the frontend to be separated from that data product. The exact manner in which software would be hosted and deployed has not yet been determined and is dependent on continued research into the operational policies and capacities of state DOTs, as well as the related development and deployment of software by other organizations such as MobilityData, which may host a global transit directory which could overlap with and be integrated with the proposed statewide or regional directory.

This project proposes to pursue the promotion of standardized data based on data specifications within the three-state region, which also apply to agencies outside the three-state region, in some cases globally. In particular, there is a specific focus on promoting the adoption of GTFS and proposed extensions to that specification, which have not yet been officially adopted and which, if adopted, could be voluntarily complied with, and used by mobile application vendors such as Google, Transit, Navilens and others. There is an existing governance process and licensing regime for the GTFS, which would be pursued by this project and by other parties, but would not necessarily result in the standardization of data according to the proposals sponsored by this project. These global conversations are an important series of operational policies and constraints which will not be detailed in this document, but which will require monitoring and consistent engagement by the system governance team to align the internal development plan with global adoption.

The proposed system would also be constrained by the budgets and staffing of transit operators. While the increase in costs of software and labor for the management of software should be minimal, as a result of much information to be standardized being already captured by currently utilized software systems[1], there would necessarily be some increased costs at least in the short-term for software vendors which would be passed down to agencies.

Finally, this proposed system makes the assumption that other state and local governmental parties, including some partners of the project that are currently sponsoring parallel regulatory and development projects such as Cal-ITP being pursued by Caltrans, AIM and Mobility4All grant-funded projects being pursued by ODOT, GTFS and GTFS-Flex development projects

[1] Internal research by Cal-ITP documented technical capacity and system structure of fixed route and demand responsive services in California.

being pursued by WSDOT, and the GOFS working group being pursued by MobilityData, will continue and be at least partially successful in achieving their ends. While there are a large number of projects that the proposed system relies on, this fact is understood as a strength and an opportunity rather than only a constraint and risk. The large number of parallel development projects indicates strong interest in the proposed work and a demonstration of intent to collaborate by partner and many other organizations. The proposed system would increase the coordination of these projects and could increase the efficiency of resources devoted to those projects while decreasing the risk of project failures.

2.5. User Characteristics

This section describes the users of the system. It builds upon Section 5.3 of the ConOps by describing each user group, including how they will interact with and use the system.

2.5.1. Transit Operators (OP)

Description: Organizations responsible for the day-to-day operation of both fixed route and demand-responsive transit.

Interactions with the system: Transit operators continue to play the role of managing scheduling systems that provide GTFS data. This role is expanded within the system of interest, however, transit operations would be outside the proposed system implemented by the project.

2.5.2. Local, State, and Federal regulators (REG)

Description: State organizations responsible for implementing federal and state law related to the transportation system.

Interactions with the system: DOTs play multiple roles within the proposed system. First, as regulators, they implement state-level requirements. They also provide technical support to the agencies they regulate and contribute to the governance of the SCC, and lastly, analyze the state transportation network to identify opportunities to increase access and equity.

2.5.3. Employers and other destinations

Description: Employers and other organizations with large campuses with an interest in supporting efficient transportation to and from their locations.

Interactions with the system: While not participating directly in the system, this is a user group that is supported by the proposed system, as they are now able to access information on transportation services available to them more effectively.

2.5.4. Business-to-Government Technology Vendors (B2G)

Description: Technology vendors providing services to government entities. These organizations provide scheduling and CAD/AVL software directly to transit operators.

Interactions with the system: CAD/AVL and scheduling software vendors are outside the system but affected by it, as they must provide data outputs from their system that align with the published guidelines.

2.5.5. Business-to-Consumer Technology Vendors (B2C)

Description: Technology vendors providing services to consumers. Specifically, vendors providing freemium or ad-based transit trip planning applications direct to consumers.

Interactions with the system: Technology vendors providing rider applications are outside the system but affected by it, as they are able to ingest new data outputs from the system and able to improve the accessibility of their applications based on the Engineers' Guide to Inclusive Transit.

2.5.6. Technical Non-profits

Description: Not for profit organizations providing services or consulting on technical issues such as data standards. The primary organization fulfilling this role in the GTFS ecosystem is MobilityData.

Interactions with the system: Technical non-profits do not directly engage in the system but are affected by it. Feedback from state DOTs, transit operators, and riders in the three-state region are now coordinated and provided through the SCC.

2.5.7. Rider Advocacy Organizations

Description: Organizations aimed at improving transit for transit riders and advancing rider interests.

Interactions with the system: While not participating directly in the system, this is a user group that is supported by the proposed system, as they are now able to access information on transportation services that would affect the riders for whom they advocate.

2.5.8. Social Service Agencies

Description: Agencies that provide services with the goal of promoting the health and well-being of individuals and families.

Interactions with the system: While not participating directly in the system, this is a user group that is supported by the proposed system, as they are now able to access information on transportation services available to their clients.

2.5.9. Brokerages (Desired)

Description: An organization or functionality that allows the coordination, sharing, or exchanging of rides between demand-responsive transit agencies.

Interactions with the system: The system increases the operational efficiency and service quality to riders through software-supported coordination, sharing, or exchanging of trips between demand-responsive agencies.

2.5.10. Riders/Public Transit Users (RID)

Description: Travelers who take public transit. Travelers utilize bus and rail service to get from their origin to their destination.

Interactions with the system: Riders do not participate in the system but are better served by the system which improves the accessibility of mobile applications they use, as well providing new interfaces.

See Section 1.3 for definitions of the following rider sub-groups

- Veteran riders (VT)
- Rural riders (RT)
- Riders with mobility disabilities (DM)
- Riders with vision disabilities (DV)
- Riders with hearing disabilities (DH)
- Riders with intellectual and developmental disabilities
- Older adult riders (OA)
- Low-income riders (LI)
- Riders with other safety concerns, e.g., women, riders of color, riders with children, recently incarcerated riders (SI)
- Riders with limited English proficiency (LEP)

2.6. Operational Scenarios

High-level overviews of each of the Operational Scenarios from Section 6 of the ConOps are provided below.

2.6.1. Scenario 1: Individual with a mobility disability who uses a mobility device is looking for a demand response service for the first time

In this use case, an individual with a mobility disability who uses a mobility device discovers a dial-a-ride service in their area. They use a commercial trip planning application to plan a trip from their origin to their destination and select the option that requires the least walking. They need to discover the service name and the information they need to book the trip.

2.6.2. Scenario 2: Person who uses a wheelchair planning a trip to work using fixed-route service near their home

In this use case, a user with a wheelchair is planning a trip to their work using the bus service near their home for the first time. They are using the agency website's embedded trip planner which forwards users to Google Maps to access information.

2.6.3. Scenario 3: A rider with a vision disability uses an agency's website to determine what times the local train stops near their house and receives alert en route to station.

In this use case, the user wants to take the train that stops near their house and is using the train agency's website to look for information about when the train comes. They retrieve that time, and are walking to the station when an alert is posted by the agency that their train has been delayed.

2.6.4. Scenario 4: A rider with a vision disability boards a demand responsive vehicle on a busy street and knows the right vehicle to board because the mobile application directs them to it in a line of vehicles.

In this use case, the user has a vision disability and has booked a demand-responsive trip. The pickup location is on a busy urban street with many vehicles parked next to the sidewalk. The user is able to be directed to the exact vehicle and approach it with confidence because their mobile application knows the location of the vehicle and also can see the digital code for that vehicle through the phone camera.

2.6.5. Scenario 5: A person with a developmental disability wants to schedule paratransit services online to pick them up at home and drop them off at their new job.

In this use case, the user is a person with a disability who is using the internet to find and book a paratransit service to pick them up at home and drop them off at work. Once at work, they need to let their sister know that they made it safely.

2.6.6. Scenario 6: A rider who is a veteran and currently on a low fixed income is researching transit in her area to see what options are available for her to go to the VA Hospital in a nearby urban center in the most efficient and economical way possible.

In this use case, the user is a veteran who is also low income. She is using the internet to find out what options are available to her to go to and from the VA Hospital in a nearby urban center. She is interested in services specifically for veterans, especially if there are fare discounts available. She will have a collapsible cart with her for carrying bags.

2.6.7. Scenario 7: An older rider who has a hearing disability is taking a long bus ride but realizes they need to alight early to find a restroom.

In this use case, the user is a person with a hearing disability who is on a long fixed-route bus ride. They realize they need to alight early to find a restroom, and must figure out if/where a restroom is available and communicate to the driver that they need to get off the bus.

2.6.8. Scenario 8: A rider with limited English proficiency is navigating to the correct bus stop in a transit mall.

In this use case, the user who is a recent refugee who has been granted asylum prepared for their trip beforehand and has just arrived at a transit mall. There are a variety of places to wait for a variety of transit lines and they need to find the correct one for their trip.

2.6.9. Scenario 9: A rider in a rural area without consistent internet needs to book a trip into the closest urban area for a shopping trip.

In this use case, the user wants to book a trip to an urban location to run errands but cannot access apps or websites that require fast or consistent internet connections. The user has a mobile device that can access internet when connected to wireless, but does not have access using data. They are able to send and receive calls and text messages.

2.6.10. Scenario 10: A rider who is a victim of stalking is planning a trip home from work at night using transit and their bike.

In this use case, the user is a victim of stalking and has significant safety concerns. They are planning a trip home from their workplace at night and evaluating which options are the safest for them. They have their bike with them and are looking at all options available that use transit and their bike.

2.6.11. Scenario 11: A state DOT analyst is supporting a social service agency in identifying the transportation services available in a new operational region and their service parameters.

In this use case, a state DOT analyst is researching services available in an area and their eligibility requirements so that they can present that information to a local social service agency.

2.6.12. Scenario 12: A small demand response operator is transitioning to a new scheduling system.

In this use case, small demand responsive transit operator of different types of general public and eligibility restricted service in a rural county is purchasing a new scheduling system to manage the scheduling of trips on their transit service.

2.6.13. Scenario 13: A rider advocacy group is working with a specialized transportation provider to present an analysis to the DOT and legislature regarding the need for investment in underserved communities.

In this use case, a rider advocacy group that works with specialized transportation operators around a state is teaming with a particular operator to make the case that fixed route and demand responsive transit services must be expanded through additional state financial resources in order to provide a level of service adequate to rider needs and equitable with other regions.

2.6.14. Scenario 14: A vendor is calculating the potential return on investment from building a new software product for the transit market

In this use case, a software vendor is considering making an investment in a new software feature and wants to calculate the expected return on their investment possible by selling that feature to transportation services within a region.

2.6.15. Scenario 15: A state DOT is trying to add additional depth of information on mobility devices to the GTFS specification

In this use case, the state DOT sees the need to represent a new mobility device-related piece of information to travelers and needs an extension of GTFS to relay this additional piece of information.

3. System Capabilities, Conditions, and Constraints

This section describes the system requirements to meet user needs organized by system component. Collectively these requirements are the necessary, concise, and achievable description of actions needed to support the ConOps.

Within the following system requirements, certain words are used consistently according to the definitions below:

- Consume – The system will include a software component which will import data according to a particular format as identified by this system requirement.

- Include as part of – Followed by a system component or technology identified within the ETRA, indicates that the system technology will have as a requirement the inclusion of the feature identified by this system requirement. If no “as part of” is included, then all components related to this system requirement will include the feature indicated by the system requirement.

- (Have the capacity to) provide – All aspects of this system requirement will be provided by components of the system, and there is no assumption that components outside the system of interest will participate in fulfilling this system requirement. If a system requirement is a labor service that will be provided occasionally but not consistently by the system, the phrase “have the capacity to provide” will indicate that the requirement is merely that at certain times as determined by the project team, the system will have the capacity to fulfill the requirement within a particular context and scope. As described above in section 2.3, the deployment of labor services for the production of data sets is not intended to be a long-term function of the system, although the capacity to manage such services as needed will be a system feature.

- Promote the use of a data standard – Refers to the system taking actions or making decisions that will increase the adoption of open data specifications which model the information identified by this system requirement.

- Publish – The system will include a software component which will export data according to a particular format as identified by this system requirement.

3.1. Transit Data Enhancements (Enhanced GTFS, GTFS Realtime, GTFS-Flex, GOFS)

The proposed system includes enhancements to a number of existing and proposed data standards in the GTFS ecosystem; those changes are summarized in section 2.3 Major System

Capabilities. As the requirements and specifics of data fields needed to support user needs map to multiple data standards the system requirements for Transit Data Enhancements for Enhanced GTFS, GTFS-Realtime, GTFS-Flex, and GOFS are presented below in a combined list.

Table 2: Transit Data Enhancement system requirements

Requirement ID	Requirement Text	Data Enhancements
M02-1	The system shall promote the use of data standards that align with the Mobility Interoperability Principles (link), such as GTFS and GTFS Realtime.	x
O02-1	The system shall promote the use of a data standard that allows users to book demand responsive trips through third party trip planning applications.	x
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips through a third party application by deeplinking to a different application for the final booking confirmation.	x
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips entirely within a third party application through the use of APIs.	x
O02-1-1	The system shall promote the use of a data standard that allows operators to define allowed booking times for demand-responsive services.	x
R01-1	The system shall promote the use of a data standard that describes available demand-responsive trips for discovery in trip planning applications.	x
R01-1-1	The system shall promote the use of a data standard that allows operators to define allowed advance booking requirements for demand-responsive services.	x
R01-3-1	The system shall promote the use of a data standard that supports modeling of expected travel time for demand-responsive trips. (i.e.: mean_duration_factor in GTFS-flex specification)	x
R01-3-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated travel time for demand-responsive trips.	x

Requirement ID	Requirement Text	Data Enhancements
R01-4-1	The system shall promote the use of a data standard that supports modeling of expected wait time prior to the beginning of the trip for demand-responsive trips.	x
R01-4-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated wait time for demand-responsive trips.	x
R03-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for transit services.	x
R04-1	The system shall promote the use of a data standard that supports including Text-to-Speech information to facilitate improved audio annunciation by data consuming systems.	x
R04-1-1	The system shall promote the use of a data standard that describes alert, wayfinding, or service regulation information.	x
R14-1	The system shall promote the use of a data standard that describes fares including passes, fare-caps, discounted or subsidized fares, and temporary price reductions.	x
R14-1-1	The system shall promote the use of a data specification that describes payment media.	x
R19-1	The system shall promote the use of a data standard that describes vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	X
R19-1-1	The system shall promote the use of a data standard or align with emerging data standards that describes real-time vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-2-1	The system shall promote the use of the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).	x
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.	x
R20-1-2	The system shall promote the use of the GTFS-Translations specification (http://gtfs.org/reference/static/#translationstxt).	x

Requirement ID	Requirement Text	Data Enhancements
M04-1	The system shall promote the use of a data standard that models two-way real-time data exchange between demand-responsive scheduling applications and trip planning applications for the purpose of increasing the quality of trip travel start time and travel time estimates.	x
O05-1	The system shall promote the use of a data standard that models unplanned real-time service changes and other information which facilitates adjustment of services to meet real-time conditions on the ground.	x
O07-1	The system shall promote the use of a data standard that allows operator payment systems to enable the sales of fares through trip planning apps.	x
O08-1	The system shall promote the use of a data standard that allows operators to reflect and restrict as needed their current vehicle capacity.	x
O08-2	The system shall promote the use of a data standard that describes real-time crowding information	x
O12-1	The system shall promote the use of a data standard that supports precise stop location information.	x
O13-1	The system shall promote the use of a data standard that includes real-time service change information for demand-responsive trips.	x
R01-5-1	The system shall promote the use of a data standard that enables distribution of system alert information for demand responsive service including whether a specific rider's trip is being provided.	x
R18-1	The system shall the use of use a data standard that describes safety features and amenities available such as lights and shelters during and near a transit trip.	x
R18-1-1	The system shall promote the use of a data standard that describes transit stop amenities such as shelters, lights, or restrooms.	x
R19-3-1	The system shall promote the use of a data standard that describes real-time vehicle capabilities including details of options for loading bicycles and wheelchair lift capabilities.	x

Requirement ID	Requirement Text	Data Enhancements
R22-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for riders who are veterans.	x
R29-1	The system shall promote the use of a data standard that describes details of wayfinding and vehicle information.	x
R34-1	The system shall promote the use of a data standard that describes real-time system alerts related to pathway accessibility, including at a minimum elevator outages and other barriers to mobility devices or limits to mobility-assistive infrastructure.	x
M05-2	The system shall promote the use of a data standard that allows for the real-time viewing of demand-responsive vehicle locations by authorized parties in a manner that accounts for the privacy concerns of demand-responsive riders.	x
O14-1	The system shall promote the use of a data standard which users to book multiple passengers or indicate other passengers will be traveling with them.	x
O15-1	The system shall promote the use of a data standard that includes information on service animal rules for transit vehicles.	x
E03-1	The system shall promote the use of a data standard that captures ridership data by stop, route, and agency.	x
E05-1	The system shall promote the use of a data standard that describes vehicles and vehicle qualities (i.e.: GTFS-Vehicles).	x
E05-1.1	The system shall promote the use of a data standard that includes the fields necessary to meet the FTA and NTD requirements for documenting assets.	x
R14-2-1	The system shall promote the use a data standard that describes any fares associated with other members of their party.	x
R18-2-1	The system shall promote the use a data standard that indicates security guard/officer presence at stops and stations.	x
R18-3-1	The system shall include as part of published best practices that rider applications provide context for amenities that are available along a planned trip.	x

Requirement ID	Requirement Text	Data Enhancements
R18-4-1	The system shall promote the use of a data standard that describes safety features and amenities available during a transit trip.	x
R18-5-1	The system shall promote the use of a data standard that describes public restrooms information at transit stops, including whether those restrooms are gendered, multi- or single-occupancy, accessible, and have baby-changing stations.	x
R19-5-1	The system shall promote the use of a data standard that supports describing the vehicle capacity to carry bikes onboard.	x
R19-6-1	The system shall promote the use of a data standard that supports describing the real-time or predicted vehicle capacity to carry bikes onboard.	x
R19-7-1	The system shall promote the use of a data standard that describes presence of outlets for mobility device charging or other purposes on vehicles.	x
R19-8-1	The system shall promote the use of a data standard that describes bike parking information at transit stops.	x
R38-1	The system shall promote the use of a data standard that describes crowding of transit waiting zones.	x
R43-1	The system shall promote the use of a data standard that describes vehicle capabilities to support service animals during the demand-responsive booking process.	x

3.2. New State DOT Responsibilities

This section contains requirements related to the new State DOT responsibilities, specifically the SCC, Data and Procurement Guidelines, and the Official List of Transportation Services. The requirements for the Official List of Transportation Services are very few, and will be determined at a lower level during Phase 2 by the SCC. It is expected that the committee will define the data fields for the list as well as appropriate metadata for the list. Transportation Services is meant to be broader than a list of transportation operators. This list will be a subset of the information included in the Data APIs and published via the Directory/Analysis Front-End. There is no known existing data standard for describing a list of transportation services that meets the project's needs, so the SCC will define a schema that satisfies the project and should be useful to any state DOT.

Table 3: New State DOT Responsibility system requirements

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
M01-1	The system shall include data on all operators (as defined by the SCC) including all routes, stops, service hours, and service times for those operators.	x		
M02-1	The system shall promote the use of data standards that align with the Mobility Interoperability Principles (link), such as GTFS and GTFS Realtime.	x	x	
M02-2	The system shall include as part of the System Coordination Committee a governance body with defined processes, members and roles, and a clear relationship with other known governance processes (such as the GTFS changes process).		x	
M02-2.1	The system shall include as part of the System Coordination Committee governance processes which are brief and documented openly.		x	
M02-2.2	The system shall provide resources that explain other related governance processes (such as the GTFS changes process).		x	
M02-2.3	The system shall include as part of the System Coordination Committee the incorporation of feedback from active contributors to open transit data specifications.		x	
M02-2.4	The system shall include as part of the System Coordination Committee the incorporation of feedback from the underserved communities identified by this project.		x	

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
M03-1	The system shall consume operator contact information including a phone number, website, and email address.			
M03-3	The system shall provide best practices for which contacts at an agency should be included in public contact information and suggested service levels for those contact channels.	x		
M03-3.1	The system shall provide suggestions of what staff or functional contacts should be included, based on different agency characteristics (such as size of agency, type of organization).	x		
M03-3.2	The system shall provide suggestions of how quickly certain types of communications should be responded to.	x		
M03-4	The system shall promote the use of a data standard to describe operator contact information, including phone numbers, websites, and email addresses for different operator functionalities.	x		
O02-1	The system shall promote the use of a data standard that allows users to book demand responsive trips through third party trip planning applications.	x		
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips through a third party application by deeplinking to a different application for the final booking confirmation.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips entirely within a third party application through the use of APIs.	x		
O02-1-1	The system shall promote the use of a data standard that allows operators to define allowed booking times for demand-responsive services.	x		
O03-1	The system shall provide best practices that data be published by agencies according to a standard of quality that can be assessed without dependence on agency technical capacity.	x		
O03-1.1	The system shall include as part of published best practices data quality guidelines including standards of data completeness and effectiveness for rider needs which extend beyond the whether data is valid.	x		
O03-1.2	The system shall include as part of published best practices educational resources for operators or links to educational resources on how to successfully produce or procure high-quality data.	x		
O03-1.3	The system shall include as part of published best practices examples of high-quality transit data that operators can use as a model.	x		
O03-1.4	The system shall include as part of published best practices references to validation tools which can be used to determine the quality of a data set in an automated fashion.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R01-1	The system shall promote the use of a data standard that describes available demand-responsive trips for discovery in trip planning applications.	x		
R01-3-1	The system shall promote the use of a data standard that supports modeling of expected travel time for demand-responsive trips. (i.e.: mean_duration_factor in GTFS-flex specification)	x		
R01-3-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated travel time for demand-responsive trips.	x		
R01-4-1	The system shall promote the use of a data standard that supports modeling of expected wait time prior to the beginning of the trip for demand-responsive trips.	x		
R01-4-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated wait time for demand-responsive trips.	x		
R03-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for transit services.	x		x
R04-1	The system shall promote the use of a data standard that supports including Text-to-Speech information to facilitate improved audio annunciation by data consuming systems.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R04-2	The system shall include as part of published best practices guidance for application developers which publish and consume Text-to-Speech data to support the needs of users who rely on audio annunciation.	x		
R04-3	The system shall include as part of published best practices that riders be provided tools to communicate feedback to data producers to improve Text-to-Speech quality.	x		
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).	x		
R04-1-1	The system shall promote the use of a data standard that describes alert, wayfinding, or service regulation information.	x		
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.	x		
R14-1	The system shall promote the use of a data standard that describes fares including passes, fare-caps, discounted or subsidized fares, and temporary price reductions.	x		
R14-1.1	The system shall promote the use of a data standard that describes fares including passes, fare-caps, discounted or subsidized fares, and temporary price reductions that specific riders are eligible for, and how those price reductions can be accessed.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R14-1-3	The system shall have the capacity to provide interagency technical coordination to facilitate adoption of payment systems which improve rider ease of use.		x	
R14-1-4	The system shall include as part of published best practices that agencies maintain an option to allow payment at time of boarding without a smartphone even if payment in advance by app is enabled.	x		
R19-2-1	The system shall promote the use of the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).	x		
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.	x		
R20-1-2	The system shall promote the use of the GTFS-Translations specification (http://gtfs.org/reference/static/#translationstxt).	x		
R20-1-3	The system shall include as part of published best practices that operators use the GTFS-Translations extension to provide translations of GTFS elements for all languages they are required to support by state and federal guidelines.	x		
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.	x		
M08-1	The system shall include a plan to share long-term costs of the data APIs and other features of the system which will incur maintenance expenses among the users of those system components.		x	
M08-2	The system shall include a plan to identify long-term actors to provide the technical and staff resources necessary to maintain all system components.		x	
O10-1	The system shall present data publication requirements, and related resources, in an easily accessible format available to all operators.	x		
O11-1	The system shall have the capacity to provide technical advice, assistance, and resources to transit operators to understand and implement the data and procurement guidelines and related best practices within their procurements and contracts.	x		
O12-1	The system shall promote the use of a data standard that supports precise stop location information.	x		
R01-5-1	The system shall promote the use of a data standard that enables distribution of system alert information for demand responsive service including whether a specific rider's trip is being provided.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R16-1	The system shall include as part of published best practices identification of the need to provide riders with multiple options for communicating with a driver.	x		
R17-1-1	The system shall include as part of published best practices the that operators provide real-time trip information via text message.	x		x
R18-1	The system shall the use of use a data standard that describes safety features and amenities available such as lights and shelters during and near a transit trip.	x		
R18-1-1	The system shall promote the use of a data standard that describes transit stop amenities such as shelters, lights, or restrooms.	x		
R23-1	The system shall include as part of published best practices that operators publish real-time vehicle locations in a standardized data format.	x		
R30-1	The system shall include as part of published best practices that operators and rider applications implement new interfaces and interface features in a fashion that does not require intensive application re-training frequently.	x		
R32-1	The system shall include as part of published best practices that transit agencies meet a level of stop location and service area precision and accuracy that allows riders to plan and make trips with confidence in their boarding and alighting locations	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R34-1	The system shall promote the use of a data standard that describes real-time system alerts related to pathway accessibility, including at a minimum elevator outages and other barriers to mobility devices or limits to mobility-assistive infrastructure.	x		
G02-1	The system shall include as part of the API endpoints the integration of automated validator software that confirms the validity of the retrieved data.	x		
M05-1	The system shall include as part of published best practices that agencies provide real-time vehicle location feeds for fixed-route services.	x		
M05-2	The system shall promote the use of a data standard that allows for the real-time viewing of demand-responsive vehicle locations by authorized parties in a manner that accounts for the privacy concerns of demand-responsive riders.	x		
M06-1	The system shall provide best practices for operator-procured software systems that can be easily referenced by operators and technology vendors in RFPs or contracts.	x		
M07-1	The system promotes the use of a data standard to map features in the right of way.	x		
M07-2	The system shall include within published best practices a list of acceptable geocoders for mapping features in the right-of-way.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
O14-1	The system shall promote the use of a data standard which users to book multiple passengers or indicate other passengers will be traveling with them.	x		
O15-1	The system shall promote the use of a data standard that includes information on service animal rules for transit vehicles.	x		
E02-2	The system shall include as part of published best practices methodologies for the anonymization and aggregation of demand-responsive trips for planning and policy decision-making	x		
E03-1	The system shall promote the use of a data standard that captures ridership data by stop, route, and agency.	x		
E04-1	The system shall provide a public official list of service administrators and the services they oversee.			x
E04-2	The system shall include as part of published best practices definitions of terms like "service", "operator", "administrator" etc that allow for the clear description of different types of administrative contacts.	x		
E05-1	The system shall promote the use of a data standard that describes vehicles and vehicle qualities (i.e.: GTFS-Vehicles).	x		
E05-1.1	The system shall promote the use of a data standard that includes the fields necessary to meet the FTA and NTD requirements for documenting assets.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R01-7-1	The system shall include as part of published best practices that booking and brokerage systems minimize wait times for trip confirmations.	x		
R14-2-1	The system shall promote the use a data standard that describes any fares associated with other members of their party.	x		
R16-1-1	The system shall include as part of published best practices that agencies provide options to riders to communicate with drivers using non-verbal methods.	x		
R18-2-1	The system shall promote the use a data standard that indicates security guard/officer presence at stops and stations.	x		
R18-3-1	The system shall include as part of published best practices that rider applications provide context for amenities that are available along a planned trip.	x		
R18-4-1	The system shall promote the use of a data standard that describes safety features and amenities available during a transit trip.	x		
R18-5-1	The system shall promote the use of a data standard that describes public restrooms information at transit stops, including whether those restrooms are gendered, multi- or single-occupancy, accessible, and have baby-changing stations.	x		

Requirement ID	Requirement Text	Data and Procurement Guidelines	System Coordination Committee	Official List of Transportation Services
R19-5-1	The system shall promote the use of a data standard that supports describing the vehicle capacity to carry bikes onboard.	x		
R19-6-1	The system shall promote the use of a data standard that supports describing the real-time or predicted vehicle capacity to carry bikes onboard.	x		
R19-7-1	The system shall promote the use of a data standard that describes presence of outlets for mobility device charging or other purposes on vehicles.	x		
R19-8-1	The system shall promote the use of a data standard that describes bike parking information at transit stops.	x		
R19-9-1	The system shall include as part of published best practices ways for communicating data quality of pathways information to users.	x		
R38-1	The system shall promote the use of a data standard that describes crowding of transit waiting zones.	x		
R43-1	The system shall promote the use of a data standard that describes vehicle capabilities to support service animals during the demand-responsive booking process.	x		

3.3. Data APIs and Directory Analysis Frontend

Table 4: Data API and Directory system requirements

Requirement ID	Requirement Text	Data APIs	Directory/ Analysis Frontend
M01-1	The system shall include data on all operators (as defined by the SCC) including all routes, stops, service hours, and service times for those operators.	x	x
M01-1.1	The system shall consume transit data through automated collection of data in standardized formats, including all data standards promoted by the system.	x	x
M01-1.2	The system shall publish transit data through an API and a UI that can be navigated by a person familiar with common transit data standards, including all data standards promoted by the system.	x	x
M01-2	The system shall include as part of a data viewing interface both list and map views of data.		x
M01-2.1	The system shall include as part of a data viewing interface the ability to search operators by route, stop, or service area through the map view.		x
M01-2.2	The system shall include as part of a data viewing interface the ability to filter operators by route, stop, or service area through the map view.		x
M01-2.3	The system shall include as part of a data viewing interface the ability to search operators by route, stop, or service area through the list view.		x
M01-2.4	The system shall include as part of a data viewing interface the ability to filter operators by route, stop, or service area through the list view.		x
M01-3	The system shall include as part of a data viewing interface a responsive site design.		x
M01-4	The system shall include as part of the API endpoints the use of open and common standards for the format of those endpoints.	x	

Requirement ID	Requirement Text	Data APIs	Directory/ Analysis Frontend
M03-1	The system shall consume operator contact information including a phone number, website, and email address.	x	x
M03-2	The system shall publish operator contact information including a phone number, website, and email address.	x	x
O01-1	The system shall include direct download links for all operators' transit data.	x	x
O01-1.1	The system shall include the ability of users to sign up for notifications when an operators' data is first published or existing data is updated.	x	x
O01-1.2	The system shall include the ability to download the newest or specific past versions of operator data sets at stable download links.	x	x
O03-1	The system shall provide best practices that data be published by agencies according to a standard of quality that can be assessed without dependence on agency technical capacity.	x	
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).	x	x
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.		x
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.		x
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.		x
G01-1	The system shall publish information regarding transportation operators including data about the size (e.g., number of routes, vehicles, stops) and modes provided by each service.	x	x

Requirement ID	Requirement Text	Data APIs	Directory/ Analysis Frontend
O12-2	The system shall publish the latitude and longitude of every transit stop with a unique ID within the region.	x	x
E01-1	The system shall support the automating the assessment of compliance with minimum data guidelines where feasible, as defined by the System Coordination Committee.		x
M05-1	The system shall include as part of published best practices that agencies provide real-time vehicle location feeds for fixed-route services.		x
E02-1	The system shall capture historical realtime data for transit services in the deployment region and store in a secure location.	x	x
E04-1	The system shall provide a public official list of service administrators and the services they oversee.	x	x

3.4. 1st Tier Support Desk

Requirement ID	Requirement Text	1st Tier Support Desk
M03-2	The system shall publish operator contact information including a phone number, website, and email address.	x
R04-3	The system shall include as part of published best practices that riders be provided tools to communicate feedback to data producers to improve Text-to-Speech quality.	x
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).	x
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.	x

Requirement ID	Requirement Text	1st Tier Support Desk
R13-2	The system shall provide a single consolidated backend system (i.e. support desk) available through multiple channels (e.g. web, SMS, phone) across the deployment area for riders needing customer service support to planning trips.	x
R13-2.1	The system shall include as part of the support desk documentation for customer service staff to assist riders when they are learning to use trip planning systems.	x
R13-2.2	The system shall include as part of the support desk a feature to track all customer service interactions using a ticketing system (i.e.: method of communication, date of communication, issue, how issue resolved).	x
R13-2.3	The system shall include as part of the support desk customer service teams who at a regular cadence will review and synthesize all interactions for riders and prioritize improving standard operating procedures or submitting bug requests and feature requests to application developers to improve rider experience.	x
R15-1	The system shall provide a general customer service support desk operated by a human to answer riders' transit questions which can be answered by reference to information within the operator's public GTFS and GTFS Realtime	x
R15-2	The system shall include as part of the support desk an auditory mode of communication for its customer service functions.	x
R15-3	The system shall include as part of the support desk text-based mode of communication for its customer service functions.	x
R17-2	The system shall provide a customer service channels that do not require internet connectivity for riders to ask general questions related to transit options in the deployment area.	x
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.	x
R20-3-3	The system shall include as part of the support desk either live chat, messaging, or TDD feature for riders who cannot otherwise access auditory phone services.	x

Requirement ID	Requirement Text	1st Tier Support Desk
R44-1	The system shall include as part of the support desk a customer feedback portal where a rider can submit comments which are then provided to the operator.	x
R44-2	The system shall include as part of the support desk the tracking of instances feedback to ensure routing to the right operator and confirmation of an issue resolution.	x

3.5. Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams

Table 5: Accessibility, Payment, Eligibility, and Wayfinding Coordination Team system requirements

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
M01-1.3	The system shall have the capacity to provide labor and technology services that provide for the completeness of the data consumed and published by the system, with a focus on providing those services to agencies that do not have accessible market-based options to procure or the technology staff to develop internally the required data.	x
M01-1.4	The system shall provide a cost estimate and transition plan for the long-term maintenance of any data developed through the labor and technology services provided by the system.	x
M02-1	The system shall promote the use of data standards that align with the Mobility Interoperability Principles (link), such as GTFS and GTFS Realtime.	x
M02-2.1	The system shall include as part of the System Coordination Committee governance processes which are brief and documented openly.	x
M02-2.2	The system shall provide resources that explain other related governance processes (such as the GTFS changes process).	x

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
M02-2.3	The system shall include as part of the System Coordination Committee the incorporation of feedback from active contributors to open transit data specifications.	x
M02-2.4	The system shall include as part of the System Coordination Committee the incorporation of feedback from the underserved communities identified by this project.	x
M03-3	The system shall provide best practices for which contacts at an agency should be included in public contact information and suggested service levels for those contact channels.	x
M03-3.1	The system shall provide suggestions of what staff or functional contacts should be included, based on different agency characteristics (such as size of agency, type of organization).	x
M03-3.2	The system shall provide suggestions of how quickly certain types of communications should be responded to.	x
O03-1.2	The system shall include as part of published best practices educational resources for operators or links to educational resources on how to successfully produce or procure high-quality data.	x
O03-1.3	The system shall include as part of published best practices examples of high-quality transit data that operators can use as a model.	x
O03-2	The system shall have the capacity to provide transit agencies in determining whether transit data meets quality guidelines or best practices which cannot be reviewed in an automated fashion.	x
O04-2	The system shall include as part of published best practices that operators maintain a phone line for booking demand responsive trips after they have implemented a digital booking tool.	x
R03-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for transit services.	x
R04-1	The system shall promote the use of a data standard that supports including Text-to-Speech information to facilitate improved audio annunciation by data consuming systems.	x

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
R04-2	The system shall include as part of published best practices guidance for application developers which publish and consume Text-to-Speech data to support the needs of users who rely on audio annunciation.	x
R04-3	The system shall include as part of published best practices that riders be provided tools to communicate feedback to data producers to improve Text-to-Speech quality.	x
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).	x
R04-1-1	The system shall promote the use of a data standard that describes alert, wayfinding, or service regulation information.	x
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.	x
R14-1-1	The system shall promote the use of a data specification that describes payment media.	x
R14-1-2	The system shall include as part of published best practices how transit apps can describe payment media, and may need to describe how to integrate mobile-based payment media directly into user interfaces.	x
R14-1-3	The system shall have the capacity to provide interagency technical coordination to facilitate adoption of payment systems which improve rider ease of use.	x
R19-1	The system shall promote the use of a data standard that describes vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-1-1	The system shall promote the use of a data standard or align with emerging data standards that describes real-time vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-2-1	The system shall promote the use of the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).	x

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
R19-2-3	The system shall include as part of published best practice that trip planning applications include information on pathways using the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).	x
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.	x
R20-1-2	The system shall promote the use of the GTFS-Translations specification (http://gtfs.org/reference/static/#translationstxt).	x
R20-1-3	The system shall include as part of published best practices that operators use the GTFS-Translations extension to provide translations of GTFS elements for all languages they are required to support by state and federal guidelines.	x
R20-1-3	The system shall include as part of published best practices that trip planning applications are internationalized and provide support for translations in multiple languages.	x
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.	x
R20-2-2	The system shall include as part of published best practices guidance for transit user interface design that all language used be at a fifth grade reading level.	x
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.	x
R20-3-2	The system shall include as part of published best practices guidance regarding inclusive design for supporting users with hearing disabilities.	x
O11-1	The system shall have the capacity to provide technical advice, assistance, and resources to transit operators to understand and implement the data and procurement guidelines and related best practices within their procurements and contracts.	x

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
O12-2	The system shall publish the latitude and longitude of every transit stop with a unique ID within the region.	x
R16-1	The system shall include as part of published best practices identification of the need to provide riders with multiple options for communicating with a driver.	x
R19-3-1	The system shall promote the use of a data standard that describes real-time vehicle capabilities including details of options for loading bicycles and wheelchair lift capabilities.	x
R21-1	The system shall include as part of published best practices for rider applications provide riders the ability to use the app with verbal commands.	x
R27-1	The system shall provide data quality assurance processes to ensure GTFS data and other essential data are maintained at the level of quality defined by the System Coordination Committee.	x
R29-1	The system shall promote the use of a data standard that describes details of wayfinding and vehicle information.	x
R33-1	The system shall implement data quality assurance processes to ensure the labels and markers on vehicles match those displayed in trip planning and booking applications	x
R33-2	The system shall provide a replicable model for confirming the location of vehicles to users through a standards-based exchange of data between the rider application and vehicle information systems.	x
R34-1	The system shall promote the use of a data standard that describes real-time system alerts related to pathway accessibility, including at a minimum elevator outages and other barriers to mobility devices or limits to mobility-assistive infrastructure.	x
C04-1	The system shall have the capacity to provide resources aimed at individual application developers to suggest methods of implementing the rider application best practices.	x
M07-1	The system promote the use of a data standard to map features in the right of way.	x

Requirement ID	Requirement Text	Accessibility, Payment, Eligibility, and Wayfinding Coordination Teams
M07-2	The system shall include within published best practices a list of acceptable geocoders for mapping features in the right-of-way.	x
R39-1	The system shall provide a list of rider applications deployed in the region including information regarding their features.	x
R40-1	The system shall include as part of published best practices that transit operators notify riders of service changes through a variety of formats.	x
R41-1	The system shall include as part of published best practices recommendations and useful references for building in-app and external accessibility tools.	x
R45-1	The system shall include as part of published best practices recommendations and useful resources for communicating with riders with limited written English proficiency.	x

3.6. Engineers' Guide to Inclusive Transit

Table 6: Engineers' Guide to Inclusive Transit system requirements

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
M02-2.4	The system shall include as part of the System Coordination Committee the incorporation of feedback from the underserved communities identified by this project.	x
O02-1	The system shall promote the use of a data standard that allows users to book demand responsive trips through third party trip planning applications.	x
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips through a third party application by deeplinking to a different application for the final booking confirmation.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips entirely within a third party application through the use of APIs.	x
O03-1.3	The system shall include as part of published best practices examples of high-quality transit data that operators can use as a model.	x
R01-2	The system shall include as part of published best practices information on how users discover and book demand-responsive trips either exclusively or supplementary to fixed-route trips, through the use of standardized data by third-party trip planning applications.	x
R01-1-2	The system shall include as part of published best practices that trip planning applications and booking applications consider different possible use cases of riders when deciding how to display trips which must be booked by or within a certain time frame (for example, whether to show a trip that could be booked next time if the rider plans further in advance).	x
R01-3-3	The system shall include as part of published best practices that consuming applications provide feedback from riders to operators in order to improve the estimation of travel time on an ongoing basis.	x
R01-4-3	The system shall include as part of published best practices that consuming applications provide feedback from riders to operators in order to improve the estimation of wait time on an ongoing basis.	x
R02-1	The system shall include as part of published best practices for trip planning applications that include the need to provide users with multiple trip options when multiple options are possible.	x
R02-2	The system shall include as part of published best practices for trip planning applications that include the need to avoid showing users trips for which they are not eligible or which are not otherwise relevant to them.	x
R04-2	The system shall include as part of published best practices guidance for application developers which publish and consume Text-to-Speech data to support the needs of users who rely on audio annunciation.	x
R04-3	The system shall include as part of published best practices that riders be provided tools to communicate feedback to data producers to improve Text-to-Speech quality.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).	x
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.	x
R14-2	The system shall include as part of published best practices that trip planning applications include information about fares, including passes, fare-caps, discounted or subsidized fares, and temporary price reductions.	x
R14-2.1	The system shall include as part of published best practices that trip planning applications include information about fares, including passes, fare-caps, discounted or subsidized fares, and temporary price reductions that specific riders are eligible for, and how those price reductions can be accessed.	x
R14-1-2	The system shall include as part of published best practices how transit apps can describe payment media, and may need to describe how to integrate mobile-based payment media directly into user interfaces.	x
R14-1-3	The system shall have the capacity to provide interagency technical coordination to facilitate adoption of payment systems which improve rider ease of use.	x
R17-1	The system shall include as part of published best practices that commercial trip planning applications provide certain offline transit information to riders by allowing them to download trip itineraries, static arrival times for specific stops and route information.	x
R19-1	The system shall promote the use of a data standard that describes vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-1-1	The system shall promote the use of a data standard or align with emerging data standards that describes real-time vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-2-3	The system shall include as part of published best practice that trip planning applications include information on pathways using the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).	x
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
R20-1-3	The system shall include as part of published best practices that trip planning applications are internationalized and provide support for translations in multiple languages.	x
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.	x
R20-2-2	The system shall include as part of published best practices guidance for transit user interface design that all language used be at a fifth grade reading level.	x
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.	x
R20-3-2	The system shall include as part of published best practices guidance regarding inclusive design for supporting users with hearing disabilities.	x
C01-1	The system shall include as part of published best practices that rider applications include a user feedback function.	x
C02-1	The system shall include as part of published best practices references to educational resources for WCAG 3.0 compliance targeted at rider application vendors.	x
M04-1	The system shall promote the use of a data standard that models two-way real-time data exchange between demand-responsive scheduling applications and trip planning applications for the purpose of increasing the quality of trip travel start time and travel time estimates.	x
O06-1	The system shall promote the use of a data standard that allows operators to set restrictions on the trips offered to ensure compliant and efficient trips.	x
R13-1-1	The system shall publish best practices for trip planning applications that include the need to design accessible, intuitive interfaces.	x
R17-1-1	The system shall include as part of published best practices the that operators provide real-time trip information via text message.	x
R17-1-2	The system shall include as part of published best practices that trip planning applications offer offline support for riders planning trips.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
R19-4-1	The system shall include as part of published best practices that trip planning applications enable riders to see when the next trip would be if they don't take the trip being viewed.	x
R20-1	The system shall include as part of published best practices that operators allow multiple applications consume their data and serve their riders.	x
R21-1	The system shall include as part of published best practices for rider applications provide riders the ability to use the app with verbal commands.	x
R23-1	The system shall include as part of published best practices that operators publish real-time vehicle locations in a standardized data format.	x
R23-2	The system shall include as part of published best practices that trip planners provide current vehicle location to users both visually and through audio or text formats.	x
R24-1	The system shall include as part of published best practices that rider applications allow users to customize trip notification recipients and include multiple recipients.	x
R25-1	The system shall include as part of published best practices that rider applications display map features such as businesses, buildings, services and landmarks nearby stop locations.	x
R26-1	The system shall include as part of published best practices that agencies and rider applications notify users that accessibility features, including TDD, are available when such features are present.	x
R28-1	The system shall include as part of published best practices that commercial trip planning applications design simple interfaces that allow a user to find the most important information quickly.	x
R30-1	The system shall include as part of published best practices that operators and rider applications implement new interfaces and interface features in a fashion that does not require intensive application re-training frequently.	x
R31-1	The system shall include as part of published best practices that rider applications allow users to indicate feature preferences for possible trips.	x
R32-2	The system shall include as part of published best practices that rider applications display and announce when possible the current user location relative to the boarding an alighting locations.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
C03-1	The system shall include as part of published best practices that user privacy related to geolocation data be considered by operators and technology vendors to ensure a reasonable level of anonymity to riders, as defined by the System Coordination Committee.	x
G02-2	The system shall include as part of published best practices references to automated data validator software and processes that assesses the quality of operator data according to the data quality guidelines established by the System Coordination Committee.	x
O14-2	The system shall include as part of published best practices that rider applications allow users to book multiple passengers or indicate other passengers will be traveling with them.	x
O16-1	The system shall include as part of published best practices that rider applications provide information regarding the expected quality of pathways data used within the application.	x
R01-6-1	The system shall include as part of published best practices that trip planning applications include a confirmation that the correct origin and destination has been acknowledged by a demand responsive service.	x
R01-7-1	The system shall include as part of published best practices that booking and brokerage systems minimize wait times for trip confirmations.	x
R16-1-1	The system shall include as part of published best practices that agencies provide options to riders to communicate with drivers using non-verbal methods.	x
R19-9-1	The system shall include as part of published best practices ways for communicating data quality of pathways information to users.	x
R35-1	The system shall include as part of published best practices that rider applications include the need to provide confirmation of user location relative to transit stops through text and audio as well as visual format.	x
R36-1	The system shall include as part of published best practices that rider applications provide trip notifications for the absence of return journeys.	x
R37-1	The system shall include as part of published best practices that rider applications provide diverse and distinct options when the user does indicate preferences to restrict those options.	x

Requirement ID	Requirement Text	Engineers' Guide to Inclusive Transit
R42-1	The system shall include as part of published best practices the need to word trip directions in a way that does not solely depend on cardinal directionality.	x
R45-1	The system shall include as part of published best practices recommendations and useful resources for communicating with riders with limited written English proficiency.	x

3.7. Brokerage (Desired)

Table 7: Brokerage system requirements

Requirement ID	Requirement Text	Brokerage (Desired)
R14-1-3	The system shall have the capacity to provide interagency technical coordination to facilitate adoption of payment systems which improve rider ease of use.	x
R19-1	The system shall promote the use of a data standard that describes vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R19-1-1	The system shall promote the use of a data standard or align with emerging data standards that describes real-time vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).	x
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.	x
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.	x
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.	x

Requirement ID	Requirement Text	Brokerage (Desired)
M04-1	The system shall promote the use of a data standard that models two-way real-time data exchange between demand-responsive scheduling applications and trip planning applications for the purpose of increasing the quality of trip travel start time and travel time estimates.	x
O06-1	The system shall promote the use of a data standard that allows operators to set restrictions on the trips offered to ensure compliant and efficient trips.	x
O09-1	The system shall include as part of published best practices that demand responsive scheduling systems, booking applications, and brokerage software all be interoperable systems.	x
O14-1	The system shall promote the use of a data standard which users to book multiple passengers or indicate other passengers will be traveling with them.	x
O14-2	The system shall include as part of published best practices that rider applications allow users to book multiple passengers or indicate other passengers will be traveling with them.	x
R01-7-1	The system shall include as part of published best practices that booking and brokerage systems minimize wait times for trip confirmations.	x

4. System Interfaces

All new system interfaces will use an API first architecture. This approach will create a more interoperable ecosystem ensuring sustainability and usefulness of system components to support additional use cases in the future. Because of the centrality of interfaces (data specifications and applications) to the system, these have been described with their detailed system requirements in Section 3 above, specifically Section 3.1 Transit Data Enhancements and Section 3.3 Data APIs and Directory/Analysis Frontend.

Appendix A. Needs-to-Requirements Traceability Matrix

In the table below, each user need from the ConOps is succeeded by the system requirements related to that user need.

Table 8. Needs-to-Requirements Traceability Matrix

User Need / Requirement ID	*Need/Requirement Text*
MUL-01 - See full network	All users need to see list and map interfaces of agencies, routes, stops, and transit connections within a region to fully understand and access the transit network.
M01-1	The system shall include data on all operators (as defined by the SCC) including all routes, stops, service hours, and service times for those operators.
M01-1.1	The system shall consume transit data through automated collection of data in standardized formats, including all data standards promoted by the system.
M01-1.2	The system shall publish transit data through an API and a UI that can be navigated by a person familiar with common transit data standards, including all data standards promoted by the system.
M01-1.3	The system shall have the capacity to provide labor and technology services that provide for the completeness of the data consumed and published by the system, with a focus on providing those services to agencies that do not have accessible market-based options to procure or the technology staff to develop internally the required data.
M01-1.4	The system shall provide a cost estimate and transition plan for the long-term maintenance of any data developed through the labor and technology services provided by the system.

User Need / Requirement ID	Need/Requirement Text
M01-2	The system shall include as part of a data viewing interface both list and map views of data.
M01-2.1	The system shall include as part of a data viewing interface the ability to search operators by route, stop, or service area through the map view.
M01-2.2	The system shall include as part of a data viewing interface the ability to filter operators by route, stop, or service area through the map view.
M01-2.3	The system shall include as part of a data viewing interface the ability to search operators by route, stop, or service area through the list view.
M01-2.4	The system shall include as part of a data viewing interface the ability to filter operators by route, stop, or service area through the list view.
M01-3	The system shall include as part of a data viewing interface a responsive site design.
M01-4	The system shall include as part of the API endpoints the use of open and common standards for the format of those endpoints.
MUL-02 - Clear governance	The operator, regulator, software vendor, and rider application vendor need a specification and governance process that is not overly convoluted or verbose, so each can participate and feel that their needs are being heard and demonstrate the value of that process to the public.
M02-1	The system shall promote the use of data standards that align with the Mobility Interoperability Principles (link), such as GTFS and GTFS Realtime.
M02-2	The system shall include as part of the System Coordination Committee a governance body with defined processes, members and roles, and a clear relationship with other known governance processes (such as the GTFS changes process).

User Need / Requirement ID	Need/Requirement Text
M02-2.1	The system shall include as part of the System Coordination Committee governance processes which are brief and documented openly.
M02-2.2	The system shall provide resources that explain other related governance processes (such as the GTFS changes process).
M02-2.3	The system shall include as part of the System Coordination Committee the incorporation of feedback from active contributors to open transit data specifications.
M02-2.4	The system shall include as part of the System Coordination Committee the incorporation of feedback from the underserved communities identified by this project.
MUL-03 - Contact information	All users need to be able to find contact information for various functionalities at each agency so that they can ask questions and get any other information they need.
M03-1	The system shall consume operator contact information including a phone number, website, and email address.
M03-2	The system shall publish operator contact information including a phone number, website, and email address.
M03-3	The system shall provide best practices for which contacts at an agency should be included in public contact information and suggested service levels for those contact channels.
M03-3.1	The system shall provide suggestions of what staff or functional contacts should be included, based on different agency characteristics (such as size of agency, type of organization).
M03-3.2	The system shall provide suggestions of how quickly certain types of communications should be responded to.

User Need / Requirement ID	Need/Requirement Text
M03-4	The system shall promote the use of a data standard to describe operator contact information, including phone numbers, websites, and email addresses for different operator functionalities.
OP-01 - Integrated trip planning	The operator needs to provide trip planning that is integrated with other regional systems so that riders can see complete information when planning trips.
O01-1	The system shall include direct download links for all operators' transit data.
O01-1.1	The system shall include the ability of users to sign up for notifications when an operators' data is first published or existing data is updated.
O01-1.2	The system shall include the ability to download the newest or specific past versions of operator data sets at stable download links.
OP-02 - Booking through rider apps	The operator needs to provide booking of trips through publicly available rider apps.
O02-1	The system shall promote the use of a data standard that allows users to book demand responsive trips through third party trip planning applications.
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips through a third party application by deeplinking to a different application for the final booking confirmation.
O02-1.1	The system shall promote the use of a data standard that allows users to book demand responsive trips entirely within a third party application through the use of APIs.

User Need / Requirement ID	Need/Requirement Text
OP-02-1 - Time of booking	The operator needs to define when demand-responsive trips can be booked within third-party applications and promote those requirements so riders are able to successfully book trips.
O02-1-1	The system shall promote the use of a data standard that allows operators to define allowed booking times for demand-responsive services.
OP-03 - Tech sophistication not required	The operator needs to publish high quality data for publication in trip planning and other applications regardless of the technical sophistication and level of financial resources of the transit system so that all riders have equal access to trip planning services.
O03-1	The system shall provide best practices that data be published by agencies according to a standard of quality that can be assessed without dependence on agency technical capacity.
O03-1.1	The system shall include as part of published best practices data quality guidelines including standards of data completeness and effectiveness for rider needs which extend beyond whether the data is valid.
O03-1.2	The system shall include as part of published best practices educational resources for operators or links to educational resources on how to successfully produce or procure high-quality data.
O03-1.3	The system shall include as part of published best practices examples of high-quality transit data that operators can use as a model.
O03-1.4	The system shall include as part of published best practices references to validation tools which can be used to determine the quality of a data set in an automated fashion.
O03-2	The system shall have the capacity to provide transit agencies in determining whether transit data meets quality guidelines or best practices which cannot be reviewed in an automated fashion.

User Need / Requirement ID	Need/Requirement Text
OP-04 - Phone reservations	The operator needs to keep accepting phone reservations so that riders who cannot effectively use internet or mobile applications can access services.
O04-2	The system shall include as part of published best practices that operators maintain a phone line for booking demand responsive trips after they have implemented a digital booking tool.
RID-01 - Discover DR	The rider needs to discover and book demand responsive trips within online/mobile trip planners so that these services can be accessed in a way similar to fixed-route trip planning.
R01-1	The system shall promote the use of a data standard that describes available demand-responsive trips for discovery in trip planning applications.
R01-2	The system shall include as part of published best practices information on how users discover and book demand-responsive trips either exclusively or supplementary to fixed-route trips, through the use of standardized data by third-party trip planning applications.
RID-01-1 - Book in advance	The rider needs to know how long in advance they must book the demand-responsive trip so they can plan accordingly and not miss the deadline.
R01-1-1	The system shall promote the use of a data standard that allows operators to define allowed advance booking requirements for demand-responsive services.
R01-1-2	The system shall include as part of published best practices that trip planning applications and booking applications consider different possible use cases of riders when deciding how to display trips which must be booked by or within a certain time frame (for example, whether to show a trip that could be booked next time if the rider plans further in advance).

User Need / Requirement ID	Need/Requirement Text
RID-01-3 - DR travel time	The rider needs to know the expected travel time for a demand-responsive trip so that they can ensure they will arrive at their destination on time.
R01-3-1	The system shall promote the use of a data standard that supports modeling of expected travel time for demand-responsive trips. (i.e.: mean_duration_factor in GTFS-flex specification)
R01-3-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated travel time for demand-responsive trips.
R01-3-3	The system shall include as part of published best practices that consuming applications provide feedback from riders to operators in order to improve the estimation of travel time on an ongoing basis.
RID-01-4 - DR wait time	The rider needs to know the expected wait time for a demand-responsive trip so that they can ensure they will be available at the pick up time and will make it to their destination on time.
R01-4-1	The system shall promote the use of a data standard that supports modeling of expected wait time prior to the beginning of the trip for demand-responsive trips.
R01-4-2	The system shall include as part of published best practices that operators publish data which allows a consuming application to calculate estimated wait time for demand-responsive trips.
R01-4-3	The system shall include as part of published best practices that consuming applications provide feedback from riders to operators in order to improve the estimation of wait time on an ongoing basis.
RID-02 - Various trips	The rider needs to discover various plausible trips (i.e., which routes or services) which meet their needs when multiple trips are possible, regardless of the transit mode of trip or geography, so that they can pick the trip that best suits their individual needs.

User Need / Requirement ID	Need/Requirement Text
R02-1	The system shall include as part of published best practices for trip planning applications that include the need to provide users with multiple trip options when multiple options are possible.
R02-2	The system shall include as part of published best practices for trip planning applications that include the need to avoid showing users trips for which they are not eligible or which are not otherwise relevant to them.
RID-03 - Eligibility process	The rider needs to know about any eligibility process they must go through in order to use the service, how to go through that process, and whether that process shall be validated before use of service so that they can effectively access that service without rejection or undue delay.
R03-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for transit services.
RID-04 - Hear text annunciation	The rider needs to hear via text annunciation all information necessary to the trip planning and wayfinding experience without any text being garbled or incoherent so that riders with vision disabilities can get the information they need for their trips and all riders understand audio announcements.
R04-1	The system shall promote the use of a data standard that supports including Text-to-Speech information to facilitate improved audio annunciation by data consuming systems.
R04-2	The system shall include as part of published best practices guidance for application developers which publish and consume Text-to-Speech data to support the needs of users who rely on audio annunciation.
R04-3	The system shall include as part of published best practices that riders be provided tools to communicate feedback to data producers to improve Text-to-Speech quality.
R04-4	The system shall provide interfaces which are compliant with federal and state accessibility guidelines (i.e.: alert text accessible to external screen reader tools).

User Need / Requirement ID	Need/Requirement Text
RID-04-1 - Audio option	The rider needs to have access to any alerts, wayfinding directions, or service regulations posted on visible signs at stations, stops, or on board vehicles, through audio annunciation, so that riders with print disabilities can get the information they need for their trips and all riders with proficiency in announced languages can understand audio announcements.
R04-1-1	The system shall promote the use of a data standard that describes alert, wayfinding, or service regulation information.
RID-13 - App guidance	The rider needs to be able to use the trip planning system with minimal guidance or be provided with adequate guidance so they can travel with independence.
R13-1	The system shall provide interfaces which follow user interface and user interaction design best practices.
R13-2	The system shall provide a single consolidated backend system (i.e. support desk) available through multiple channels (e.g. web, SMS, phone) across the deployment area for riders needing customer service support to planning trips.
R13-2.1	The system shall include as part of the support desk documentation for customer service staff to assist riders when they are learning to use trip planning systems.
R13-2.2	The system shall include as part of the support desk a feature to track all customer service interactions using a ticketing system (i.e.: method of communication, date of communication, issue, how issue resolved).
R13-2.3	The system shall include as part of the support desk customer service teams who at a regular cadence will review and synthesize all interactions for riders and prioritize improving standard operating procedures or submitting bug requests and feature requests to application developers to improve rider experience.

User Need / Requirement ID	Need/Requirement Text
RID-14 - Cost of service	The rider needs to be informed of the cost of the service, whether the service is free, and whether there are ways to reduce the cost of the trip and how to access those price reductions, so that the rider can spend their money effectively and know if price is going to be a barrier to accessing the service.
R14-1	The system shall promote the use of a data standard that describes fares including passes, fare-caps, discounted or subsidized fares, and temporary price reductions.
R14-1.1	The system shall promote the use of a data standard that describes fares including passes, fare-caps, discounted or subsidized fares, and temporary price reductions that specific riders are eligible for, and how those price reductions can be accessed.
R14-2	The system shall include as part of published best practices that trip planning applications include information about fares, including passes, fare-caps, discounted or subsidized fares, and temporary price reductions.
R14-2.1	The system shall include as part of published best practices that trip planning applications include information about fares, including passes, fare-caps, discounted or subsidized fares, and temporary price reductions that specific riders are eligible for, and how those price reductions can be accessed.
RID-14-1 - Standard payment media	The rider needs to pay fares including reduced fares using a payment media that they have routine access to rather than need a special form of payment media so that they are able to understand and feel comfortable with the payment method and are only required to learn as few new systems as possible.
R14-1-1	The system shall promote the use of a data specification that describes payment media.
R14-1-2	The system shall include as part of published best practices how transit apps can describe payment media, and may need to describe how to integrate mobile-based payment media directly into user interfaces.
R14-1-3	The system shall have the capacity to provide interagency technical coordination to facilitate adoption of payment systems which improve rider ease of use.

User Need / Requirement ID	Need/Requirement Text
R14-1-4	The system shall include as part of published best practices that agencies maintain an option to allow payment at time of boarding without a smartphone even if payment in advance by app is enabled.
RID-15 - Customer service	The rider needs to be able to contact customer service to ask questions via both audio and text so any questions about how to use the system can be addressed.
R15-1	The system shall provide a general customer service support desk operated by a human to answer riders' transit questions which can be answered by reference to information within the operator's public GTFS and GTFS Realtime
R15-2	The system shall include as part of the support desk an auditory mode of communication for its customer service functions.
R15-3	The system shall include as part of the support desk text-based mode of communication for its customer service functions.
RID-17 - No internet	The rider needs information presented in ways that do not require internet or a smartphone device so that they can access their trip without these devices or if their internet service is unavailable.
R17-1	The system shall include as part of published best practices that commercial trip planning applications provide certain offline transit information to riders by allowing them to download trip itineraries, static arrival times for specific stops and route information.
R17-2	The system shall provide a customer service channels that do not require internet connectivity for riders to ask general questions related to transit options in the deployment area.
RID-19 - Device accessible	The rider needs to be able to know whether each part of their trip is accessible to mobility devices and bikes so they can plan for a safe and multimodal trip.

User Need / Requirement ID	Need/Requirement Text
R19-1	The system shall promote the use of a data standard that describes vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).
RID-19-1 - Space for mobility device	The rider needs to tell whether there is space onboard the vehicle for their mobility device and other equipment or items they intend to bring along on their trip, and any device or luggage limits they might need to stay within, so that they know the trip they plan for ahead of time is a trip they can complete.
R19-1-1	The system shall promote the use of a data standard or align with emerging data standards that describes real-time vehicle capabilities (capabilities to support wheelchair, bike, or other mobility devices).
RID-19-2 - Pathways in advance	The rider needs to understand the pathways they will use to get to their boarding location, between transfer points, and to their destination including possible barriers in reaching those pathways so that they can confirm the entire trip is accessible, bring the right mobility equipment if applicable, and approach stops from the appropriate pathway.
R19-2-1	The system shall promote the use of the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).
R19-2-2	The system shall include as part of published best practices that transit operators should publish GTFS-Pathways data at a level of quality necessary for riders with vision disabilities and intellectual/developmental disabilities to navigate through complex facilities.
R19-2-3	The system shall include as part of published best practice that trip planning applications include information on pathways using the GTFS-Pathways data specification (https://gtfs.org/reference/static/#pathwaystxt).
RID-20-1 - Preferred language	The rider needs to access any written text in their preferred language so transit information is communicated to everyone, regardless of their primary language.

User Need / Requirement ID	Need/Requirement Text
R20-1-1	The system shall provide interfaces which are internationalized (i18n) to support the loading of translations in any language.
R20-1-2	The system shall promote the use of the GTFS-Translations specification (http://gtfs.org/reference/static/#translationstxt).
R20-1-3	The system shall include as part of published best practices that operators use the GTFS-Translations extension to provide translations of GTFS elements for all languages they are required to support by state and federal guidelines.
R20-1-3	The system shall include as part of published best practices that trip planning applications are internationalized and provide support for translations in multiple languages.
RID-20-2 - Plain language	The rider needs to be provided visual and audio information which uses plain language where words are necessary so that information is accessible regardless of English proficiency.
R20-2-1	The system shall include as part of published best practices that operators regularly to evaluate existing website, application, and marketing copy to determine whether it needs to exist or be rewritten for clarity and conciseness.
R20-2-2	The system shall include as part of published best practices guidance for transit user interface design that all language used be at a fifth grade reading level.
RID-20-3 - Visual or text	The rider needs to have access to all information presented to riders in a visual or text media so that riders with hearing disabilities are able to access the information they need.
R20-3-1	The system shall provide interfaces that are designed inclusively to meet state and federal ADA guidelines for supporting users with hearing disabilities.

User Need / Requirement ID	Need/Requirement Text
R20-3-2	The system shall include as part of published best practices guidance regarding inclusive design for supporting users with hearing disabilities.
R20-3-3	The system shall include as part of the support desk either live chat, messaging, or TDD feature for riders who cannot otherwise access auditory phone services.
B2C-01 - Connection with customer	The rider application vendor needs to maintain a direct connection with their customer, the public transit rider, especially if there is a payment integration in that application, to receive feedback from the user and correct any critical issues identified by the user such as an improper charge.
C01-1	The system shall include as part of published best practices that rider applications include a user feedback function.
B2C-02 - Accessibility guidance	The rider application vendor needs to have clear guidance on the design of an interface that is WCAG 3.0 compliant (or the applicable current standard) and which is accessible to the use of a range of assistive technologies in common use or planned to be in common use, so they can implement a user interface which meets the needs of all users.
C02-1	The system shall include as part of published best practices references to educational resources for WCAG 3.0 compliance targeted at rider application vendors.
B2G-01 - Identify customers	The software vendor needs to identify which agencies within a region are potential customers for their services so that they can sell their services and maintain their business.
G01-1	The system shall publish information regarding transportation operators including data about the size (e.g., number of routes, vehicles, stops) and modes provided by each service.

User Need / Requirement ID	Need/Requirement Text
MUL-04 - Two-way exchange in booking	The software vendor and rider application vendor need to have a method of realtime, two-way exchange between their respective systems in order to facilitate the scheduling of realistic trips which suit rider needs.
M04-1	The system shall promote the use of a data standard that models two-way real-time data exchange between demand-responsive scheduling applications and trip planning applications for the purpose of increasing the quality of trip travel start time and travel time estimates.
MUL-08 - Trust in system longevity	All users need to have reason to believe that the key system components will continually function for many years, or have a plan to be migrated, replaced, or deprecated due to lack of use over some number of years.
M08-1	The system shall include a plan to share long-term costs of the data APIs and other features of the system which will incur maintenance expenses among the users of those system components.
M08-2	The system shall include a plan to identify long-term actors to provide the technical and staff resources necessary to maintain all system components.
OP-05 - Changes to road network	The operator needs to manage the impacts of changes to the road and pedestrian network such as construction or the effects of weather on infrastructure so they can adjust their service with as minimal disruption as possible.
O05-1	The system shall promote the use of a data standard that models unplanned real-time service changes and other information which facilitates adjustment of services to meet real-time conditions on the ground.
OP-06 - Serve requests precisely	The operator needs to be able to serve rider requests for pickup and drop off time as closely as possible, and within the hour-window mandate of the ADA to be ADA compliant, but also to provide transportation services with competitive pickup/drop-off punctuality.

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O06-1	The system shall promote the use of a data standard that allows operators to set restrictions on the trips offered to ensure compliant and efficient trips.
OP-07 - Integrated fare payment	The operator needs to provide trip planning that is integrated with fare payment so that riders can easily pay for their trips without needing to have the correct payment method at the stop or on the vehicle.
O07-1	The system shall promote the use of a data standard that allows operator payment systems to enable the sales of fares through trip planning apps.
OP-08 - Different types of trips	The operator needs to schedule many different types of trips with the same vehicles, including trips for riders with a disability, the general public, and groups, so they can optimize service productivity and provide needed service features to riders.
O08-1	The system shall promote the use of a data standard that allows operators to reflect and restrict as needed their current vehicle capacity.
O08-2	The system shall promote the use of a data standard that describes real-time crowding information
OP-09 - Transfer trips	The operator needs to transfer trips from one scheduling system to another when multiple scheduling systems are used by different subcontractors or different agencies so that scheduling information is always accurate for riders regardless of how they are accessing the information.
O09-1	The system shall include as part of published best practices that demand responsive scheduling systems, booking applications, and brokerage software all be interoperable systems.
OP-10 - Assess data quality	The operator needs to assess whether they are meeting data publication requirements (which will be published by the SCC) or what steps should be taken to meet those requirements so that they don't encounter regulatory issues and know that they are providing high quality information to riders.

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O10-1	The system shall present data publication requirements, and related resources, in an easily accessible format available to all operators.
OP-11 - Procure software	The operator needs to find and procure software systems which provide for its needs so they have the best available information when deciding which tools are best for their specific case.
O11-1	The system shall have the capacity to provide technical advice, assistance, and resources to transit operators to understand and implement the data and procurement guidelines and related best practices within their procurements and contracts.
OP-12 - Precise stop locations	The operator needs to provide precise stop locations through open datasets so that rider applications can help riders locate themselves relative to those stops and follow wayfinding directions.
O12-1	The system shall promote the use of a data standard that supports precise stop location information.
O12-2	The system shall publish the latitude and longitude of every transit stop with a unique ID within the region.
OP-13 - Notify riders of delay	The operator needs to notify riders of a delay in demand responsive service or of the updated time of arrival, so that the rider can know the current status of their trip and be prepared to ride.
O13-1	The system shall promote the use of a data standard that includes real-time service change information for demand-responsive trips.
REG-01 - Assess compliance	The regulator needs to assess whether agencies are complying with regulations regarding data quality so they can ensure and enforce accurate and consistent information across an entire region.

User Need / Requirement ID	Need/Requirement Text
E01-1	The system shall support the automating the assessment of compliance with minimum data guidelines where feasible, as defined by the System Coordination Committee.
RID-01-5 - DR delay	The rider needs to know whether a delay in a demand-responsive service is expected, or a result of the service/ride being cancelled, so that they can decide between either waiting for the delayed vehicle or planning a new trip.
R01-5-1	The system shall promote the use of a data standard that enables distribution of system alert information for demand responsive service including whether a specific rider's trip is being provided.
RID-13-1 - No experience necessary	The rider needs to be provided with an interface which does not require experience with similar interfaces to operate to ensure all riders, regardless of their level of technical knowledge, can use trip planning tools.
R13-1-1	The system shall publish best practices for trip planning applications that include the need to design accessible, intuitive interfaces.
RID-16 - Communicate with driver	The rider needs to be able to communicate through text, audio, and visual formats at the time of trip to the driver so that they are given timely information about the rider's needs directly. This ensures the least amount of steps in the way of rider-operator information "hand-off."
R16-1	The system shall include as part of published best practices identification of the need to provide riders with multiple options for communicating with a driver.
RID-17-1 - Real-time through SMS	The rider needs to be able to access real-time and other information through text message so that they do not have to be connected to the internet to get updates.

User Need / Requirement ID	Need/Requirement Text
R17-1-1	The system shall include as part of published best practices the that operators provide real-time trip information via text message.
RID-17-2 - Limited internet	The rider needs the app to (partially) function even when there is limited or no internet access so that they do not have to rely on a stable connection when making time-sensitive trip decisions.
R17-1-2	The system shall include as part of published best practices that trip planning applications offer offline support for riders planning trips.
RID-18 - Safety features	The rider needs to know about safety features and amenities available during their trip such as lights and shelters so that they can plan for a trip on which they feel both safe and comfortable
R18-1	The system shall the use of use a data standard that describes safety features and amenities available such as lights and shelters during and near a transit trip.
RID-18-1 - Safety at waiting area	The rider needs to know the safety amenities at the waiting location so that they can evaluate the amenities and plan a safe trip.
R18-1-1	The system shall promote the use of a data standard that describes transit stop amenities such as shelters, lights, or restrooms.
RID-19-3 - Loading mobility device	The rider needs to know whether they will be able to get their mobility device and belongings into the vehicle (as opposed to whether this equipment will fit once onboard the vehicle) so that they know the trip they plan for ahead of time is a trip they can complete.
R19-3-1	The system shall promote the use of a data standard that describes real-time vehicle capabilities including details of options for loading bicycles and wheelchair lift capabilities.

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RID-19-4 - Space for mobility device real-time	The rider needs to know whether the spaces for mobility devices on a vehicle are already occupied, and, if so, what the wait for the next vehicle is so they can plan their travel accordingly.
R19-4-1	The system shall include as part of published best practices that trip planning applications enable riders to see when the next trip would be if they don't take the trip being viewed.
RID-20 - Diversity of interfaces	The rider needs to be able to give and receive information in a variety of ways so that riders of all backgrounds, abilities, and preferences can give and receive the information necessary to plan and take a successful trip.
R20-1	The system shall include as part of published best practices that operators allow multiple applications consume their data and serve their riders.
RID-21 - Talk to app	The rider needs to be able to talk to the phone/app to make a request for a ride through a conversational format so that services can be accessed without the dexterity/technical expertise needed to operate a smartphone app manually.
R21-1	The system shall include as part of published best practices for rider applications provide riders the ability to use the app with verbal commands.
RID-22 - Veteran info	The rider needs to have access to information about services or prices geared specifically towards veterans within online and mobile trip planners so they can discover transportation services intended for a specific user population.
R22-1	The system shall promote the use of a data standard that supports eligibility program information and eligibility verification requirements for riders who are veterans.

User Need / Requirement ID	Need/Requirement Text
RID-23 - Present location	The rider needs to know their present location along the route in audio and visual formats so they know when they are approaching their stop, can communicate with others (such as the driver), and know where they are if they need to deboard earlier than planned.
R23-1	The system shall include as part of published best practices that operators publish real-time vehicle locations in a standardized data format.
R23-2	The system shall include as part of published best practices that trip planners provide current vehicle location to users both visually and through audio or text formats.
RID-24 - Various notifications	The rider needs to be able to assign pick up and drop off notifications to different individuals, such as a caregiver, so that other people can confirm the trip has been successfully completed.
R24-1	The system shall include as part of published best practices that rider applications allow users to customize trip notification recipients and include multiple recipients.
RID-25 - Safety feature hours	The rider needs to know the availability of businesses, buildings, services, and landmarks, and the hours of operation of these features, near waiting locations so they can plan their trip according to their needs outside of transportation.
R25-1	The system shall include as part of published best practices that rider applications display map features such as businesses, buildings, services and landmarks nearby stop locations.
RID-26 - Know about TDD	The rider needs to know that Telecommunications Device for the Deaf (TDD) is an option available to them for customer service, because a rider with a hearing disability is more likely to access the service if they know it is TDD-compatible.

User Need / Requirement ID	Need/Requirement Text
R26-1	The system shall include as part of published best practices that agencies and rider applications notify users that accessibility features, including TDD, are available when such features are present.
RID-27 - Confidence in info	The rider needs to have confidence that the information provided is correct so that they can effectively and safely plan their trip.
R27-1	The system shall provide data quality assurance processes to ensure GTFS data and other essential data are maintained at the level of quality defined by the System Coordination Committee.
RID-28 - Limit words	The rider needs to be provided trip planning data in a simple format that does not rely on more words than necessary or a cluttered interface which contains excessive information so that information can be found quickly and does not require a high level of English proficiency.
R28-1	The system shall include as part of published best practices that commercial trip planning applications design simple interfaces that allow a user to find the most important information quickly.
RID-29 - Info before arrival	The rider needs to have access to information about wayfinding signs, landmarks, and vehicle prior to arrival at the station or pick-up/drop off location so that they can look out for those features.
R29-1	The system shall promote the use of a data standard that describes details of wayfinding and vehicle information.
RID-30 - Consistent experience	The rider needs a consistent and predictable experience when seeking online/mobile information so that they do not need to learn a new system frequently, ensuring easier access for people with developmental disabilities or other accessibility needs.
R30-1	The system shall include as part of published best practices that operators and rider applications implement new interfaces and interface features in a fashion that does not require intensive application re-training frequently.

User Need / Requirement ID	Need/Requirement Text
RID-31 - Adjust preferences	The rider needs to be able to change their preferences various aspects of their trip, and be able to change those preferences easily while searching trips so they can choose the best trip for their specific needs.
R31-1	The system shall include as part of published best practices that rider applications allow users to indicate feature preferences for possible trips.
RID-32 - Exact stop locations	The rider needs very precise and accurate stop locations presented to them visually to ensure they know where to board/alight.
R32-1	The system shall include as part of published best practices that transit agencies meet a level of stop location and service area precision and accuracy that allows riders to plan and make trips with confidence in their boarding and alighting locations
R32-2	The system shall include as part of published best practices that rider applications display and announce when possible the current user location relative to the boarding an alighting locations.
RID-33 - Confirm vehicle	The rider needs to be able to confirm that the vehicle they are boarding is the right vehicle to serve their desired trip, so that they can avoid accidentally boarding the wrong vehicle.
R33-1	The system shall implement data quality assurance processes to ensure the labels and markers on vehicles match those displayed in trip planning and booking applications
R33-2	The system shall provide a replicable model for confirming the location of vehicles to users through a standards-based exchange of data between the rider application and vehicle information systems.
RID-34 - Elevators in service	The rider needs to know whether lifts, elevators, and other automated equipment along their pathways or onboard vehicles are in operation in real time, so that they know if their trip is actually accessible at time of their trip.

User Need / Requirement ID	Need/Requirement Text
R34-1	The system shall promote the use of a data standard that describes real-time system alerts related to pathway accessibility, including at a minimum elevator outages and other barriers to mobility devices or limits to mobility-assistive infrastructure.
B2C-03 - Precise user location	The rider application vendor needs access to the precise, real-time position and direction of the rider relative to the stop, in order to satisfy the rider needs for boarding and alighting at the correct stop.
C03-1	The system shall include as part of published best practices that user privacy related to geolocation data be considered by operators and technology vendors to ensure a reasonable level of anonymity to riders, as defined by the System Coordination Committee.
B2C-04 - Specific feedback	The rider application vendor needs suggestions for improvements to their interface that reference their particular application.
C04-1	The system shall have the capacity to provide resources aimed at individual application developers to suggest methods of implementing the rider application best practices.
B2G-02 - Assess quality	The software vendor needs to assess whether the agencies using their software meet data quality regulations to maintain good standing with industry partners consuming that data.
G02-1	The system shall include as part of the API endpoints the integration of automated validator software that confirms the validity of the retrieved data.
G02-2	The system shall include as part of published best practices references to automated data validator software and processes that assesses the quality of operator data according to the data quality guidelines established by the System Coordination Committee.

User Need / Requirement ID	Need/Requirement Text
MUL-05 - Real-time vehicle auditing	The operator and regulator need to be able to identify the location of vehicle assets in real-time to get a full picture of the transportation network in operation and confirm that service has been provided as expected.
M05-1	The system shall include as part of published best practices that agencies provide real-time vehicle location feeds for fixed-route services.
M05-2	The system shall promote the use of a data standard that allows for the real-time viewing of demand-responsive vehicle locations by authorized parties in a manner that accounts for the privacy concerns of demand-responsive riders.
MUL-06 - Alignment on needs	The operator and software vendor need to have the ability to communicate clearly about each other's needs and capacities, and be able to price services reasonably so that each party is engaged in a mutually beneficial partnership, and that that partnership can be sustained productively long term.
M06-1	The system shall provide best practices for operator-procured software systems that can be easily referenced by operators and technology vendors in RFPs or contracts.
MUL-07 - Map data	The operator, regulator, software vendor, and rider application vendor each need to have access to a high-quality map data set with reasonably similar accuracy in order to allow them to place attributes such as stop amenities relative to the map and know the presence and status of sidewalks, curb cuts, and other accessibility features along pedestrian rights of way.
M07-1	The system promote the use of a data standard to map features in the right of way.
M07-2	The system shall include within published best practices a list of acceptable geocoders for mapping features in the right-of-way.

User Need / Requirement ID	Need/Requirement Text
OP-14 - Caregivers and other rider DR partners	The operator needs to schedule trips for riders who may have other passengers along with them, such as kids or caregivers, so that the service is prepared to accommodate those travelers.
O14-1	The system shall promote the use of a data standard which users to book multiple passengers or indicate other passengers will be traveling with them.
O14-2	The system shall include as part of published best practices that rider applications allow users to book multiple passengers or indicate other passengers will be traveling with them.
OP-15 - Service animals	The operator needs to schedule trips for riders who have service animals and confirm to that there is space available for that service animal so the rider knows they will be able to travel safely.
O15-1	The system shall promote the use of a data standard that includes information on service animal rules for transit vehicles.
OP-16 - Communicate pathway quality	The operator needs to communicate to riders the completeness and quality of pathway accessibility information or information regarding the process by which that information has been validated, so that riders can trust information provided regarding pathway accessibility.
O16-1	The system shall include as part of published best practices that rider applications provide information regarding the expected quality of pathways data used within the application.
OP-17 - Rider feedback	The rider needs to be able to provide feedback to the operator regarding the trip, such as quality of amenities, service, or driver interactions, so that preferences and knowledge of riders can be used to improve service and information about service.

User Need / Requirement ID	Need/Requirement Text
REG-02 - Anonymized DR trips	The regulator needs to be able to archive and analyze historical (anonymized) trips to evaluate equity and transportation planning and policy decisions.
E02-1	The system shall capture historical realtime data for transit services in the deployment region and store in a secure location.
E02-2	The system shall include as part of published best practices methodologies for the anonymization and aggregation of demand-responsive trips for planning and policy decision-making
REG-03 - Review ridership	The regulator needs to be able to review ridership by stop, route, and agency so they can evaluate equity of service and make informed transportation planning and policy decisions.
E03-1	The system shall promote the use of a data standard that captures ridership data by stop, route, and agency.
REG-04 - Administrative contact	The regulator needs to be able to identify the administrative agency responsible for service so that they can make contact about issues or audits.
E04-1	The system shall provide a public official list of service administrators and the services they oversee.
E04-2	The system shall include as part of published best practices definitions of terms like "service", "operator", "administrator" etc. that allow for the clear description of different types of administrative contacts.
REG-05 - Vehicle location auditing	The regulator needs to identify where vehicle assets are located by region and whether those vehicles are in a state of good repair to make informed funding allocation decisions.

User Need / Requirement ID	Need/Requirement Text
E05-1	The system shall promote the use of a data standard that describes vehicles and vehicle qualities (i.e.: GTFS-Vehicles).
E05-1.1	The system shall promote the use of a data standard that includes the fields necessary to meet the FTA and NTD requirements for documenting assets.
RID-01-6 - DR origin and destination	The rider needs to confirm that the correct origin and destination has been acknowledged by the demand-responsive service so that they can correct any errors and know that they will be picked up and dropped off at the correct locations.
R01-6-1	The system shall include as part of published best practices that trip planning applications include a confirmation that the correct origin and destination has been acknowledged by a demand responsive service.
RID-01-7 - Book quickly	The rider needs to avoid long times for scheduling and confirmation, so that trips are easy to plan and do not unduly interfere with the rest of their day.
R01-7-1	The system shall include as part of published best practices that booking and brokerage systems minimize wait times for trip confirmations.
RID-14-2 - Cost for party	The rider needs to know the cost and if the cost differs based on the number of people in their party, and who the other people in their party are (e.g. caregiver as opposed to friend or child) so that they can ensure the trip is affordable and have the required payment available.
R14-2-1	The system shall promote the use a data standard that describes any fares associated with other members of their party.
RID-16-1 - Communicate without voice	The rider needs to be able to communicate to other riders and the driver if they're not able to communicate with them through voice so that they can ask questions and get to the right location.

User Need / Requirement ID	Need/Requirement Text
R16-1-1	The system shall include as part of published best practices that agencies provide options to riders to communicate with drivers using non-verbal methods.
RID-18-2 - Station patrol	The rider needs to know whether security guards or officers routinely patrol the stop or station area, and if those officers are armed, so that riders can plan for their personal safety.
R18-2-1	The system shall promote the use a data standard that indicates security guard/officer presence at stops and stations.
RID-18-3 - Stops along route	The rider needs to know all the stops along the route so they can see what features and amenities they can or can't access at intermediate stops in order to plan for charging equipment, using the restroom, or other errands, especially at night or if the rider has a vision or mobility disability.
R18-3-1	The system shall include as part of published best practices that rider applications provide context for amenities that are available along a planned trip.
RID-18-4 - Safety at intermediate points	The rider needs to know the safety amenities at intermediate points along their trip so that they are safe during the entirety of their trip.
R18-4-1	The system shall promote the use of a data standard that describes safety features and amenities available during a transit trip.
RID-18-5 - Restroom locations	The rider needs to be shown the locations of public restrooms along the route, and know if the restrooms are gendered, multi or single-occupancy, accessible, and have baby-changing stations so that they can safely use the restroom when needed.

User Need / Requirement ID	Need/Requirement Text
R18-5-1	The system shall promote the use of a data standard that describes public restrooms information at transit stops, including whether those restrooms are gendered, multi- or single-occupancy, accessible, and have baby-changing stations.
RID-19-5 - Bikes on board	The rider or group of riders needs to know whether they can bring their bike or bikes onboard the vehicle so they can plan for multimodal trips.
R19-5-1	The system shall promote the use of a data standard that supports describing the vehicle capacity to carry bikes onboard.
RID-19-6 - Bikes on board real-time	The rider needs to know whether bike stowage is available onboard the vehicle at the time of the trip so they can plan for any changes affecting their multimodal travel.
R19-6-1	The system shall promote the use of a data standard that supports describing the real-time or predicted vehicle capacity to carry bikes onboard.
RID-19-7 - Mobility device charging	The rider needs to know whether there is a port for mobility device charging or other outlets onboard the vehicle or at the transit stop so that they can plan accordingly and have enough power to reach their destination.
R19-7-1	The system shall promote the use of a data standard that describes presence of outlets for mobility device charging or other purposes on vehicles.
RID-19-8 - Bike parking	The rider needs to be aware whether and where bike parking is available near the transit stop so they can plan for multimodal trips.
R19-8-1	The system shall promote the use of a data standard that describes bike parking information at transit stops.

User Need / Requirement ID	Need/Requirement Text
RID-19-9 - Trust pathway validation	The rider needs to trust the validation of pathway accessibility so they can plan with confidence, knowing that what they encounter on the ground is the same as what they see ahead of time.
R19-9-1	The system shall include as part of published best practices ways for communicating data quality of pathways information to users.
RID-35 - Right stop	The rider needs to be sure they are boarding or alighting at the right stop without seeing the area so they can complete their trip, regardless of any vision disability or time of day.
R35-1	The system shall include as part of published best practices that rider applications include the need to provide confirmation of user location relative to transit stops through text and audio as well as visual format.
RID-36 - Way back home	The rider needs to be sure they won't be caught at their destination without a way back home so they don't get stranded and can maintain their safety during their trip.
R36-1	The system shall include as part of published best practices that rider applications provide trip notifications for the absence of return journeys.
RID-37 - Various options	The rider needs to be presented with a wide variety of options to accomplish their goals when they have few restrictions on their travel (i.e., walking more or less, using a bike or not using a bike, etc.) so that they are offered a degree of flexibility when trip planning.
R37-1	The system shall include as part of published best practices that rider applications provide diverse and distinct options when the user does indicate preferences to restrict those options.
RID-38 - Expect crowding	The rider needs to know if transit waiting zones or vehicles will likely be crowded to evaluate the safety/convenience of a given trip.

User Need / Requirement ID	Need/Requirement Text
R38-1	The system shall promote the use of a data standard that describes crowding of transit waiting zones.
RID-39 - Aware of apps	The rider needs to be aware of the available rider applications and their features so they can make informed choices as a consumer of software.
R39-1	The system shall provide a list of rider applications deployed in the region including information regarding their features.
RID-40 - Schedule changes	The operator needs to inform riders regarding changes in planned schedules through a variety of media such as push notifications, SMS, or phone calls, so that all riders are aware of changes even if they don't use rider apps.
R40-1	The system shall include as part of published best practices that transit operators notify riders of service changes through a variety of formats.
RID-41 - Assistive tech awareness	The rider needs to be aware of assistive technology applications or other services, so that they can use those applications regardless of vision, hearing, dexterity or other disabilities.
R41-1	The system shall include as part of published best practices recommendations and useful references for building in-app and external accessibility tools.
RID-42 - Navigation directions	The rider needs to receive navigation directions in a way that doesn't presuppose they can determine which cardinal direction they are headed in, so the necessary steps to complete the trip are easily understood.
R42-1	The system shall include as part of published best practices the need to word trip directions in a way that does not solely depend on cardinal directionality.

User Need / Requirement ID	Need/Requirement Text
RID-43 - Service animal	The rider needs to confirm that their service animal will have space on board the demand-response vehicle, so that they are able to travel with their service animal.
R43-1	The system shall promote the use of a data standard that describes vehicle capabilities to support service animals during the demand-responsive booking process.
RID-44 - Operator feedback	The rider needs to be able to provide feedback to the operator regarding the trip, such as quality of amenities, service, or driver interactions, so that preferences and knowledge of riders can be used to improve service and information about service.
R44-1	The system shall include as part of the support desk a customer feedback portal where a rider can submit comments which are then provided to the operator.
R44-2	The system shall include as part of the support desk the tracking of instances feedback to ensure routing to the right operator and confirmation of an issue resolution.
RID-45 - Communicate without text	The rider needs to be able to communicate needs to the service without typing text or needing to spell words correctly so that typing errors, or the ability to type overall, do not impede the correctness of trip decisions, eligibility status, or level of accommodations provided.
R45-1	The system shall include as part of published best practices recommendations and useful resources for communicating with riders with limited written English proficiency.

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