

Multimodal and Accessible Transportation (MAT) Standards – Phase 3

RSD Systems Requirements Specification (SyRS)

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1 Introduction

1.1 System Requirements Specification Document Scope

The System Requirements Specification (SyRS) covers the requirements for a Reservations-Scheduling-Dispatching (RSD) system as described in the RSD Concept of Operations (May 2026).

1.2 Project Overview

The Institute of Transportation Engineers (ITE), in coordination with the United States Department of Transportation (USDOT), and their standards development partners, have supported the advancement of Intelligent Transportation Systems (ITS) standards for more than two decades. Over time, traditional ITS technologies have evolved from supporting primarily fixed-route and roadway-based transportation systems to enabling integration with multimodal transportation environments that serve travelers using a wide range of modes and mobility options. This evolution has highlighted the need for coordinated standards that support interoperability and security across various transportation services and platforms.

Recent developments in transportation technology have accelerated the convergence of ITS with multimodal travel systems that support travelers using vehicles, walking, bicycling, micromobility devices, assistive mobility technologies, and other emerging transportation modes. These systems often operate within shared public infrastructure such as roadways and pedestrian pathways and therefore require consistent technical standards to ensure reliable communication, coordinated operations, and protection of traveler data. Ensuring that cybersecurity considerations are addressed within both standards and deployments has become a critical priority for enabling safe and trusted transportation services.

The objective of this project is to continue prior Multimodal for All Travelers (MAT) standards work related to RSD systems for demand-responsive services and to support the development of near-term standards that enable interoperable, secure, and accessible transportation operations. This includes identifying standards gaps, coordinating stakeholder engagement, defining operational use cases, and supporting implementation readiness. By advancing these activities, the effort aims to enable a transportation ecosystem in which mobility services including demand responsive services can operate cohesively while maintaining strong security protections and meeting the needs of agencies, operators, and travelers.

1.3 What is a Well-formed Requirement (Tutorial)

1.3.1 *Purpose of System Requirements*

This SyRS defines the system requirements for the proposed system.

The SyRS is a foundational systems engineering document that provides a detailed description of the intended purpose, features, functionality, and other aspects of the overall system. The SyRS follows the Concept of Operations (ConOps) in the systems engineering process. Requirements listed in this document trace back to user needs in the ConOps, as shown in the Needs to Requirements Traceability Matrix (NRTM) [Appendix A], and then forward to the design specification and other later stages of systems engineering.

The purpose of developing system requirements is to establish a shared technical understanding among stakeholders, system owners, developers, implementers, testers, and maintainers. The requirements translate stakeholder needs into clear, specific, and measurable statements of what

the system must do, how it must perform, and under what conditions it must operate. This common technical baseline helps guide system design decisions, procurement, development, integration, testing, and acceptance.

1.3.2 *Characteristics of Well-Formed Requirements*

A well-formed requirement can be defined as: a statement of system functionality (a capability) that can be validated, and that must be met or possessed by a system to solve a customer problem or to achieve a customer objective and is qualified by measurable conditions and bounded by constraints (Institute of Electrical and Electronic Engineers (IEEE) 1233:1998).

Good functional requirements are:

- a) **Necessary.** Useful (traceable to needs)
- b) **Unambiguous.** Susceptible to only one interpretation
- c) **Concise.** Stated in declarative language ("shall statements")
- d) **Consistent.** Contradict neither itself, nor any other stated requirement
- e) **Complete.** Stated completely in one place. (Requirements may be grouped.)
- f) **Attainable.** Realistic to achieve with available resources and time
- g) **Testable.** Able to determine that the requirement has been met through one of four possible methods (inspection, analysis, demonstration, or test)

1.3.3 *Structure of a Requirement*

Well-formed requirements will generally take the form:

- Actor [The System]
- Action [shall do/not do something to]
- Target [the object of the action]
- Constraint [how, how often, how many, how fast]
- Condition/Localization [if, when, where]

The condition/localization and constraint portions are important, but not all requirements will have both. The constraint identifies how one will measure success or failure of the requirement. The condition or localization identifies the circumstances under which the requirement applies.

An example of a well-formed requirement (following the simple grammar) is as follows:

[Actor] [Action] [Target] [Localization]
[The System] [shall get] [the transit vehicle's location] [from the dispatching system].

If a requirement cannot be stated using this structure, it may be necessary to divide complex functionality into multiple requirements to improve clarity, traceability, and testability.

2 References

- [ARC-IT 9.4] *Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) Version 9.4*. July 15, 2026. <https://www.arc-it.net/>.
- [GOFS-Lite] *GOFS GitHub Repo*, General On-Demand Feed Specification, <https://gofs.org/>.
- [GTFS-Flex] *GTFS Schedule Changes*, General Transit Feed Specification, <https://gtfs.org/documentation/schedule/change-history/recent-additions/>.
- [MAT RSD ConOps] *Final Draft Multimodal for All Travelers (MAT) Reservations, Scheduling, and Dispatch (RSD) Concept of Operations*, prepared by ITE Standards Coordination Committee and RSD subcommittee. Not Yet Published.
- [NEMT] *Non-Emergency Medical Transportation Levels of Service Standard*, Non-Emergency Medical Transportation Accreditation Commission (NEMTAC). October 2024. <https://nemtac.co/wp-content/uploads/2024/10/BSR-NEMTAC-1001-202X-Levels-of-Service-Standard-Approved-10.11.2024.pdf>.
- [NTD S-10] *Service Non-Rail (S-10) – DR DO – Summary*, Federal Transit Administration. August 11, 2023. <https://www.transit.dot.gov/sites/fta.dot.gov/files/2023-08/2023%20S-10.pdf>.
- [RSD Glossary] *Reservations, Scheduling, and Dispatch (RSD) Glossary*, prepared and approved by ITE Standards Coordination Committee and RSD subcommittee, approved 8 October 2025. Not Yet Published.

3 Glossary

The SyRS uses the terms from the [RSD Glossary]. Additional terms are also used in this document. These new RSD related terms are described in Table 1. In addition, Table 2 lists terms from the computing and security domains that are used in this document.

Ed. Note: Table 1 terms will be incorporated into the RSD Glossary once the final SyRS is balloted.

Table 1. RSD Glossary

Term	Description	Source
Accommodations (reasonable)	A modification to the Demand Response provider's standard policies, practices, or procedures. Recorded within a Registered Customer's profile or requested at the time of booking that is necessary to avoid discrimination on the basis of disability and to ensure the customer can access and use the transportation service from origin to destination. A reasonable accommodation must be granted unless doing so would fundamentally alter the nature of the service, create a direct threat to health or safety, or impose an undue financial or administrative burden. Requests do not require the use of specific legal terminology to be valid, and shall be determined in advance whenever feasible.	49 CFR § 37.169 — Process to be used by public entities providing designated public transportation service in considering requests for reasonable modification. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-G/section-37.169 . Accessed: 14 June 2026.
Advanced [reservations]	A booking request submitted by or on behalf of a Registered Customer in advance of the desired trip date and time through the maximum permissible advance reservation window. An advanced booking may be a single trip, return trip, or a subscription trip.	Adapted from 49 CFR § 37.131(b) — Service Criteria for Complementary Paratransit: Trip Reservations. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Amenity	An optional or supplementary feature of service beyond the minimum regulatory requirements that is recorded within a customer's profile in the Reservations System to reflect individual preferences or comfort needs. Amenities may include, but are not limited to, vehicle type preference, communication channel preference, language preference, or escort/companion accommodation, and are captured at booking to enhance the customer experience where operationally feasible.	49 CFR § 37.167 — Other Service Requirements and 49 CFR Appendix C to Part 37. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-G/section-37.167 . Accessed: 14 June 2026.
Available Resources	The fleet of vehicles, drivers, and associated operational capacity that the Reservations System may draw upon at any given time to fulfill valid booking requests within the defined service area and hours of operation. Available resources are the operational inventory against which the Reservations System schedules and	49 CFR § 37.131(f) — Service Criteria for Complementary Paratransit: Capacity Constraints. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-

Term	Description	Source
	assigns trips, subject to vehicle accessibility characteristics, driver qualifications, and service area constraints.	49/subtitle-A/part-37/subpart-F/section-37.131. Accessed: 14 June 2026.
Coordinating Agency	A public entity, private nonprofit organization, or human services agency that partners with the Demand Response provider to plan, fund, or deliver coordinated transportation services to individuals.	Executive Order 13330 — Human Service Transportation Coordination (2004), as implemented through the Coordinating Council on Access and Mobility (CCAM). Federal Transit Administration, U.S. Department of Transportation. https://www.transit.dot.gov/regulations-and-programs/access/ccam/about/transportation-coordination . Accessed: 14 June 2026.
Customer	An individual who has been determined eligible to receive Demand Response/Paratransit transportation services and whose profile is recorded in the Reservations System against a unique identification number, and who is the direct recipient of origin-to-destination service. A Customer may initiate booking requests directly, through a Companion, a Personal Care Attendant (PCA), or an Agency customer service representative via a verified Customer Access System. The term Customer is distinct from Companion, PCA, and Coordinating Agency.	49 CFR § 37.123 — ADA Paratransit Eligibility: Standards. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.123 . Accessed: 14 June 2026.
Disruption to Service	Any event, whether attributable to the provider or to causes beyond the control of the entity, that prevents or significantly impairs the delivery of a scheduled Demand Response trip to a Registered Eligible Customer. Disruptions include untimely pickups, missed trips, trip denials, vehicle breakdowns, and unanticipated weather or traffic conditions.	49 CFR § 37.131(f) — Service Criteria for Complementary Paratransit: Capacity Constraints. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Eligible	The status of a Registered Customer whose formal written eligibility determination confirms that they meet the qualifying criteria for Demand Response/Paratransit service on the basis of disability, age, or other program-specific criteria and whose eligibility record in the Reservations System is current, unexpired, and not suspended. Eligibility may be unconditional, conditional, or temporary, and governs which booking requests the Reservations System is authorized to process.	49 CFR § 37.123(b) and (c) — ADA Paratransit Eligibility: Standards. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.123 . Accessed: 14 June 2026.
Eligible Funding Source	A specific federal, state, local, or private funding program that has been authorized to pay for a Registered Eligible Customer's trip, and under which the customer meets the	FTA Guidance Clarification: Coordination with Human Services Organizations and National Transit Database

Term	Description	Source
	program's eligibility criteria. An eligible fund source determines the applicable service conditions, fare obligations, trip purpose restrictions, and reporting requirements for each trip processed by the Reservations System. A single customer may be associated with multiple eligible fund sources, and the Reservations System must record and apply the correct fund source per trip for billing and compliance reporting purposes.	Reporting (2025). Federal Transit Administration, U.S. Department of Transportation. https://www.transit.dot.gov/sites/fta.dot.gov/files/2025-09/FTA-Guidance-Clarification-on-Coordination-and-NTD-Reporting-2025.pdf . Accessed: 14 June 2026.
Financial Provision	The fare, fee, subsidy, or third-party payment arrangement associated with a Demand Response trip, recorded in the Reservations System against the trip record and linked to the applicable Eligible Fund Source. Financial provisions govern what the customer, PCA, companion, or sponsoring agency is charged per trip, and comply with the regulatory fare ceiling and non-discrimination requirements. Key financial provision rules applicable to the Reservations System include: the fare charged to an ADA paratransit eligible customer shall not exceed twice the full fixed-route fare for a comparable trip at a similar time of day, a PCA shall not be charged for complementary paratransit service, companions shall be charged the same fare as the accompanying eligible individual, a sponsoring agency may be charged a higher fare for agency-guaranteed trips.	49 CFR § 37.131(c) — Service Criteria for Complementary Paratransit: Fares. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Funding Source	The federal, state, local, or private program under which a Registered Eligible Customer's trip is authorized and billed, determining applicable eligibility criteria, service conditions, fare obligations, and reporting requirements for that trip.	FTA Guidance Clarification: Coordination with Human Services Organizations and National Transit Database Reporting. Federal Transit Administration, U.S. Department of Transportation. Identifies over 130 federal programs across 9 agencies eligible to fund human services transportation for transportation-disadvantaged populations, and provides guidance on paratransit NTD reporting obligations by funding source. https://www.transit.dot.gov/sites/fta.dot.gov/files/2025-09/FTA-Guidance-Clarification-on-Coordination-and-NTD-Reporting-2025.pdf . Accessed: 14 June 2026.
Location	A specific point identified by a civic address, geographic coordinates, or named landmark that designates the origin or destination of a trip	49 CFR § 37.3 — <i>Definitions</i> and 49 CFR § 37.129(a) — <i>Types of Service</i> . Electronic Code of

Term	Description	Source
	in a valid booking request, and that falls within the defined service area of the Demand Response system. A location may also refer to a vehicle's real-time geographic position.	Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/section-37.3 and https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.129 . Accessed: 14 June 2026.
Manifest	A dynamically generated schedule and passenger list detailing a specific vehicle's assigned trip pickups, drop-offs, times, and locations for a given shift.	Adapted from RTAP Transit Manager's Toolkit, https://www.nationalrtap.org/Toolkits/Transit-Managers-Toolkit/Operations-and-Planning/Planning-and-Evaluation , accessed August 7, 2026.
Metrics	The quantitative measures derived from Trip Reconciliation Data and operational records that the Reservations System captures, calculates, and reports to evaluate service performance against regulatory requirements and agency standards.	49 CFR § 37.131(f)(3) — Service Criteria for Complementary Paratransit: Capacity Constraints and FTA ADA Circular 4710.1, Chapter 8, Sections 5.3–5.6 — On-Time Performance. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Operating Day	An operating day in demand-response transit is a 24- or over 24-hour period (e.g., 27 hours), or the specific service span within it, during which a transit agency accepts trip requests, dispatches flexible-route vehicles, and actively provides passenger transportation service.	Adapted from National Academies of Sciences, Engineering, and Medicine. 2008. <i>Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation</i> . Washington, DC: The National Academies Press. https://doi.org/10.17226/23112 .
Operational Event	Real-time occurrence that impacts normal operations.	Adapted from Transmodel: EVENT, see Transmodel-v6.2-Data-Dictionary.pdf . Accessed August 7, 2026
Preferences	Optional, customer-specific settings recorded in the Reservations System against a Registered Eligible Customer's profile that govern how the system communicates with, and delivers service to, that customer. Preferences are distinct from Trip Needs which are mandatory trip-specific requirements and from Accessibility features, which are disability-related obligations. Preferences reflect individual	49 CFR § 37.167(f) — Other Service Requirements. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-G/section-37.167 . Accessed: 14 June 2026.

Term	Description	Source
	discretionary choices, including but not limited to: Communication channel (e.g., SMS, IVR, mobile app, email) for booking confirmations, trip reminders, service notifications, language for communications and service information, pickup/drop-off style (e.g., curb-to-curb vs. door-to-door, where locally permitted beyond the regulatory minimum), frequently used addresses (e.g., home, recurring destinations)	
Properly Formed / Conformant Verified [customer access system]	A booking request message is properly formed (conformant) when it satisfies all structural, data type, and content constraints defined in the applicable Schema. A Verified Customer Access System is any rider-facing interface. Including IVR, web portal, mobile application, or call center platform that has been pre-authorized as a trusted endpoint permitted to submit booking request messages to the Reservations System, and whose identity is authenticated on each submission.	Teal, R., et al. (2020). TCRP Research Report 210: Development of Transactional Data Specifications for Demand-Responsive Transportation. TCRP Project G-16. Transportation Research Board, National Academies of Sciences, Engineering, and Medicine. ISBN: 978-0-309-48135-9. DOI: https://doi.org/10.17226/25800 . Accessed: 14 June 2026.
Registered Customer	A Customer whose eligibility has been formally determined through the public entity's ADA paratransit eligibility process, whose profile is recorded in the Reservations System, and who is thereby authorized to submit booking requests through a verified Customer Access System, directly or through a Companion, PCA, or Agency customer service representative.	49 CFR § 37.125 — ADA Paratransit Eligibility: Process. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.125 . Accessed: 14 June 2026.
Registered	The state of a Customer whose identity, eligibility determination, and service profile have been formally recorded in the Reservations System against a unique identification number, enabling the system to authenticate the Customer as an authorized source of valid booking requests. A Customer becomes Registered upon completion of the public entity's eligibility process and written determination of eligibility, and remains Registered until eligibility expires, is suspended, or is revoked.	49 CFR § 37.125(d) and (e) — ADA Paratransit Eligibility: Process. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.125 . Accessed: 14 June 2026.
Schedule Adherence	The degree to which actual pickup and drop-off times for completed Demand Response trips conform to the scheduled pickup windows and appointment times recorded in the Reservations System. Schedule adherence is measured by comparing the actual time of vehicle arrival at the origin against the negotiated pickup window, and actual drop-off time against the customer's appointment time at the destination.	49 CFR § 37.131(f)(3)(i) — Service Criteria for Complementary Paratransit: Capacity Constraints. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.

Term	Description	Source
Schema	A formally defined, machine-readable specification that prescribes the structure, data types, required fields, and validation rules for messages exchanged between the Reservations System and connected systems.	Teal, R., et al. (2020). TCRP Research Report 210: Development of Transactional Data Specifications for Demand-Responsive Transportation. TCRP Project G-16. Transportation Research Board, National Academies of Sciences, Engineering, and Medicine. ISBN: 978-0-309-48135-9. DOI: https://doi.org/10.17226/25800 . Accessed: 14 June 2026.
Service	The transportation operation provided to a Registered Eligible Customer by the Demand Response system encompassing origin-to-destination conveyance, trip scheduling, and the service criteria governing response time, hours and days of operation, geographic service area, fares, and absence of trip purpose restrictions.	49 CFR § 37.129 — Types of Service and 49 CFR § 37.131 — Service Criteria for Complementary Paratransit. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.129 and https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Trip Anchor	The fixed time point specified in a valid booking request against which the Reservations System schedules and negotiates a trip. A trip is anchored by either a pickup anchor, the customer's desired departure time, or a drop-off anchor, a required appointment or delivery time at the destination. The anchor determines the direction of scheduling: for a pickup-anchored trip, the pickup window is independently set and the drop-off window is derived from it; for a drop-off-anchored trip, the drop-off window is independently set and the pickup window is derived from it.	49 CFR § 37.131(b)(2) — Service Criteria for Complementary Paratransit: Trip Reservations. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Trip Assignment	The algorithmic process of matching and allocating individual passenger ride requests to specific vehicles and time slots, integrating new pickups and drop-offs into existing routes while optimizing fleet efficiency, vehicle capacity, and travel time windows.	Adapted from Giovanni Calabrò, Michela Le Pira, Giuseppe Inturri, Where and when does demand-responsive transport work best? A parametric analysis using agent-based modelling, EURO Journal on Transportation and Logistics, Volume 15, 2026, 100173, ISSN 2192-4376, https://doi.org/10.1016/j.ejtl.2025.100173 .
Trip Needs	The complete set of trip-specific requirements	49 CFR § 37.131(b) — Trip

Term	Description	Source
	associated with a valid booking request, submitted by or on behalf of a Registered Eligible Customer, that the Reservations System must capture and accommodate in order to schedule and fulfill the trip.	Reservations. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Trip Reconciliation (Data)	The set of actual operational data captured for each completed, cancelled, missed, or denied trip compared against the original booking request that the Reservations System records to verify service delivery, support billing, enable ADA compliance reporting, and identify capacity constraints. Trip reconciliation data includes, at minimum: actual pickup and drop-off times, vehicle and driver assigned, trip status (completed, no-show, missed, denied, cancelled), passenger miles traveled, unlinked passenger trips, and the funding source billed.	FTA National Transit Database (NTD) Glossary and Reporting Policy. Federal Transit Administration, U.S. Department of Transportation. https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary . Accessed: 14 June 2026.
Valid Booking Request	A properly formed (conformant) message, originating from a verified Customer Access System and satisfying the applicable Schema, that contains all required trip needs for a registered eligible customer. This includes a verified unique customer identifier, origin location, destination location, trip anchor, accessibility requirements, PCA or companion accompaniment, and eligible fund source.	49 CFR § 37.131(b) — Service Criteria for Complementary Paratransit: Trip Reservations. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Validation (checking against potential changes or obstacles on that day)	The process by which the Reservations System checks each previously confirmed booking against current operational conditions on the day of service prior to or during trip execution, to identify and respond to any changes, obstacles, or disruptions that may affect the ability to fulfill the trip as scheduled. Day-of-service validation may include checking for: fixed route service changes affecting the service area or hours, weather or traffic conditions impacting vehicle travel, vehicle or driver availability changes, customer cancellations or no-shows, and real-time schedule deviations.	49 CFR § 37.131(b)(3) and § 37.131(f)(3)(ii) — Service Criteria for Complementary Paratransit. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Vehicle Features	The physical characteristics and accessibility equipment of a Demand Response vehicle that are recorded in the Reservations System and matched against a customer's Trip Needs and Accessibility requirements at the time of booking and scheduling. Vehicle features include, but are not limited to: lift or ramp type and capacity, wheelchair securement locations and devices, interior clearance dimensions, priority seating, handrails and stanchions, seat belts and shoulder harnesses, and lighting.	49 CFR Part 38, Subpart B — ADA Accessibility Specifications for Transportation Vehicles: Buses, Vans and Systems. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-38/subpart-B . Accessed: 14 June 2026.

Table 2. Security and Computing Glossary

Term	Description	Source
Access Control	The process of granting or denying specific requests to obtain and use information, services, systems, or physical resources based on established security policies.	NIST Glossary (NIST SP 800-53 Rev. 5; NIST SP 800-162)
Asset Tracking	The process of identifying, inventorying, monitoring, and maintaining information about organizational assets throughout their lifecycle. Assets may include hardware, software, virtual machines, cloud resources, applications, services, data repositories, network devices, and other components that support organizational operations. Asset tracking typically includes information such as asset ownership, location, configuration, version, status, classification, and relationships to other assets.	NIST SP 800-53 Rev. 5; NIST Cybersecurity Framework 2.0, and ARC IT: https://www.arc-it.net/html/servicepackages/sp218.html#tab-2
Authenticate	To verify the identity of a user, device, process, or other entity by validating one or more credentials (authenticators) presented to a system. Authentication establishes that the claimant is the legitimate holder of the asserted identity.	NIST SP 800-63B, Digital Identity Guidelines
Authorization (Authorize)	The process of granting an authenticated user, device, process, or entity permission to access specific resources, perform actions, or use services based on established policies and privileges.	NIST SP 800-53 Rev. 5 (AC Family)
Cryptographic Key	A value used by a cryptographic algorithm to encrypt, decrypt, sign, verify, authenticate, or otherwise protect information. The security of cryptographic operations depends on the confidentiality and integrity of the key.	NIST Cryptographic Standards (FIPS 140-3, NIST SP 800-57)
Data Communications Performance / Quality	Data communication performance metrics are measurable indicators used to evaluate how effectively a network or communication system transfers data between devices. They provide quantifiable data on network behavior, capacity, reliability, and efficiency, enabling organizations to monitor performance, identify issues, and optimize services	“Network Performance Metrics on Data Communications and Networking.” Source: https://www.siberoloji.com/network-performance-metrics-on-data-communications-and-networking/ Accessed: 29 July 2026
Digital Certificate (Certificate)	A digitally signed electronic credential that binds an entity's identity to a public cryptographic key and enables authentication, encryption, digital signatures, and trust establishment.	NIST SP 800-57; Public Key Infrastructure (PKI) standards
Encrypt (Encryption)	The cryptographic transformation of plaintext into ciphertext using an algorithm and a key to protect the confidentiality of information from unauthorized access.	NIST Glossary; FIPS 140-3; NIST SP 800-57
Exfiltration	The unauthorized transfer, disclosure, or extraction of data from an information system,	NIST Cybersecurity Framework and incident response

Term	Description	Source
	network, device, or storage environment to an external destination.	terminology
Funding Source	The federal, state, local, or private program under which a Registered Eligible Customer's trip is authorized and billed, determining applicable eligibility criteria, service conditions, fare obligations, and reporting requirements for that trip.	FTA Guidance Clarification: Coordination with Human Services Organizations and National Transit Database Reporting. Federal Transit Administration, U.S. Department of Transportation. Identifies over 130 federal programs across 9 agencies eligible to fund human services transportation for transportation-disadvantaged populations, and provides guidance on paratransit NTD reporting obligations by funding source. https://www.transit.dot.gov/sites/fta.dot.gov/files/2025-09/FTA-Guidance-Clarification-on-Coordination-and-NTD-Reporting-2025.pdf . Accessed: 14 June 2026.
Geographic Coordinate System	A geographic coordinate system (GCS) uses a three-dimensional spherical surface to define locations on the earth. A GCS is often incorrectly called a datum, but a datum is only one part of a GCS. A GCS includes an angular unit of measure, a prime meridian, and a datum (based on a spheroid). A point is referenced by its longitude and latitude values. Longitude and latitude are angles measured from the earth's center to a point on the earth's surface. The angles often are measured in degrees (or in grads).	"What are geographic coordinate systems?" https://desktop.arcgis.com/en/arcmap/latest/map/projections/about-geographic-coordinate-systems.htm . Accessed: 22 June 2026.
Integrity	The property that information, data, software, hardware, systems, and processes are protected from unauthorized modification, destruction, or corruption and remain accurate, complete, authentic, and trustworthy. Integrity is one of the three foundational objectives of information security (Confidentiality, Integrity, Availability).	NIST Glossary; FIPS 199
Intrusion Detection	The process of monitoring systems, networks, or activities to identify unauthorized access, malicious activity, policy violations, or other indicators of compromise and generate alerts for investigation.	NIST SP 800-94, Guide to Intrusion Detection and Prevention Systems
Malicious	Characterized by an intent to compromise confidentiality, integrity, or availability; cause harm; gain unauthorized access; disrupt operations; or otherwise violate security policies. Examples include malicious code, malicious actors, and malicious activities.	NIST SP 800-53 Rev. 5; NIST Glossary

Term	Description	Source
Manifest	A dynamically generated schedule and passenger list detailing a specific vehicle's assigned trip pickups, drop-offs, times, and locations for a given shift.	Adapted from RTAP Transit Manager's Toolkit, https://www.nationalrtap.org/Toolkits/Transit-Managers-Toolkit/Operations-and-Planning/Planning-and-Evaluation , accessed August 7, 2026.
Message Tag	A tag is a semantic element in a message header that is used to provide additional information to the message broker or destination.	Adapted from a computing / software construct in Message Passing Interface (MPI) technology. Additional information may be found When to use tags when sending and receiving messages in MPI? - Stack Overflow , accessed August 7, 2026
Non-Person Entity (NPE)	A system component, application, service, device, process, or automated agent that interacts with systems or data but is not a human user. Non-person entities often require unique identities, credentials, authentication, and authorization.	NIST SP 800-63 Digital Identity Guidelines concept of subjects and system entities; NIST identity management practices
Publish (computing)	The act of creating or sending data, documents, or messages for access by devices or systems. Publishing can include posting data to a file server, database or website, or pushing it to a broker for distribution.	Adapted from https://dictionary.cambridge.org/dictionary/english/publish and Pub/Sub Architecture - GeeksforGeeks (for publish / subscribe messaging pattern). Access August 7, 2026
Reliability	The ability of a system, component, service, or process to perform its required functions under stated conditions for a specified period of time without failure. Reliability focuses on consistent and dependable operation and is often considered a prerequisite for system availability and resilience.	NIST SP 800-160 Volume 1; ISO/IEC/IEEE 24765
Resilience (Cyber Resilience)	The ability of a system, organization, or mission to anticipate, withstand, recover from, adapt to, and continue operating during and after adverse conditions, stresses, attacks, failures, or compromises. Cyber resilience includes the capability to maintain essential functions while resisting and recovering from cybersecurity incidents.	NIST SP 800-160 Volume 2; NIST Cybersecurity Framework 2.0
Role-Based Access Control (RBAC)	An access control model that grants permissions based on assigned organizational roles or job functions. Users inherit permissions associated with their assigned roles rather than receiving permissions directly.	NIST SP 800-53 AC-3(7); NIST Glossary
Sensitive	A subset of PII that, if compromised, could	NIST SP 800-122; Federal

Term	Description	Source
Personally Identifiable Information (SPII)	result in substantial harm, embarrassment, inconvenience, identity theft, financial loss, or other adverse effects to an individual. Examples include Social Security numbers, biometric data, financial account numbers, and medical information.	privacy guidance
Service	The transportation operation provided to a Registered Eligible Customer by the Demand Response system encompassing origin-to-destination conveyance, trip scheduling, and the service criteria governing response time, hours and days of operation, geographic service area, fares, and absence of trip purpose restrictions.	49 CFR § 37.129 — Types of Service and 49 CFR § 37.131 — Service Criteria for Complementary Paratransit. Electronic Code of Federal Regulations, U.S. Department of Transportation. https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.129 and https://www.ecfr.gov/current/title-49/subtitle-A/part-37/subpart-F/section-37.131 . Accessed: 14 June 2026.
Token	A physical or logical authenticator used to prove identity or convey authorization information. Examples include hardware security tokens, smart cards, software-generated one-time passwords, and OAuth access tokens.	NIST SP 800-63B

4 Need Definitions

This section outlines need definitions for reservations, scheduling, dispatching, security and privacy, and other general needs. These need definitions are drawn from Section 3.2.1 of the RSD ConOps document, where the rationale for each need is also provided.

4.1 Reservations

Table 3 includes the need definitions for reservations.

Table 3. Reservations Need Definitions

#	Need	Definition
1a	Multiple Booking Access Methods	Passengers need the ability to access Reservations through customizable communications channels.
1b	Multiple Passenger Reservations	Customers need the ability to make advanced reservations for the specific rider and their companion(s) (e.g., self-serve, agency driven, caregiver).
1c	Recurring Trips	Passengers need the ability to make and manage subscriptions/ standing order bookings for recurring trips (e.g., every Monday, every third Wednesday).
1d	Flexibility	Passengers need flexibility in making spontaneous reservations.
1e	Preferences and Accommodations	Passengers need to tailor their reservations to accommodate their preferences including (but not limited to): • Select pick-up/drop-off locations and times (days) • Identify notifications to be sent • Group travel (multiple passengers including family members and/or caregivers) • Select preferred language • Accommodate support animal • Accommodate wheelchairs and other mobility devices including tie-down types. • Accommodate luggage, shopping charts, buggies, etc.
1f	User Profile	Passengers need to access regularly used/requested information such as rider profile information (e.g., frequently used addresses, preferences, mobility aids, etc.) without having to retype the information into the reservations request.
1g	Fare Benefits	Passengers meeting transit agency policies for fare benefits need to confirm they are using a reduced fare when making a reservation.
1h	Connecting Multiple Modalities	Customers need to be able to personalize their trip plans using multimodal transportation methods that include walking, microtransit, and fixed route transit.
1i	Manage Reservations	Customers need the ability to manage their reservations including viewing or cancelling the reservations or updating details that will not impact scheduling. For example, it may include adding notifications, changing contact information, and changing companion information. It does not include changing pick up / drop

#	Need	Definition
		off times or locations or changing the number of passengers.
1j	Energy Considerations	Customers need the ability to select an option to reserve a trip that provides for carbon reduction based on the type of vehicles and/or policies supported by the Transit Agency.

4.2 Scheduling

Table 4 includes the need definitions for scheduling.

Table 4. Scheduling Need Definitions

#	Need	Definition
2a	Customer Service Schedule	Scheduling systems need to schedule reservations to accommodate customer preferences and to meet customer convenience and trustworthiness.
2b	Service Productivity and Optimization	Scheduling systems need to schedule agency resources (driver work, vehicle usage – wear and tear, fuel) to balance agency efficiency with customer convenience.
2c	Route Optimization	Scheduling systems need to minimize the miles traveled with and without passengers for each daily vehicle schedule (from pull-out to pull-in) while meeting customer reservations needs.
2d	Service Coordination	Coordinating agencies need to integrate key services including inter-agency resource availability and service schedules.
2e	Coordination with Fixed Routes	Scheduling systems need to coordinate with the Transit Agency fixed-route services depending on agency policies (e.g., riders can use demand-response services to access fixed-route services).
2f	Customer Reservation Communication	Scheduling systems need to share the reservation details and status via the customer's preferred communications channel throughout reservations planning process.
2g	Reschedule	Scheduling systems need to update the trip plans (manifests) for drivers and vehicles due to many planned changes such as construction, weather, and customer bookings including cancellations.
2h	Track Rider Status	Scheduling systems need to track riders' reservations and trip histories for reporting and billing.

4.3 Dispatching

Table 5 includes the need definitions for dispatching.

Table 5. Dispatching Need Definitions

#	Need	Definition
3a	Reliable Dispatch/Operator Communication	Dispatchers need dependable data and voice communication methods (such as data radios, cell phones, tablets, or mobile data terminals (MDTs)) to provide timely information between vehicle operators and Dispatchers including current (or updated) manifests and manifest change notifications.
3b	Service Coordination and Support	Dispatchers need the ability to manage and coordinate service as resources and information change, including moving trips from one vehicle to another, or from an agency vehicle to another service provider's vehicle.
3c	Safety Considerations	Dispatch systems need to provide safe notifications [communications] for vehicle operators during operations.
3d	Advanced Customer Status Communications	Dispatch systems need to collect, aggregate and notify Passengers of their current reservation event and status information. This may include information about same day confirmation status, expected delays and estimated time of arrival (ETA).
3e	Dispatch Management	Dispatch systems need to manage functions including vehicle and operator schedules and rescheduling, monitor and report on vehicle and rider status, and manage system incidents.

4.4 Security and Privacy

Table 6 includes the need definitions for security and privacy.

Table 6. Security and Privacy Need Definitions

#	Need	Definition
4a	Security and Privacy Considerations	Systems need to ensure Confidentiality, Integrity, and Availability (CIA) for at-rest and in-transit data at all layers of security including data and communications.
4b	PII Data ownership	Passenger and users need to manage and control the use and distribution of their personal and operational data throughout the lifecycle of their engagement with the reservations system.

4.5 General

Table 7 includes the need definitions for general needs.

Table 7. General Need Definitions

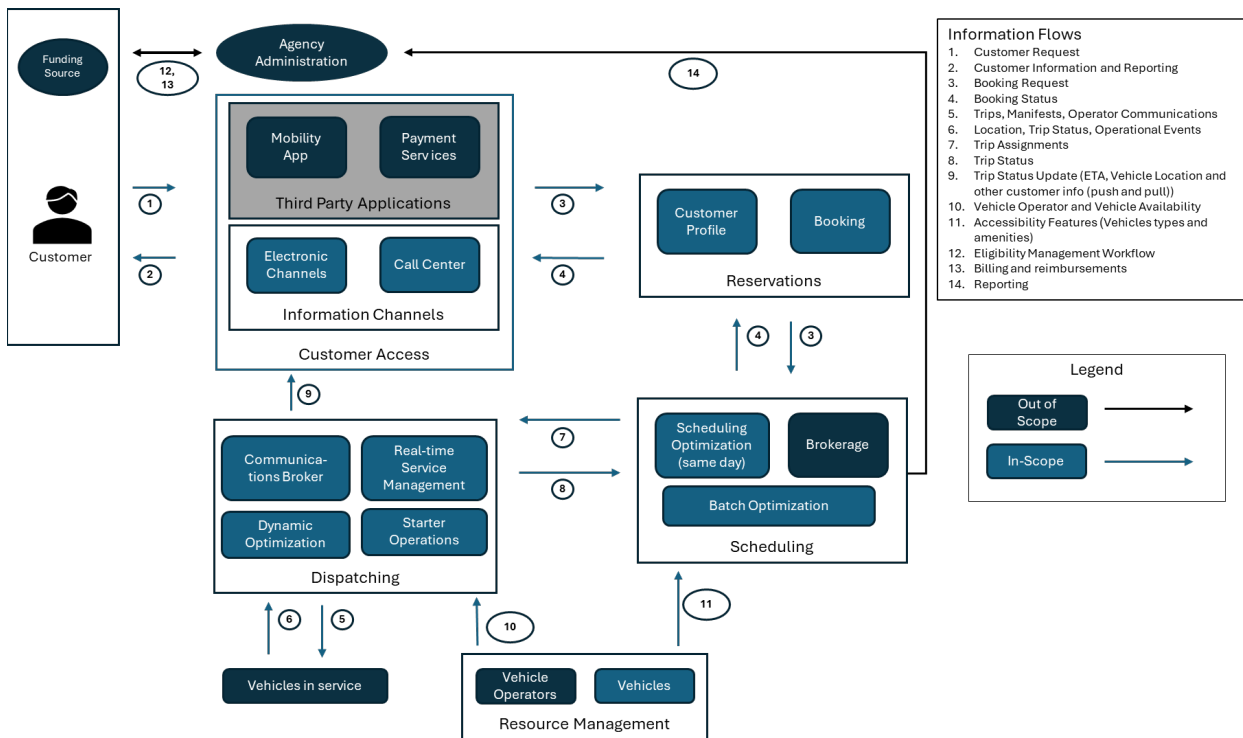
#	Need	Definition
5a	Accessible Design	All RSD system users need the ability to customize the accessibility features in the RSD system to accommodate their abilities.
5b	Preparedness and Response	Agency staff (schedulers and dispatchers) need to prepare plans for communicating the impact of disaster response to current or impacted demand responsive transit (DRT) riders.
5c	Service Trustworthiness and Convenience	Passengers need to have confidence in the booking, implementation, and quality of the service articulated by agency policies and reservation request.
5d	Information Management	The agency needs to manage a database's information and underlying data structures so that data remains organized, consistent, accessible, and easy to maintain throughout its lifecycle.

5 General System Description

The Reservations, Scheduling, and Dispatching (RSD) System Description provides a description of the proposed RSD System of Interest (SOI), with a focus on those critical functions, components, and interfaces within the RSD system. The descriptions in this section are extracted or summarized from the MAT RSD Concept of Operations (ConOps) [MAT RSD ConOps].

- Section 5.1 describes the System Context including the proposed SOI (Figure 1), a description of the RSD Actors, Components and Subsystems (the boxes and ovals from the Context Diagram in Table 9). Table 10 lists the Information Flow descriptions identified in the SOI.
- Section 5.2 lists the system modes and states during normal, degraded and failure operations.
- Section 5.3 lists the major system constraints, assumptions and dependencies.
- Section 5.4 lists the actor or component functions, subfunctions and processes.
- Section 5.5 lists a summary of the nine use cases and the groupings of the use cases into user perspectives – customer, agency and multiagency.

5.1 System Context



(Source: S. Mishra, 2026)

Figure 1. RSD Context Diagram

Table 8. RSD Actors, Components, and Subsystems

Actor / Component / Subsystems Name	Description	Description Source
Agency Administration	Identifies a transit entity which is often synonymous with a transit agency. Note that in some cases, such as when a single agency operates multiple separate services, agencies and brands are distinct. This document uses the term "agency" in place of "brand".	RSD Glossary 2.9 Agency
Booking	The process of making a reservation for space on a means of transport for the movement of people or goods.	RSD Glossary 2.21 Booking
Brokerage	This is a service model where the transit agency contracts with one or more service providers to deliver portions of the dedicated service such as in specific geographic areas. Alternatively, it is a service model where the transit agency retains a third-party entity to be a "middleman" between one or more trip-sponsoring agencies and (commonly) a multi-carrier service delivery network. Typically, the broker enters into a main agreement with a transit agency but also enters into sponsorship agreements with other funding entities such as human service agencies that fund transportation for their clients. On the service delivery side, a broker contracts with and pays each service provider on behalf of the sponsors. One of the broker's main functions is to organize the service delivery network. A broker can also perform other functions more typically associated with a transit agency transportation service.	Adapted from RSD Glossary 2.24 Brokerage and 2.108 Partial (or Hybrid) Broker
Call Center	A center (centralized or distributed) used to handle calls from travelers or potential riders related to booking, payment, and service information.	Generated
Communications Broker	A service that manages (forwards and stores) message traffic between systems or subsystems for priority communications. Communications include between vehicles/vehicle operators and dispatch system, dispatch system and riders, agency and other service providers, agency and different provider vehicles, and other key stakeholders as needed.	Generated
Customer	A person who explores and needs to procure demand responsive travel services.	Generated
Customer Profile	A description of information about a customer. This information may include private information about them including name, demographic information, address, contact information, preferences, accommodations and other details as needed to provide transportation services.	Generated
Dispatching	This is the process of monitoring vehicle operations and transmitting voice/data instructions. This may involve making sure that the drivers are keeping up with their schedules, responding to no-shows, assisting drivers [vehicle operators] with incidents and emergencies, communicating late cancellations to the drivers, scheduling same day add-on trips to vehicle runs and communicating these add-on trips to	RSD Glossary 2.50 Dispatching

Actor / Component / Subsystems Name	Description	Description Source
	the drivers, switching trips from one run to another in response to vehicles running late or to vehicles that have become disabled and communicating these changes to the drivers, assisting lost drivers and assisting with navigation, responding to the ETA calls from customers, and, where the system has MDT/Automatic Vehicle Location (AVL) capabilities, ensuring that the proper pickup/ drop-off times are being entered into the system, and ensuring that the vehicle is in the right place.	
Vehicle Operator (for RSD)	A person who safely operates and navigates [a transit vehicle], collects fares, helps passengers (including those with disabilities), answers questions, performs vehicle inspections, maintains route schedules and trip logs, communicates with dispatchers and traffic controllers, and troubleshoots incidents and emergencies.	RSD Glossary 2.25.
Dynamic Optimization	Dynamic optimization, also called real-time continuous optimization, is a capability of a paratransit scheduling/dispatching system as well as of on-demand technologies currently being utilized for microtransit and alternative services. This capability is an automated function which is designed to run virtually continuously (or at configured intervals) throughout the service day. For paratransit systems, the process typically begins once the next-day scheduling has been completed. Dynamic optimization considers changes that have occurred (such as cancellations, late running vehicles, no-shows, etc.) since the last time the process was run, and then re-assigns trips among dedicated vehicles and non-dedicated vehicles if available, to fill in the new holes that have been created and to otherwise re-optimize the schedule in an objective fashion. In addition, these systems have configurable guards against modifying a rider's pick-up time or interrupting what a driver [vehicle operator] is doing at the moment.	RSD Glossary 2.58 Dynamic Optimization (also called Real-Time, Continuous Optimization)
Electronic Channel	A communication source that is implemented by computer such as a web site, mobile application, or integrated voice response system. The channel manages translating messages from and to different formats such as voice to text, text to voice, haptic signals and more.	Generated
Funding Source	The source of finance [for a service]	Generated
Information Channel	An information source [where users can access information about services].	Generated
Mobility App	A software application that is typically available on a smart phone or mobility device.	Generated
Payment Service	A service or function that allows people to pay for work performed	Generated
Reservations	The process of receiving and booking requests, and the allotment in advance of seating accommodation	RSD Glossary 2.123

Actor / Component / Subsystems Name	Description	Description Source
	for a passenger for immediate-response, same day, advance-reservation, and/or subscription (standing order) trips. In many systems, the staff that receive reservations also receive process cancellations, change-orders, and provide general information about the system and other customer service functions.	Reservations
Real-time Service Management	Vehicle and operator revenue service that is dispatched, managed and monitored now.	Generated
Resource Management	Source of supply and support that is administered. [This includes the asset information that is collected about the resource.]	Generated
Scheduling	In a demand-responsive service, the process of determining the path and schedule of vehicles in the system so that they serve the trips that have been requested. Also, the process of assigning a booked trip request to a specific vehicle run and determining in the vehicle run the scheduled (as opposed to requested) pick-up time and drop-off times for the trip.	RSD Glossary 2.133 Scheduling
Scheduling Batch	The specific process to schedule the resources, pick up / drop off times/locations, and paths of travel to design the most efficient (cost and convenience) based on all the reservations booked prior to the day of work.	Generated
Scheduling Optimization (same day)	The specific process to schedule the resources, pick up / drop off times/locations, and paths of travel to design the most efficient (cost and convenience) based on same day bookings.	Generated
Starter Operations	Processes that occur prior to dispatching work to the field including checking vehicle health, validating trip manifests, verifying operator availability and more.	Generated
Vehicle (for RSD)	A means of conveyance to transport people and goods. [The vehicle includes vehicle characteristics to accommodate rider needs such as ramps, lifts, seat belts, luggage storage, bicycle racks and more.]	Generated

The information flows identified in Figure 1 are described in Table 9.

Table 9. Information Flows

Info Flow #	Name	Description	Source
1	Customer Request	User input from a traveler to summon assistance, request travel information, make a reservation, or request any other traveler service.	ARC-IT 9.4 (traveler request)
2	Customer Information and Reporting	Multimodal (possibly non-roadway) transit provider services information and trip reservation confirmations.	ARC-IT 9.4 (service information request)
3	Booking Request	Request for paratransit support.	ARC-IT 9.4 (demand responsive transit)

Info Flow #	Name	Description	Source
			request)
4	Booking Status	The situation at a particular time during the booking process. A booking state may include, but is not limited to, one of the following: Started: User requested the usage or reservation of an asset(s) or a seat(s). Pending: The requested seat(s) or asset(s) is/are temporary reserved for the user. Reservation is pending for payment. Released: If a User decides to go for other options than the one(s) narrowed down, the PENDING state can be cancelled by the Provider. Then the booking state is changed to RELEASED. Confirmed: Reservation has been paid and the seat(s) or vehicle(s) has/have been granted for the user Cancelled: The reservations have been cancelled by one of the parties involved Changed: If a reservation needs to be changed after it has been CONFIRMED by the User or TO (e.g., a different asset has been assigned, different starting time), the Provider will indicate it to the other party and the booking state will change to CHANGED. Finished: Reservation period has ended and the utilization of the asset or seat is no longer valid.	RSD Glossary 2.22 Booking State
5	Trips, Manifests, Driver Communications	2.157 Trip A trip reflects the completed transport of a passenger from origin to destination and is synonymous with a "passenger trip." A round trip therefore consists of 2 trips. The total trips figure usually includes trips taken by customers, personal care attendants (PCAs) and companions, whereas customer or registrant trips include just trips taken by program registered (or eligible) customers. 2.53 Driver Manifest, Trip Manifest, Or Trip Sheet A printed or electronic driver/trip manifest/sheet includes the list of trips or stops in the proper sequence for a specific vehicle run, along with needed information about the customers to be transported (name, mobility device used, disability, etc.). The manifests also provide spaces or capabilities for the driver to document actual service data that pertain to each trip and stop (that is not captured automatically) and run-level summary information.	RSD Glossary 2.157 Trip 2.53 Driver Manifest, Trip Manifest, Or Trip Sheet
6	Location, Trip Status, Operational	Location: Dynamic transit schedule adherence and transit vehicle location information.	Location: ARC-IT 9.4 [transit schedule

Info Flow #	Name	Description	Source
	Events	2.162 Trip Status Refers to the current state or progress of a scheduled trip within a transportation or dispatching system. It indicates where the trip is in its lifecycle, helping agencies, drivers, and passengers understand whether the trip is upcoming, in progress, delayed, canceled, or completed. Examples: - Scheduled – The trip is planned and confirmed, but has not yet started. - Assigned – A vehicle/driver has been allocated to the trip. - In Progress / En Route – The vehicle is actively traveling to pick up or drop off passengers. - Arrived / Boarding – The vehicle has reached the pickup location and is waiting or boarding passengers. - Completed – The trip has finished, and all planned drop-offs are done. - No-Show – The passenger did not appear at the scheduled time and location. - Canceled – The trip was canceled by the agency, passenger, or due to operational issues. - Delayed – The trip is running behind schedule due to traffic, mechanical issues, or other disruptions. - Operational Events: Visual or audio information (e.g., routes, messages, guidance, emergency information) that is provided to the traveler.	adherence information] RSD Glossary 2.162 Trip Status Operational Events: ARC-IT 9.4 [traveler interface updates]
7	Trip Assignments	Route assignment information for transit vehicle operator. Alternatively: Current and projected transit schedule information used to initialize the transit vehicle with a vehicle assignment, monitor schedule performance, and develop corrective actions on-board.	ARC-IT 9.4 [route assignment or transit schedule information]
8	Trip Status	2.162 Trip Status Refers to the current state or progress of a scheduled trip within a transportation or dispatching system. It indicates where the trip is in its lifecycle, helping agencies, drivers, and passengers understand whether the trip is upcoming, in progress, delayed, canceled, or completed. Examples:	RSD Glossary 2.162 Trip Status

Info Flow #	Name	Description	Source
		- Scheduled – The trip is planned and confirmed, but has not yet started. - Assigned – A vehicle/driver has been allocated to the trip. - In Progress / En Route – The vehicle is actively traveling to pick up or drop off passengers. - Arrived / Boarding – The vehicle has reached the pickup location and is waiting or boarding passengers. - Completed – The trip has finished, and all planned drop-offs are done. - No-Show – The passenger did not appear at the scheduled time and location. - Canceled – The trip was canceled by the agency, passenger, or due to operational issues. - Delayed – The trip is running behind schedule due to traffic, mechanical issues, or other disruptions.	
9	Trip Status Update (ETA, Vehicle Location and other customer info (push and pull))	Dynamic transit schedule adherence and transit vehicle location information. Note: see Location in flow 6	ARC-IT 9.4 [transit schedule adherence information]
10	Vehicle Operator and Vehicle Availability (Resource Availability)	2.124 Resource Availability The ability of an asset to perform a required function under given conditions at a given instant in time, or over a given time interval, assuming that the required external resources are provided.	RSD Glossary 2.124 Resource Availability
11	Accessibility Features	2.3 Accessibility Features Elements of a structure or system that would enable people with different abilities to use the service or structure. Accessible features may include required equipment (ramps, lifts, stop announcement systems, video displays, audio equipment, securement systems, etc.). The regulations require transit agency (or vendor) employees to be properly trained in how to use them and for these systems to be operable.	RSD Glossary 2.3 Accessibility Features
12	Eligibility Management Workflow	2.60 Eligibility With respect to ADA complementary paratransit, the USDOT regulations limit eligibility to individuals who are unable to use fixed route services due to a disability. Eligibility for paratransit is to be based on an individual's functional ability, specifically whether they are able to use the fixed route system independently. The regulations define three categories of eligibility: a person with a disability who cannot navigate the transit system without assistance, a	RSD Glossary 2.3 Accessibility Features

Info Flow #	Name	Description	Source
		person with a disability who requires an accessible vehicle when one is not available on fixed route, and a person with a disability who is unable to reach the transit stop, The regulatory requirements and nuances related to the ADA complementary paratransit eligibility and the eligibility determination process are found in 49 CFR Part 37, Sections 37.123 and 37.125	
13	Billing and reimbursements	Information exchange on services rendered, invoicing and remittance between Funding Source and Agency Administration (organization who delivered services).	Generated
14	Reporting	Information exchange on services rendered and requested between scheduling (including as reported by dispatching) and Agency Administration.	Generated

5.2 System Modes and States

The modes of operations are described in Table 10.

Table 10. Modes of Operations

Mode	Definition
Normal (operational)	All interfaces and subsystems are operating normally.
Degraded when Client Profiles in the Reservations is not working	This mode may occur due to several circumstances that range in severity. Regardless, the Customer will need to input their saved information from scratch (e.g., contact information, favorite places, favorite trips, preferences, etc.) The various priorities are listed below. • Critical: cyberattack will require implementing a cybersecurity plan. • Medium: Due to communications or interface issue
Degraded when Reservations functions cannot be accessed	This mode may occur when the Reservations system cannot be accessed through any of the Information Channels including the Call Center or Electronic Channels. This mode may be precipitated when one or more components of Reservations is not operating including cyber attacks. This function is of high priority and may need to be addressed by non-electronic and automated methods.
Degraded when Scheduling is not operating consistently	This mode occurs when the Scheduling functions are down or not working properly. Each booking option may revert to manual recording and the optimization of the schedule will need to be manually processed and formatted; exchange of information with Dispatching may require communications via email to operate properly.
Degraded when Dispatching is not operating consistently	This mode occurs when the Dispatching functions are down or not working properly. Manual processes may be required to provide manifests and daily work schedules to vehicle operators such as hard copies of schedule. A backup process may be implemented (e.g., via email) to send the

Mode	Definition
	manifest electronically to vehicles in service. In addition, there may be a backup system to track vehicles and communicate vehicle locations and estimated time of arrival to Customers.
Degraded when Resource Management is off-line	This mode occurs when communications between Resources and Scheduling or Resources and Dispatching cannot communicate about available resources. This exchange is of high priority but can be backfilled by manual exchanges (via radio, email or telephone) with Resource Management staff.
Degraded when communications is disrupted between vehicles and dispatching	This mode occurs when communications between vehicles and dispatching is disrupted and dispatching staff cannot exchange information with vehicle operators. This exchange is of high priority and usually mitigated by backup or duplicate communications systems such as cell phone or radio.
Failure	Failure mode operates as a mission critical impact. Information provision, communications and services between systems will be manually implemented. If no backup or redundant service is available, the operations will be suspended temporarily.

5.3 Major System Constraints, Assumptions and Dependencies

Certain conditions may preclude the application of some or all components of this standard. The following operational policies and constraints may apply:

- Public agencies may implement operational policies, rules, or regulations that take precedence over the use of this standard. No governmental operational policies, rules or regulations shall be violated when applying this proposed Reservations, Scheduling and Dispatching (RSD) standard. Regulatory and legal constraints must include ADA Compliance labor rules, driver standards from Federal Transit Administration (FTA) / Federal Motor Carrier Safety Administration (FMCSA), FTA vehicle standards, Title VI, and billing constraints from funding sources (when services beyond ADA paratransit are used). Such constraints may drive how trips are booked, schedules are developed, and driver/vehicle assignments are made.
- Each operating agency may have service quality standards that the RSD standard has to fulfill.
- Each operating agency may have operational and financial constraints that restrict the use of this standard. Operational constraints may include the availability of specialized vehicles, trained drivers, data sharing capabilities or accessibility capabilities (e.g., Telecommunication Devices for the Deaf (TDD), Braille).
- While developers are aware of the need for guidance that is feasible and implementable, certain technologies may not be available given resource constraints.

5.3.1 Security Policies and Constraints

The following operational policies and constraints may apply:

- Data Scope:** Protect customer data (identity, location, trip, payment) across its lifecycle from app input to brokerage and vehicle systems.

- **Encryption:** Encrypt data in transit and at rest.
- **Access Control:** Limit access to authorized flows and minimum necessary information; enforce least-privilege (the minimum access required)
- **Integrity and Audit:** Ensure data integrity and maintain audit logs for accountability.
- **Privacy Compliance:** Apply consent mechanisms and privacy governance for lawful collection, processing, and retention.
- **Segmentation and Monitoring:** Use system segmentation and monitoring to prevent over-sharing and insider misuse.

5.4 Component Characteristics

Table 11 provides a more detailed set of characteristics for each actor or component. Each actor includes a set of functions, subsystems, or activities. The actors include descriptions that list the high level functional descriptions performed by the actor. This is included to ensure that the scope of the actor is understood.

Table 11. Actor Functions

Actor	Functions / Subsystems	Description (subfunctions)
Customer	Rider	• Registers for DRT service. • Manages reservations (including cancellations). • Takes trips using DRT service based on their reservations. • Uses appropriate Information Channel for their preferences and accessibility needs. • Receive updates / notification on their trips
Information Channels	Call Center Electronic Channels	• Relays communications between customer and Reservations through multiple communications channels. • Manages information media between Customer and Reservations based on Customer access needs.
Call Center	Call Agents IVR	• Provides telephone medium for Customer to manage their reservations including agent or interactive voice response (IVR). • Provides TTY-type (teletypewriter) capability for Customer to manage their reservation.
Electronic Channels	Mobile device Web IVR	• Provides automated media such as web or mobile device for Customer to manage and view their reservations. This includes methods that support people with auditory and visual disabilities. • Provides automated means for Customer to receive updates on their reservations and trip status.
Reservations	Reservations System	• Manages and stores Customer Profile (so that customer does not need to update their preferences and capabilities for each booking request). • Completes and forwards booking request from Customer to agency Scheduling system. • Stores information about Customer reservations and trip history.

Actor	Functions / Subsystems	Description (subfunctions)
Scheduling System	Batch Optimization Scheduling Optimization (same day)	- Exchanges information on bookings between Customer (via Information Channels) and Scheduling. - Identifies availability of service resources (vehicle types / characteristics) to meet reservation needs. - Optimizes schedules to meet reservations needs. - Documents trip plans (stop sequence for rider pickup and dropoff and rider information for manifest) for each vehicle. Batch Optimization: - Generates trip plans at a certain time prior to the operating day - Sends trip plans to Dispatching for validation and distribution to vehicles/operators Scheduling Optimization (same day): - Groups and inserts reservations into trip plans based on same day receipt and cancellations - Sends trip plans to Dispatching for validation and distribution to vehicles/operators as the trip plans are filled.
Brokerage	3 rd Party Broker	- Acts as intermediary between transit agency (provider) and customer (rider). - Manages discovery by customer of service information of one or more transit agencies (service operators). - Manages forwarding of customer reservation requests to service provider (e.g., transit agency, social service agency) that can meet customer travel needs.
Resource Management	Vehicle Asset Management and Operator Availability Lists	- Master resource that stores vehicle asset information including accessibility features such as lifts, ramps, special seats (child), number of seats, etc. - Resource on periodic bidding, selection and assignment process (a.k.a. bid pick) of drivers operating DRT vehicles. The resource may also contain information about the driver, their training, certifications, and other private information.

5.5 Operational Scenarios

The operational scenarios are defined as nine Use Cases and collected into three groups that correspond to a stakeholder perspective. The groups include Customer, Agency and Multiagency. The perspectives as defined in the ConOps (Section 5) follow:

- Customer Perspective.** The customer's perspective for planning a trip using a mobility application. The use cases in this section will present actions and multiple flows on who, what, and how to create a profile, book trips, cancel trips and monitor their trips. The main flow will note steps taken by a customer using a mobility app to navigate around the mobility application. The alternate flow will focus on, but not limited to, steps taken by the customer's companion, when the customer does not have the capability of using the application to plan their own trip.

The areas that are not specifically covered in these use cases from the customer's perspective include eligibility determination/process, payment, payment reconciliation,

and financial management functions.

- **Agency (Business) Perspective.** This section presents the business perspective from the agency's point of view. The use cases in this section present actions and flows on who, what, when, how and how often agencies support the provision of service information for users / customers to discover and book rides that serve the customer's needs. During booking, the agency will schedule and optimize the vehicle and driver manifests to optimize the use of their resources to serve their customers. These resources are then managed and dispatched throughout the agency's region to provide the scheduled services.

Operations are not specifically covered in the use cases; operations include the provision of real-time information to customers en-route to their destinations, management and dynamic scheduling for on-demand travel, rerouting due to obstacles in the roadway, vehicle replacement, and other communications with drivers or passengers during service. In addition, these use cases exclude payment, payment reconciliation, or financial management functions, call center or complaint communications with customers.

- **Multiagency (Broker) Perspective.** As defined in the RSD Glossary, a broker:
“[A] broker enters into a main agreement with a transit agency but also enters into sponsorship agreements with other funding entities such as human service agencies that fund transportation for their clients. On the service delivery side, a broker contracts with and pays each service provider on behalf of the sponsors. One of the broker's main functions is to organize the service delivery network. A broker can also perform other functions more typically associated with a transit agency or sponsoring human service agency (e.g., eligibility determination, fare media or account management, complaint management and customer service functions).”

As described, a multiagency perspective is typically managed by a broker that organizes service delivery among multiple transit agencies. In this role, a broker collects and aggregates information on services provided by multiple transit agencies, presents the information for service discovery by customers, and acts as a channel for customers to book travel with specific agencies (without referral, agency bidding or other optimization functions). The functions serve as an alternative flow for the agency information provision (Use Case 8) and reservations (Use Case 9).

Similar to the agency perspective, these use cases exclude payment/financial activities, reporting and customer communications.

A summary of the Use Cases that are described in the ConOps are listed below. The first four use cases are grouped into the customer perspective. Use cases 5 through 7 are associated with the agency perspective. The final two use cases (use cases 8 and 9) are associated with the multi-agency perspective.

5.5.1 Use Case 1 – Registration

The goal of this use case is to illustrate the process for the Customer to access transit-based transportation services using smart devices.

This use case consists of the registration process for discovering, planning, and signing up for mobility services. The main flow focuses on the methods used to get the customer information into the mobility application to create a profile. However, the alternate flows focus on how the customer can register for a profile in person as well as setting up a profile including additional information for paratransit mobility option. The exception flow looks into how the customer can use a phone to contact the call center to create a profile.

5.5.2 Use Case 2 – Reservations and Bookings

The goal of this use case is to illustrate how Mobility reservations/scheduling from the Customer's perspective are used across various sectors to provide efficient, reliable, and accessible transportation options for diverse user needs

This use case consists of the process for a customer to book a request using a mobility app. The alternate flow will document the steps taken by the customer's companion to book a request for a customer not able to book a trip on their own. The exception flow will show the steps the customer can take to book a trip without the use of a smart device.

5.5.3 Use Case 3 – Cancel Reservation

The goal of this use case is to illustrate how to cancel a booked trip from the Customer's perspective.

This use case consists of the process for a customer canceling a trip using a mobility app. The alternate flow will document the steps taken by the customer's companion to cancel a trip for a customer not able to cancel a trip on their own. The exception flow will show the steps the customer can take to cancel a trip without the use of a smart device.

5.5.4 Use Case 4 – Trip Execution

The goal of executing a trip in transit is to achieve a seamless, reliable, and convenient travel experience that maximizes time efficiency and minimizes stress.

The use case for execution is from the Rider's perspective and will focus on the seamless delivery of the service, and the process after completion using a mobility app. The alternate flow will focus on the rider's companion using their mobility application to receive a seamless delivery of service for the rider and themselves. The exception flow will focus on the rider's ability to confirm a trip and monitor the arrival of their mode of transportation without using a smart device.

5.5.5 Use Case 5 – Reservations and Scheduling

Manage information needed to provide information to customer and retrieve information needed to optimize on-demand scheduling of resources that meet customer demand.

This use case describes retrieval of information needed to provide the customer with demand-responsive service options and collect information needed to generate optimized schedules for agency resources.

5.5.6 Use Case 6 – Scheduling and Dispatching

Provide optimized planned schedules for demand-responsive transit that can be actuated by dispatching to start and manage the service.

This use case describes the processes associated with scheduling resources, transmitting the resources to dispatching, and allocating the resources to transit services.

- Case 1: Scheduling submits optimized schedule prior to Dispatching.
- Case 2: Scheduling receives a cancellation to an optimized schedule and sends an exception to Dispatching (to forward to the vehicle/driver).

5.5.7 Use Case 7 – Dispatching and Service Management

Generating and transmitting tactical service plans to resources delivering the service.

This case describes the processes associated with delivering transit services as the demand-responsive activities are initiated. This includes transacting information through channels with the customer, driver, and other stakeholders that require information.

5.5.8 Use Case 8 – Agency Information Provision

Collect and aggregate agency service information from multiple agencies for customer discovery.

This use case describes the processes for acquiring and processing information from multi-agencies and transforming the data for customer discovery.

5.5.9 Use Case 9 – Reservations Brokerage

Managing reservations with multiple agencies.

This use case describes the processes associated with brokering reservations requests from potential riders to initiate the reservation process with a service provider.

NOTE: This use case does not include tendering bids to service providers (agencies) to bid on booking requests (flow 3).

6 System Requirements

This section details the requirements at the system level, providing insight into the RSD System capabilities, conditions, performance and constraints. In detail, this section lists the requirements for:

- General Functional characteristics
- Security and privacy
- System Policy and Regulations
- Information Management

Each requirement table includes three fields:

Req# -- a unique ID for each requirement. Each ID is derived from the Need IDs established in Appendix A – Needs-to-Requirements Traceability Matrix. The ID combines the Need-ID and Need sub-ID from Appendix A with a sequential number, in the format [Need].[Need sub-ID].[###]. For example, the first Reservations need requirement related to *Multiple Booking Access Methods* (1a) is designated as **1.a.01**. The numbering sequence starts at the first requirement traced to Need 1a and continues consecutively through Need 5c.

Req Title – a title that summarizes the requirement description

Req Description – a well-formed requirements statement.

6.1 General Functional Characteristics

The General Functional Characteristics are driven by the General Needs category. Each need, with the relevant section that includes related requirements, are listed below:

Need 5a -- Accessible Design

All RSD system users need the ability to customize the accessibility features in the RSD system to accommodate their abilities.

- 6.1.1 System Accessibility
- 6.1.2 Mapping

Need 5c -- Service Trustworthiness and Convenience

Passengers need to have confidence in the booking, implementation, and quality of the service articulated by agency policies and reservation requests.

- 6.1.3 Metrics and Reporting

Need 5d -- Information Management

The agency needs to manage a database's information and underlying data structures so that data remains organized, consistent, accessible, and easy to maintain throughout its lifecycle.

- 6.1.4 Information Management

6.1.1 System Accessibility

Table 12 details system accessibility requirements that meet user needs. These requirements pertain to every subsystem.

Table 12. System Accessibility Requirements

Req #	Req Title	Req Description
5.a.01	WCAG	The system shall comply with the current versions of the Web Content Accessibility Guidelines (WCAG) for web (version 2.1) and mobile applications (version 2.2).
5.a.02	ADA Compliance	The system shall comply with the ADA.
5.a.03	Multiple Languages	The system shall support multiple language selections for stakeholders to choose from. The associated languages are described by the local policies.
5.a.04	Digital and Hands-off Technologies	The system shall implement digital and hands-off technologies to support persons with disabilities (mobility, visual or auditory) to communicate among staff and with customers, especially riders. These technologies may include fully automated relay services (Internet Protocol Captioned Telephone Service (IP-CTS)), Automatic Speech Recognition (ASR), Text-to-Speech (TTS), speech to text, AI powered agents and TTY-type technologies.

6.1.2 Mapping

Table 13 details map use and display requirements that meet user needs. These requirements pertain to every subsystem.

Table 13. Mapping Functional Requirements

Req #	Req Title	Req Description
5.a.05	Digital Map Database	The system shall use a digital map database that includes various location referencing systems including addresses and geographic coordinate systems (e.g., WGS84).
5.a.06	Geolocator Services	The system shall include a geolocator that converts an address to a geographic coordinate system and vice versa.
5.a.07	Map Feature Update	The system shall display the current location of each vehicle on the map database.
5.a.08	Map Functions	The system shall display a map that is scalable and interactive (pan, zoom) and includes a level of detail and feature selection (layers) that users can customize.
5.a.09	Map Overlay	The system shall provide feature layers and data management functions for RSD systems.

6.1.3 Metrics and Reporting

Table 14 details metrics and reporting requirements that meet user needs. These requirements pertain to every subsystem.

Table 14. Metrics and Reporting Functional Requirements

Req #	Req Title	Req Description
5.c.01	Collect Quality of Service Metrics	The Agency shall collect metrics on their quality of service as defined by agency policies.
5.c.02	Solicit Feedback on Quality of Service Metrics	The agency shall solicit feedback from customers on their service trustworthiness, reliability, comfort, customer convenience, and on-time performance based on their documented quality of service metrics.
5.c.03	Document Quality of Service Measures	The Agency shall document quality of service measures that describes service reliability, and other quantitative measures for federal, state and local reporting, for example, [NTD S-10].

6.1.4 Information Management

Table 15 details information management requirements that meet user needs. These requirements pertain to every subsystem.

Table 15. Information Management Functional Requirements

Req #	Req Title	Req Description
5.d.01	Message Storage	The system shall record and store all transactional exchanges between systems. The stored information includes (a) the sequence of messages, (b) the content, (c) datetime of the message transmission or receipt, and (d) source or destination.
5.d.02	Database Integrity	The data storage system shall include procedures to ensure the integrity of the data.
5.d.03	Database Data Dictionary	The system shall include a data dictionary for the data storage systems, that is, it shall document the data definition and format for each data element stored in the data storage systems.
5.d.04	Database Schema	The system shall include a database schema for each data storage system that details each database entity.
5.d.05	Database Archiving Lifetime	The system shall archive the data stored in the data storage systems based on agency policies.
5.d.06	Database Sorting and Retrieving	The stored data shall be time and date stamped and shall contain sufficient information to enable selective sorting and retrieval based on user-specified selection criteria. For example, the following sorting and selection criteria may be supported for accessing the historical data from both the online and archived storage: date and time, latitude/longitude, name of service provider, vehicle number, vehicle operator number, dispatcher number, trip/run number, funding source(s)/eligibility, trip purpose, and incident type (where needed).
5.d.07	Message Data Dictionary	The system shall include a data dictionary and syntax for each message, that is, it shall document the data definition and format for each data element contained in a message, data specification, or application programming interface.

Req #	Req Title	Req Description
5.d.08	Message Schema	The system shall include a schema for each message that is transmitted by the system.

6.2 System Security and Privacy

The System Security and Privacy Functional Requirements are driven by the Security and Privacy Needs Category. The needs consist of the following:

4a -- Security and Privacy Considerations

Systems need to ensure Confidentiality, Integrity, and Availability (CIA) for at-rest and in-transit data at all layers of security including data and communications.

- 6.2.1 Security

4b -- PII Data ownership

Passenger and users need to manage and control the use and distribution of their personal and operational data throughout the lifecycle of their engagement with the reservations system.

- 6.2.2 Privacy

6.2.1 Security

Table 16 details security requirements that meet user needs. These requirements pertain to every subsystem, unless specified.

Table 16. System Security

Req #	Req Title	Req Description
4.a.01	Administrative Authentication, Authorization, and Access Control	The system shall authenticate and authorize all users, programs, processes, and services prior to performing administrative actions, including user account management; prohibit the use of default user accounts except during initial provisioning; and enforce access controls for non-person entities (NPEs) conducting administrative functions.
4.a.02	Secure Communications and Protected Network Connections	The system shall provide secure communications and connection mechanisms that authenticate communicating entities, encrypt data in transit using approved cryptographic protocols and algorithms, protect against unauthorized access and tampering, and restrict communications to authorized users, devices, services, and network interfaces.
4.a.03	Continuous Vulnerability Management and Intrusion Detection	The system shall implement continuous vulnerability management capabilities that verify only authorized software is installed and executed, continuously monitor for unauthorized changes to software and system configurations, and employ intrusion detection and prevention mechanisms to identify, alert on, and respond to malicious or unauthorized activity.

Req #	Req Title	Req Description
4.a.04	Stored Data Protection and Ransomware Resilience	The system shall protect sensitive stored data from unauthorized modification, deletion, or malicious encryption via ransomware activity, through the use of access controls, integrity protection mechanisms, monitoring, and recovery capabilities to ensure the integrity, availability, and reliable operation of the system.
4.a.05	Secure Network Communications and Managed Interface Protection	The system shall employ secure, integrity-protected, and up-to-date communication protocols for all wireless and network communications, including at a minimum protective technologies that reflect the current state of the art (e.g., TLS 1.3, DTLS 1.3, SFTPv3, SSH2, and SNMPv3) and are appropriate to the identified risks; restrict and monitor unauthorized network traffic to critical components through managed interfaces such as gateways, routers, firewalls, guards, and other network control mechanisms; and enforce secure communications between all network-capable devices to protect the confidentiality, integrity, and availability of data in transit.
4.a.06	Fault Reporting, Functional Isolation, and Secure Software Update Management	The system shall provide mechanisms for applications to report faulty or anomalous operations that may indicate safety or security risks; separate user functionality from system and security management functionality through logical or physical isolation mechanisms; and provide tools to support timely, complete, and verified updates of firmware, operating systems, and middleware, including manual and automated update capabilities, installation validation, and removal of superseded software versions.
4.a.07	Asset Tracking, Inventory Management, and Unauthorized Movement Detection	The system shall provide asset tracking capabilities for designated critical components and generate alerts upon detection of removal, or deviation from approved locations including at a minimum: software/hardware name, major and minor version number, installation date.
4.a.08	Security Event Logging, Audit Monitoring, and Network Service Visibility	The system shall generate and maintain security event logs with synchronized and accurate timestamps to support security auditing, monitoring, and incident investigation; and shall provide current status information for network-enabled features and services that reflect the current state of the art such as HTTP, HTTPS, SSH2, FTP, SFTP, and associated network ports in use.
4.a.09	System Backup, Recovery, and Restoration Management	The system shall provide backup and recovery capabilities for system state information, operating system software, middleware, application software, licenses, documentation, and configuration data to support timely restoration and recovery from system failures, corruption, or cyber attacks.
4.a.10	Secure Communications with External Service Providers	The system shall provide authenticated, encrypted, and integrity-protected communications with external service providers.

Req #	Req Title	Req Description
4.a.11	Secure Communications with Vehicles	The Dispatching System shall provide authenticated, encrypted, and integrity-protected communications with vehicles.

6.2.2 Privacy

Table 17 details privacy requirements that meet user needs. These requirements pertain to every subsystem.

Table 17. System Privacy

Req #	Req Title	Req Description
4.b.01	Sensitive Data Protection and Confidentiality Management	The system shall protect sensitive data from unauthorized access, disclosure, modification, or exfiltration during storage, processing, and transmission through the use of access controls, encryption, and integrity protection mechanisms.
4.b.02	Role-Based Access Control and Least Privilege Enforcement	The system shall enforce role-based access controls that restrict access to sensitive information, administrative functions, and protected resources to authorized users, devices, and services based on least privilege and need-to-know principles.
4.b.03	Data-in-Transit Encryption and Communications Protection	The system shall encrypt sensitive data in transit across interfaces with other subsystems using approved cryptographic protocols and algorithms to protect the confidentiality and integrity of communications.
4.b.04	Data-at-Rest Encryption and Cryptographic Key Protection	The system shall encrypt sensitive data at rest using state of the art cryptographic mechanisms and protect cryptographic keys from unauthorized access or disclosure.
4.b.05	Authentication Secret and Credential Protection	The system shall protect passwords, cryptographic keys, certificates, tokens, and other authentication secrets from unauthorized access, disclosure, modification, or reuse.
4.b.06	Sensitive Data and Administrative Function Isolation	The system shall logically or physically separate sensitive data, administrative functions, and user-accessible services using isolation mechanisms such as segmentation, virtualization, or dedicated processing environments.
4.b.07	Secure Remote Access and Session Protection	The system shall restrict remote access to authenticated and authorized users and devices through encrypted and monitored communication sessions.
4.b.08	Sensitive Information Monitoring and Exfiltration Detection	The system shall monitor for unauthorized access, disclosure, transfer, or exfiltration of sensitive information and generate alerts upon detection of suspicious activity.
4.b.09	Data Minimization and Controlled Information Handling	The system shall limit the collection, processing, storage, and transmission of sensitive information to the minimum necessary to support authorized operational or mission requirements.

Req't #	Req't Title	Req't Description
4.b.10	Backup Media and Recovery Data Protection	The system shall protect backup data, recovery images, and storage media from unauthorized access, disclosure, modification, removal, or destruction.
4.b.11	Data Sanitization and Secure Media Disposal	The system shall sanitize or securely destroy sensitive data and storage media prior to disposal, transfer, reuse, or decommissioning.

6.3 System Policies

This section identifies requirements based on State and Agency policies. Section 5.3 identifies that agencies are constrained by the service quality policies as well as Federal policies and regulations. The following requirement descriptions recognize these diversity of state and agency policies within the text with a constraint on the requirement. These constrained requirements are listed in Table 18.

Table 18: Requirements Constrained by Agency Policies

Req't ID	Requirement Title	SyRS Table Reference	Comment
1.d.01	Update Existing Reservations	Table 22	Agencies have different policies on the deadline prior to which a customer may request a change to their reservation(s).
1.f.04	Manage (CRU) User Profile	Table 25	Some agencies do not allow certain information to be changed. When specific information is changed, it may impact their eligibility.
1.h.01	Multimodal Trip Options Meeting Agency Policies	Table 27	
1.i.06	Display Customer Trip History	Table 28	
1.j.01	Carbon Neutral Trip Option	Table 29	This selection provides an option for customers when agencies have alternative fuel vehicle options available.
1.j.02	Automated Vehicle Trip Options	Table 29	This selection provides an option for customers when agencies have automated vehicles available.
2.c.01	Daily Trip Assignment Optimization	Table 33	There are different types of optimization - - Revenue, Efficiency, Cost, Minimize time or miles.
2.e.01	Multimodal Connections	Table 35	
3.e.07	Monitor Schedule	Table 42	Deviation from schedule adherence is an agency-defined time-based window for pick-up and drop-off.

	Adherence		(e.g., if a pick-up is 3 minutes or less late according to the schedule, it may be considered as “on-time”).
4.b.09	Data Minimization and Controlled Information Handling	Table 17	A provision is added for the policy to define sensitive data and levels of access.
5.a.03	Multiple Languages	Table 12	
5.c.01	Collect Quality of Service Metrics	Table 14	
5.d.05	Database Archiving Lifetime	Table 15	

7 Subsystem Requirements

This section presents the requirements for each subsystem including Reservations, Scheduling and Dispatching systems.

7.1 Reservations

The Reservations Functional Requirements are driven by the Reservations Needs Category. Each need, with the relevant section that includes related requirements, are listed below:

1a – Multiple Booking Access Methods

Passengers need the ability to access Reservations through customizable electronic channels.

- 7.1.1 Booking Request and Response

1b – Multiple Passenger Reservations

Customers need the ability to make advanced reservations for the specific rider and their companion(s) (e.g., self-serve, agency driven, caregiver).

- 7.1.2 Booking Request and Response

1c Recurring Trips

Passengers need the ability to make and manage subscriptions/ standing order bookings for recurring trips (e.g., every Monday, every third Wednesday).

- 7.1.3 Recurring Trips

1d Flexibility

Passengers need flexibility in making spontaneous reservations.

- 7.1.4 Flexibility

1e Preferences and Accommodations

Passengers need to tailor their reservations to accommodate their preferences including (but not limited to):

Select pick-up/drop-off locations and times (days)
 Identify notifications to be sent
 Group travel (multiple passengers including family members and/or caregivers)
 Select preferred language
 Accommodate support animal
 Accommodate wheelchairs and other mobility devices including tie-down types.
 Accommodate luggage, shopping charts, buggies, etc.

- 7.1.5 Booking Accommodations
- 7.1.6 Customer Preferences

1f User Profile

Passengers need to access regularly used/requested information such as rider profile information (e.g., frequently used addresses, preferences, mobility aids, etc.) without having to retype the information into the reservations request.

- 7.1.7 User Profile

1g Fare Benefits

Passengers meeting transit agency policies for fare benefits need to confirm they are using a reduced fare when making a reservation.

- 7.1.8 Fare Benefits

1h Connecting Multiple Modalities

Customers need to be able to personalize their trip plans using multimodal transportation methods that include walking, microtransit, and fixed route transit.

- 7.1.9 Connecting Multiple Modalities

1i Manage Reservations

Customers need the ability to manage their reservations including viewing or cancelling the reservations or updating details that will not impact scheduling. For example, it may include adding notifications, changing contact information, and changing companion information. It does not include changing pick up / drop off times or locations, or changing the number of passengers

- 7.1.10 Manage Reservations

1j Energy Considerations

Customers need the ability to select an option to reserve a trip that provides for carbon reduction based on the type of vehicles and/or policies supported by the Transit Agency.

- 7.1.11 Energy Considerations

7.1.1 Booking Request and Response

Table 19 details the booking request and response requirements that meet user need 1a – Multiple Booking Access Methods.

Table 19. Booking Request and Response Requirements

Req# #	Title	Description
1.a.01	Mobile, Web and Call Center Access to Reservations System	The Reservations System shall provide access to customers to its functionality through electronic devices (mobile or web app) and telephony via call center agents.
1.a.02	Booking Request Validation	The Reservations System shall process properly formed (conformant) booking requests generated from a verified Customer Access System.
1.a.03	Assign Unique Number to each Registered User	The Reservations System shall assign a unique identification number to each registered customer.
1.a.04	Registered Customer Request	The Reservations System shall process booking requests generated by a registered customer or the Customer's Companion or Agency customer service representative from a call center. A customer may have to be eligible for service (e.g., by age, by disability, or another eligibility criteria).
1.a.05	Booking Request Response	The Reservations System shall respond to messages that are received through the Customer Access system.
1.a.06	Booking Response Content	The Reservations System shall respond to each valid booking request from the Customer Access System with, at a minimum, the customer identifier/contact, trip details and booking state via the customer's preferred electronic channel.

7.1.2 Multiple Passenger Reservations

Table 20 details the multiple passenger reservations requirement that meet user need 1b – Multiple Passenger Reservations.

Table 20. Booking Request and Response Requirement

Req #	Title	Description
1.b.01	Advanced Booking for Rider Companion	The Reservations System shall allow a customer to book reservations in advance for him/herself and his/her Rider Companion through the Customer Access system.

7.1.3 Recurring Trips

Table 21 details the recurring trips requirement that meet user need 1c – Recurring Trips.

Table 21. Recurring Trips Requirement

Req #	Title	Description
1.c.01	Booking Options for Advanced Reservations	The Reservations System shall provide customers with the following types of advanced booking reservation services: (a) one-time trip (regular service); (b) standing orders (for recurring trips); (c) return trips; or (d) multiple saved trips (at different times).

7.1.4 Flexibility

Table 22 details the flexibility requirement that meets user need 1d – Flexibility.

Table 22. Flexibility Requirement

Req #	Title	Description
1.d.01	Update Existing Reservations	The Reservations System shall provide customers with the ability to update their reservations a pre-defined period prior to the reservation in accordance with the agency's policies.

7.1.5 Booking Accommodations

Table 23 details the booking accommodations requirements that meet user need 1e – Preferences and Accommodations.

Table 23. Booking Accommodations Requirements

Req #	Title	Description
1.e.01	Customer Access Channel Discovery Solicitation	Customer Access Systems shall solicit information from the Reservations System so that customers can select and tailor their trip based on service, accessibility, and amenity information.
1.e.02	Tailor Trip Needs, Preferences and Accommodations	The Reservations System shall provide a variety of options to customers so they can tailor their trip needs, preferences and accommodations in the booking request.
1.e.03	Booking Response Service	The Reservations System shall respond to a customer's request through the Customer Access System with information about the agency's services upon request or on a subscription basis.

7.1.6 Customer Preferences

Table 24 details the customer preferences requirements that meet user need 1e – Preferences

and Accommodations.

Table 24. Customer Preferences Requirement

Req #	Title	Description
1.e.04	Manage Preferences during Booking Trip	The Reservations System shall provide the customer with the ability to change needs, preferences for a specific trip during the booking process.
1.e.05	Save Preferences in User Profile	The Reservations System shall provide customers with the option to save their needs, preferences, and accommodations (in a user profile), save their needs/preferences/accommodations for specific trips (e.g., subscription/standing order trips) only, or not save the preferences.
1.e.06	User Profile Default Booking Preferences	The Reservations System shall provide the customer with the option to include stored needs and accommodations from their user profile into their booking request. Options include the preferences in the user need (Need #1e) such as mobility devices, support animals and more.

7.1.7 User Profile

Table 25 details the user profile requirements that meet user need 1f – User Profile.

Table 25. User Profile Requirements

Req #	Title	Description
1.f.01	User Profile	The Reservations System shall provide a user profile for users to manage their frequently used information including needs, accommodations, preferences, trip histories, and trip status.
1.f.02	User Profile During Registration	Upon registration, the Reservations System shall query the customer for their preferred contact information, payment options, trip preferences, needs and accommodations.
1.f.03	Customer Information Source	The Reservations System shall provide the same customer information (e.g., request message, profile, trip status and history) regardless of information channel the customer prefers for the RSD system.
1.f.04	Manage (CRU) User Profile	The Reservations System shall provide services for customers to manage their user profile including create, view (review), and update their profile options.
1.f.05	Manage Update of User Profile	The Agency shall approve or acknowledge changes made by the customer to their Profile based on their organization policies.

7.1.8 Fare Benefits

Table 25 details the fare benefits requirements that meet user need 1g – Fare Benefits.

Table 26. Fare Benefits Requirements

Req #	Title	Description
1.g.01	Verify User Profile	The Reservations System shall verify information in the user profile with an external agency (e.g., funding sources), such as contact information, payment options including fare benefits, and customer needs.
1.g.02	Confirm Funding Source Usage	The Reservations System shall confirm with the customer through the Customer Access System the cost of the trip with a customer's designated funding source.

7.1.9 Connecting Multiple Modalities

Table 27 details the modalities requirement that meets user need 1h – Connecting Multiple Modalities.

Table 27. Connecting Multiple Modalities Requirement

Req #	Title	Description
1.h.01	Multimodal Trip Options Meeting Agency Policies	The Reservations System shall provide multimodal options to the Customer Access System to plan a trip that meets agency policies for transferring customers from demand-responsive trip segments with other trip segments such as demand-response, fixed-route, microtransit or walking based on their ability, availability, and preference.

7.1.10 Manage Reservations

Table 28 details the reservations management requirements that meet user need 1i – Manage Reservations.

Table 28. Manage Reservations Requirements

Req #	Title	Description
1.i.01	Manage (CRUD) Advanced Reservations	The Reservations System shall provide services for customers to manage their advanced reservations upon request by the customer. Management includes viewing, cancelling, updating accommodations or preferences, or changing dates/times. The change or cancellation of a specific trip type (refer to Req # 1.c.01 for description of trip type) may be subject to agency policy.
1.i.02	Scheduling Trip Availability Query	The Reservations System shall query the scheduling system for trip availability using the customer's booking request.
1.i.03	Booking Response via Preferred Customer Access	The Reservations System shall generate and send a response to the customer through their preferred Customer Access, based on the response from the Scheduling System.
1.i.04	Booking Status Response to Booking Request	The Reservations System, after processing the booking request, shall respond with either the proposed trip information and a booking state or just the booking state. A booking state [Glossary, 2025, § 2.22] may include, but is not limited to, one of the following: Started: User requested the usage or reservation of an

Req #	Title	Description
		asset(s) or a seat(s). Pending: A requested seat(s) or asset(s) is/are temporary reserved for the user. Reservation is pending for payment. Released: If a User decides to go for other options than the one(s) narrowed down, the PENDING state can be cancelled by the Provider. Then the booking state is changed to RELEASED. Confirmed: Reservation has been paid and the seat(s) or vehicle(s) has/have been granted for the user Cancelled: The reservations have been cancelled by one of the parties involved Changed: If a reservation needs to be changed after it has been CONFIRMED by the User or Transit Agency (e.g., a different asset has been assigned, different starting time), the Provider will indicate it to the other party and the booking state will change to CHANGED. Finished: Reservation period has ended and the utilization of the asset or seat is no longer valid.
1.i.05	Confirm Reservation Option	The Reservation System shall confirm a reservation with Scheduling System after the customer verifies the booking response options including but not limited to customer ID, PCA travel, date/time, location (pick-up, drop-off), trip anchor, payment type, benefits, needs, accommodations, and preferences.
1.i.06	Display Customer Trip History	The Reservation System shall display (or annunciate) the Customer's trip requests with its respective booking state on the Customer's user profile based on agency policy.

7.1.11 Energy Considerations and Emerging Vehicle Technologies

Table 29 details the energy considerations requirement that meets user need 1j – Energy Considerations.

Table 29. Energy Considerations Requirement

Req #	Title	Description
1.j.01	Carbon Neutral Trip Option	The Reservations System shall include an option for customers to choose carbon neutral or low-carbon emitting vehicles for their trip. The vehicle options are limited by vehicle types and availability operated by the Transit Agency or service provider.
1.j.02	Automated Vehicle Trip Option	The Reservations System shall include an option for customers to choose an automated vehicle for their trip. The vehicle options are limited by vehicle types and availability operated by the Transit Agency or service provider.

7.2 Scheduling

The Scheduling Functional Requirements are driven by the Scheduling Needs Category. Each

need, with the relevant section that includes related requirements, are listed below:

2a – Customer Service Schedule

Scheduling systems need to schedule reservations to accommodate customer preferences and to meet customer convenience and trustworthiness.

- 7.2.1 Process Reservations

2b –Service Productivity and Optimization

Scheduling systems need to schedule agency resources (driver work, vehicle usage – wear and tear, fuel) to balance agency efficiency with customer convenience.

- 7.2.2 Scheduling Metrics and Updates
- 7.2.3 Resource and Trip Assignment Management

2c – Route Optimization

Scheduling systems need to minimize the miles traveled with and without passengers for each daily vehicle schedule (from pull-out to pull-in) while meeting customer reservations needs.

- 7.2.4 Daily Trip Assignment Optimization

2d – Service Coordination

Coordinating agencies need to integrate key services including inter-agency resource availability and service schedules.

- 7.2.5 Service Coordination

2e – Coordination with Fixed Routes

Scheduling systems need to coordinate with the Transit Agency fixed-route services depending on agency policies (e.g., riders can use demand-response services to access fixed-route services).

- 7.2.6 Multimodal Connections

2f – Customer Reservation Communication

Scheduling systems need to share the reservation details and status via the customer's preferred communications channel throughout reservations planning process

- 7.2.7 Follow up Booking Response

2g – Reschedule

Scheduling systems need to update the trip plans (manifests) for drivers and vehicles due to many planned changes such as construction, weather, and customer bookings including cancellations.

- 7.2.8 Manage Trip Assignment

2h – Track Rider Status

Scheduling systems need to track riders' reservations and trip histories for reporting and billing.

- 7.2.9 Store Reservations History

7.2.1 Process Reservations

Table 30 details the process reservations requirements that meet user need 2a – Customer Service Schedule.

Table 30. Process Reservations Requirements

Req #	Title	Description
2.a.01	Process Booking	The Scheduling System shall process booking requests

Req #	Title	Description
	Requests (Scheduling System)	from the Reservations System.
2.a.02	Respond to Booking Request (Scheduling)	The Scheduling System shall respond to each booking request from the Reservations System with an up-to-date booking status message (see Glossary for booking status definition).
2.a.03	Accommodate Customer Bookings	The Scheduling System shall accommodate customer booking requests, such as advanced bookings, same-day reservations, return trips, standing order (subscription) trips, and customer needs and accommodations, when developing daily vehicle schedules.
2.a.04	Reasons for Booking Request Denials	The Scheduling System shall respond to booking requests from the Reservations System that are denied with the reason that the request cannot be met.
2.a.05	Save Standing Orders	The Scheduling System shall save standing orders and incorporate them into future scheduling processes where appropriate.

7.2.2 Scheduling Metrics and Updates

Table 31 details the scheduling metrics and updates requirements that meet user need 2b – Service Productivity and Optimization.

Table 31. Scheduling Metrics and Updates Requirements

Req #	Title	Description
2.b.01	Schedule Basis	The Scheduling System shall build schedules based on available agency resources (vehicles and drivers) and customer requests (e.g., needs and accommodations). For some trips, there are established levels of service, e.g., curb-to-curb, curb-to-curb with assistance, door-to-door, and door-through-door. These are described in [NEMT].
2.b.02	Batch Scheduling Distribution Time	The Scheduling System shall generate and transmit the batch schedules to the Dispatching System prior to the operating day.
2.b.03	Update Schedules	The Scheduling System shall generate an updated schedule when there is a disruption to service (e.g., weather, trip cancellation).

7.2.3 Resource and Trip Assignment Management

Table 32 details the resource and trip assignment management requirements that meet user need 2b – Service Productivity and Optimization.

Table 32. Resource and Trip Assignment Management Requirements

Req #	Title	Description
2.b.04	Available Operator Resources	The Resource Management System shall provide information on the available vehicle operators to the Scheduling System.
2.b.05	Available Vehicle	The Resource Management System shall provide

Req# #	Title	Description
	Resources	information about the available vehicle types and features to the Scheduling System.
2.b.06	Trip Assignment for each Vehicle	The Scheduling System shall generate a schedule composed of Trip Assignments for each vehicle.
2.b.07	Publish Vehicle Schedule	The Scheduling System shall publish the Trip Assignments to the Dispatching System for review and distribution.
2.b.08	Updated vehicle published schedules	The Scheduling System shall publish updated Trip Assignments to the Dispatching System for review and distribution.

7.2.4 Daily Trip Assignment Optimization

Table 33 details the daily trip assignment optimization requirement that meets user need 2c – Route Optimization.

Table 33. Daily Trip Assignment Optimization Requirement

Req# #	Title	Description
2.c.01	Daily Trip Assignment Optimization	The Scheduling System shall generate Trip Assignment for schedulers to select alternatives based on optimization parameters defined by the agency.

7.2.5 Service Coordination

Table 34 details the service coordination requirements that meet user need 2d – Service Coordination.

Table 34. Service Coordination Requirements

Req# #	Title	Description
2.d.01	Resource Management of Coordination Agencies	When multiple agencies coordinate their services, the Scheduling System shall incorporate the coordinating agency's available resources (operators, vehicles, vehicle types) from their Resource Management System.
2.d.02	Generate Coordinated Agency Schedules	When multiple agencies coordinate their services, the Scheduling System shall build the respective Trip Assignments for each coordinating agency with its respective own and multiple agency(ies) resources based on coordination rules. (see related Dispatching Req't 3.b.02)

7.2.6 Multimodal Connections

Table 35 details the multimodal connections requirement that meets user need 2e – Coordination with Fixed Routes.

Table 35. Multimodal Connections Requirement

Req# #	Title	Description
2.e.01	Multimodal Connections	The Scheduling System shall apply multimodal connections to the customer's trip plan that meets agency policies for transferring customers between demand-responsive trip segments and other agency's

Req #	Title	Description
		services.

7.2.7 Follow up Booking Response

Table 36 details the follow up booking response requirement that meets user need 2f – Customer Reservation Communication.

Table 36. Follow up Booking Response Requirement

Req #	Title	Description
2.f.01	Follow up Booking Response	The Scheduling System shall respond to each booking request from the Reservations System with initial and follow-up booking response messages.

7.2.8 Manage Trip Assignment

Table 37 details the follow up manage trip assignment requirements that meet user need 2g – Reschedule.

Table 37. Manage Trip Assignment Requirements

Req #	Title	Description
2.g.01	Reschedule Trip Assignments when Trip Cancelled or Disrupted	The Scheduling System shall reschedule trip assignments when customer trips and trip plans are disrupted due to unforeseen events (e.g., no-show, weather, emergency, major incident).
2.g.02	Inform Customer when Trip Changed	The Scheduling System (via the Reservations System) shall send an alert to the customer through their preferred Customer Access System when changes occur to their confirmed trip.

7.2.9 Store Reservations History

Table 38 details the follow up store reservations history requirement that meet user need 2h – Track Rider Status.

Table 38. Store Reservations History Requirements

Req #	Title	Description
2.h.01	Store Reservations History	The Scheduling System shall store information on reservation history (including accommodations, eligibility, funding sources, changes, cancellations) and trip reconciliation data including trip status whenever the reservation is updated and created.

7.3 Dispatching

The Dispatching Functional Requirements are driven by the Dispatching Needs Category. Each need, with the relevant section that includes related requirements, are listed below:

3a – Reliable Dispatch/Operator Communication

Dispatchers need dependable data and voice communication methods (such as data radios, cell phones, tablets, or mobile data terminals (MDTs)) to provide timely

information between vehicle operators and Dispatchers including current (or updated) manifests and manifest change notifications.

- 7.3.1 Communications

3b – Service Coordination and Support

Dispatchers need the ability to manage and coordinate service as resources and information change, including moving trips from one vehicle to another, or from an agency vehicle to another service provider's vehicle.

- 7.3.2 Agency Coordination

3c – Safety Considerations

Dispatch systems need to provide safe notifications [communications] for vehicle operators during operations.

- 7.3.3 Safety Considerations

3d – Advanced Customer Status Communications

Dispatch systems need to collect, aggregate and notify Passengers of their current reservation event and status information. This may include information about same day confirmation status, expected delays and estimated time of arrival (ETA).

- 7.3.4 Customer Communications

3e – Dispatch Management

Dispatch systems need to manage functions including vehicle and operator schedules and rescheduling, monitor and report on vehicle and rider status, and manage system incidents.

- 7.3.5 Trip Management

Need 5b -- Preparedness and Response

Agency staff (schedulers and dispatchers) need to prepare plans for communicating the impact of disaster response to current or impacted DRT riders.

- Req # 3.d.06 (see Section 7.3.4 Customer Communications)

7.3.1 Communications

Table 39 details the communications requirements that meet user need 3a – Reliable Dispatch/Operator Communication.

Table 39. Communications Requirements

Reqt #	Title	Description
3.a.01	Vehicle Voice and Data Communications	The Dispatching System shall provide voice and data communications to communicate with operators driving agency vehicles. Agency vehicles may include supervisor vehicles and locations.
3.a.02	Automatically Distribute Customer Alerts	The Dispatching System shall automatically generate and send message alerts to customers/riders who have booked trips that experience planned or unplanned events (e.g., delays, cancellations, emergencies) impacting their same day services.
3.a.03	Store Message Exchanges	The Dispatching System shall process and store transactions (message exchanges) with external systems including coordinating agencies, DRT vehicle/operator terminals.
3.a.04	Data Communication	The Dispatching System shall provide data

Req #	Title	Description
	Quality Measures	communications performance/ quality measures (as defined in Glossary) upon request.
3.a.05	Distribute Messages to Vehicles	The Dispatching System shall send data messages to the MDT on-board a vehicle.
3.a.06	DRT Vehicle Location and Events	The Dispatching System shall receive and process data messages containing vehicle location, trip status, operational events, and trip status from vehicles in revenue or non-revenue service.

7.3.2 Agency Coordination

Table 40 details the agency coordination requirements that meet user need 3b – Service Coordination and Support.

Table 40. Agency Coordination Requirements

Req #	Title	Description
3.b.01	On Demand Resource Management of Coordination Agencies	The Dispatching System shall process information from coordinating agencies about available resources which can be used to integrate or replace resources supporting Agency Trip Assignments.
3.b.02	Agency Coordination Rule Sharing	The coordinating agencies shall establish and exchange rules for shared and coordinated services between providers.

7.3.3 Safety Considerations

Table 41 details the safety considerations requirements that meet user need 3c – Safety Considerations.

Table 41. Customer Communications Requirements

Req #	Title	Description
3.c.01	Apply Message Tags	The Dispatching System shall provide tags to messages directed to vehicles that can be used for non-textual alerts, for example, audio cues that alert operators to the type of message received in their MDT. Different audio cues may be designated for various types of alerts, for example, change of pickup/schedule, construction en-route or at a pickup spot.

7.3.4 Customer Communications

Table 42 details the customer communications requirements that meet user need 3d – Advanced Customer Status Communications.

Table 42. Customer Communications Requirements

Req #	Title	Description
3.d.01	Determine ETA Status at Pickup	The Dispatching System shall determine the status (including delay) for each rider's reservation relative to the expected pickup time.
3.d.02	Determine ETA	The Dispatching System shall determine the status

Req #	Title	Description
	Status at Dropoff	(including delay) for each rider's reservation relative to the expected dropoff time.
3.d.03	Distribute Customer Preferred Notifications	The Dispatching System shall notify the rider of their reservation status and details at the agency's update discretion prior to the rider's pickup time.
3.d.04	Distribute Customer Notification During Trip Execution	The Dispatching System shall update the rider on their expected pickup time/location when their vehicle is en-route to their pickup location.
3.d.05	En-route Customer Notification for Departure Time	Upon arrival at the pickup location, the Dispatching system shall update the rider with the time the vehicle will depart that location.
3.d.06	En-route Customer Alerts for Incidents and Events	The Dispatching System shall notify the rider and/or caregiver with information on issues that may arise en-route to their destination (e.g., incident, delay, disaster response alert, change of service).

7.3.5 Trip Management

Table 43 details trip management requirements that meet user need 3e – Dispatch Management.

Table 43. Trip Management Requirements

Req #	Title	Description
3.e.01	Acquire Current Resource Availability Information	The Dispatching System shall acquire up-to-date information on resource availability from the Resource Management System that may be used for replacing vehicles or operators in the event of an incident or activity.
3.e.02	Ingest Trip Assignments	The Dispatching System shall ingest schedules (trip assignments) from the Scheduling System following their generation.
3.e.03	Trip Operator Verification	The Dispatching System shall verify and/or assign an operator and vehicle to a daily work schedule prior to starting the work day.
3.e.04	Trip Assignment Validation	The Dispatching System shall check and validate the manifests supplied by the Scheduling System. Validation includes but is not limited to: checking for path and pickup/dropoff locations against known work zones, street closures, and operator / vehicle availability.
3.e.05	Share Trip Status	The Dispatching System shall generate and send trip status updates to the Scheduling System based on validating trip assignments, making changes, and managing system resources.
3.e.06	Collect Operational and Performance Metrics	The Dispatching System shall monitor and record the status of each vehicle in terms of rider status, trip duration, schedule and route adherence.
3.e.07	Monitor Schedule Adherence	The Dispatching System shall monitor schedule adherence to ensure that the trip assignments are on-time (within their window of operation). Deviation from schedule adherence is an agency defined time-based window for pick-up and drop-off.
3.e.08	Trip Assignment	When Trip Assignments deviate from the schedule, the

Req #	Title	Description
	Reassignment	Dispatching System shall re-assign trips to dedicated vehicles and non-dedicated vehicles (if available) to fill in gaps to meet customer bookings. The schedule processes may include guards against modifying a rider's pick-up time or interrupting the operator's current activity.
3.e.09	Schedule Reassignment	The Dispatching System shall replace any Trip Assignment or part of a Trip Assignment with an alternative operator or vehicle if the scheduled resource is unavailable.
3.e.10	Incident Management Information	The Dispatching System shall collect, log and save incident information and exchange with appropriate parties as identified by the Agency.

7.3.6 Preparedness and Response

Table 44 details preparedness and response requirements that meet user need 5b – Preparedness and Response.

Table 44. Preparedness and Response Requirements

Req #	Title	Description
3.d.06	En-route Customer Alerts for Incidents and Events	See Table 41.

7.4 Related Systems

The System of Interest (**Figure 1**) includes several support and external systems that are used to exchange information, but whose functionality is only partially incorporated into the system. In particular, these include the Resource Management System and other providers or agencies that coordinate their service (*Coordinating Agencies*) with the primary service provider. The resource management system is composed of multiple systems that inventory and manage fleet and operator information. These requirements are documented in Scheduling subsystem requirements sections. Each need, with the relevant section that includes related requirements, are listed below:

The need that drives *Coordinating Agency* requirements includes:

2d – Service Coordination

Coordinating agencies need to integrate key services including inter-agency resource availability and service schedules.

- 7.2.5 Service Coordination

The needs that drive the *Resource Management System* requirements includes:

2b –Service Productivity and Optimization

Scheduling systems need to schedule agency resources (driver work, vehicle usage – wear and tear, fuel) to balance agency efficiency with customer convenience.

- 7.2.3 Resource and Trip Assignment Management, specifically --
 - Req # 2.b.04 Available Operator Resources

- Req # 2.b.05 Available Vehicle Resources
- 7.2.5 Service Coordination, specifically --
 - Req # 2.d.01 Resource Management of Coordination Agencies

8 APPENDIX A – NEEDS-TO-REQUIREMENTS TRACEABILITY MATRIX

Table 45 provides the needs to requirement traceability. The conformance column indicates whether a requirement is mandatory (M) or optional (O).

Table 45. Needs-to-Requirements Traceability Matrix

Need ID	Need Title	Req ID	Req Title	Conformance	Notes
1	Reservations				
1a	Multiple Booking Access Methods				
		1.a.01	Mobile, Web and Call Center Access to Reservations System	M	
		1.a.02	Booking Request Validation	M	
		1.a.03	Assign Unique Number to each Registered User	M	
		1.a.04	Registered Customer Request	M	
		1.a.05	Booking Request Response	M	
		1.a.06	Booking Response Content	M	
1b	Multiple Passenger Reservations				
		1.b.01	Advanced Booking for Rider Companion	M	
1c	Recurring Trips				
		1.c.01	Booking Options for Advanced Reservations	M	
1d	Flexibility				
		1.d.01	Update Existing Reservations	M	
1e	Preferences and Accommodations				
		1.e.01	Customer Access Channel Discovery Solicitation	M	
		1.e.02	Tailor Trip Needs, Preferences and Accommodations	M	
		1.e.03	Booking Response Service	M	
		1.e.04	Manage Preferences during Booking Trip	M	
		1.e.05	Save Preferences in User Profile	M	
		1.e.06	User Profile Default Booking Preferences	M	
1f	User Profile				
		1.f.01	User Profile	M	
		1.f.02	User Profile During Registration	M	
		1.f.03	Customer Information Source	M	

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Need ID	Need Title	Req ID	Req Title	Conformance	Notes
		1.f.04	Manage (CRU) User Profile	M	
		1.f.05	Manage Update of User Profile	O	
1g	Fare Benefits				
		1.g.01	Verify User Profile	M	
		1.g.02	Confirm Funding Source Usage	M	
1h	Connecting Multiple Modalities				
		1.h.01	Multimodal Trip Options Meeting Agency Policies	M	
1i	Manage Reservations				
		1.i.01	Manage (CRUD) Advanced Reservations	M	
		1.i.02	Scheduling Trip Availability Query	M	
		1.i.03	Booking Response via Preferred Customer Access	M	
		1.i.04	Booking Status Response to Booking Request	M	
		1.i.05	Confirm Reservation Option	M	
		1.i.06	Display Customer Trip History	M	
1j	Energy Considerations				
		1.j.01	Carbon Neutral Trip Option	O	
		1.j.02	Automated Vehicle Trip Options	O	
	2 Scheduling				
2a	Customer Service Schedule				
		2.a.01	Process Booking Requests (Scheduling System)	M	
		2.a.02	Respond to Booking Request (Scheduling)	M	
		2.a.03	Accommodate Customer Bookings	M	
		2.a.04	Reasons for Booking Request Denials	M	
		2.a.05	Save Standing Orders	M	
2b	Service Productivity and Optimization				
		2.b.01	Schedule Basis	M	
		2.b.02	Batch Scheduling Distribution Time	M	
		2.b.03	Update Schedules	M	
		2.b.04	Available Operator Resources	M	
		2.b.05	Available Vehicle Resources	M	
		2.b.06	Trip Assignment for each Vehicle	M	
		2.b.07	Publish Vehicle Schedule	M	

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Need ID	Need Title	Req ID	Req Title	Conformance	Notes
		2.b.08	Updated vehicle published schedules	M	
2c	Route Optimization				
		2.c.01	Daily Trip Assignment Optimization	M	
2d	Service Coordination				
		2.d.01	Resource Management of Coordination Agencies	M	
		2.d.02	Generate Coordinated Agency Schedules	M	
2e	Coordination with Fixed Routes				
		2.e.01	Multimodal Connections	M	
2f	Customer Reservation Communication				
		2.f.01	Follow up Booking Response	M	
2g	Reschedule				
		2.g.01	Reschedule Trip Assignments when Trip Cancelled or Disrupted	M	
		2.g.02	Inform Customer when Trip Changed	M	
2h	Track Rider Status				
		2.h.01	Store Reservations History	M	
	3 Dispatching				
3a	Reliable Dispatch/Operator Communication				
		3.a.01	Vehicle Voice and Data Communications	M	
		3.a.02	Automatically Distribute Customer Alerts	M	
		3.a.03	Store Message Exchanges	M	
		3.a.04	Data Communication Quality Measures	M	
		3.a.05	Distribute Messages-to Vehicles	M	
		3.a.06	DRT Vehicle Location and Events	M	
3b	Service Coordination and Support				
		3.b.01	On Demand Resource Management of Coordination Agencies	M	
		3.b.02	Agency Coordination Rule Sharing	O	
3c	Safety Considerations				
		3.c.01	Apply Message Tags	M	

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Need ID	Need Title	Req ID	Req Title	Conformance	Notes
3d	Advanced Customer Status Communications				
		3.d.01	Determine ETA Status at Pickup	M	
		3.d.02	Determine ETA Status at Dropoff	M	
		3.d.03	Distribute Customer Preferred Notifications	M	
		3.d.04	Distribute Customer Notification During Execution	M	
		3.d.05	En-route Customer Notification for Departure Time	O	
		3.d.06	En-route Customer Alerts for Incidents and Events	M	
3e	Dispatch Management				
		3.e.01	Acquire Current Resource Availability Information	M	
		3.e.02	Ingest Trip Assignments	M	
		3.e.03	Trip Operator Verification	M	
		3.e.04	Trip Assignment Validation	M	
		3.e.05	Share Trip Status	M	
		3.e.06	Collect Operational and Performance Metrics	M	
		3.e.07	Monitor Schedule Adherence	M	
		3.e.08	Trip Assignment Reassignment	M	
		3.e.09	Schedule Reassignment	M	
		3.e.10	Incident Management Information	M	
4 Security and Privacy					
4a	Security and Privacy Considerations				
		4.a.01	Administrative Authentication, Authorization, and Access Control	M	
		4.a.02	Secure Communications and Protected Network Connections	M	
		4.a.03	Continuous Vulnerability Management and Intrusion Detection	M	
		4.a.04	Stored Data Protection and Ransomware Resilience	M	
		4.a.05	Secure Network Communications and Managed Interface Protection	M	
		4.a.06	Fault Reporting, Functional Isolation, and Secure Software Update Management	M	

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Need ID	Need Title	Req ID	Req Title	Conformance	Notes
		4.a.07	Asset Tracking, Inventory Management, and Unauthorized Movement Detection	M	
		4.a.08	Security Event Logging, Audit Monitoring, and Network Service Visibility	M	
		4.a.09	System Backup, Recovery, and Restoration Management	M	
		4.a.10	Secure Communications with External Service Providers	M	
		4.a.11	Secure Communications with Vehicles	M	
4b	PII Data ownership				
		4.b.01	Sensitive Data Protection and Confidentiality Management	M	
		4.b.02	Role-Based Access Control and Least Privilege Enforcement	M	
		4.b.03	Data-in-Transit Encryption and Communications Protection	M	
		4.b.04	Data-at-Rest Encryption and Cryptographic Key Protection	M	
		4.b.05	Authentication Secret and Credential Protection	M	
		4.b.06	Sensitive Data and Administrative Function Isolation	M	
		4.b.07	Secure Remote Access and Session Protection	M	
		4.b.08	Sensitive Information Monitoring and Exfiltration Detection	M	
		4.b.09	Data Minimization and Controlled Information Handling	M	
		4.b.10	Backup Media and Recovery Data Protection	M	
		4.b.11	Data Sanitization and Secure Media Disposal	M	
	5 General				
5a	Accessible Design				
		5.a.01	WCAG	M	
		5.a.02	ADA Compliance	M	
		5.a.03	Multiple Languages	M	
		5.a.04	Digital and Hands-off Technologies	M	
		5.a.05	Digital Map Database	M	
		5.a.06	Geolocator Services	M	
		5.a.07	Map Feature Update	M	
		5.a.08	Map Functions	M	
		5.a.09	Map Overlay	M	
5b	Preparedness and Response				
		3.d.06	En-route Customer Alerts for Incidents and Events	M	

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Need ID	Need Title	Req ID	Req Title	Conformance	Notes
5c	Service Trustworthiness and Convenience				
		5.c.01	Collect Quality of Service Metrics	M	
		5.c.02	Solicit Feedback on Quality of Service Metrics	M	
		5.c.03	Document Quality of Service Measures	M	
5d	Information Sharing				
		5.d.01	Message Storage	M	
		5.d.02	Database Integrity	M	
		5.d.03	Database Data Dictionary	M	
		5.d.04	Database Schema	M	
		5.d.05	Database Archiving Lifetime	M	
		5.d.06	Database Sorting and Retrieving	M	
		5.d.07	Message Data Dictionary	M	
		5.d.08	Message Schema	M	

9 APPENDIX B – ACRONYMS

Table 46 defines the acronyms and abbreviations referenced throughout this document.

Table 46. Acronyms

Acronyms and Abbreviations	Definitions
ADA	Americans with Disabilities Act
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ASR	Automatic Speech Recognition
AVL	Automatic Vehicle Location
CCAM	Coordinating Council on Access and Mobility
CIA	Confidentiality, Integrity, and Availability
CFR	Code of Federal Regulations
ConOps	Concept of Operations
DOT	Department of Transportation
DRT	Demand-responsive Transportation
ETA	Estimated Time of Arrival
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
GOFS	General On-Demand Feed Specification
IEEE	Institute of Electrical and Electronic Engineers
IP-CTS	Internet Protocol Captioned Telephone Service
ITE	ITE-A Community of Transportation Professionals
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
MAT	Multimodal for All Travelers
MDT	Mobile Data Terminals
NIST	The National Institute of Standards and Technology
NPE	Non-Person Entities
NRTM	Needs to Requirements Traceability Matrix
NTR	Need to Requirements
PCA	Personal Care Attendant
RSD	Reservations, Scheduling, and Dispatching
SOI	System of Interest
SyRS	System Requirements Specification
TCRP	Transit Cooperative Research Program
TDD	Telecommunication Devices for the Deaf
TNC	Transportation Network Company
TTS	Text-to-Speech
USDOT	United States Department of Transportation