U²C PROGRAM

Supervisory System

Business Case and Market Analysis

Basic Requirements

FEBRUARY 2019

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0 EXECUTIVE SUMMARY

This document describes the desired basic functional, architectural and interoperability requirements of the U²C Supervisory System. The basic requirements will serve as direct input into the Market Study with the intent to encourage and obtain industry feedback, and to confirm the feasibility of the desired approach.

This document is **structured** into four sections:

- 1.0 – **Introduction**: This section describes the purpose and scope of this document, the background of the existing elevated Skyway, and how the emerging technology and the evolving needs of Jacksonville's downtown development present a unique opportunity to reevaluate existing infrastructure and provide greater connectivity, mobility, and sustained economic growth. The section also describes envisioned interoperability strategies, including a Modular Open Systems Approach (MOSA) and the Connected Vehicle Reference Implementation Architecture (CVRIA) to avoid vendor lock-in.

- 2.0 – U²C Supervisory **System Overview**: The U²C Supervisory System is only one of several key components of the JTA's U²C program. As such, this section describes how the U²C Supervisory System fits into the overall U²C program providing a U²C Supervisory System Boundary diagram. The enables the identification of interfacing systems and their stakeholders, which are then further analyzed and tabulated.

- 3.0 – U²C Basic Supervisory **System Requirements**: For each of the identified stakeholder groups, this section describes the desired requirements from the listed stakeholder's viewpoint in tabular format. The requirements are further structured following the categories identified in *Task 2A – Basic Supervisory System Requirements*, e.g. by *Location / Route Setting* or *Passenger Safety and Security* category. Each requirement received a timeline allocation, for example short-term, mid-term, or long-term. Additionally, each requirement can be identified by a unique number for easier reference during industry feedback.

- 4.0 – U²C Basic Supervisory **Interoperability Requirements**: While section 3.0 described the requirements from a stakeholder's perspective, this *section* describes the system requirements from the interface system's perspective. The section follows the same structure as described for section 3.0.

The following **key requirements for the U²C Supervisory System** have been identified:

- The system should be a modern, modular state-of-the-art system that is easily adaptable and expandable.

- The system must be Interoperable, and avoid vendor lock, and use widely supported and consensus-based standards for its key interfaces, especially vehicle to vehicle (V2V) and vehicle to infrastructure (V2I).

- Compliance with existing USDOT standards for Cooperative Intelligent Transportation Systems as applicable to Connected and Automated Vehicles (C/AV)

- Must be capable to operate a variety of C/AVs on the converted JTA elevated skyway as well as public at-grade roadways

- The system must offer a pleasant, safe and secure passenger experience, utilizing mobile applications for reserving rides, receiving status updates, and easy payments of C/AV rides
- Seamless integration with existing and new JTA Enterprise system
- Automation of key functions, providing an efficient and cost-effective system
- Hardened system that provides a high level cyber-security

Next Steps:

As part of *Task 3 – Market Study Analysis* n industry feedback will be obtained to confirm the feasibility of the desired approach. Potential participants include:

- Transit Agencies
- Transit Operators
- Software Developers
- Systems Integrators

This document will be provided to each representative, with the request for feedback regarding the feasibility of developing the desired system and interoperability requirements.

The industry feedback will be compiled and summarized and presented at a work shop with the JTA team to review the feedback, and to develop a strategy for the next steps.

A final document summarizing results of the market study analysis will be submitted to JTA after the workshop.

1   INTRODUCTION

1.1   Purpose & Scope

Purpose: This document intends to encourage and obtain **industry feedback** on the desired stakeholder and interoperability requirements of the Jacksonville Transportation Authority's (JTA) Ultimate Urban Circulator (U^{2}C) **Supervisory System** (SVS).

The requirements have been described intentionally on a high-level from various stakeholder perspectives, and will be further detailed during subsequent project development stages prior to development of procurement documents.

Scope: This document addresses step 2 of the JTA seven-step U^{2}C Business Case process outlined below:

- *Task 1 – Initiation*
- ***Task 2 – Outline Basic Requirements*** *(this document)*
- *Task 3 – Market Study Analysis*
- *Task 4 – Market Soundings*
- *Task 5 – Issue RFI with Draft Requirements*
- *Task 6 – RFI Responses*
- *Task 7 – Prepare RFP Documents*

JTA has authorized the first three steps as part of this U^{2}C Planning Business Case and Market Analysis. *Task 2 – Outline Basic Requirements* builds on the input received during *Task 1 - Initiation*, and serves as direct input into *Task 3 – Market Study Analysis.*

Task 2 – Outline Basic Requirements breaks further down into sub-tasks 2A and 2B, and addresses the supervisory and interoperability requirements:

3 (Task 2A)   U^{2}C Basic Supervisory System Requirements

3.1   General Requirements
　　　　3.1.1   System Level Requirements
　　　　　　　　3.1.1-01 Business & Stakeholder Requirements
　　　　　　　　3.1.1-02 Applicable Standards
　　　　　　　　3.1.1-03 System Functionality
　　　　　　　　3.1.1-04 System Architecture
　　　　　　　　3.1.1-05 Expandability / Scalability
　　　　　　　　3.1.1-06 System Connectivity
　　　　　　　　3.1.1-07 (Operations) Control Center
　　　　　　　　3.1.1-08 Data Requirements
　　　　　　　　3.1.1-09 Location / Route Setting
　　　　　　　　3.1.1-10 Voice Passenger Communication
　　　　　　　　3.1.1-11 Passenger Safety & Security
　　　　　　　　3.1.1-12 Cyber Security

3.2   JTA Enterprise Stakeholders

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        3.2.1-02 Data Requirements

        3.2.1-03 Health Monitoring

        3.2.1-04 Location / Route Setting

        3.2.1-05 (Voice) Passenger Communications

        3.2.1-06 Passenger Safety and Security

        3.2.1-07 Cyber Security

    3.2.2   Safety & Security

        3.2.2-01 (Voice) Passenger Communications

        3.2.2-02 Passenger Safety and Security

    3.2.3   Information Technology

        3.2.3-01 Cyber Security

    3.2.4   Planning

        3.2.4-01 Data Requirements

    3.2.5   Capital Programs*

    3.2.6   Engineering*

    3.2.7   Finance

        3.2.7-01 Data Requirements

    3.2.8   Procurement*

    3.2.9   Compliance

        3.2.9-01 Applicable Standards

        3.2.9-02 Data Requirements

    3.2.10   Communications

        3.2.10-01 (Voice) Passenger Communications

        3.2.10-02 Data Requirements

3.3   U²C Supervisory System Operators

    3.3.1   Skyway Operations

        3.3.1-01 (Operations) Control Center

        3.3.1-02 Data Requirements

        3.3.1-03 Health Monitoring

        3.3.1-04 Location / Route Setting

        3.3.1-05 (Voice) Passenger Communications

3.4   End Users

      3.4.1   System Connectivity
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3.5   Automated Vehicle Stakeholders

      3.5.1   Dedicated JTA C/AVs
            3.5.1-01 System Connectivity

      3.5.2   Third Party C/AVs
            3.5.2-01 System Connectivity

3.6   Infrastructure Stakeholders

      3.6.1   Dedicated JTA Elevated Guideway
            3.6.1-01 Location / Route Setting

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            3.6.2-01 Location / Route Setting

      3.6.3   Roadside Equipment
            3.6.3-01 System Connectivity

3.7   Third Parties
      3.7.1   Third Party Fleet Management
            3.7.1-01 System Connectivity

      3.7.2   Third Party Data User or Provider
            3.7.2-01 System Connectivity

4 (Task 2B)   U²C Basic Supervisory Interoperability Requirements

4-01   General Interoperability Requirements
      4-02   Vehicles from different manufacturers
      4-03   Connectivity – Dedicated System Infrastructure and/or (V2I)
      4-04   Connectivity – External (V2X) (e.g. DSRC, 4G and 5G)
      4-05   Interface with JTA Enterprise System
      4-06   Customer Interface
      4-07   Cybersecurity
      4-08   Safety

*Requirements will be developed in subsequent project development stages.

1.2 Background

1.2.1 U²C System Overview

For nearly 30 years, the Skyway has transported Jacksonville's commuters throughout the urban core. However, emerging technology and the evolving needs of Jacksonville's downtown development present a unique opportunity to reevaluate existing infrastructure and provide greater connectivity, mobility, and sustained economic growth.

This can be achieved by utilizing investment in the existing elevated Skyway, expanding the area it serves, and employing automated transit technology as depicted in Figure 1-1. The U²C can cost-effectively reach beyond the current system to serve existing and planned downtown development. The U²C will provide:

- High frequency service and accessibility
- Service flexibility
- Extensions that can serve at both elevated and street levels

Figure 1-1: Envisioned U²C Skyway System

The U²C concept takes full advantage of the existing Skyway assets and fully integrates emerging technologies. Implementing this bold, but necessary vision to enhance the transportation system will require successful agency partnerships, community buy-in and adequate financial resources. While JTA continues coordination with federal, state and local agencies to evaluate funding, right-of-way requirements, environmental compliance and modifications existing streets; the following actions will be taken:

- Continue community outreach to gain strong support for the project
- Continue to maintain existing Skyway system until the future system is defined
- Identify the preferred vehicle and future operating system
- Develop a plan to convert the existing monorail structure for the new vehicle
- Develop an automated vehicle demonstration project
- Prepare a project phasing plan to coordinate the design and construction of the system extensions
- Develop Skyway decommissioning plan to coincide with the system conversion plan.

1.2.2 U²C Interoperable Supervisory System

The current Skyway system is a tightly coupled system with proprietary interfaces consisting of the guideway (elevated infrastructure), the concrete guidebeam, stations, vehicles, and the supervisory system. Replacing a single system component – such as vehicles or the supervisory system – requires changes to the interfacing system components and knowledge of the proprietary interfaces, resulting in undesirable vendor lock-in.

The future U²C system is envisioned to be based upon a **Modular Open Systems Approach** (MOSA), following the five (5) MOSA principles as defined by the Department of Defense (DoD):

1. Establish an Enabling Environment
2. Employ Modular Design
3. Designate Key Interfaces
4. Use Open Standards
5. Certify Conformance

In context of the U²C system, the **U²C Supervisory System** (SVS) is considered a stand-alone module that will communicate with other U²C system modules (e.g. connected and automated vehicles) via well defined, widely used and open interfaces, thereby establishing **Interoperability**, as presented in Figure 1-2.
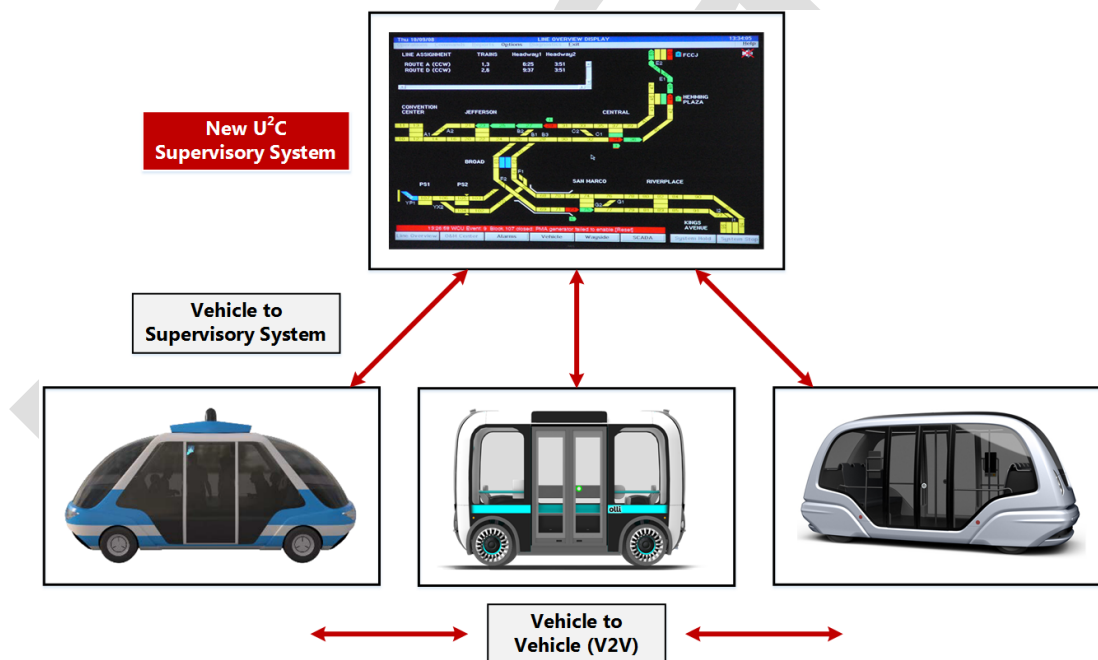
Figure 1-2: Envisioned U²C Interoperable Supervisory System

An open system employs modular system components, uses widely supported and consensus-based standards for its key interfaces, and is subject to verification and validation to ensure the openness of its key interfaces, resulting in **affordable** and **adaptable** systems. For more information on MOSA refer to: http://acqnotes.com/acqnote/careerfields/modular-open-systems-approach.

Additionally, the United States Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) has sponsored the **Connected Vehicle Reference Implementation Architecture** (CVRIA), enabling **Cooperative Intelligent Transportation Systems** (C-ITS), with the strategic goal to enable efficient, **interoperable**, secure and cost-effective ITS infrastructure, connected vehicle and automated vehicle deployments across North America. As of 2017, the National ITS Architecture and the CVRIA were combined into the National ITS Reference Architecture, also known as the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT). For the purpose of this document, and to emphasize the applicably to Connected and Automated Vehicles (C/AV), references to the CVRIA will be made.

The CVRIA was developed as the basis for identifying the **Key Interfaces** across the connected vehicle environment which will support further analysis to identify and prioritize **Standards Development** activities. CVRIA also supports policy considerations for certification, standards, core system implementation, and other elements of the connected vehicle environment.

Figure 1-3 provides a depiction of the Physical View of the Connected Vehicle Reference Implementation Architecture. **Interoperability** can be achieved by adhering to the CVRIA.
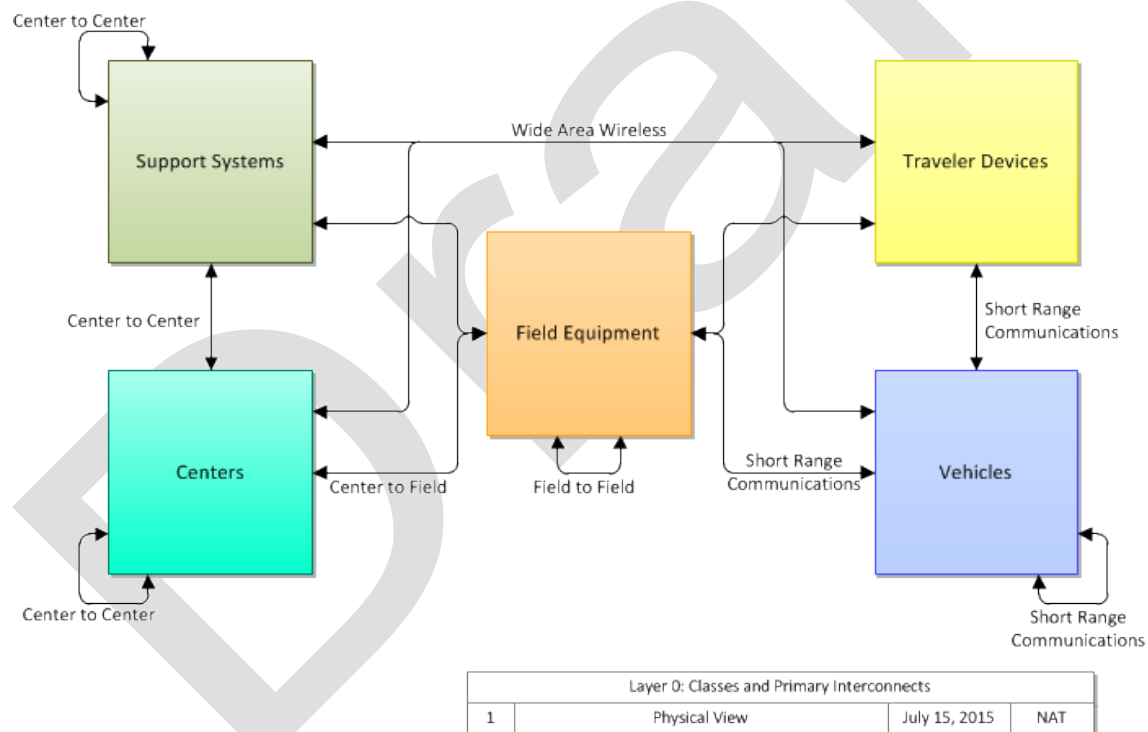
Figure 1-3: Connected Vehicle Reference Implementation Architecture – Physical View

For more information on CVRIA, refer to Appendix A, or visit https://local.iteris.com/cvria/index.html.

For more information on ARC-IT, visit https://local.iteris.com/arc-it/.

1.3 References

The following Table 1-1presents references to other information relevant to this document.

Table 1-1: References

Reference
Jacksonville Transportation Authority. **TBD**. *Skyway – Requirements Document (***TBD***)*
Jacksonville Transportation Authority. *U²C Project Vision (*https://u2c.jtafla.com/*)*
Iteris, Inc. 2017. *Connected Vehicle Reference Implementation Architecture* (https://local.iteris.com/cvria/index.html)
US Department of Defense. 2013. *DoD, Open Systems Architecture, Contract Guidebook for Program Mangers.* Version 1.1. (http://www.acqnotes.com/Attachments/Open%20System%20Architecture%20%28OSA%29%20 0Contract%20Guidebook%20for%20Program%20Managers%20June%2013.pdf)
US Department of Transportation. 2014. *Prioritizing Candidate Connected Vehicle Standards: Candidate Approach and Methodology to Determine USDOT Future Support & Activities.* (http://local.iteris.com/cvria/docs/V2xStandardizationPlanApproachWhitepaper_10March2014.p df)

1.4 Acronyms & Abbreviations

The following Table 1-2 presents acronyms and abbreviations used throughout this document. For additional abbreviations refer to Appendix A, or visit https://local.iteris.com/cvria/html/glossary/acronym-a.html.

Table 1-2: Acronyms & Abbreviations

Acronyms & Abbreviations	
4G	Fourth Generation (of Broadband Cellular Network Technology)
5G	Fifth Generation (of Broadband Cellular Network Technology)
AASHTO	American Association of State Highway and Transportation Officials
AI	Artificial Intelligence
ANSI	American National Standards Institute
App	Application
APC	Automatic Passenger Count
APTA	American Public Transportation Association
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ASTM	American Society for Testing and Materials

Acronyms & Abbreviations	
AVL	Automated Vehicle Location
C-ITS	Cooperative Intelligent Transportation System
C/AV	Connected and Automated Vehicle
CAD	Computer Aided Dispatch
CCTV	Close Circuit Television
CFR	Code of Federal Regulations
CVRIA	Connected Vehicle Reference Implementation Architecture
DoD	Department of Defense
DOT	Department of Transportation
DSRC	Dedicated Short-Range communication
ERB	Enterprise Service Bus
ERP	Enterprise Resource Planning
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transportation Administration
HVAC	Heating, Ventilation and Air-Conditioning
INCOSE	International Council on Systems Engineering
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
JPO	Joint Program Office
JTA	Jacksonville Transportation Authority
LT	Long-Term
MOSA	Modular Open System Approach
MT-E	Mid-Term, Elevated (Guideway)
MT-A	Mid-Term, At-Grade (Roadway)
NEMA	National Electrical Manufacturers Association
NHTSA	National Highway Traffic Safety Administration
NTCIP	National Transportation Communications for Intelligent Transportation System Protocol

Acronyms & Abbreviations	
OBE	Onboard Equipment
OCC	Operations Control Center
RFI	Request for Information
RFP	Request for Proposal
RSE	Roadside Equipment
SAE	Society of Automotive Engineer's
SE	Systems Engineering
SCADA	Supervisory Control and Data Acquisition
ST	Short-Term
U²C	Ultimate Urban Circulator
USDOT	United States Department of Transportation
V2I	Vehicle to Infrastructure (Communication)
V2V	Vehicle to Vehicle (Communication)
V2X	Vehicle to Everything (Communication)
W3C	World Wide Web Consortium

1.5   Definitions

The following Table 1-3 presents definitions used throughout this document.

Table 1-3: Definitions

Definitions	
Business Requirement	INCOSE: Definition of the business framework within which stakeholders will define their requirements. Business requirements govern the project, including agreement constraints, quality standards, and cost and schedule constraints.
Enterprise System	JTA: Large-scale applications software that integrates processes for the agency, not the end users.
Interoperability	Ability to exchange information and services with minimal effort. Facilitated by common standards or interfaces.
Mid-Term	JTA: Time horizon for implementation of the desired System Requirements. To be demonstrated on either the converted JTA Elevated Skyway Guideway, or in a shared At-Grade environment (Public Roadways).
Long-Term	JTA: Time horizon for implementation of the desired System Requirements. Full U²C System Build Out, including the converted JTA

Definitions	
	Elevated Skyway Guideway AND the shared At-Grade environment (Public Roadways).
Supervisory System	JTA: Control System that oversees a variety of systems, including proprietary devices and networks (vehicle, infrastructure, telecom, etc.)
Short-Term	JTA: Time horizon for implementation of the desired System Requirements. To be demonstrated on the JTA Test Track
System Requirement	INCOSE: What the system needs to do, how well, and under what conditions, as required to meet the project and design constraints. In the context of this document *System Requirement* refer to the U²C Supervisory System requirements.
Stakeholder Requirement	INCOSE: Requirements from various stakeholders that will govern the project, including required system capabilities, functions, and/or services; quality standards; systems constraints; and cost and schedule constrains.
V2I	JTA: Signal communication of standardized data (e.g., signal timing) to and from vehicles from roadside units (RSE). Concept informally includes infotainment.
V2V	JTA: Vehicle to Vehicle Communication through wireless, ad hoc network (DSRC). Concept informally includes 5G.
V2X	JTA: Overall vehicle communication to environment, including other vehicles, pedestrians and infrastructure.

2   U²C SUPERVISORY SYSTEM OVERVIEW

2.1   System Context Diagram

The purpose of <u>this</u> document is to describe the basic requirements of the **U²C Supervisory System** and its interoperability requirements. As such it is important to define a boundary between the U²C Supervisory System and other systems and system elements being part of the larger U²C system.

The U²C Supervisory **System Context Diagram** as presented in Figure 2-1 identifies the **System Boundary** between the U²C Supervisory System and its environment (context), including interfacing systems and their stakeholders, as well as future U²C SVS operators.
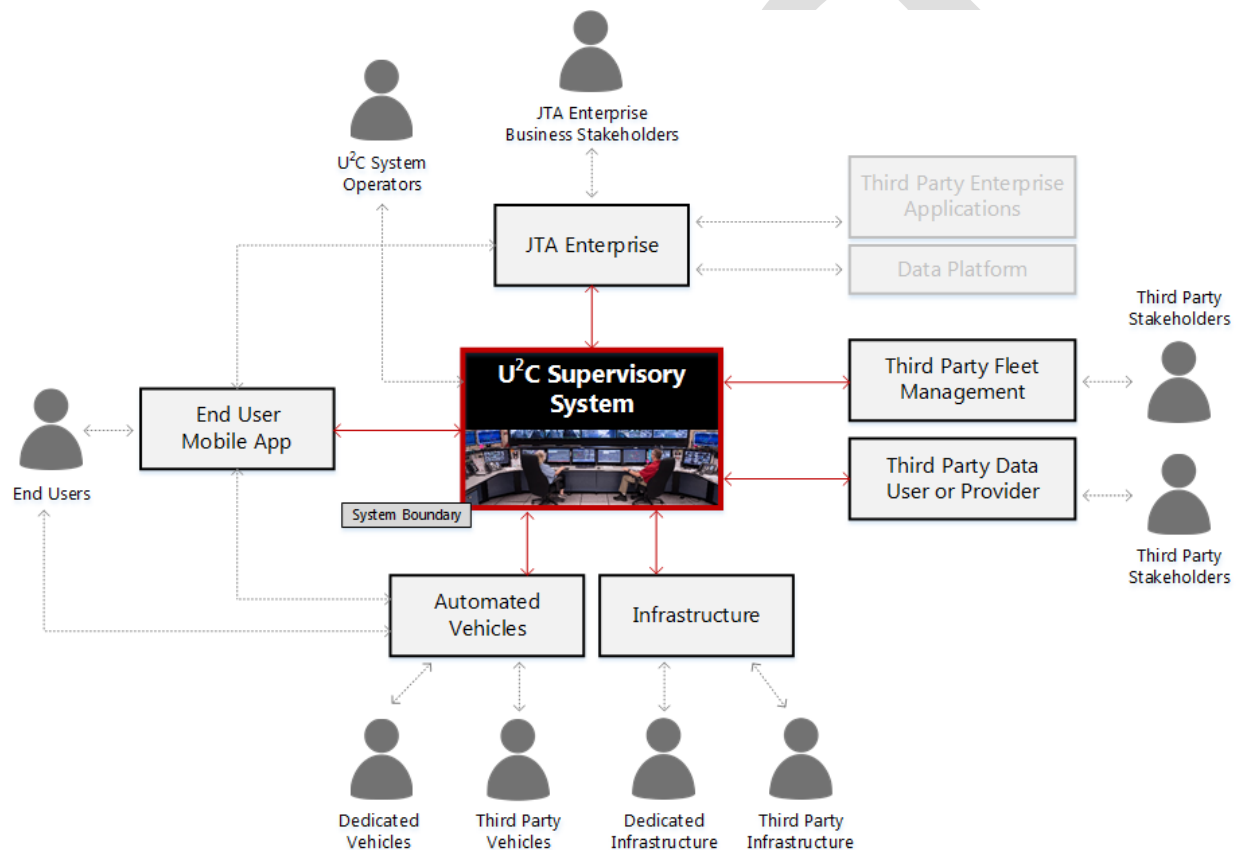
Figure 2-1: U²C Supervisory System Context Diagram

Section 2.2 below analyzes in more detail the **U²C Stakeholders and Interfacing Systems,** starting with the JTA Enterprise using a counterclockwise approach.

Section 3 defines the **Basic Requirements** of the U²C Supervisory System using the U²C stakeholder groups (e.g. JTA Enterprise) and individual stakeholders (e.g. Information Technology) identified in Section 2.2 to structure the basic requirements.

Section 4 defines the **Interoperability Requirements** of the U²C Supervisory.

2.2 Stakeholders and Interfacing Systems

This section breaks the U²C Stakeholders and Interfacing Systems (Figure 2-1) further down.

Refer to the following sections for each group of stakeholders and interfacing systems:

- Section 2.2.1: JTA Enterprise
- Section 2.2.2: U²C Supervisory System Operators
- Section 2.2.3: End Users
- Section 2.2.4: Automated Vehicle
- Section 2.2.5: Infrastructure
- Section 2.2.6: Third Parties

It is recommended to eventually fully map JTA stakeholders to the CVRIA definitions:

- CVRIA Stakeholders: https://local.iteris.com/cvria/html/about/stakeholders.html, and
- CVRIA Stakeholder Concerns: https://local.iteris.com/cvria/html/about/concerns.html.

2.2.1 JTA Enterprise

This section identifies the JTA Enterprise stakeholders and associated systems interfacing with the U²C Supervisory System.

JTA Enterprise Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- Operations & Maintenance: (Center/Field User, Maintainer)
- Safety & Security: (Policy Setter, Manager)
- Information Technology: (Policy Setter, Manager)
- Planning: (Policy Setter, Transportation Planner)
- Capital Programs: (Policy Setter)
- Engineering: (Application Developer, Device Developer, Tester)
- Finance: (Policy Setter)
- Procurement: (Policy Setter, Acquirer)
- Compliance: (Policy Setter, Enforcement)
- Communications: (Policy Setter)

JTA Enterprise Systems:
- ERP & ESB Applications
  - Oracle
  - Oracle Service Bus
- Safety & Security
  - Symantec
  - Cymotive Technologies
  - Olympus Sky
  - Argus Cyber Security
- Communications
  - Verizon
- Other Systems
  - SCADA System

2.2.2 U²C Supervisory System Operators

This section identifies the U²C Supervisory System Operators stakeholders and associated systems.

U²C Supervisory System Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- Skyway Operations: (Center/Field User)
- Skyway Maintenance: (Maintainer)

U²C Supervisory System(s):
- Trapeze
- Waze
- Bestmile
- SCADA
- Others

2.2.3 End Users

This section identifies the End User stakeholders and associated systems interfacing with the U²C Supervisory System.

Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- Traveler / Rider: (Mobile User)

Systems:
- Mobile Application (Smartphone, Tablet)
- Web Interface (Personal Computer, Tablet)
- Telephone (Automated or Human Interface)

2.2.4 Automated Vehicle Stakeholders

This section identifies the Automated Vehicle stakeholders and associated systems interfacing with the U²C Supervisory System.

Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- JTA C/AVs Operators: (Mobile Users)
- Third Party C/AV Operators: (Mobile Users, Service Provider)

Systems:
- Dedicated JTA C/AVs operating on the dedicated JTA guideway
- Third Party C/AVs operating on the dedicated JTA guideway
- Third Party C/AVs operating in a shared At-Grade environment

2.2.5 Infrastructure Stakeholders

This section identifies the Infrastructure stakeholders and associated systems interfacing with the U^{2}C Supervisory System.

Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- Dedicated JTA Guideway Stakeholders: (N/A)
- Shared At-Grade Environment (Public Roadways) Stakeholders: (N/A)
- Roadside Equipment Stakeholders: (Field User, Service Provider)

Systems:
- Dedicated JTA Guideway
- Shared At-Grade Environment (Public Roadways)
- Roadside Equipment

2.2.6 Third Parties

This section identifies the Third Party stakeholders and associated systems interfacing with the U^{2}C Supervisory System.

Stakeholders: (CVRIA Stakeholder Roles in Parenthesis)
- Third Party Fleet Manager: (Service Provider)
- Third Party Data User or Provider: (Service Provider)

Systems:
- Third Party Fleet
- Third Party Data Interface/System

3 U²C BASIC SUPERVISORY SYSTEM REQUIREMENTS

This section describes the **Basic Requirements** of the **U²C Supervisory System** as a black box, defining an initial set of requirements as input into *Task 3 – Market Study Analysis* (Section 1.1). For interoperability requirements, refer to Section 4.

The requirements will be further developed to an RFP level at a later stage in *Task 7 – Prepare RFP Documents*. In the current state, the requirements can be used to request additional information from the industry, as needed.

The requirements in this section are **organized by stakeholders** as shown below. This enables stakeholders to readily identify their requirements by means of **keyword search**:

- Heading 2: Stakeholder Group (e.g. Section 3.2 JTA Enterprise Stakeholders)
    - Heading 3: Individual Stakeholders (e.g. Section 3.2.3 Information Technology)

The requirements are further grouped by **categories** as shown in Table 3-1, following in general scope of work items identified in Section 1.1. Each requirement will receive a **unique identifier**. Additionally, requirements will be allocated to **U²C stages** as defined in section 1.4:

- **ST**: Short-term
- **MT-E**: Mid-term, use of existing JTA Skyway Elevated Guideway
- **MT-A**: Mid-term, use of shared At-Grade Environment
- **LT**: Long-term, full build out

Table 3-1: U²C Basic Supervisory System Requirements – Example

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
	Category: e.g. Cyber Security				
#XYZ	System Requirement: The U²C SVS shall …	X			

3.1 General Requirements

3.1.1 System Level Requirements

This section describes "high-level" (system-level) requirements of the U²C Basic Supervisory System Requirements, which are refined in the following section.

Table 3-2: System Level Requirements

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.1.1-01	**Business & Stakeholder Requirements**				
3.1.1-01.01	The U²C SVS shall meet and/or exceed the system requirements set forth in this requirements documents, thereby meeting the JTA Enterprise (business) and stakeholder requirements.		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.1.1-02	**Applicable Standards**				
3.1.1-02.01	The U²C SVS shall meet and/or exceed applicable federal, state, and local regulations, codes, and standards.	X	X	X	X
3.1.1-01.02	Federal, state, and local regulations, codes, and standards include (in alphabetical order), but are not limited to: • American Association of State Highway and Transportation Officials (AASHTO) • American National Standards Institute (ANSI) • American Public Transportation Association (APTA) • American Society for Testing and Materials (ASTM) • Code of Federal Regulations (CFR) • Connected Vehicle Reference Implementation Architecture (CVRIA) Standards • Federal Highway Administration (FHWA) • Florida Department of Transportation (FDOT) • Intelligent Transportation System (ITS) Joint Program Office (JPO) • International Organization for Standardization (ISO) • Internet Engineering Task Force (IETF) • Institute of Electrical and Electronics Engineers (IEEE) • Institute of Transportation Engineers (ITE) • National Electrical Manufacturers Association (NEMA) • National Highway Traffic Safety Administration (NHTSA) • National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) • Society of Automotive Engineers (SAE) • United States Department of Transportation (USDOT) • World Wide Web Consortium (W3C)	X	X	X	X
3.1.1-03	**System Functionality**				
3.1.1-03.01	The U²C SVS shall support connected and automated vehicles (C/AV) with automation level 4 (high automation), as defined by the Society for Automotive Engineers (SAE).	X	X	X	X
3.1.1-03.02	The U²C SVS shall support connected and automated vehicles (C/AV) with automation level 5 (full automation), as defined by the Society for Automotive Engineers (SAE).		X	X	X
3.1.1-03.03	The U²C SVS shall provide the applicable functionality currently provided by the existing JTA Skyway (Monorail) system.	X	X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.1.1-03.04	The U²C SVS shall demonstrate its functionality on JTA's automated vehicle test track.	X			
3.1.1-03.05	The U²C SVS shall support C/AVs operation on dedicated JTA elevated guideway that is currently being used for the existing JTA Skyway system. The guideway will be converted for C/AV operation.	X	X		
3.1.1-03.06	The U²C SVS shall support C/AVs operation on shared at-grade infrastructure (public roadways).	X		X	
3.1.1-03.07	The U²C SVS shall support the following four CVRIA Applications, their sub-groups and associated functionality, including but not limited to: • Environmental; • Mobility; • Safety; and • Support. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/applications/applications.html.		X	X	X
3.1.1-03.08	The U²C SVS shall support the CVRIA functional requirements, presented as CVRIA Processes. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/pspecs/processes.html.		X	X	X
3.1.1-04	**System Architecture**				
3.1.1-04.01	The U²C SVS shall implement a modular and open system architecture, thereby enabling U²C SVS interoperability. A modular and open system architecture is defined in section 1.2.2.	X	X	X	X
3.1.1-04.02	The U²C SVS shall meet the intent of a Cooperative Intelligent Transportation Systems (C-ITS), as defined by CVRIA.	X	X	X	X
3.1.1-04.03	For detailed U²C SVS interoperability requirements refer to section 4.	–	–	–	–
3.1.1-04.04	The U²C SVS may be comprised of the following components: • Central/Operations Control Center equipment (Center/OCC); • C/AV onboard equipment (OBE); and/or • Roadside equipment (RSE).	X	X	X	X
3.1.1-04.05	Interfaces between the U²C SVS components shall meet the U²C SVS interoperability requirements.	X	X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.1.1-04.06	Interfaces between U²C SVS "Physical Objects" – as defined by the CVRIA – shall meet the U²C SVS interoperability requirements: • Center (Operations/OCC); • Field (RSE); • Support (Maintenance); • Traveler (End User); and • Vehicle (C/AV). For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/viewpoints/physical.html.	X	X	X	X
3.1.1-05	**Expandability / Scalability**				
3.1.1-05.01	The U²C SVS shall be able to handle as many C/AVs as required by the current JTA Skyway ridership demand.	X	X		
3.1.1-05.02	The U²C SVS shall be able to handle as many C/AVs as required for future anticipated U²C ridership.	X	X	X	X
3.1.1-06	**System Connectivity**				
3.1.1-06.01	The U²C SVS shall be able to connect and interoperate with the interfacing (hardware and software) systems as identified in Figure 2-1.	X	X	X	X
3.1.1-06.02	The U²C SVS shall be able to connect and interoperate with other "Physical Objects", as defined by the CVRIA. For more information, refer to Appendix A, or visit: https://local.iteris.com/cvria/html/physobjects/physobjects.html.		X	X	X
3.1.1-06.03	For detailed U²C SVS interoperability requirements refer to section 4.	–	–	–	–
3.1.1-07	**(Operations) Control Center**				
3.1.1-07.01	The U²C SVS shall meet the applicable functional requirements of the CVRIA "Center" Class (OCC) and their "Physical Objects", including but not limited to: • Center Archived Data Center; • Authorizing Center; • Commercial Vehicle Administration Center; • Emergency Management Center; • Fleet and Freight Management Center; • Maint(enance) and Constr(uction) Management Center; • Payment Administration Center; • Traffic Management Center; • Transit Management Center; and		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
	• Transportation Information Center. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/physobjects/physobjects.html#tab-2.				
3.1.1-07.02	For additional operations control center (OCC) requirements, refer to section 3.3.	–	–	–	–
3.1.1-08	**Data Requirements**				
3.1.1-08.01	The U²C SVS shall be able to exchange data with the interfacing systems as identified in Figure 2-1.	X	X	X	X
3.1.1-08.02	The U²C SVS shall be able to exchange data with other "Physical Objects", as defined by the CVRIA, using the specified: • Data Flows; and • Information Flows. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/dataflows/dataflows.html http://local.iteris.com/cvria/html/infoflows/infoflows.html		X	X	X
3.1.1-08.03	For additional U²C SVS data requirements refer to section 4.	–	–	–	–
3.1.1-09	**Location / Route Setting**				
3.1.1-09.01	The U²C SVS shall be able to provide location and route setting requirements that resembles the existing JTA Skyway (Monorail) system. For the list of the current functionality refer to section 1.3.	X	X		
3.1.1-09.02	The U²C SVS shall be able to provide to "4.2 – Plan and Schedule Transit Services", as defined by the CVRIA. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/pspecs/dfd5061.html.	X	X	X	X
3.1.1-09.03	For additional location / route setting requirements, refer to section 3.3.	–	–	–	–
3.1.1-10	**Voice Passenger Communication**				
3.1.1-10.01	The U²C SVS shall be able to provide voice passenger requirements that resembles the existing JTA Skyway (Monorail) system, but utilizes modern passenger communication technology. For the list of the current functionality refer to section 1.3.	X	X	X	X
3.1.1-10.02	The U²C SVS shall provide applicable traveler information and communication, as defined by the CVRIA.		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.1.1-10.03	For additional voice passenger requirements, refer to section 3.3 and section 3.4.	–	–	–	–
3.1.1-11	**Passenger Safety & Security**				
3.1.1-11.01	The U²C SVS shall support a safe and secure passenger ride experience.	X	X	X	X
3.1.1-11.02	The U²C SVS shall be a fail-safe system, routing C/AVs to a place of safety in case of safety or security issues.	X	X	X	X
3.1.1-11.03	The U²C SVS shall support the CVRIA "Safety" Application, their sub-groups and associated functionality, including but not limited to: • Transit Safety; • V2I Safety; and • V2V Safety. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/applications/applications.html.		X	X	X
3.1.1-11.04	For additional voice passenger requirements, refer to section 3.3 and section 3.4.	–	–	–	–
3.1.1-12	**Cyber Security**				
3.1.1-12.01	The U²C SVS shall support the CVRIA "Security" requirements. For more information, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/about/security.html		X	X	X
3.1.1-12.02	For additional cyber security requirements, refer to section 3.2.	–	–	–	–

3.2 JTA Enterprise Stakeholders

3.2.1 Operations & Maintenance

This section describes U²C Basic Supervisory System Requirements from a JTA Operations & Maintenance perspective, including all modes of transportation. For larger JTA Skyway requirements, refer to section 3.3.

Table 3-3: JTA Enterprise Stakeholder Requirements – Operations & Maintenance

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.1-01	**(Operations) Control Center**				
3.2.1-01.01	The U²C SVS shall provide the applicable C/AV monitoring and controlling functionality that resembles a typical	X	X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
	Computer-Aided Dispatch/Automated Vehicle Location (CAD/AVL) system.				
3.2.1-01.02	The U²C SVS shall provide different user classes, including but not limited to: • Dispatcher; • Supervisor; and • Administrator.		X	X	X
3.2.1-01.03	The U²C SVS shall allow the management of C/AVs by means of: • Geographical Areas; • Routes • Group of C/AVs; and • Other Means.		X	X	X
3.2.1-01.04	The U²C SVS shall provide status information and failure notifications supporting timely operational responses.		X	X	X
3.2.1-02	**Data Requirements**				
3.2.1-02.01	The U²C SVS shall be able to collect, analyze, and report historical information.		X	X	X
3.2.1-02.02	The U²C SVS shall provide JTA Operations & Maintenance personnel a variety of standard performance metrics for operations & maintenance purpose.		X	X	X
3.2.1-02.03	The U²C SVS shall enable JTA Operations & Maintenance to configure custom performance metrics.		X	X	X
3.2.1-02.04	The U²C SVS shall provide automatic passenger count (APC) information.		X	X	X
3.2.1-02.05	The U²C SVS shall provide a reliable farebox system.		X	X	X
3.2.1-03	**Health Monitoring**				
3.2.1-03.01	The U²C SVS shall provide the capability monitor and report the C/AV health status.	X	X	X	X
3.2.1-03.02	The U²C SVS shall monitor the C/AV health status supporting a preventive maintenance regime.		X	X	X
3.2.1-04	**Location / Route Setting**				
3.2.1-04.01	The U²C SVS shall enable the planning of C/AV service schedules and routes.	X	X	X	X
3.2.1-04.02	The U²C SVS shall be able to monitor and report the C/AV on-time performance.		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.1-04.03	The U²C SVS shall be able to monitor and report the C/AV schedule and route deviations.		X	X	X
3.2.1-05	**(Voice) Passenger Communications**				
3.2.1-05.01	The U²C SVS shall provide the capability to provide ADA compliant pre-recorded and ad-hoc visual and audible customer information including major intersection street names and transit stops.		X	X	X
3.2.1-05.02	The U²C SVS shall provide the capability to upload pre-recorded visual and audible customer information to the C/AVs.		X	X	X
3.2.1-05.03	The U²C SVS shall provide real-time location and arrival information to End Users via mobile applications (e.g. NextBus, BusTime).		X	X	X
3.2.1-06	**Passenger Safety and Security**				
3.2.1-06.01	The U²C SVS shall enable JTA Operations personnel to view on-board video cameras in real time.		X	X	X
3.2.1-06.02	The U²C SVS shall enable passengers to call for help in case of an emergency.		X	X	X
3.2.1-07	**Cyber Security**				
3.2.1-07.01	The U²C SVS shall monitor and report unauthenticated or unauthorized access attempts.	X	X	X	X

3.2.2   Safety & Security

This section describes U²C Basic Supervisory System Requirements from a JTA Safety & Security perspective.

Table 3-4: JTA Enterprise Stakeholder Requirements – Safety & Security

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.2-01	**(Voice) Passenger Communications**				
–	The U²C SVS shall provide voice passenger communication as defined in section 3.4.	–	–	–	–
3.2.2-02	**Passenger Safety and Security**				
3.2.2-02.01	The U²C SVS shall enable viewing of on-board video cameras in real time.		X	X	X
3.2.2-02.02	The U²C SVS shall enable passenger recognition functionality.				X

3.2.3   Information Technology

This section describes U^{2}C Basic Supervisory System Requirements from a JTA Information Technology perspective.

Table 3-5: JTA Enterprise Stakeholder Requirements – Information Technology

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.3-01	**Cyber Security**				
3.2.3-01.01	The U^{2}C SVS shall provide access to authenticated and authorized users and systems only.	X	X	X	X
3.2.3-01.02	The U^{2}C SVS shall use secure communication protocols and secure handshakes when establishing connections with other systems.	X	X	X	X

3.2.4   Planning

This section describes U^{2}C Basic Supervisory System Requirements from a JTA Information Technology perspective.

Table 3-6: JTA Enterprise Stakeholder Requirements – Information Technology

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.4-01	**Data Requirements**				
3.2.4-01.01	The U^{2}C SVS shall provide JTA Planning personnel a variety of standard performance metrics for transportation planning purpose.		X	X	X
3.2.4-01.02	The U^{2}C SVS shall enable JTA Planning personnel to configure custom performance metrics.		X	X	X

3.2.5   Capital Programs

Requirements will be developed in subsequent project development stages.

3.2.6   Engineering

Requirements will be developed in subsequent project development stages.

3.2.7 Finance

This section describes U^{2}C Basic Supervisory System Requirements from a JTA Finance department perspective.

Table 3-7: JTA Enterprise Stakeholder Requirements – Finance

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.7-01	**Data Requirements**				
3.2.7-01.01	The U^{2}C SVS shall collect and store data to improve financial business decisions.		X	X	X
3.2.7-01.02	The U^{2}C SVS shall provide real time and location based information to enable advertisers to provide customized advertisement.				X
3.2.7-01.03	The U^{2}C SVS shall provide an assisting interface analyzing data for improved advertisement decisions, including but not limited to: • Artificial Intelligence (AI); • Alexa; • Watson; and • Other.				X
3.2.7-01.04	The U^{2}C SVS shall track how much revenue JTA generated from advertisement.				X
3.2.7-01.05	The U^{2}C SVS shall provide payment verification functionality.				X

3.2.8 Procurement

Requirements will be developed in subsequent project development stages.

3.2.9 Compliance

This section describes U^{2}C Basic Supervisory System Requirements from a JTA Compliance department perspective.

Table 3-8: JTA Enterprise Stakeholder Requirements – Compliance

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.9-01	**Applicable Standards**				
3.2.9-01.01	The U^{2}C SVS shall be in compliance with applicable standards identified in section 3.1.	X	X	X	X
3.2.9-02	**Data Requirements**				
3.2.9-02.01	The U^{2}C SVS shall track how much revenue JTA generated from advertisement to report to the Federal Transportation Administration (FTA).				X

3.2.10 Communications

This section describes U²C Basic Supervisory System Requirements from a JTA (Enterprise) Communications department perspective.

Table 3-9: JTA Enterprise Stakeholder Requirements – Communications

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.2.9-01	**(Voice) Passenger Communications**				
3.2.9-01.01	The U²C SVS shall provide on-board monitors as a method of communications to the customers.		X	X	X
3.2.9-01.02	The U²C SVS shall provide two-way communication between system operations and E.		X	X	X
3.2.9-01.03	The U²C SVS shall provide alert capabilities through integration of the mobile applications, such as *MYJTA app* or *See and Say*.		X	X	X
3.2.9-01.04	The U²C SVS communication technologies and the communication messages shall be reflective of JTA's overall brand promise that is an aspirational, premium experience and easily accessible anywhere.		X	X	X
3.2.9-01.05	The U²C SVS communication technology shall comply with all ADA requirements.		X	X	X
3.2.9-02	**Data Requirements**				
3.2.9-02.01	The U²C SVS shall provide a compatible fare payment system that does not require a different program application.		X	X	X

3.3   U²C Supervisory System Operators

3.3.1   Skyway Operations

This section describes U²C Basic Supervisory System Requirements from a Skyway Operations perspective.

Table 3-10: U²C Supervisory System Operators – Skyway Operations

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.3.1-01	**(Operations) Control Center**				
3.3.1-01.01	The U²C SVS shall provide efficient operation avoiding conflicts, congestion, and/or collisions between C/AVs, including but not limited to: • While taking into or out of service; • During service runs; • During boarding or alighting of passengers; and • Other.		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.3.1-01.02	The U²C SVS shall enable the monitoring and controlling of all operations and maintenance system functions from a central (OCC) location.		X	X	X
3.3.1-01.03	The U²C SVS shall enable the monitoring and controlling of all operations and maintenance system functions from one or more mobile locations.		X	X	X
3.3.1-01.04	The U²C SVS shall provide user and user groups allowing flexible assignment of operating and maintenance control function on a granular access / permission level.		X	X	X
3.3.1-01.05	The U²C SVS shall provide a graphical user interface (GUI).		X	X	X
3.3.1-01.06	The U²C SVS shall be able to present the GUI on video walls.		X	X	X
3.3.1-01.07	The U²C SVS GUI shall be customizable by a system administrator.		X	X	X
3.3.1-01.08	The U²C SVS GUI shall be able to present selected or all C/AVs.		X	X	X
3.3.1-01.09	The U²C SVS GUI shall be able to present selected or all C/AV statuses and prioritize statuses.		X	X	X
3.3.1-01.10	The U²C SVS GUI shall be able to present selected or all previous, current and planned C/AV routes.		X	X	X
3.3.1-01.11	The U²C SVS shall support operational territories, dividing responsibilities between various operators and maintainers.		X	X	X
3.3.1-01.12	The U²C SVS shall bring standby C/AVs into service due to, including but not limited: • Ridership demand • Other				X
3.3.1-01.13	The U²C SVS shall take be able to take C/AVs automatically out of service due to, including but not limited: • Planned maintenance activities (e.g. charging); • Unplanned maintenance (e.g. repairs); • Loss of contact with the vehicle for an extended period of time; and • Other.				X
3.3.1-02	**Data Requirements**				
3.3.1-02.01	The U²C SVS shall provide automatic passenger count information.		X	X	X
3.3.1-02.02	The U²C SVS shall collect, record and archive vehicle route information (short-term and long-term).		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.3.1-02.03	The U²C SVS shall collect, record and archive vehicle diagnostic information (short-term and long-term).		X	X	X
3.3.1-03	**Health Monitoring**				
3.3.1-03.01	The U²C SVS shall be able to receive, process, and present failure alarms.		X	X	X
3.3.1-03.02	The U²C SVS shall be able to perform traffic management, determining whether a vehicle has stopped, where, and why.		X	X	X
3.3.1-03.03	The U²C SVS shall be able to perform trouble-shooting from OCC and mobile locations.		X	X	X
3.3.1-03.04	The U²C SVS shall offer solution options when trouble-shooting the U²C SVS system and/or vehicles.		X	X	X
3.3.1-03.05	The U²C SVS shall utilize historical data to provide predictive maintenance recommendations.				X
3.3.1-03.06	The U²C SVS shall provide standard and customizable analytical diagnostic reports.				X
3.3.1-04	**Location / Route Setting**				
3.3.1-04.01	The U²C SVS shall provide location / route setting functionality for fixed routes and schedules.		X	X	X
3.3.1-04.02	The U²C SVS shall provide location / route setting functionality for flexible <u>routes</u> based on ridership demand.				X
3.3.1-04.03	The U²C SVS shall provide location / route setting functionality for flexible <u>schedules</u> based on ridership demand.				X
3.3.1-04.04	The U²C SVS shall be able to handle different workloads, including but not limited to: • Weekdays/Weekends; • Seasonal Demand; • Holidays; • High Demand (e.g. Rush-Hours, Special events); and • Low Demand (e.g. Nights, Midday).		X	X	X
3.3.1-04.05	The U²C SVS shall be able to skip (pass through) station stops if the vehicle cannot accommodate additional riders.			X	X
3.3.1-04.06	The U²C SVS shall be able to skip (pass through) station stops if there are no scheduled station stops.			X	X
3.3.1-04.07	The U²C SVS shall be able to bypass C/AVs (run around) as required by the situation.			X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.3.1-04.08	The U²C SVS shall use historical data, current and upcoming event data, and/or AI to predict ridership demand, and recommend location / route settings.				X
3.3.1-04.09	The U²C SVS shall support platooning of C/AVs.	X	X	X	X
3.3.1-04.10	The U²C SVS shall support platooning of C/AVs from different manufacturers.	X	X	X	X
3.3.1-04.11	The U²C SVS shall support platooning of dedicated JTA and Third Party C/AVs.			X	X
3.3.1-05	**(Voice) Passenger Communications**				
3.3.1-05.01	The U²C SVS shall enable operations and maintenance personnel to contact riders on the C/AVs		X	X	X

3.4 End Users

This section describes U²C Basic Supervisory System Requirements from an End User perspective.

Table 3-11: End Users

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.4-01	**System Connectivity**				
3.4-01.01	The U²C SVS shall provide End Users the following user interfaces: • Mobile application (Smartphone, Tablet); • Website (Personal Computer); and • Other (e.g. Customer Service).		X	X	X
3.4-01.02	The U²C SVS shall enable End Users to buy tickets with their mobile devices/applications.		X	X	X
3.4-01.03	The U²C SVS shall enable End User to schedule a C/AV ride on demand (similar to Uber; Lyft, etc.).			X	X
3.4-01.04	The U²C SVS shall enable End User to schedule a C/AV ride as Paratransit service.			X	X
3.4-01.05	The U²C SVS shall provide End Users with service updates, including but not limited to: • Wait/Arrival time; • Vehicle real time location; and • Vehicle visual identification (color, license plates).		X	X	X
3.4-02	**(Voice) Passenger Communications**				
3.4-02.01	The U²C SVS shall enable End Users to use voice passenger communication for <u>information</u> requests.		X	X	X

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.4-02.02	The U²C SVS shall enable End Users to use voice passenger communication <u>reporting criminal activity</u>, resulting in a quick response.		X	X	X
3.4-02.03	The U²C SVS shall enable End Users to use voice passenger communication to call for <u>help</u> in case of an emergency.		X	X	X

3.5 Automated Vehicle Stakeholders

3.5.1 Dedicated JTA C/AVs

Dedicated JTA C/AVs will be procured separately. This section describes U²C Basic Supervisory System Requirements from dedicated JTA C/AV perspective.

Table 3-12: Automated Vehicle Stakeholders – Dedicated JTA C/AVs

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.5.1-01	**System Connectivity**				
3.5.1-01.01	The U²C SVS Onboard Equipment (OBE) shall be able to interface with the dedicated JTA C/AVs.	X	X	X	X
3.5.1-01.02	Dedicated JTA C/AVs will make provisions for spatial, electrical, mechanical, HAVC, data and other interfaces, as required.	X	X	X	X

3.5.2 Third Party C/AVs

Third Party C/AVs may operate as part of the U²C Supervisory System. This section describes U²C Basic Supervisory System Requirements from a Third Party C/AV perspective.

Table 3-13: Automated Vehicle Stakeholders – Third Party C/AVs

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.5.2-01	**System Connectivity**				
3.5.2-01.01	The U²C SVS (Onboard Equipment) shall be able to interface with the Third Party C/AVs.	X			X
3.5.2-01.02	Third Party C/AVs will make provisions for spatial, electrical, mechanical, HVAC, data and other interfaces, as required.	X			X

3.6 Infrastructure Stakeholders

3.6.1 Dedicated JTA Elevated Guideway

The dedicated JTA guideway will be converted as part of a separate procurement. This section describes U²C Basic Supervisory System Requirements from a Dedicated JTA Elevated Guideway perspective.

Table 3-14: Infrastructure Stakeholders – Dedicated JTA Elevated Guideway

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.6.1-01	**Location / Route Setting**				
3.6.1-01.01	The U^{2}C SVS shall be able to operate dedicated JTA C/AVs on the dedicated JTA Elevated Guideway.	X	X		X
3.6.1-01.02	The U^{2}C SVS shall be able to operate Third Party C/AVs on the dedicated JTA Elevated Guideway.	X			X

3.6.2   Shared At-Grade Infrastructure (Public Roadways)

The dedicated JTA guideway will be converted as part of a separate procurement. This section describes U^{2}C Basic Supervisory System Requirements from a Dedicated JTA Elevated Guideway perspective.

Table 3-15: Infrastructure Stakeholders – Shared At-Grade Infrastructure

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.6.2-01	**Location / Route Setting**				
3.6.2-01.01	The U^{2}C SVS shall be able to operate dedicated JTA C/AVs on shared At-Grade Infrastructure (Public Roadways).	X		X	X
3.6.2-01.02	The U^{2}C SVS shall be able to operate Third Party C/AVs, operating as part of the U^{2}C system, on shared At-Grade Infrastructure (Public Roadways).				X

3.6.3   Roadside Equipment

This section describes U^{2}C Basic Supervisory System Requirements from a Roadside Equipment perspective.

Table 3-16: Infrastructure Stakeholders – Roadside Equipment

ID	U^{2}C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.6.3-01	**System Connectivity**				
3.6.3-01.01	The U^{2}C SVS (Onboard Equipment) shall be able communicate with Roadside Equipment via Vehicle to Infrastructure (V2I).	X		X	X

3.7   Third Parties

3.7.1   Third Party Fleet Management

This section describes U^{2}C Basic Supervisory System Requirements from a Third Party Fleet Management perspective.

Table 3-17: Third Parties – Third Party Fleet Management

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.7.1-01	**System Connectivity**				
3.7.1-01.01	Dedicated JTA C/AVs with U²C SVS (Onboard Equipment) shall be able to be operated by Third Party Fleet Management.				X
3.7.1-01.02	The U²C SVS shall be able to operate Third Party C/AVs on the dedicated JTA Elevated Guideway.				X

3.7.2 Third Party Data User or Provider

This section describes U²C Basic Supervisory System Requirements from a Data User or Provider perspective.

Table 3-18: Third Parties – Third Party Data User or Provider

ID	U²C Basic Supervisory System Requirements	ST	MT-E	MT-A	LT
3.7.2-01	**System Connectivity**				
3.7.2-01.01	The U²C SVS shall be able to receive and process data from Third Parties (e.g. for advertisement purposes).		X	X	X
3.7.2-01.02	The U²C SVS shall be able to process and send data to Third Parties (e.g. for analytics purposes).		X	X	X

4 U²C BASIC SUPERVISORY INTEROPERABILITY REQUIREMENTS

This section describes the **Interoperability Requirements** of the **U²C Supervisory System**, defining an initial set of requirements as input into *Task 3 – Market Study Analysis* (Section 1.1). For **Basic Requirements** of the **U²C Supervisory System**, refer to Section 3.

Table 4-1: Interoperability Requirements

ID	U²C Basic Supervisory Interoperability Requirements	ST	MT-E	MT-A	LT
4-01	**General Interoperability Requirements**				
4-01.01	The U²C SVS shall be based upon a Modular Open Systems Approach (MOSA) employing a modular design, and use widely supported, open (publicly available) and consensus-based standards for its key interfaces. Proprietary interface standards shall not be acceptable.		X	X	X
4-01.02	The U²C SVS shall implement the Connected Vehicle Reference Implementation Architecture, as applicable to the U²C Supervisory System. For more information on the CVRIA, refer to Appendix A, or visit: https://local.iteris.com/cvria/index.html.		X	X	X
4-01.03	The U²C SVS modules shall be compatible with the CVRIA "Physical Objects" module architecture and their allocated requirements. For more information on CVRIA "Physical Objects", refer to Appendix A, or visit: https://local.iteris.com/cvria/html/physobjects/physobjects.html.		X	X	X
4-01.04	The U²C SVS interfaces shall be compatible with the applicable interfaces identified by the CVRIA and their allocated interface requirements, including the data flows and information flows.		X	X	X
4-02	**Vehicles from different manufacturers**				
4-02.01	The U²C SVS shall be able to interact with single C/AVs from the same manufacturer using interoperable interface standards.	X	X	X	X
4-02.02	The U²C SVS shall be able to interact with platooned C/AVs from the same manufacturer using interoperable interface standards.		X		X
4-02.03	The U²C SVS shall be able to interact with single C/AVs from different manufacturers using interoperable interface standards.		X	X	X
4-02.04	The U²C SVS shall be able to interact with platooned C/AVs from different manufacturers using interoperable interface standards.				X

ID	U²C Basic Supervisory Interoperability Requirements	ST	MT-E	MT-A	LT
4-03	**Connectivity – Dedicated System Infrastructure and/or (V2I)**				
4-03.01	The U²C SVS (OBE) shall be able to interact with roadside equipment (RSE) using interoperable interface standards. For more information on roadside equipment, refer to Appendix A, or visit: http://local.iteris.com/cvria/html/physobjects/physobj11.html#tab-0.	X	X	X	X
4-04	**Connectivity – External (V2X) (e.g. DSRC, 4G and 5G)**				
4-04.01	The U²C SVS (OBE) shall be able to interact with other CVRIA "Physical Objects" via <u>Dedicated Short Range Communication</u> (DSRC), using interoperable interface standards. For more information on CVRIA "Physical View" and "Physical Objects", refer to Appendix A, or visit: https://local.iteris.com/cvria/html/viewpoints/physical.html https://local.iteris.com/cvria/html/physobjects/physobjects.html.	X	X	X	X
4-04.02	The U²C SVS (OBE) shall be able to interact with other CVRIA "Physical Objects" via <u>Wide Area Wireless</u> Communication, including 4G and 5G, using interoperable interface standards. For more information on CVRIA "Physical View" and "Physical Objects", refer to Appendix A, or visit: https://local.iteris.com/cvria/html/viewpoints/physical.html https://local.iteris.com/cvria/html/physobjects/physobjects.html.	X	X	X	X
4-05	**Interface with JTA Enterprise System**				
4-05.01	The U²C SVS shall be able to interact with JTA Enterprise systems, using interoperable interface standards. For JTA Enterprise systems, refer to section 2.2.1.		X	X	X
4-05.02	The U²C SVS shall be able to interact with other U²C Supervisory systems, using interoperable interface standards. For U²C Supervisory systems, refer to section 2.2.2.	X	X	X	X
4-05.03	The U²C SVS shall be able to interact with other CVRIA "Enterprise Objects", using interoperable interface standards. For more information on CVRIA "Enterprise Objects", refer to Appendix A, or visit:		X	X	X

ID	U²C Basic Supervisory Interoperability Requirements	ST	MT-E	MT-A	LT
	https://local.iteris.com/cvria/html/eobjects/enterpriseobjects.html.				
4-05.04	The U²C SVS shall implement the CVRIA "Integrated Multi-Modal Electronic Payment", using interoperable interface standards. For more information, refer to Appendix A, or visit: https://local.iteris.com/cvria/html/applications/app37.html#tab-3.		X	X	X
4-06	**Customer Interface**				
4-06.01	The U²C SVS shall be able to interact with Customer Interfaces (End User systems), using interoperable interface standards. For Customer Interface systems, refer to section 2.2.3.		X	X	X
4-06.02	The U²C SVS shall be able to interface with the JTA mobile App to schedule rides.		X	X	X
4-06.03	The U²C SVS shall be able to interact with other CVRIA "Personal Information Device", using interoperable interface standards. For more information on CVRIA "Personal Information Device", refer to Appendix A, or visit: https://local.iteris.com/cvria/html/physobjects/physobj23.html.		X	X	X
4-07	**Cybersecurity**				
4-07.01	The U²C SVS shall implement the CVRIA Security Concept and the "Cooperative ITS Credentials Management System". For more information, refer to Appendix A, or visit: https://local.iteris.com/cvria/html/about/security.html https://local.iteris.com/cvria/html/physobjects/physobj86.html.	X	X	X	X
4-08	**Safety**				
4-08.01	The U²C SVS shall implement the CVRIA Safety "Applications", using interoperable interface standards. For more information, refer to Appendix A, or visit: https://local.iteris.com/cvria/html/applications/applications.html.	X	X	X	X

Appendix-A: Connected Vehicle Reference Implementation Architecture (Excerpts)

Please visit: https://local.iteris.com/cvria/index.html.