COMPLETE TRIP

ITS4US

Task 2 Training:
Concept of Operations
Agenda

- Brief Program Overview

- Concept of Operations (ConOps) Development
  - Deliverable Overview
  - ConOps Overview
  - ConOps Sections
  - ConOps Walkthrough

- Resources
  - Useful References
  - Stay Connected
Program Overview
Complete Trip - ITS4US Deployment Program

- A USDOT Multimodal Deployment Effort, led by ITSJPO and supported by OST, FHWA and FTA

- Supports multiple large-scale replicable deployments to address the challenges of planning and executing all segments of a complete trip

**Vision**

Innovative and integrated complete trip deployments to support seamless travel for all users across all modes, regardless of location, income, or disability
Program Goals

- Spur high-impact integrated Complete Trip deployments nationwide
- Identify needs and challenges by populations
- Develop and deploy mobility solutions that meet user needs
- Measure impact of integrated deployments
- Identify replicable solutions and disseminate lessons learned
Complete Trip Phase 1 Awardees

University of Washington
OR, WA, MD

California Association of Coordinated Transportation
CA, OR, and WA

Heart of Iowa Regional Transit Agency
Dallas County, IA

ICF
Buffalo, NY

Atlanta Regional Commission
Gwinnett County, GA
Deployment Phases

**PHASE 1: Concept Development**
- Concept Development for Complete Trip Deployment
- Establish Cohort Roundtables

**PHASE 2: Design & Test**
- Design, Test and Deploy Complete Trip Solutions
- Evaluation Framework and Planning

**PHASE 3: Operate & Evaluate**
- Demonstrate Multiple Large-Scale Deployments
- Evaluate Deployments
- Share Data & Lessons Learned

**Operations Maintenance**
- Sustain operations for a minimum period of five years after the program is completed with no supplementary federal funds

**Deployment**
- Up to 12 months
- Up to 24 months
- Minimum of 18 months

**Post-Deployment**
- 5 years
Task 2: Concept of Operations (ConOps)
ConOps Overview

- The ConOps baselines the concept for deployment for all stakeholders and guides the rest of the project by:
  - Refining a set of priority needs for a new system/deployment through structured stakeholder interactions
  - Defining a set of key performance measures
  - Defining the existing environment and system
  - Documenting high-level enabling technologies to be deployed
  - Describing Improvements and outcomes expected from the deployment
The purpose of the task is to refine the proposed deployment concept and document in a Concept of Operations that describes the specific combination of applications to be deployed, and how operational practice will be altered based on the introduction of these applications.

**Deliverables**

1. Draft Stakeholder ConOps Review Panel Roster – Kick-Off + 8 weeks (April 19th)
2. Draft Needs Summary – Kick-Off + 8 weeks (April 19th)
3. Final Stakeholder ConOps Review Panel Roster – Kick-Off + 10 weeks (May 3rd)
4. Final Needs Summary – Kick-Off + 10 weeks (May 3rd)
5. Draft ConOps – Kick-Off + 13 weeks (May 24th)
6. ConOps Walkthrough Briefing Deck – Kick-Off + 13 weeks (May 24th)
7. Draft ConOps Comment Resolution Report – Kick-Off + 15 weeks (June 7th)
8. Final ConOps – Kick-Off + 18 weeks (June 28th)
9. Final ConOps Comment Resolution Report – Kick-Off + 18 weeks (June 28th)
10. Public ConOps Webinar – Kick-Off + 21 weeks (Week of July 19th)
## ConOps Major Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope</strong></td>
<td>Provide an overview of the ConOps document and the system to which it applies.</td>
</tr>
<tr>
<td><strong>Reference Documents</strong></td>
<td>List the document number, title, revision, and date of all documents referenced in the ConOps document.</td>
</tr>
<tr>
<td><strong>Current System and Environment</strong></td>
<td>Describe the system or situation as it currently exists. Introduce the problems that have motivated the development of the new system.</td>
</tr>
<tr>
<td><strong>Justification for and Nature of Changes</strong></td>
<td>Describe shortcomings of current system/situation, which helps to bridge the gap between sections 3 and 5. User needs are identified.</td>
</tr>
<tr>
<td><strong>Concept for Proposed Environment</strong></td>
<td>Describe the new system that is a result of the justification of changes and user needs in section 4.</td>
</tr>
<tr>
<td><strong>Operational Scenarios</strong></td>
<td>Document operational scenarios/use cases for the new system. Use cases provide a description of how the new system should operate.</td>
</tr>
<tr>
<td><strong>Summary of Impacts</strong></td>
<td>Describe the operational impacts of the new system on users, developers, maintainers, and other agencies and stakeholders.</td>
</tr>
<tr>
<td><strong>Analysis of the Proposed System</strong></td>
<td>Provide an analysis of the benefits, limitations, advantages/disadvantages, and alternatives/trade-offs considered.</td>
</tr>
</tbody>
</table>

**COMPLETE TRIP**

[Logo]

**U.S. Department of Transportation**

**ITS Joint Program Office**
## ConOps Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>2021</th>
<th>2022</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Feb Mar Apr</td>
<td>May Jun Jul Aug Sep</td>
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<tr>
<td>Task 1</td>
<td>User Needs</td>
<td>Project Management</td>
</tr>
<tr>
<td>Task 2</td>
<td>Concept of Operations</td>
<td></td>
</tr>
<tr>
<td>Task 3</td>
<td>Data Management Plan</td>
<td></td>
</tr>
<tr>
<td>Task 4</td>
<td>Safety Plan</td>
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<tr>
<td>Task 5</td>
<td>Performance Measurement</td>
<td></td>
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<tr>
<td>Task 6</td>
<td>System Requirements</td>
<td></td>
</tr>
<tr>
<td>Task 7</td>
<td>Tech Readiness</td>
<td></td>
</tr>
<tr>
<td>Task 8</td>
<td>Human Use Approval</td>
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<tr>
<td>Task 9</td>
<td>Training Plan</td>
<td></td>
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<tr>
<td>Task 10</td>
<td>Institutional, Partnership, and Financial Plan</td>
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<tr>
<td>Task 11</td>
<td>Outreach Plan</td>
<td></td>
</tr>
<tr>
<td>Task 12</td>
<td>SEMP</td>
<td></td>
</tr>
<tr>
<td>Task 13</td>
<td>Deployment Plan</td>
<td></td>
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<tr>
<td>Task 14</td>
<td>Deployment Readiness Summary</td>
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ConOps Interdependencies

Inputs

Systems Engineering Planning
Task 1B: UNIRP

Concept of Operations

Scope
Referenced Documents
Current Systems
Justification for Change
Proposed/New System
Operational Scenarios
Summary of Impacts
Analysis of New System

Outputs

Operational Concepts
Task 3: DMP
Task 6: SyRS
Task 9: Training Plan
Task 13: ICTD Plan
Task 14: Dep. Briefing
Task 2 Deliverables

- USDOT requires each site to use the template provided

<table>
<thead>
<tr>
<th>ID</th>
<th>BAA Section</th>
<th>Task 2: Concept of Operations (ConOps)</th>
<th>Due Date</th>
<th>Format</th>
<th>Site Specific Date</th>
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<tr>
<td>P1T02D1</td>
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<tr>
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<td>award +10 weeks</td>
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<tr>
<td>P1T02D10</td>
<td>5.2</td>
<td>ConOps Webinar (Public)</td>
<td>award +21 weeks</td>
<td>PPT</td>
<td></td>
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</table>

*508 Compliant Deliverables
ConOps Sections
Section 1: Scope

- Provides introduction and overview of the ConOps.
- Subsections:
  - 1.1 - Background
    - Introduce the USDOT ITS4US Program and your initial concept
    - Define “underserved” communities for your specific project
    - Include glossary and acronym list
  - 1.2 - Document Overview
  - 1.3 - System Overview
Subsection 1.3: System Overview

- Introduce purpose of new system
- Describe the high-level components of the deployment / new system
- Develop a context diagram depicting the high-level components and their relationship
Section 3: Current System and Situation

- Describes the current system (or lack of a system). This section begins to define the problem by showing readers how the current system operates.

- Subsections:
  - 3.1: Background and Scope
  - 3.2: Description of the Current System and Situation
  - 3.3: Current System Stakeholders
  - 3.4: Support Environment
  - 3.5: Modes of Operation for Current System
  - 3.6: Operational Policies and Constraints
Section 3.2: Description of the Current System and Situation

- This section should describe aspects of the current system including:
  - The operational environment
  - Major system components and features
  - Interfaces to external systems
  - Context Diagram
  - Performance characteristics
  - Requirements for safety, security etc.

- If no current system exists, the section should describe the current environment and motivation for a new system.
  - Describe the stakeholders involved and what they are doing currently without any system
Context Diagram Example

**Web Application**
- Cloud Services
- Hosted Web Applications

**Backoffice**
- Decision System
- ML/AI Analysis Engine
- Data Collection
- Data Dissemination
- Data archive

**Traffic Management Center**
- Traveler Information System
- Emergency Management/Public Safety
- Weather Service System

**3RD PARTY PROVIDER**
- Mobility Services
  - Shared-use mobility
  - Micromobility
  - Demand Response services
- Payment Services
  - Payment Card
  - Integrated Payment Services

**EDGE DEVICES**
- End User Device
  - Smartphone Application
  - Wearable Technology
  - Browser-based application

**FIELD DEVICES**
- ITS Infrastructure Equipment
  - ITS Roadway Equipment
  - Traffic Signal Equipment
  - Traveler Support Equipment
- Communications Infrastructure
  - Municipal Wi-Fi
  - 4G/5G Cellular Base Station
- Internet of Things (IoT) Device
  - CCTV
  - Sensors

**PUBLIC/GOVERNMENT**
- **PUBLIC TRANSIT**
  - Bus
  - Subway
  - Rail
  - ADA Paratransit

**OPS & MAINTENANCE**
- System Monitoring
- Training
- Outreach

**SYSTEM OF INTEREST (SOI)**

**Legend**
- Network
- Wireless

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Section 3.3: Current System Stakeholders

- Identify all the stakeholders and users involved in the operation, usage, and maintenance of the current system and mapping their roles and responsibilities to the current system(s).

- The identified system stakeholders should all be involved at some level in the creation of the ConOps.

- Regional Commuter Rail Agency
- Local DOT
- Transit Agency
- End Users
- Paratransit Provider
Section 3.4: Support Environment

- Describe the support environment of the current system. Describe other supporting systems such as:

  - Communications Networks
  - Maintenance and Support Facilities and Systems
  - Enterprise Technology Services
  - Other Supporting Tools, Resources, or Systems
Section 3.5: Modes of Operation

- Describe the modes of operation of the current system

- The section should at least cover:
  - **Normal** mode – normal daily operation of the system
  - **Degraded** mode – when a part or component of the system is offline, what happens to the working and offline components?
  - **Failure** mode – describe what happened when the entire system goes offline. How is the system restored? What are the expected performance metrics?
Section 3.6: Operational Policies and Constraints

- Describe policies and other factors that constrain current system.

- Examples include:
  - Hours of operations
  - IT-related policies
  - Manpower limitations
  - Financial limitations
  - Service Level Agreements
  - Other Contractual Agreements
Section 4: Justification for Changes and Description of Changes

- Describes shortcoming(s) of current system as depicted by the system stakeholders. These shortcomings are then used for the justifications of the new system.

- Subsections:
  - 4.1: Justification of Changes
  - 4.2: Description of Desired Changes
  - 4.3: Priorities Among Changes
  - 4.4: Changes Considered but not Included
  - 4.5: Assumptions and Constraints
4.1: Justification of Changes

- Provide justification for a new system by:
  - Summarizing **new or modified aspects** of the user needs, missions, objectives, environments, interfaces, personnel, or other factors that require a new or modified system
  - Summarizing the **deficiencies or limitations** of the current system(s) that make it unable to respond to new or changed factors
  - Explaining **why a new system should be developed to meet this opportunity** for underserved communities, describing the rationale behind the decision to modify the existing system and explain why new functionality is needed.
4.2: Description of Desired Changes

- Capture the user needs of the new system, summarizing the capabilities, functions, interfaces, and other changes to fully answer the justifications for changes. Well-written user needs have the following characteristics:
  - **Uniquely Identifiable.** Each need shall be uniquely identified (i.e., each need shall be assigned a unique number and title)
  - **Major Desired Capability (MDC).** Each need shall express a major desired capability in the system, regardless of whether the capability exists in the current system or situation or is a gap
  - **Solution Free.** Each need shall be solution free, thus giving designers flexibility and latitude to produce the best feasible solution
  - **Capture Rationale.** Each need shall capture the rationale or intent as to why the capability is needed in the system
2.6.2.1 Transferring from subway platform to other modes. Transferring from subway platform to shared use service boarding location transit users need to navigate from the subway platform to the shared services hailing location in order to allow users to transition between modes and continue on their trip.
User Need Examples

2.6.2.1.1 Accurate positioning inside buildings. Transit users with disabilities need to be able to accurately locate their position within buildings, in order to navigate through a transit station and determine their exact location in the environment.

2.6.2.1.2 Precise localization inside buildings. Transit users with disabilities need to be able to precisely locate their position with respect to other features such as doorways and escalators, in order to navigate through a transit station and identify building features and points of interest.

Solution Free
4.3: Priorities Among Changes

- Each user need should be classified as:
  - Essential
  - Desirable
  - Optional

- The section should also give justification as to why a need falls within the given category
4.4: Changes Considered but not Included

- Describe any features, functions, use cases, or users that were considered for the new system

- Provide explanation to readers and users to understand why an issue may not be addressed by the system

- Provide historical reference throughout the project to document why particular aspects may have been not included in the system at the beginning.
4.5: Assumptions and Constraints

- Describe assumptions and constraints in the current system

  - Assumptions may be any conditions which are accepted to be true, for example the system will need to double capacity in two years.

  - Constraints are external requirements, limits or other factors that may impact the development and operation of the system

- Examples of constraints:

  - Standards
  - Rules
  - Regulations
  - Processes
  - Policies
Section 5: Concepts for the Proposed System

- Describe new system

Subsections:

- 5.1: Background and Scope
- 5.2: Description of the Current System and Situation
- 5.3: Stakeholders for the Proposed System
- 5.4: Support Environment
- 5.5: Modes of Operation for Proposed System
- 5.6: Operational Policies and Constraints

These subsections follow the same structure as section 3 except the proposed system should be explained.
5.2: Description of the Proposed System

- Describe aspects of the new system including:
  - The operational environment
  - Major system components and features
  - Interfaces to external systems
  - Context Diagram
  - Performance characteristics
  - Requirements for safety, security etc.

- This section can be broken down into subsections to logically explain the system. The context diagram can help to set up this subsystem structure.
5.3: Stakeholders for Proposed System

- Identify all the stakeholders and users that may be involved in the operation, usage, and maintenance of the **proposed system** and mapping their roles and responsibilities to the **proposed system(s)**.

- The identified system stakeholders should all be involved at some level in the creation of the ConOps

- Note: The remaining subsections apply to the **proposed system** following the same structure as the existing system described in Section 3.
Section 6: Operational Scenarios

- Describes operational scenarios or uses cases for the proposed system.
- Should provide a step-by-step description of how the proposed system should operate.
- The scenarios should depict all aspects of the system to show how users will interact with the system.
- Scenarios should cover positive and negative (failure or error) scenarios.
- The scenarios should be comprehensive to cover all major capabilities and user classes but do not need to be exhaustive of every detail of the system.
## Example Operational Scenario

<table>
<thead>
<tr>
<th>Short Description</th>
<th>Integrating Deployment Solutions Across Multiple Trip Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In this use case, the user disembarks from the subway and enters an underground transit station where there is little to no GPS signal. The user needs help with localization and navigation through the underground transit station to the exit. Upon exiting the subway station, the user must locate the pay station and then locate a ride share service to complete the final leg of their trip.</td>
</tr>
<tr>
<td>Goal</td>
<td>The goal of this use case is to illustrate how integrating deployment solutions across multiple trip segments such as indoor navigation, vehicles and mode transfers/payment stops and stations, and connecting and completing trip segments, can be obtained to allow a traveler seamless transition. It also illustrates how enabling components can be a technology or a service.</td>
</tr>
</tbody>
</table>
## Example Operational Scenario (cont.)

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Integrating Deployment Solutions Across Multiple Trip Segments</th>
</tr>
</thead>
</table>
| • A significant constraint in this use case for all underserved population is the lack of positional accuracy when the user is underground.  
• Another constraint for all underserved populations is the need for the solution to be integrated across each trip segment  
• There are also constraints that should be considered for the underserved population, for example, individuals with visual impairments may need additional assistance navigating the underground facility and a visual solution may not be sufficient. Individuals with a mobility impairment, may need specific routes in the facility to navigate such as the use of elevators or elevated platforms. The intended user(s) ability to perform the actions in this use case must be considered. |

| Geographic Scope | Underground transportation facilities with multiple tracks for subways, limited escalators and elevators, limited lateral space, and potentially long corridors. Accessibility features may also be limited, GPS and phone signal are limited, and the facilities could be subject to heavy foot traffic during all hours. |
## Example Operational Scenario (final)

<table>
<thead>
<tr>
<th>Actors</th>
<th>Integrating Deployment Solutions Across Multiple Trip Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Wayfinding and localization application</td>
</tr>
<tr>
<td></td>
<td>• Trip Planning Applications</td>
</tr>
<tr>
<td></td>
<td>• Ride-share service</td>
</tr>
<tr>
<td></td>
<td>• Payment Application</td>
</tr>
<tr>
<td></td>
<td>• Application Programming Interface (API) to integrate and connect applications</td>
</tr>
<tr>
<td></td>
<td>• Smart Phone with IOT localization device</td>
</tr>
<tr>
<td></td>
<td>• Bluetooth Beacons (waypoints)</td>
</tr>
<tr>
<td></td>
<td>• Transit Agency</td>
</tr>
<tr>
<td></td>
<td>• Underserved Population User/Traveler</td>
</tr>
</tbody>
</table>
Operational Scenario Illustration
## Operational Scenario

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preconditions</td>
<td>1. The underground transportation facility has Bluetooth enabled beacons placed throughout the facility to provide location and navigation information.</td>
</tr>
<tr>
<td></td>
<td>1. User disembarks from the subway into an underground station. Upon exiting the train, the user accesses the API that integrates all travel solutions together.</td>
</tr>
<tr>
<td></td>
<td>2. The API accesses the localization and navigation application that shares the user’s location with the nearest Bluetooth beacon.</td>
</tr>
<tr>
<td></td>
<td>3. Using GPS provided by the beacons, the application provides a path to the station exit where the ride-share will be picking up the user. The path the application gives is based on predefined preferences from the user such as the use of escalators, stairs or elevators, front of the train or the back, how to pay, best route based on mobility factors or limitations, etc.</td>
</tr>
<tr>
<td></td>
<td>4. Upon approaching the pay station, the API automatically pulls up a touch-and-go payment service allowing the user to pay for the subway trip without opening a different application or paying with a transit fare card. Because the user was able to pre-program his trip within the app, the application automatically hailed a ride-share service in the area when he reached his correct stop.</td>
</tr>
<tr>
<td></td>
<td>5. Upon exiting the underground facility, the ride-share is waiting for the user</td>
</tr>
</tbody>
</table>
## Operational Scenario (cont.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternate Flows</strong></td>
<td>4a. Instead of the API providing a path to the nearest exit, it could call an accessibility service (human helper/assistant?) to help the user through the underground station</td>
</tr>
<tr>
<td><strong>Post-conditions</strong></td>
<td>1. The Trip planning application in the user’s phone alerts a legal guardian or caretaker of a successful trip or if the user has traveled of the predetermined route.</td>
</tr>
</tbody>
</table>
| **Information Requirements** | • Bluetooth Beacon: location, status (e.g. operating, receiving, transmitting)  
• API: location, status, route preferences, payment preferences  
• Traveler Information Advisories, route detours, maintenance, unavailable accessibility points |
| **Related User Need** | List user needs this use case meets here:  
2.6.2.1 Transferring from subway platform to shared use service boarding location  
2.6.2.1.1 Accurate positioning inside buildings  
2.6.2.1.2 Precise localization inside buildings  
2.6.2.1.3 Transit Station Information |
Section 7: Summary of Impacts

- Describe the impacts of the new system on the users, developers, maintainers, and other agencies and organizations involved with the system.

Operational Impacts

Organizational Impacts

Impacts During Development
Section 8: Analysis of the Proposed Systems

- Describe and focus on the proposed system and the benefits, limitations and/or disadvantages of the system.

- Alternatives and Trade-Offs Considered
  - Analyze alternatives considered at the ConOps phase that are not part of the project.
  - Build upon Section 4.4 and discuss the trade-offs and document the decisions made for each alternative.

![Travel Time Savings](chart)

![Impact on Existing System](chart)

![Implementation Costs](chart)
ConOps Walkthrough
ConOps Walkthrough Overview

- The ConOps walkthrough is the event when stakeholders from across the different stakeholder groups can get together to discuss use cases and user needs
  - These events are critically important to gaining consensus and clarity on the user needs and ensure all stakeholders have a common understanding of the proposed system

- During the walkthrough you will:
  - Review System Context Diagrams
  - Review All Use Cases
  - Review All User Needs

- Having discussions among the stakeholder groups is the point of this process and a good thing!
ConOps Walkthrough Expectations

- Sites should plan for 3 days of ConOps Walkthrough
  - Should be virtual based on current timeframe for walkthroughs
  - Accommodate multiple time zones if necessary (e.g. 11 AM EST – 5 PM EST)

- Sites should try and maximize stakeholder group participation
  - Try to get 1 or 2 stakeholders from each stakeholder group
  - It is acceptable to schedule certain reviews to accommodate stakeholder participation
  - It is important that key stakeholders participate in the reviews where their user needs are being addressed

- Recommend Scheduling the ConOps Walkthrough for roughly 1.5-2 weeks after Draft ConOps release
  - Allows stakeholders to review and bring their comments to the walkthrough

- ConOps Walkthrough Briefing Deck should guide present the Context Diagrams, Use Cases and User Needs
Resources
Useful References

ITS4US ConOps Template

IEEE Resources:
- These versions or later revisions are all acceptable for use

FHWA SE Resources:
- Systems Engineering for Intelligent Transportation Systems - provides an introduction to systems engineering and leads the reader step by step through the project life cycle and describes the systems engineering approach at each step.
- Systems Engineering Guidebook for Intelligent Transportation Systems - provides a more in-depth reference for ITS practitioners applying systems engineering to plan, implement, manage, and operate ITS.
- Applying Scrum Methods to ITS Projects – provides information for those interested in learning about Scrum Methods, one of the Agile Methodologies, and how to incorporate Scrum into ITS project development. Also incudes links to Agile resources.
Stay Connected

For more information please contact:

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Visit the Complete Trip - ITS4US Deployment Program Website and FAQs:
https://its.dot.gov/its4us/
https://www.its.dot.gov/its4us/its4us_faq.htm
Any questions?