U.S. Department of Transportation

# ITS4US

IT'S TRANSPORTATION FOR ALL OF US

**Task 2-B:**

Systems Architecture & Design Document

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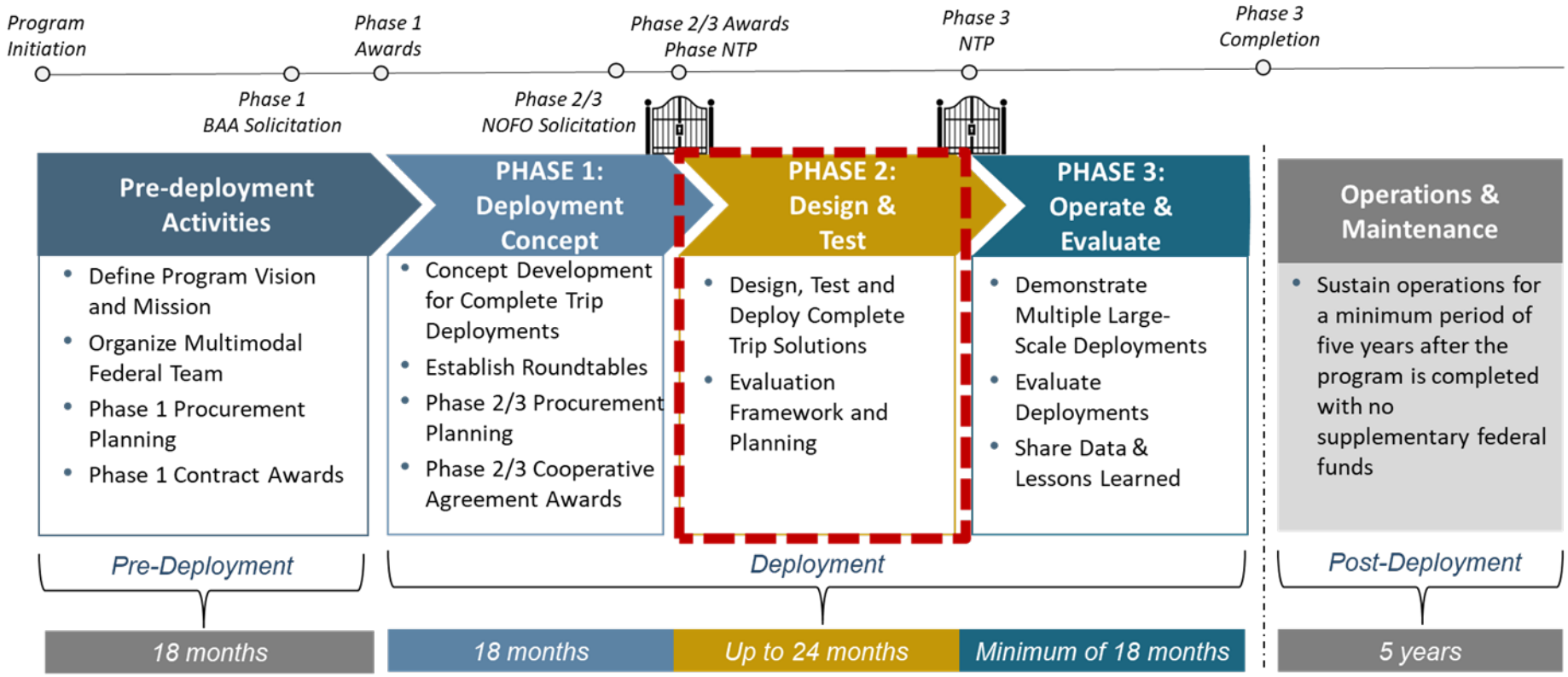
# ITS4US Program Overview

- A USDOT Multimodal Deployment effort, led by ITS JPO 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

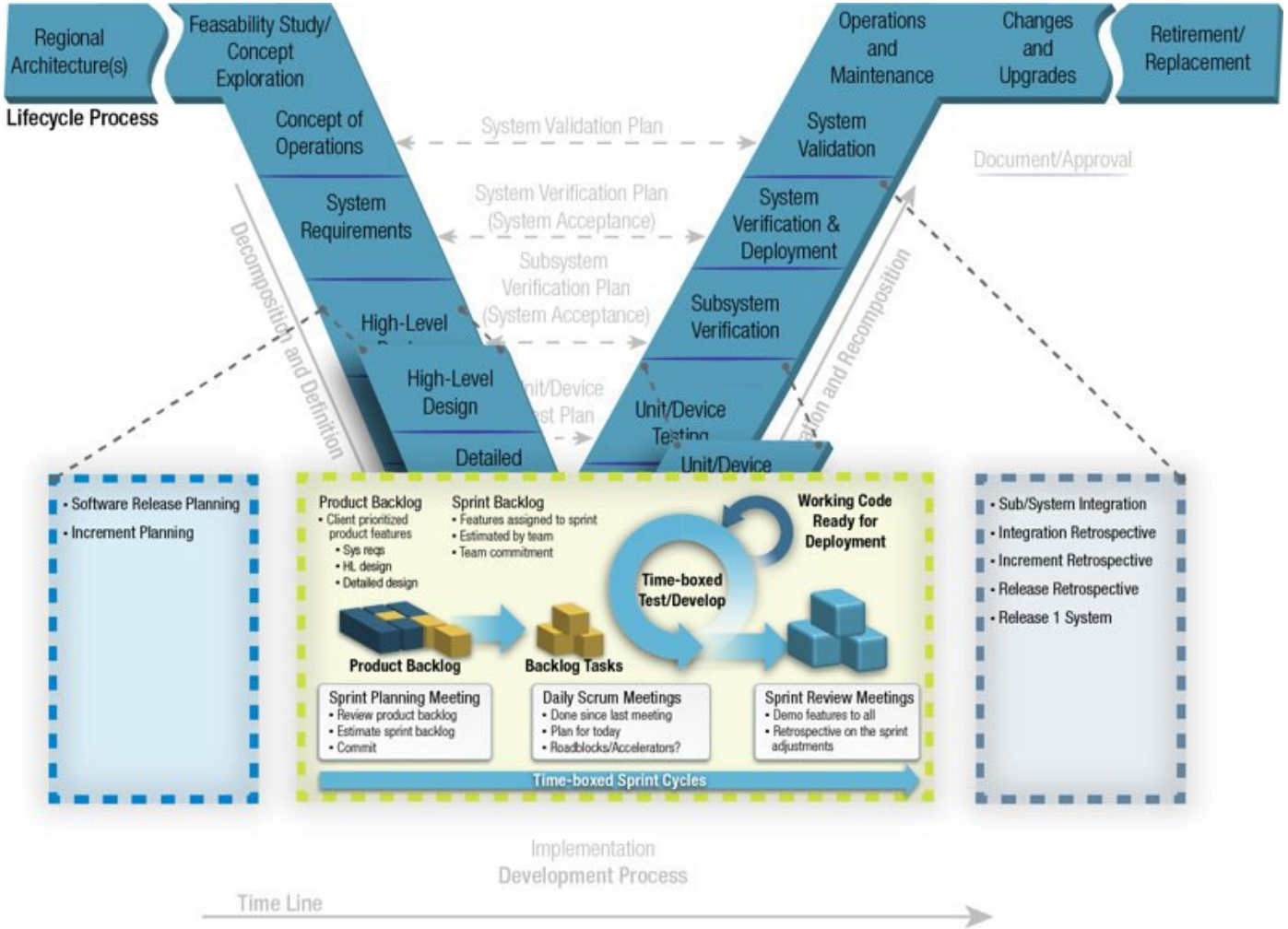
ITS4US
IT'S TRANSPORTATION FOR ALL OF US

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

# Deployment Phases



# Systems Engineering "Vee" Diagram




(Source: FHWA 2007 and modified by Noblis 2017)

# Task 2-B:
# Systems Architecture and Design

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# 2-B System Architecture and Design

Task 2-B extends from Month 1 to Month 12. There are several key activities for this task and can be broken into two tasks. The first task is the System Architecture Document (first 6 months), and the second task is the System Design Document (second 6 months). Each document will be accompanied with a walkthrough. The objective of this task is to build on the Phase 1 ConOps, SyRS, SEMP and ICTDP by creating a well-developed architecture of the deployment site and system design based on that architecture.

***Deliverables***

1. ***System Architecture Document (SAD)***
2. ***System Design Document (SDD)***
3. ***SAD Walkthrough and Workbook***
4. ***SDD Walkthrough and Workbook***

# 2-B Deliverables

- Draft, Revised, & Final System Architecture Document (SAD)
  - The objective of this document is to create the implementation architecture for the proposed deployment system that defines the structure, behavior, and viewpoints of the system. The SAD will also include a Standards Plan and Interface Control Document.
- SAD Walkthrough & Workbook
  - Each site shall prepare a workbook and conduct a walkthrough to review and discuss the draft SAD and solicit feedback.
- Draft, Revised, & Final System Design Document (SDD)
  - The objective of the SDD is to create a system design, based on the SyRS and SAD, describing the full scope of the system. Subsystems of the system are identified and decomposed further into components. SDD Walkthrough & Workbook
  - Each site shall prepare a workbook and conduct a walkthrough to review and discuss the draft SDD and solicit feedback.

# 2-B Key Activities

- **SAD Walkthrough**
  - Each site will conduct a System Architecture Walkthrough (see IEEE Standard 1028-2008) with the AOR and federal team members in the Washington DC metro area (including a Walkthrough Workbook to structure and expedite the Walkthrough process) to demonstrate the completeness and technical soundness of the architectural approach
- **SDD Walkthrough**
  - Each site will host and conduct a System Design Walkthrough (see IEEE Standard 1028-2008) within or near the deployment site (as well as a web conference or remote access capability) with the AOR, federal team members, and other key stakeholders that have participated in the ConOps and System Requirements walkthroughs, to demonstrate the completeness and technical soundness of the system design (including a Walkthrough Workbook to structure and expedite the Walkthrough process).

# 2-B Important Items to Consider

- The templates for the SAD, ICD and SDD provided by USDOT are a starting point and can be changed
  - The architecture and design phases are specific to each individual project
  - Tailoring is a key activity in the SE process, and it is expected that these deliverables will need to be tailored to each individual sites needs
  - Please reach out to the SE team to discuss issues or changes you would like to make, in the vast majority of these cases making the requested change is not a problem
- Traceability between User Needs, Requirements and Design is important
  - It helps ensure that the system will meet the users needs at the end
  - It is also a powerful tool for helping identify the impacts of changes to user needs or requirement to the system design
- Maintain configuration management of user needs and requirements during the architecture design phase and update the ConOps and System Requirements when the SAD, ICD and SDD are complete
  - It's expected that some user needs and requirements may change in Phase 2, make sure that is tracked and reflected in updated Phase 1 documents

# 2-B Challenges and Possible Strategies

- **Agile Process**
  - Issue: Utilizing the agile process makes delivering a full systems architecture and design difficult
  - Possible Strategy: Consider identifying a high-level architecture and design early and reviewing with the USDOT earlier, updating the architecture and design documentation as agile development occurs and delivering the full system architecture and design later.

- **Non-existing Standard**
  - Issue: No current standard/significant gaps in standards for system architecture/design
  - Possible Strategy: If no current standard meets the needs of a specific interface/capability or significant gaps exist within a standard for a specific interface, document this issue in the Standards Plan appendix in the SDD and document your detailed solution for the interface/capability ICD or SDD. USDOT will coordinate these issues with the ITS standards project for future ITS Standards program consideration.

# 2-B Lessons Learned

- Engage Stakeholders early and often
- Reach out to the USDOT SE team if you have questions or want to change document templates
- Maintain traceability between User Needs, Requirements and Design
  - Maintain configuration management with Phase 1 documents (e.g. – after the SADD and SDD are complete update the ConOps and System Requirements with any changes)
- Use experienced agile software developers over engineers when developing software applications
- Design systems using published standards when possible
- Utilize professional installers for device/system installations
- While designing your system consider what parts of your system might upgrade to next generation technologies in the future
- Apply and update standard conformance where appropriate

# Relationship between SE Tasks

- Phase 2 SE activities build on the SE activities in Phase 1, adding more technical detail and refining user needs and requirements as appropriate
  - Traceability between the User Needs, Requirements, System Design and Testing is very important in Phase 2
- Phase 2 activities, whether traditional waterfall processes or Agile, become more connected and interrelated
  - Acquisition plans may be heavily reliant on system requirements to drive procurement efforts
  - Installation plans will be driven by requirements and system design
  - A logical test program that builds from lower-level Unit/Component tests, to integration testing to full system testing will be verifying system requirements, validating user needs and demonstrating that the system is ready to enter operations
- Phase 2 activities can move very quickly and the USDOT SE Team is always available to help with any questions and concerns that arise during any of the Phase 2 SE activities

# References for SE Session

- Phase 1 Connected vehicle pilot deployment program phase 1 : lessons learned : final report. (bts.gov)
- Phase 2 Connected Vehicle Pilot Deployment Program: Driving Towards Deployment: Lessons Learned From the Design/Build/Test Phase (bts.gov)
- Architecture Reference for Cooperative and Intelligent Transportation
- https://www.its.dot.gov/pilots/thea_obu.htm
- https://www.its.dot.gov/press/2018/nycdot_airsupport.htm
- https://www.its.dot.gov/pilots/disparate_systems.htm

# ITS4US Contact Information

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Visit the ITS4US Deployment Program Website:

https://its.dot.gov/its4us/

ITS4US Deployment Program Video

https://youtu.be/pztl1lRyXAc