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# SYSTEMS ENGINEERING RESEARCH PROGRAM



## Introduction

Systems Engineering is a key research program of the Intelligent Transportation Systems Joint Program Office (ITS JPO) within the U.S. Department of Transportation (USDOT) Office of the Assistant Secretary for Research and Technology. Through the multimodal connected vehicle research program, the ITS JPO and the private sector have begun to harness wireless technology and information-sharing capabilities between vehicles and infrastructure to achieve transformative safety, mobility, and environmental benefits to the multimodal transportation sector.



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## Vision

The vision for the Systems Engineering research program is to update the ITS Concept of Operations (ConOps) and broaden the scope that has evolved from the Vehicle Infrastructure Integration (VII) program; update the System Architecture to accommodate the new definition of the system; and provide recommendations for updates to standards used to define system elements and interfaces. Stakeholder needs will be incorporated into the new system definition. An updated set of security requirements will also emerge from this process.

## Research Plan

The ConOps, architecture, standards interfaces, and the system requirements are based on the previous work that defined the VII system and the requirements of the dedicated short-range communications (DSRC) technologies. In 2008, the VII architecture was expanded to include both DSRC and non-DSRC-based technologies, and the VII program evolved into a program focused on smart communications including, vehicle-to-vehicle and vehicle-to-infrastructure connectivity.

To complete the research needed to develop the new wireless communication technologies, a systems engineering process is being used to update critical foundation documents. The USDOT is using a systems engineering approach to ensure that the final products are comprehensive, and thorough, and reflect user needs.

## Research Goals

The Systems Engineering research program has the following goals:

- To describe and define the elements of the connected vehicle system
- To update existing documentation to reflect changes that occurred as a result of the evolution of the VII Program and reflect input from key stakeholder groups.

## Research Outcomes

This research will result in a set of critical products that define a comprehensive and interoperable system:

- A revised ConOps
- An updated System Architecture showing all components and interfaces, and identifying how security processes will ensure the integrity of the system and protect the privacy of its users
- A refined System Requirements Specification that will result in inputs to standards updates
- Analysis, Modeling, and Simulation (AMS) tools for use in evaluation.



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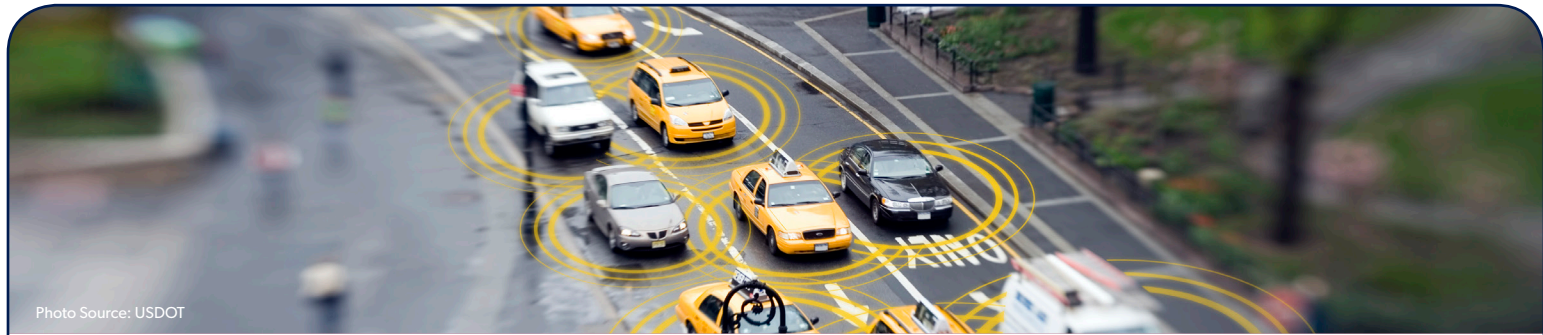


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The solicitation of related requirements from stakeholders is a key scheduled activity along with workshops where user needs, critical to the development of the new ITS ConOps are identified. These activities strive to incorporate new and updated information including:

- A revised ConOps that is based on the needs of users
- Analysis and development of revised and refined requirements for the core operating system. These requirements define the key interface requirements that govern how applications gain access to new capabilities and services.

The Systems Engineering program will also develop an alternative systems architecture set for further analysis and stakeholder input. The architecture documents will describe:

- The physical architecture that identifies all system components.
- The security architecture that describes how security and privacy will be handled and consideration of alternative implementations of the anonymity by design approach.
- An architecture that identifies all major functions performed within the core system and allocates those functions to the critical components.
- AMS tools to assess the feasibility and trade-offs of the proposed system architectures and examine performance issues related to the different technical solutions.

Workshops defining security requirements at various levels are designed to address:

- **Physical Security** and related requirements associated with infrastructure, hardware, facilities, and staff, typically governed by laws and procedures in place with public and private sector organizations responsible for existing infrastructure. Under the policy research plan, these laws and procedures will be reviewed to understand their relevance.

- **Data, Software, and Communications Security** focused on credentials that determine who can communicate with and in the ITS environment. The Systems Engineering research program will pursue the development of processes that establish the trust relationship among communicating partners. For instance, adding a signature to each transmitted message or by establishing a certification process that determines what equipment is allowed to interact with the system. Options for certification will be a part of the larger Policy and Institutional Issues program and based on certifying who (travelers, drivers, system operators) can interact with the system, and how credentials are managed.



The USDOT is using a systems engineering process to ensure that the final products are comprehensive, and thorough, and reflect user needs.



Identification of architecture components will provide a robust set of criteria for further analysis and stakeholder review.

For more information, please contact:

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