# New Jersey Connected Technology Integration and Implementation (NJCTII)

By New Jersey Department of Transportation


## Summary

The New Jersey Department of Transportation (NJDOT) recognized the significant safety, operations, and mobility benefits associated with Connected Vehicles (CV) technologies. NJDOT realized that the best way to implement a real-world TSMO solution, would be to create a complete CV test-bed environment with pilot field locations, leading to the New Jersey Connected Technology Integration and Implementation (NJCTII) project. NJDOT successfully deployed and integrated CV technology to broadcast SPaT, TIM, BSM, MAP CV data. The NJCTII team used a spiral based testing approach in the lab to validate the CV systems. NJDOT used the lessons learned from the lab to deploy a fully functional CV system at 5 pilot intersections.


## In this case study you will learn:

1. How NJDOT used a Connected Vehicles test bed environments and pilot field locations to integrate CV technologies.
2. How NJDOT used trainings and lab demonstrations to educate staff and stakeholders on benefits of CV technologies.
3. How the project allowed NJDOT to learn from the ground up everything that is required with the planning design, procurement, and installation of a functional CV system.

**NOCoE Case Study**

DIGITAL INFRASTRUCTURE

## BACKGROUND

Ongoing advancements in Connected Vehicle (CV) technologies are providing motorists throughout the world with increased benefits related to transportation operations, mobility, and safety. The New Jersey Department of Transportation (NJDOT) recognized the significant safety, operations, and mobility benefits associated with CV technologies. Considering New Jersey is one of the most congested states in the country, NJDOT wanted to offer its motorists these benefits. Over the last several years, NJDOT has introduced several initiatives and participated in various CV related working groups to evaluate the requirements associated with upgrading its digital infrastructure to allow for the successful deployment and integration of CV equipment into the existing NJDOT ITS architecture. Ultimately, this evaluation period resulted in NJDOT realizing that the best way to implement a real-world TSMO solution, would be to create a complete CV test-bed environment with pilot field locations. This realization led to NJDOT completing its New Jersey Connected Technology Integration and Implementation (NJCTII) project.

## TSMO PLANNING, STRATEGIES AND DEPLOYMENT

NJDOT used a robust TSMO implementation process for the NJCTII project that was based on the Federal Highway Administration's (FHWA) System Engineering Process. NJDOT recognized that based on the evolving nature of CV technology, a thorough planning and evaluation process would need to be implemented for the successful procurement, deployment and validation of enhanced digital infrastructure hardware and software for CV technologies. The NJCTII project included the following implementation steps:

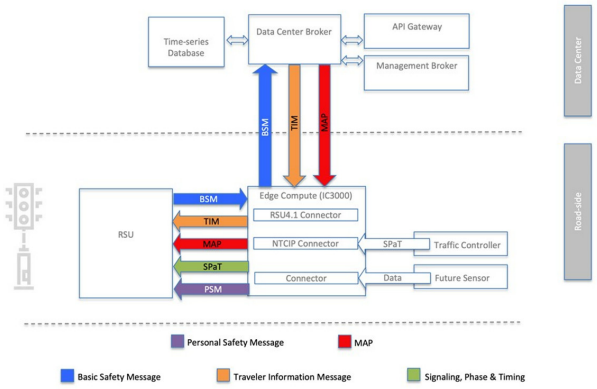
• **Capability Maturity Matrix (CMM)** – NJDOT realized that agency staff had little to no practical experience with CV technology. To better understand its own abilities, NJDOT followed the FHWA Capability Maturity Matrix (CMM). This process allowed them to prioritize the proper actions and areas of emphasis throughout the NJCTII project.

• **Concept of Operations (ConOPS)** – After NJDOT completed its self-assessment, it developed a ConOPS document to clearly identify the specific goals and objectives associated with CV technology. The document outlined NJDOT's current digital infrastructure and communications systems and identified the needs required to achieve statewide connectivity, CV data management and networking, procurement, and CV application deployments. The needs referenced in this document were used to create the requirements for the NJCTII project.

• **System Requirements Document (SRD)** – NJDOT hosted a series of workshops to determine the overall system requirements of the digital infrastructure and CV technologies for successful deployment. A document and new DOT process were created to evaluate locations and determine needs for CV technology implementation. The document summarized system requirements associated with the location selection, hardware selection, data flows, security, and interoperability with existing NJDOT systems. It should be noted that at the beginning of the NJCTII project, there were no known deployments of CV technology at SCATS enabled traffic signals, making this the first project in the country to integrate the systems.


• **Solution Design Document (SDD)** – NJDOT used the specific requirements from the SRD to design the digital infrastructure and CV systems for deployment at 5 pilot intersections. The SDD included wiring diagrams, networking, network equipment layout and field equipment installation for the function of the CV system and

digital infrastructure upgrades. The use of this detailed TSMO implementation process allowed NJDOT to successfully procure the hardware and software components required to complete a full system CV system validation in a lab facility located at The College of New Jersey (TCNJ).




## COMMUNICATIONS PLANNING AND EXECUTION

NJDOT utilized an extensive communications process to coordinate with key stakeholders and other transportation agencies. This outreach and communications process was used to determine the needs and goals associated with the deployment of a CV system on NJ's roadway network. NJDOT held stakeholder coordination meetings during the planning process to discuss operational and safety issues that could be improved by the deployment of TSMO strategies, specifically CV systems. These communications included direct coordination with other transportation agencies within NJ, CV vendor and Original Equipment Manufacturers (OEMs), along with other departments within NJDOT.

NJDOT realized that there were many groups within NJ that were investigating CV technologies, but that they were working independent of each other. NJDOT and the NJCTII project team encouraged coordination between these groups and committees to promote the successful implementation of CV technology throughout the state. NJDOT took the following actions to maximize the stakeholder communications efforts:

• **Conferences** – NJDOT presented the NJCTII project and CV program at various conferences and seminars. These seminars ranged from internal NJDOT only sessions, to larger industry conferences. Throughout the course of the project, the NJDOT presented the project at 4 ITS statewide meetings (New Jersey, Pennsylvania, Maryland, and New Hampshire), a Traffic Safety Conference and a national conference (Transportation Research Board).

• **Training** – NJDOT has developed an internal training program so staff can learn how to operate and maintain the CV systems that are being deployed in the field. The training program consists of more than 10 modules that provides NJDOT with information ranging from an introduction to CV systems, remote operations and physical installation and troubleshooting guidelines.

• **Lab Demonstrations** – NJDOT established a permanent testing facility at TCNJ to conduct live demonstrations to show key stakeholders how the CV system functions. The lab setup provided stakeholders with a unique visual experience that allows them to better understand how NJDOT is operating its CV system. These demonstrations also allowed for maintenance staff to configure and troubleshoot the CV systems to assist with future field deployments.

## OUTCOME, LEARNINGS AND PUBLIC BENEFIT

NJDOT successfully deployed and integrated CV technology to broadcast SPaT, TIM, BSM, MAP CV data. The NJCTII team used a spiral based testing approach in the lab to validate the CV systems. This approach allowed NJDOT to validate each CV component and digital infrastructure equipment both individually and as a functional system. A compatibility matrix was developed to show which CV hardware was functional and interoperable on NJDOT's network. NJDOT used the lessons learned from the lab to deploy a fully functional CV system at 5 pilot intersections.

The NJCTII project provided many benefits to both the motorists of NJ and NJDOT. These benefits included/resulted in:

- Work completed was directly used to develop the standard specifications and drawings associated with CV deployments.
- Project successfully procured, deployed, integrated, and tested both the backend Connected Vehicle Management Platform and a Statewide Security Credentials Management System (SCMS)
- Project research resulted in NJDOT designing and advertising multiple construction contracts that will ultimately deploy approximately 100 RSUs across key corridors in southern New Jersey (Awarded in May 2021).
- Project resulted in NJDOT staff gaining hands-on exposure and practical experience/training with CV systems.
- Project resulted in the first deployment of CV2X RSUs within NJ.
- Project was able to determine hardware compatibility within NJDOT's architecture.
- Project resulted in the first active deployment of SPaT data broadcasts integrated with SCATS adaptive traffic signal systems in the country. This integration with SCATS will provide NJDOT with the ability to deploy CV technology along a greater portion of its signalized corridors.
- As a result of the various research and testing completed under this effort, the motorists of NJ will be able to realize the benefits associated with increased mobility and safety applications associated with CVs.

The project allowed NJDOT to learn from the ground up everything that is required with the planning design, procurement, and installation of a functional CV system.

After the success of the initial pilot deployment, NJDOT has decided to initiate an additional phase of the project to test other CV applications. NJDOT is currently in the process of testing Wrong Way Driving and Pedestrian Safety related applications, with the expectation that these will also lead to pilot deployments. These additional applications will provide the motorists and pedestrians within New Jersey additional safety benefits.