Distributed Testing and the Virtual Open Innovation Collaborative Environment for Safety (VOICES™)

As transportation technologies advance, ensuring their safety and effectiveness is crucial. The U.S. Department of Transportation's (USDOT) Federal Highway Administration (FHWA) is at the forefront of leveraging innovative methods to safely integrate and test new technologies. FHWA has invested in developing secure, mixed-reality, distributed testing capabilities to facilitate development of a safer, more efficient, and more equitable transportation system.

WHAT IS DISTRIBUTED TESTING?

Distributed testing enables the safe evaluation of interactions between heterogeneous systems within a cosimulation environment. These systems may consist of both physical and simulated test assets, which can be geographically dispersed. This approach can facilitate real-world testing conditions and extensive data collection, which are essential for evaluating the performance and safety of intelligent transportation systems, including both vehicles and infrastructure. Distributed testing requires four key components, as shown in figure 1: a secure network, a middleware (a common "language") for the components to interact interoperably, a scenario that can be applied across all sites to create a shared reality, and the test assets. Figure 2 shows a real-world example and a digital twin, and figure 3 is an example of a vehicle-in-the-loop test, which involves a live electric vehicle on a chassis dynamometer test stand.
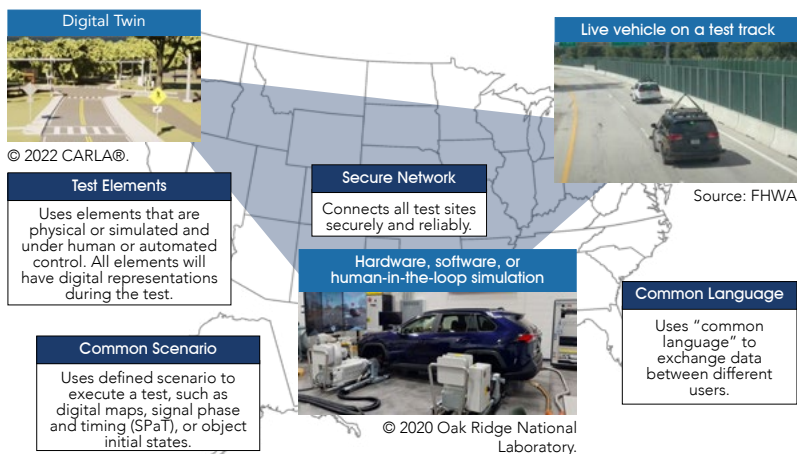

Figure 1. Graphic. Components of a distributed test.

To facilitate cross-industry and cross-organizational collaboration, USDOT has focused on the development of the common middleware and the secure network known as VOICES. Developed by USDOT and now fully managed and operated by the MITRE Corporation®, VOICES is a secure, scalable, and cost-efficient, cloud-hosted network designed to explore novel surface transportation concepts.[1,2] The platform enables users to quickly create and connect to test events with their selected partners, which facilitates a safe and innovative testing environment. The common middleware used in distributed testing builds on well-established investments and proven testing experience from other Government agencies. The common middleware enables the efficient exchange of ground truth states and message data, which creates lightweight and rapid data flows across the network of multiple sites.

KEY BENEFITS

- **Reducing costs:** Resolving integration issues early in a virtual environment.

- **Reusing models:** Using models across different simulation platforms. No recoding is needed.

- **Collaborating on best practices:** Advancing best practices and innovative system of systems solutions that improve transportation safety, efficiency, and equity.

- **Protecting intellectual property:** Securely connecting with others while safeguarding intellectual property.

Source: FHWA.

Figure 2. Photo and Image. An example of a real-world environment (left) and its digital twin (right).

Distributed testing reduces barriers for researchers and developers, which facilitates the safe integration of various existing and emerging technologies within the transportation ecosystem. As a result, Government, industry, and academia can more easily collaborate to create a mobility system that is safer, more sustainable, and more equitable.

FACT SHEET

U.S. Department of Transportation
Federal Highway Administration

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RESOURCES

For more information, including previous distributed testing webinars, videos, summaries, and technical reports, visit the following links:

- **A webinar hosted by Mcity provides an overview and live demonstration of distributed testing (located at minute 50):** https://tinyurl.com/distributedtest-pilot2-webinar.[3]

- **VOICES concept animated overview video:** https://www.youtube.com/watch?v=8htV-OQX2TI.[4]

- **Systems Integration Test 1 video:** https://www.youtube.com/watch?v=-thpVfL4tgY.[5]

- **Systems Integration Test 1 report:** https://doi.org/10.21949/1521742.[6]

- **Pilot 1 video:** https://www.youtube.com/watch?v=4WtdFYDcnuk.[7]

- **Pilot 1 report:** https://doi.org/10.21949/1521602.[8]

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Figure 3. Image. Example of a vehicle-in-the-loop simulation.

For more information regarding FHWA's Distributed Testing program, please contact Danielle Chou at danielle.chou@dot.gov.

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Recommended citation: Federal Highway Administration. *Distributed Testing and the Virtual Open Innovation Collaborative Environment for Safety (VOICES™)*. (Washington, DC: 2024). https://doi.org/10.21949/1521526