Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Unmanned Aircraft Systems (UAS) Communications Mesh Test Deployment

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PROJECT COST: $705,000

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Using smart infrastructure for beyond line-of-sight drone operations

As drones take on more roles in package delivery, emergency response and infrastructure inspection, they need to fly farther – often beyond the operator's line of sight. The Michigan Department of Transportation (MDOT) conducted research to determine whether its existing connected vehicle infrastructure, built for ground transportation, could also support drones in flight. Using a mix of drones, helicopters and ground vehicles, the team demonstrated that smart transportation technologies can reliably guide drones over longer distances. The results lay the groundwork for a future where air and ground transportation systems work together safely and efficiently.

PROBLEM

In recent years, MDOT has invested heavily in smart infrastructure for connected and autonomous vehicles. Short-range wireless technologies like dedicated short-range communications (DSRC) and cellular vehicle-to-everything (C-V2X) allow ground vehicles to share information and safely navigate the state's roads, raising an interesting question: Could the same communication tools used for connected vehicles also support drone operations? If they could, MDOT could expand and improve drone capabilities without building new networks using technology that is already available.

A wireless communications roadside unit is positioned at the southwest corner of the mesh network test area.

RESEARCH

The research team began testing in a tightly controlled airport environment and then set up real-world demonstrations using existing connected transportation infrastructure. The

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> *"We saw an opportunity to use existing ground transportation technology as a low-cost solution to enable beyond visual line-of-sight drone operations."*
>
> **Linn Smith**
> Project Manager

technology was configured to support aerial coverage up to 400 feet above ground, which is sufficient for most drones and low-flying crewed aircraft like helicopters.

DSRC and C-V2X roadside communication units were first installed at the Detroit City Airport to determine both viability and effectiveness. Then drones were outfitted with onboard units that could communicate and transmit signals to the short-range radio equipment. Once initial measurements were taken and testing performed at City Airport, the DSRC and C-V2X roadside communication units were installed at a test pilot site in Lansing to create a communications mesh network.

Researchers conducted trials at the test pilot site using drones, helicopters and connected vehicles. The drone operators, helicopter pilots and connected vehicle drivers could see each other's current location, altitude and planned routes on a live digital dashboard similar to what drivers see on their vehicles' GPS screens.

Team members studied how well the system supported real-time communication across vehicles, including areas with environmental obstacles like trees, electrical and/or water towers and buildings. They analyzed signal strength, information lag, network availability and other metrics to determine how well different types of vehicles coordinated operations using the same communication system.

RESULTS

The study confirmed that MDOT's existing smart transportation infrastructure built for ground vehicles can also support drone operations, especially when drones need to fly beyond the operator's line of sight.

Test flights showed that drones can successfully send and receive data over the wireless mesh network, confirming that the technology works in real-world conditions in both urban and rural environments. The tests demonstrated that drones can operate alongside connected ground vehicles using the same communication system, opening the door to fully integrated, multimodal transportation networks.

The study also highlighted some practical considerations for implementation. During the test flights, researchers found that environmental obstacles like trees, structures and uneven terrain can impact the strength of the communication signals. Careful placement of the roadside units is critical. The team found that performance in areas with obstructions improved significantly when units were strategically placed at the launch and landing zones and were distributed across the flight path.

As a result of this research, MDOT's traffic engineers, emergency responders, aviation planners and other end users could soon expand their drone operations, using these units more safely and effectively. For MDOT, this means future planning and infrastructure projects should consider not just ground transportation but also potential flight paths for unmanned aerial vehicles. The study also opens the door to future advancements, including swarm drone operations, 3-D flight coordination and aerial payment systems for tolling and other transactions.

With continued investment and smart planning, MDOT is positioned to lead the way in safe and efficient coordinated transportation systems – on the ground and in the skies.

IMPLEMENTATION

MDOT now has a roadmap for using its existing connected vehicle systems to support drone operations across the state. The breakthrough findings and detailed implementation recommendations will help MDOT make smarter infrastructure decisions to enable safe and efficient beyond line-of-sight drone flights, enhancing the state's transportation capabilities and supporting its broader vision for a connected, multimodal mobility system.

Research Administration

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The final report is available online at
MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1753.

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