DEVELOPING A COMMUNICATIONS FRAMEWORK FOR ADVANCED AIR MOBILITY

A look at WSP's work with the U.S. state of Michigan as it prepares for AAM

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Around the world, advanced air mobility (AAM) services are being developed and tested toward becoming part of transportation systems.

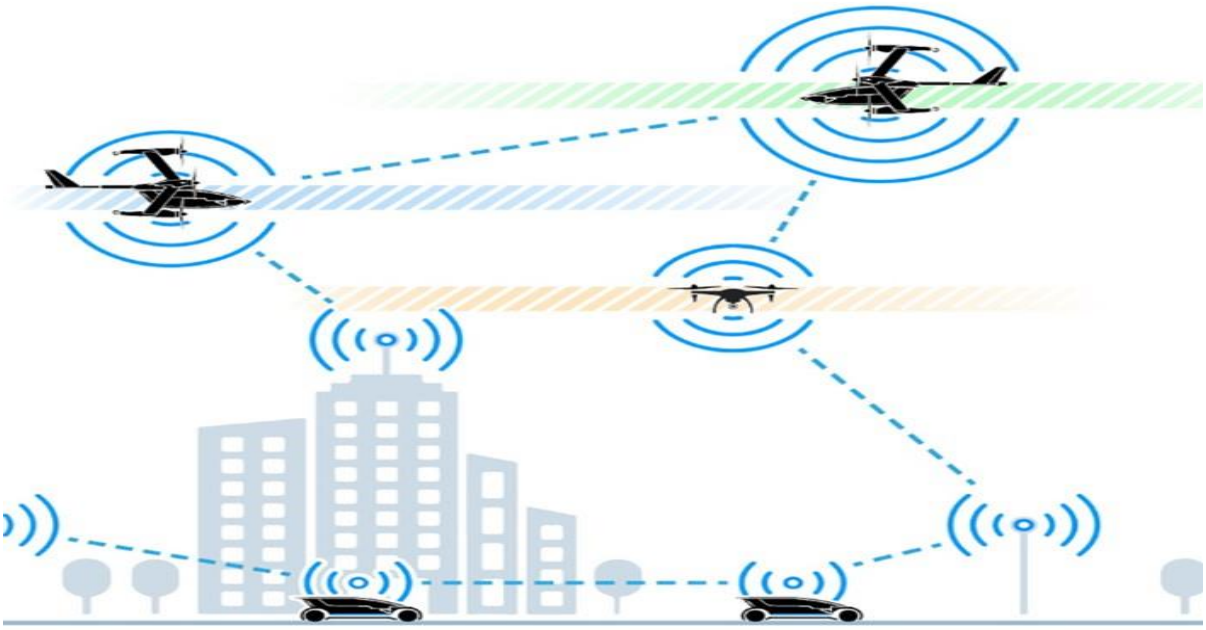
In the United States, WSP has been working with Michigan to advance a communications framework for the state's emerging AAM ecosystem. In the following article, Vice President of Aerial Innovation Paul Wheeler, WSP in the U.S., discusses the role of a robust communications framework in the overall success of AAM. He also addresses how Michigan's approach to AAM infrastructure development can be applied or adapted to other regions or countries seeking to establish similar systems.

Can you describe WSP's work with Michigan relative to AAM?

Paul Wheeler: Michigan, historically a focal point for automotive technologies in the United States, is now poised to extend its influence into the realm of advanced air mobility. Building on its legacy, Michigan is actively engaged in advancing aviation to establish itself as a frontrunner in next-generation aerial mobility and drone technologies. By doing so, Michigan Department of Transportation (MDOT) seeks to solidify its position as a hub for mobility solutions, not only in traditional automotive sectors but also in the rapidly evolving field of AAM. This strategic move aims to future-proof Michigan's standing and attract substantial economic opportunities, aligning with an industry anticipated to generate over $50 billion globally by 2030.[1]

[1] Michigan Central, "MDOT launch Advanced Aerial Innovation Region in Detroit to accelerate commercial drone development," Michigan Department of Transportation, October 25, 2023.

As part of this goal, WSP has partnered with Michigan to explore the integration of short-range wireless technology to address the gaps between uncrewed aircraft systems (UAS), often referred to as drones, and autonomous ground-based vehicles. Our primary objectives involve evaluating the efficacy of a short-range communications mesh[2] in facilitating beyond visual line-of-sight UAS deployments—toward developing a robust communications framework. Moreover, our goal is to utilize this technology to improve communication and integration between various transportation modes—including buses and trains—and AAM aircraft, contributing to the development of a more efficient and interconnected transportation system.



Source: Aerospace Experience Technologies (ASX) – depiction of connectivity when forming an interconnected multimodal communications network

What role does a robust communications framework play in the overall success of AAM operations?

Paul Wheeler: A robust communications framework will play a key role in the overall success of AAM. As AAM operations scale, there is the potential for numerous aerial vehicles operating in close proximity. An interconnected communications system will enable seamless coordination between these vehicles, supporting safe and efficient operations. It can help prevent collisions, manage traffic flow and allow more efficient operations between multiple transportation modes. A communications network that facilitates low-

[2] A communications mesh for this scope encompasses a comprehensive network architecture that integrates Cooperative Intelligent Transportation Systems (C-ITS) frameworks and wireless technologies to facilitate seamless communication among various modes of transportation, including UAS and AAM Vehicles, as well as automated connected vehicles, trains, buses and other transit systems. This mesh is engineered to address short-range wireless communication scenarios, requiring a fusion of mission planning, cooperative behaviour and autonomous capabilities.

latency data exchange between UAS, passenger air mobility vehicles, ground control stations, vertiports and other relevant entities can enable instant updates on travel times, vehicle locations, weather conditions and other critical information, allowing for timely decision-making and adjustments to flight plans.

As AAM operations take hold in their full complexity, having an efficient traffic management system that can assist by providing advisories and communications will be essential. A sophisticated traffic management system will enable aircraft to receive and respond to traffic advisories, route changes and other instructions rapidly, contributing to a smooth and organized traffic flow. Additionally, there will be a need for advanced situational awareness due to the scale of operations. A communications network can facilitate enhanced situational awareness for both crewed and uncrewed vehicles. Pilots and operators can receive information about positions, intentions and status of other vehicles in the vicinity, reducing the risk of conflicts between operations.

Another factor will be emergency response. In the event of emergencies, a robust communications network can provide quick and effective communication to facilitate rapid response and coordination. When incorporating the transportation system of the future, a necessity will be multimodal integration with existing infrastructure. A comprehensive communications network can facilitate smooth incorporation into established aviation and air traffic control systems. Moreover, this network can enhance travel times and operational efficiencies by linking various modes of transportation, mitigating congestion through effective coordination. As AAM and UAS operations evolve and expand, a robust communications network must allow for scalability and be adaptable to accommodate new technology and increased operations.

Project team members—from WSP, MDOT and ASX—in front of the advanced air mobility aircraft developed by ASX, WSP's partner on the Michigan communications mesh project.

"Serving and connecting people, communities and the economy through transportation is the goal of MDOT; advanced aerial mobility will be help us achieve that.

When emerging aviation technology is used to benefit all citizens, promote mobility, spur economic growth and reduce congestion within our transportation system, we develop sustainability in our communities."

Linn Smith

Program Manager,
Airspace & Emerging Aviation
Michigan Department of Transportation (MDOT)

Let's turn to the challenges in implementing and maintaining a communications framework for AAM. How can these challenges be addressed to maintain the reliability and efficiency of the infrastructure?

Paul Wheeler: There are multiple factors that could prove challenging in building and maintaining a communications network for AAM, with many new technologies that need to be integrated into the existing national airspace system. Building in redundancy to support safety in vehicle-to everything (V2X) communications will be essential where any failure could lead to critical safety issues. Introducing fail-safe and redundant systems and checks can help validate the data and mitigate potential safety risks. AAM systems will involve many components and technologies from different manufacturers, which may prove difficult when interoperability is needed. Additionally, bridging silos between vehicles that have traditionally been separate may also prove difficult. To help mitigate these risks, there should be a standard created for communications protocols and interfaces within the AAM ecosystem**.** Developing and implementing this standard would require collaboration among stakeholders toward forming a seamless communications mesh.

Security and privacy will also need to be addressed to confirm adherence to data security protocols. Some solutions would be to require data encryption mechanisms to secure all V2X communication channels. Security protocols would also need to be updated frequently to address any emerging threats. Scalability may also prove to be a challenge as infrastructure needs grow to accommodate a growing and diverse number of vehicles. To mitigate this challenge, it would be helpful to design a scalable V2X communications framework that can adapt to the increasing number of connected vehicles introduced through AAM and as part of other developments in new mobility.

Given the close proximity of multiple aircraft, maintaining low-latency communication is imperative for real-time operations. Large data packets can cause delays in communication channels between aircraft. One solution is to optimize V2X communications protocols for low latency and leverage edge computing to process critical data closer to the source, reducing round-trip times.

Additionally, the evolving regulatory landscape must be considered to make it possible for the system to remain adaptable to changing requirements, aligning with legal standards. While current global regulations primarily impact flight operations rather than network hardware, there's a risk that future regulations may mandate unforeseen minimum standards or components. The development of this communications network should inform these standards and hardware requirements for future iterations, to support scalability and compliance.

In parallel with regulatory considerations, fostering workforce development in the AAM sector is essential. Collaboration with universities and investment in training and skills development programs are vital to cultivate a workforce equipped with the necessary expertise to design, operate and maintain AAM systems. This involves interdisciplinary education and training initiatives encompassing aviation, engineering, data science, cybersecurity and regulatory compliance. By nurturing a skilled workforce, the industry can address emerging challenges, innovate effectively, and support the safe and efficient integration of AAM into the global airspace system.

Furthermore, establishing partnerships between industry stakeholders, academia and government agencies can facilitate knowledge exchange and collaborative research efforts. These partnerships can drive innovation, address workforce gaps and promote the development of cutting-edge technologies and best practices in AAM operations.

Navigating the regulatory landscape and investing in workforce development are integral components of building a sustainable and successful AAM ecosystem. By addressing these aspects comprehensively, the industry can foster growth, support safety and realize the full potential of AAM.

Can you discuss AAM in relation to other modes of transportation within communities and across regions?

Paul Wheeler: AAM serves as an overarching framework encompassing a spectrum of emerging technologies poised to revolutionize aviation and extend its reach into previously underserved markets. Collaborating closely with public authorities, we are diligently integrating AAM components into existing transportation infrastructure with a keen eye on enhancing community and regional accessibility.

Consider the transformative potential: leveraging both small and large UAS to alleviate food and medical scarcity by facilitating direct deliveries to cargo hubs, food banks and even individual residences; concurrently, electric vertical takeoff and landing (eVTOL) passenger aircraft stand ready to ameliorate transportation deficits in remote or underdeveloped regions.

The integration of AAM is not intended to supplant existing transportation modalities but rather to complement and fortify them. By seamlessly incorporating AAM technologies alongside traditional transit options, such as rail, bus and micromobility, we can foster the development of interconnected and resilient transportation networks, thereby offering individuals a broader spectrum of travel choices and facilitating connected communities.

How can Michigan's approach to AAM infrastructure development be applied or adapted to other regions or countries seeking to establish similar systems?

Paul Wheeler: Michigan is truly forward-thinking and pioneering the way for other regions when it comes to developing infrastructure that will enable safe AAM integration. At the core of Michigan's success lies robust leadership support and coordination. From the unwavering backing of the governor's office to the internal leadership within MDOT Division of Aeronautics, a culture of collaboration and trust permeates the state's AAM initiatives. This sustained leadership buy-in has fostered seamless coordination with both internal and external stakeholders, laying a solid foundation for addressing emerging technologies like AAM.

Crucially, Michigan has demonstrated prowess in establishing a regulatory framework conducive to AAM adoption. Through proactive engagement with the Federal Aviation Administration (FAA), MDOT has forged a collaborative relationship aimed at harmonizing state and federal regulations. This forward-thinking approach positions Michigan as a pivotal player complementing the FAA's regulatory efforts.

Furthermore, Michigan's phased approach to technology integration underscores its commitment to safe and effective AAM deployment. Recognizing the importance of digital and communications infrastructure, the state, in collaboration with partners like WSP, is spearheading projects to test and evaluate the feasibility of critical components such as communications mesh networks. These initiatives lay the groundwork essential for the seamless integration of AAM technologies into existing infrastructure.

Central to Michigan's approach is a steadfast commitment to community wellbeing. Embracing the principle of improving lives, MDOT prioritizes the wellbeing of the people it serves. This community-centric ethos permeates every facet of Michigan's AAM strategy, toward the ultimate goal of enhancing services and opportunities for its residents.

In essence, Michigan's experiences exemplify best practices that can guide and inspire other regions and government entities venturing into the realm of AAM adoption. By leveraging leadership support, fostering regulatory cooperation, prioritizing technological readiness and maintaining a steadfast focus on community wellbeing, Michigan sets a compelling precedent for the realization of safe and equitable AAM integration on a global scale.

Contact

Paul Wheeler
Vice President of Aerial Innovation
WSP in the U.S.
Paul.Wheeler@wsp.com

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