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Key Considerations of Physical and Digital Infrastructure and Exploring Minimum Service Levels

AAM MULTISTATE COLLABORATIVE

MEMBERS OF THE COLLABORATIVE

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ABOUT THE NASAO CENTER

The National Association of State Aviation Officials (NASAO) established its Center for Aviation Research and Education (C.A.R.E) in 1986, a nonprofit organization (501(c)(3)) that seeks to enhance state roles in the future of the national air transportation system. Through its relationship with NASAO and the states, this organization is uniquely situated to collect, analyze, and disseminate state-focused information on the aviation industry and the National Airspace System. The Center also provides educational opportunities aimed at youth and educators, fostering enthusiasm for the diverse careers found within the industry.

An early meeting of the multistate collaborative, hosted in July, 2024 in Oregon. (Photo by Kenji Sugahara)

ABOUT THE COLLABORATIVE

The NASAO AAM Multi-state Collaborative is an initiative of state government agencies or instrumentalities focused on the role of states in the development and integration of Advanced Air Mobility into the US National Airspace System. The Collaborative serves as a forum for states to discuss state-level policies and infrastructure needed to support AAM operations, with expert contributions from a variety of private sector stakeholders across this growing sector of the aviation industry.

INTRODUCTION

Advanced Air Mobility (AAM) represents a significant evolution in air transportation, introducing new technologies and a new mode of travel that can greatly enhance mobility. States have a crucial role to play by understanding and implementing Minimum Service Levels (MSL) for both physical and digital infrastructure. A minimum service level represents the baseline at which the infrastructure becomes truly useful for AAM operations, providing the necessary support for safe and efficient transportation. By leveraging existing ground infrastructure or aviation facilities, states can facilitate the adoption of emerging aerial vehicles and associated technologies. To fully unlock AAM's potential, it is essential to develop a robust and efficient framework that is standardized across state lines. While many aspects deserve attention, a primary focus should be on defining the MSL needed to ensure safe, reliable, and scalable operations. The physical and digital infrastructure of AAM are closely interconnected, each critical to the success of this new transportation mode. By establishing a harmonized framework that all states can adopt, necessary support and focus can be directed toward the Federal Aviation Administration (FAA) to ensure the viability and safety of AAM.

With the support of industry, the FAA is continuing to provide the basis of several aspects of AAM. However, state DOTs and Aviation Authorities have the responsibility to work with the FAA, other federal agencies, and industry to ensure seamless development and integration of existing and new infrastructure being developed by both private and public proponents. States can have a role in filling in data gaps where the FAA does not have primary coverage. States have a critical role to support infrastructure licensing/registration, system planning, and local municipalities. State governments should lean on their aviation departments for expertise as subject matter experts. If the aviation department needs assistance, they can turn to other state aviation agencies such as those that are part of the AAM Multistate Collaborative or the National Association of State Aviation Officials (NASAO).

KEY CONSIDERATIONS

Below is a fairly comprehensive list of key considerations for states as they develop their own frameworks for Minimum Service Levels for Infrastructure (MSL-I). These considerations are organized into sections addressing various aspects: where the infrastructure may be located, the minimal digital infrastructure required, how it can be managed, and how it can be integrated into the existing aviation system.

These considerations should be taken within the context of a crawl-walk-run methodology; the industry is still in the crawl phase. Industry and government are still figuring out what works. Investments should be made with an eye toward evaluating products rather than full deployment. Coordination with the FAA is critical to ensure that investments in technology are made with consideration to acceptance by the FAA. Physical infrastructure may be developed through public-private partnerships (PPP) with other state agencies or industry. The approach to infrastructure development can be either proactive or passive, depending on each state's mission, goals, and potential legislative support. This paper takes into account the role of states in comparison to the FAA. All statements refer to what activities are in the purview of the states, which may be different pending specific statutory authority. This service level should not be geographically confined or constrained; instead, it should begin by defining the characteristics of a service area including the level of both air and ground risk. Identifying and focusing on key service areas will be crucial in establishing a state-level minimum service level. Initially, key service areas will likely start at airports, where existing infrastructure and air traffic control procedures, where applicable, are already in place. As the Federal Aviation Administration (FAA) provides further guidance, this service can be extended to new vertiports/drone ports (AAM facilities) specifically designed for AAM operations.

The general needs of operators and FAA acceptance must also be considered when defining these minimum service levels. The specific infrastructure will vary depending on the operator and the type of airframe they use as well as their level of autonomy. Operators will need to develop their own procedures tailored to their operations unless they are required to integrate with existing aviation procedures. Understanding and categorizing different operator groups will be key to ensuring that the minimum service level meets diverse needs. Relevant standards, such as those established by ASTM International and RTCA, should guide the development of these service levels and should be informed by international work with organizations such as ICAO. The FAA's guidance will also play a critical role in shaping the requirements for AAM infrastructure and should be adopted at state level whenever appropriate. One important consideration is whether a facility must meet a minimum level of data service as part of its state licensing requirements. The answer is likely yes, and ASTM standards may serve as a benchmark for these data service requirements.

Physical Infrastructure

In the context of Advanced Air Mobility (AAM), the question of where infrastructure is situated is crucial for the successful integration of this new mode of transportation. The infrastructure for AAM can be located at traditional aviation facilities such as airports or at new, off-airport sites specifically designed to accommodate electric vertical takeoff and landing (eVTOL) vehicles or drones. The choice of location will significantly influence the types of infrastructure needed and the procedures required to support AAM operations. Where possible, states should explore leveraging existing infrastructure as well as creating infrastructure that benefits existing incumbent aviation. These themes are explored in the leveraging existing infrastructure paper.

States and municipalities are often responsible for approving and system planning where AAM facilities can be built. This involves supporting local municipality zoning decisions and land use planning to ensure that facilities are located in areas that are compatible with surrounding land uses, such as residential, commercial, or industrial zones. Municipalities must integrate AAM facilities into broader urban planning efforts, considering factors like traffic flow, proximity to other transportation hubs, and potential impacts on local communities. This includes aligning vertiport locations with multi-modal transit options to facilitate last mile service.

Local governments are typically responsible for issuing construction and operational permits for aviation facilities. This process ensures that development meets local building codes, safety standards, and other regulatory requirements. States may establish specific licensing requirements for vertiport and droneport operators, ensuring that they comply with both state and federal regulations. This could include criteria related to safety, operational procedures, accessibility, and environmental standards. State aviation entities are often tasked with regulating both public and private heliports and will likely be tasked with regulation of vertiports and drone ports.

eVTOLs require charging stations to recharge their batteries between flights, and the necessary stations use three phase electrical charging. Firefighting equipment, first aid stations, and other emergency response infrastructure are critical and must be updated to handle any incidents that may occur at the vertiport. States that plan to regulate sites should leverage FAA Infrastructure guidance for comprehensive designs standards.

The vertiport must be easily accessible by other modes of transportation, possibly with adequate parking facilities for passengers and staff. This connectivity is crucial for integrating the vertiport into the broader transportation network. Where possible, the vertiport should be connected to public transportation systems, such as buses or trains, to facilitate passenger transfers and enhance overall accessibility. Droneport facilities will need to be developed with the use case as well as community needs in mind.

For facilities, whether on or off airport, the use and extension of existing aviation supplement charts will be important to ensure that AAM operations align with established standards. This may involve the development of additional procedures to accommodate the unique aspects of AAM, such as vertical takeoff and landing, operations near or on airports, and the integration of these procedures into the broader aviation system. Other aspects may include notation on charts of droneports and high AAM traffic areas.

Digital Infrastructure

Digital air traffic procedures also play a critical role in AAM infrastructure. These procedures must be supported by robust systems that could be either private or public, depending on the nature of the operations and the facility. Facility-specific procedures will need to be clearly defined and supported by Geographic Information System (GIS) data, which provides essential spatial information for navigation and operations.

A full complement of sensors located at both on airport and off airport facilities may be necessary to ensure safety, security, and efficiency in AAM operations throughout all phases of flight especially in areas where there is no or limited FAA primary radar coverage. Sensors should be scaled to the risks of service areas. These sensors could include Automatic Dependent Surveillance-Broadcast (ADS-B) for tracking aircraft, radar systems for airspace with high tempo operations, optical and acoustic sensors to assist with detection of non-cooperative aircraft, and weather sensors to monitor atmospheric conditions.

Remote Identification (Remote ID) is also essential, especially for tracking uncrewed aircraft systems (UAS) and ensuring that non-cooperative detections, such as those of unauthorized or unidentified aircraft, are managed effectively. The specific needs of a site should be independently studied and tailored to airspace complexity at the location.

Solutions need to be tested and scaled appropriately, and decisions and investments should be made on an evaluation and testing basis as AAM is still in its infancy. Developments such as federal requirements for universal conspicuity for all aircraft or changes to right of rules could affect risk calculations.

In addition to radar and ADS-B, optical sensors and systems designed for UAS detection are potentially critical components that protect legacy aviation infrastructure. These systems will ensure that all vehicles, whether cooperative or non-cooperative, are detected and managed within the AAM ecosystem, likely all operating in a low altitude environment. What will be crucial is the work with the FAA to ensure that operators are able to leverage the data produced by states or third parties to receive credit for their operators' safety cases.

Ultimately, the successful deployment of AAM infrastructure relies on a careful balance between physical facilities, digital procedures, and an interoperable comprehensive network of sensors and detection systems. Each of these elements must be seamlessly integrated to support the safe and efficient operation of AAM vehicles, whether they are operating in controlled or uncontrolled airspace from existing airport facilities or from new, purpose-built facilities.

Data Standards

Data information is a cornerstone of the infrastructure that supports AAM. The digital landscape for AAM is composed of various databases and data sources, managed at both the state and federal levels, as well as by private entities. These data resources are crucial for ensuring safe, efficient, and reliable operations within the AAM ecosystem.

State-run databases and infrastructure play a vital role in supporting AAM. These systems often include obstacle and GIS data, which provide critical information on terrain, buildings, and other potential obstacles for aircraft.

Weather data is another key component, offering real-time information on atmospheric conditions that can affect flight safety. Additionally, sensor data collected by state-run networks contributes to a comprehensive understanding of the airspace environment, enhancing situational awareness. Master Record Surveys, which provide detailed information about airports and landing sites, are also maintained at a state level, ensuring that AAM operators have access to up-to-date data. The concept of digital twins—virtual models of physical assets—is increasingly being integrated into state infrastructure, allowing for advanced simulation and planning of AAM operations.

Federally run databases and infrastructure are equally critical in supporting AAM. The FAA's Airport Data and Information Portal (ADIP), which includes Master Record Surveys, is a key resource for accurate and reliable airport data. The System Wide Information Management (SWIM) system is another essential federal resource, providing a centralized platform for sharing real-time air traffic management information. ADS-B data, while managed federally, can be supplemented by state sensor networks to provide a more complete picture of air traffic, particularly in areas not fully covered by the federal system.

Private databases also contribute to the digital infrastructure for AAM. These databases may contain proprietary information that is kept confidential unless the owners choose to publish it voluntarily. Private entities may collect data on various aspects of AAM operations, including specialized weather information, sensor data, or other operational insights. While this data remains private, it can play a significant role in enhancing the overall safety and efficiency of AAM if shared within the broader ecosystem.

Existing information sources, such as weather data from airports and other weather services like NOAA and state Departments of Transportation (DOTs), also feed into the AAM digital infrastructure. These sources provide critical environmental data that supports both air navigation and other operational considerations. The integration of information from SWIM, ADIP, and ADS-B further enriches the digital landscape, ensuring that AAM operations are underpinned by comprehensive and accurate data.

In summary, the data infrastructure that supports AAM is a complex and layered system involving state-run, federally managed, and privately held databases. Each component plays a vital role in ensuring that AAM operations are safe, efficient, and well-coordinated, ultimately supporting the growth and success of this new mode of transportation. States have a role to support the data collection, visualization and governance of all these databases. Planning should be conducted to simplify and maximize the value of data collection and retention procedures.

DIFFERENTIATING AAM

States should continue evaluating the need and FAA CONOPs surrounding uncrewed traffic management (UTM). For UTM, it is important to define the roles and responsibilities of various authorities, including the FAA and local air traffic control (ATC). AAM operations will need to draw on lessons learned from the operations of existing heliports.

Understanding how low altitude airspace is managed at heliports, both on and off airports, provides valuable insights that can be adapted for AAM. Additionally, the role of ATC in managing these operations, particularly in congested or complex airspaces, must be clearly delineated. States should adopt a statewide plan to evaluate statewide UTM services.

One approach to avoid conflicts between AAM operations and traditional aviation is to site AAM infrastructure, such as vertiports or droneports, separate from conventional runways unless they are operating as conventional aircraft. This separation minimizes the risk of operational interference and simplifies prioritization issues. Existing procedures related to Notice to Air Missions (NOTAM) and Temporary Flight Restrictions (TFR) will need to be adapted to account for AAM, ensuring that these new modes of transportation are fully integrated into the broader airspace management system.

The interaction between different modes of communication is another critical consideration for AAM. Communication services may be provided by either private or public entities, with various technologies playing a role. Cellular networks and satellite communications will be essential for maintaining connectivity, especially in areas where traditional aviation communication infrastructure may be lacking. The Federal Communications Commission (FCC) has set aside specific spectrum for Uncrewed Aircraft Systems (UAS), which will be crucial for ensuring reliable communication links for AAM operations. Spectrum considerations. Additionally, Common Traffic Advisory Frequency (CTAF) will play a role in facilitating communication among aircraft operating in the same airspace, particularly in non-towered environments.

SUMMARY

Overall, the successful integration of AAM into the national airspace system will require careful consideration of these factors, leveraging existing procedures where applicable, and adapting new strategies to meet the unique demands of this emerging mode of transportation.

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