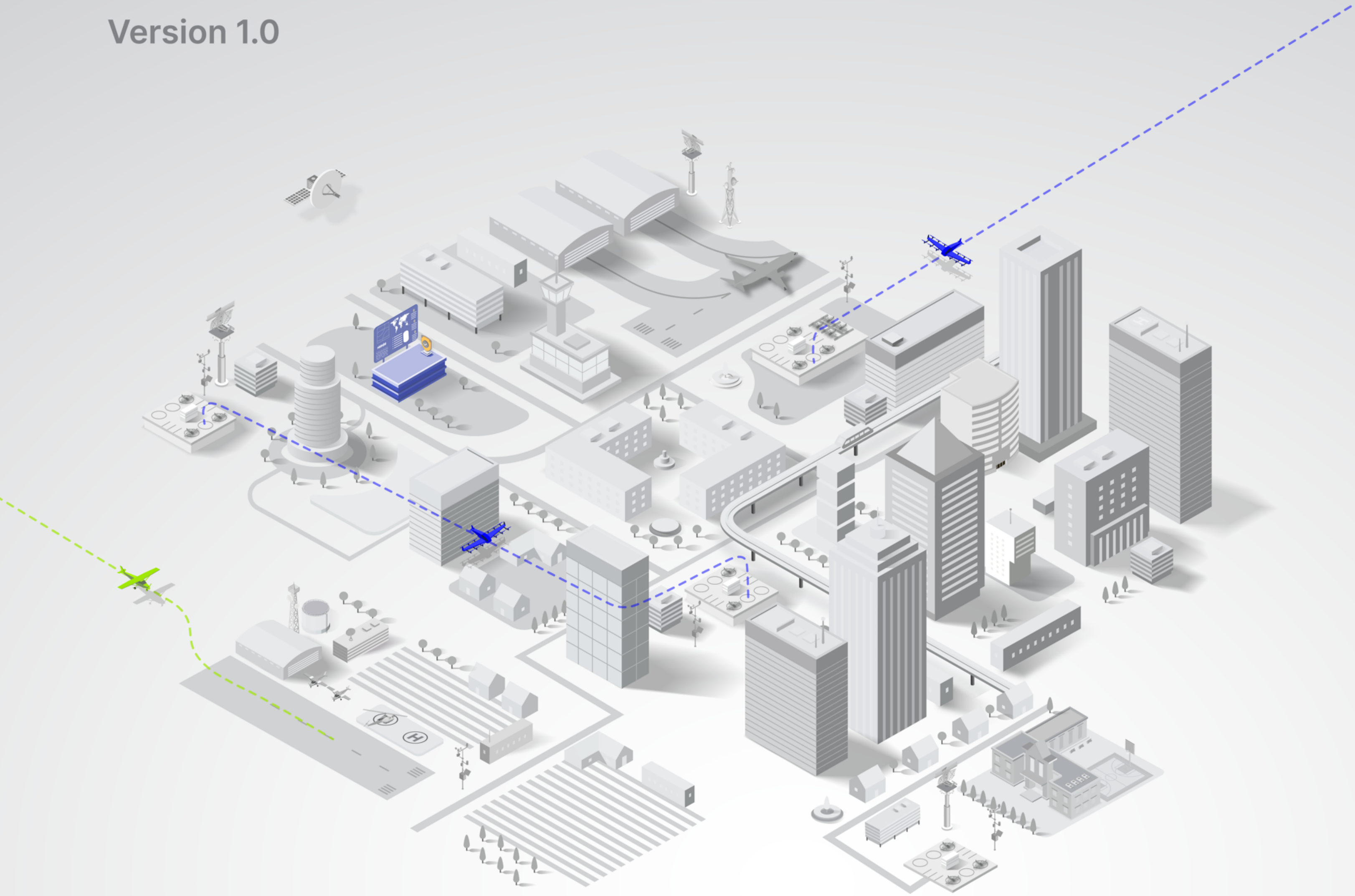
Concept of Operations for Third-Party Services

Supporting the Airspace Integration of Advanced Air Mobility

Version 1.0



Foreword

> *The desire to fly is an idea handed down to us by our ancestors who, in their grueling travels across trackless lands in prehistoric times, looked enviously on the birds soaring freely through space, at full speed, above all obstacles, on the infinite highway of the air. - Orville Wright*

Contemporary humans gridlocked on terrestrial highways must also *look enviously on the birds soaring freely through space*. There must be a better way.

More than a century ago, the persevering genius of Orville and Wilbur Wright ushered forth the history of practical flight. Today, the convergence of autonomy, digitization, and electrification promises to fully open the third dimension of mobility – to render into life, with even greater vividness and fluidity, Orville's *infinite highway of the air*.

Delivery drones, autonomous cargo aircraft, and air taxis are among the new "advanced aerial mobility" vehicles that will soon soar above and connect our communities. These aircraft upend aviation's once immutable scaling and economic laws – no longer are vehicles necessarily sized by the pilot. They challenge the steep performance tradeoffs in vertical and transitional flight with electrification and new configurations. And they usher forth, we hope and *engineer*, an era of pervasive and accessible aerial mobility.

The proverbial tech stack for advanced aviation extends beyond the aircraft. The industry must also wrestle with integrating increasingly autonomous aircraft, flying efficiently at higher volumes, into our complex, already strained airspace. Efficient digital operations and airspace integration are vital for scaling operations, creating thriving AAM businesses, and delivering meaningful social impact. Autonomous aircraft, operating without the *in situ* sense-decide-act network embodied in the onboard pilot, also require new tools to integrate safely into the airspace alongside existing users. One thing is clear: to spark and sustain the Second Golden Age of flight, we must get much smarter about how we build and orchestrate the *highways of the air*.

SkyGrid answers this call. We exist to open the sky for autonomous aviation and advanced air mobility. We achieve this by delivering assured data, decision support, and infrastructure integration to support AAM operations, autonomous aircraft integration, and airspace automation. And we know with conviction that we must do this at a demonstrably high level of assurance.

This concept of operations sets forth our vision for integrating AAM and autonomous aviation into today's airspace. The capabilities outlined in this ConOps will operate even more efficiently and support more aviation segments as the global airspace digitizes. We write this ConOps to help elevate and enrich the vital conversation around AAM operations and airspace integration. Your feedback and engagement will help us make this vision real with OEMs, operators, regulators, and our partners at Boeing and Wisk. On a mission that takes a literal global village, we must not – and will not journey alone.

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Executive Summary

Advanced Air Mobility, or AAM, promises to introduce several novel operations into the global airspace system over the next decade, with missions including vertical take-off and landing (VTOL) operations in urban environments and fixed-wing operations in regional settings. While the proposed use cases for AAM are diverse, they generally share the use of highly automated aircraft, ranging from Simplified Vehicle Operations (SVO) with a pilot on board to uncrewed operations with a remote supervisor.

Given a market focus on urban and regional settings, AAM operations are expected to occur in highly complex and constrained airspaces. These operations will therefore require a detailed understanding of their operating environments to navigate them in a way that is safe, efficient, and acceptable to Air Traffic Control (ATC) and current users of the air traffic system. In addition, uncrewed AAM operations will require new capabilities and services to retain their situational awareness and ability to avoid hazards without a pilot onboard.

As an aviation Third-Party Service Provider (TSP), SkyGrid is developing a system to address these emerging needs. The SkyGrid system will provide AAM operators flying crewed and uncrewed missions with a detailed digital representation of their operating environment for pre-flight and in-flight situational awareness, as well as decision support services to help them navigate today's airspace system safely and efficiently. Services offered by SkyGrid will be delivered to operators through a dedicated user interface and application programming interfaces (APIs) and will provide planning, alerting, and advisory capabilities. SkyGrid aims to obtain regulatory safety approval for its system – the first commercial system of its kind – to provide operators of uncrewed aircraft with a primary source of information for in-flight situational awareness and decision-making.

This Concept of Operations (ConOps) document provides an overview of the SkyGrid system, its envisioned use, and planned capabilities during early to midterm AAM operations. During this period, SkyGrid expects that AAM operations will take place using Visual and Instrument Flight Rules (VFR and IFR) without changes to airspace structure, and with ATC retaining responsibility for providing air traffic services. The objective of this ConOps is to describe, from an operator perspective, how the SkyGrid system will be used in this context to facilitate the airspace integration of AAM.

This document represents the first iteration of SkyGrid's concept of operations as a TSP supporting AAM operations in the current airspace environment. SkyGrid welcomes feedback and looks forward to future collaborations as it continues to refine this ConOps.

1 Introduction

Advanced Air Mobility (AAM) is set to introduce new types of operations into the global airspace system over the next decade. These include vertical take-off and landing (VTOL) missions in urban areas and fixed-wing operations for regional transportation. While the potential applications of AAM vary widely, they share a reliance on highly automated aircraft, ranging from Simplified Vehicle Operations (SVO) with an onboard pilot to uncrewed operations monitored by a remote supervisor.

Given an industry focus on urban and regional markets, AAM operations will often take place in highly complex, structured, and constrained environments. These environments may impose several restrictions on AAM operations, including the need to be deconflicted from existing aircraft operations and to not exceed the workload capacity of current Air Traffic Control (ATC). In addition, when operating uncrewed, AAM operations will require new capabilities to enable a Remote Pilot or Remote Supervisor to develop the necessary situational awareness[1] of their operating environment.

To operate effectively in this context, AAM operations will require a detailed understanding of their operating environments. In addition, uncrewed AAM operations may require new ground-based technology and services to retain their situational awareness and ability to avoid hazards without a pilot onboard. As an aviation Third-Party Service Provider (TSP), SkyGrid is developing a ground-based system to address these emerging needs.

The foundation of SkyGrid's system will be a high-fidelity and high-assurance digital representation of the operating environment. This model will provide operators with accurate real-time and forecast information from their operating environment, including information on traffic, weather, airspace structure, and ground infrastructure. Additional strategic and tactical decision support services will be offered by SkyGrid that leverage this digital representation. Before a flight, strategic decision support capabilities will support the airspace integration of AAM by helping operators plan flights that are safe, efficient, and acceptable to air traffic control. During a flight, tactical decision support tools will help operators manage new conditions, hazards and constraints – a key capability for supporting uncrewed operations.

This Concept of Operations (ConOps) document provides an overview of the SkyGrid system, its envisioned use, and planned capabilities during early to midterm AAM operations. During this period, SkyGrid expects that AAM operations will take place using Visual and Instrument Flight Rules (VFR and IFR) without changes to airspace structure, and with ATC retaining responsibility for providing air traffic services.

[1] The FAA defines situational awareness as *"the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements (pilot, aircraft, environment, and type of operation) that affect safety before, during, and after the flight"* in its Aeronautical Information Manual (AIM).

1.1 Purpose

The purpose of this Concept of Operations (ConOps) document is to describe, from an operational perspective, how the SkyGrid system will deliver approved third-party services to support the airspace integration of Advanced Air Mobility (AAM). Focus is given to providing high-level descriptions of the capabilities offered by the SkyGrid system, and how operators will interface with the system to conduct AAM operations.

This ConOps also intends to capture SkyGrid's vision for how the role of Third-Party Service Providers may evolve as ground-based capabilities, AAM operations, and operating rules mature.

This document represents the first iteration of SkyGrid's concept of operations as a TSP supporting AAM operations in the current airspace environment and will continue to be refined over time.

1.2 Scope

During the phase of operations captured in this ConOps, SkyGrid will provide flight-relevant information and decision support to help AAM operators navigate complex and highly constrained airspaces. Flight-relevant information will be delivered using a high-fidelity digital representation of the airspace. This digital model will be used by operators of uncrewed aircraft as their primary source of information for in-flight situational awareness and decision-making. Additional decision support services will be offered that leverage this digital representation, although they are intended for advisory[2] use only and are not considered safety-critical during this phase of operations[3]. As such, the Pilot-in-Command (PIC) – an Onboard Pilot, Remote Pilot, or Remote Supervisor – retains final authority and responsibility for all in-flight decision-making.

The SkyGrid system will be used by ground-based operators with no onboard elements. Users will include Operations Managers responsible for planning, scheduling, and monitoring flights, as well as Remote Pilots and Remote Supervisors of uncrewed aircraft.

1.3 Intended Audience

The intended audience of the document includes all stakeholders who will use, support, regulate, or otherwise interact with the SkyGrid system in the context of AAM operations. This audience includes:

- Aviation regulatory bodies including the Federal Aviation Administration (FAA), the European Aviation Safety Agency (EASA), and the International Civil Aviation Organization (ICAO).

[2] Advisory services are defined as those that support the operator's decision-making processes by highlighting key information and feasible actions.

[3] An exception is SkyGrid's Ground-Based Detect-and-Avoid service, which is in fact considered safety-critical in this phase of operations.

- National research organizations including the National Aeronautics and Space Administration (NASA).
- Air Navigation Service Providers (ANSP).
- Technical standard organizations including RTCA, ASTM, NIST, SAE, and EUROCAE.
- AAM fleet operators and airlines.
- AAM Original Equipment Manufacturers (OEM).
- Companies developing aircraft equipment and systems for AAM.
- Companies developing and operating physical infrastructure (e.g., vertiports and airports) that may be used to support AAM operations.
- Supplemental Data Service Providers (SDSPs), who may provide the aeronautical, weather and aeronautical data used by the SkyGrid system.

1.4 Document Outline

Section 2 of this document describes the operating environment in which the SkyGrid system is expected to function, along with the basic principles and assumptions made by SkyGrid in the development of its system.

Section 3 provides an overview of the SkyGrid system, its capabilities, value proposition, and external interfaces. Third-party services planned by SkyGrid are described in this section.

Section 4 provides a narrative description of a typical Advanced Air Mobility flight as envisioned by SkyGrid and how an operator will be expected to interact with the SkyGrid system.

Section 5 concludes this ConOps by highlighting opportunities for future collaborations that could support the maturation of Third-Party Service Provider systems.

2 Operating Environment

This section discusses the operating environment in which the SkyGrid system will be expected to operate, provides an overview of future Advanced Air Mobility (AAM) operations, and outlines the roles that third-party service providers are expected to play in the AAM ecosystem.

2.1 Overview of AAM Operations

Advanced Air Mobility (AAM) promises to introduce several novel operations into the global airspace system over the next decade. These will range from highly automated vertical take-off and landing (VTOL) operations in urban environments to uncrewed fixed-wing operations in regional settings.

SkyGrid is developing its third-party services platform to initially support the integration of three distinct types of AAM operations:

- Crewed Vertical Take-off and Landing (VTOL) operations.
- Uncrewed Vertical Take-off and Landing (VTOL) operations.
- Uncrewed Conventional Take-off and Landing (CTOL) operations.

VTOL AAM operations are represented by new, highly automated operations that aim to transport paying passengers and cargo within urban markets (i.e., Urban Air Mobility, or UAM). New aircraft proposed for this market segment are often electric (eVTOL), and both crewed and uncrewed vehicles have been proposed. While crewed VTOL operations may take place under both Visual Flight Rules (VFR) and Instrument Flight Rules (IFR), uncrewed operations are expected to occur solely under IFR. Typical missions are expected to cover less than 50 nautical miles, with aircraft cruising at airspeeds between 100 and 150 knots, and at low altitudes (less than 5000 ft AGL).

CTOL AAM operations are represented by highly automated fixed-wing operations, which will initially be used to transport cargo in regional markets using existing turboprop aircraft converted for uncrewed operations. These operations are expected to occur under IFR, and have similar mission profiles (i.e., altitudes, speeds and ranges) as current cargo feeder operations flown by turboprop aircraft.

These initial AAM operations are expected to take place in both controlled airspaces (i.e., Class B, C, D, E) and uncontrolled airspaces (i.e., Class G). Flight in uncontrolled airspaces is expected to be limited to takeoff and landing operations.

The initial integration of these novel operations into the global airspace system will require two key challenges to be addressed:

1. Operations taking place in complex low-altitude environments (i.e., Urban Air Mobility operations by VTOL aircraft) will require a detailed understanding of their operating environments to avoid hazards and to efficiently navigate airspace constraints.
2. Uncrewed operations will require new data services to maintain their situational awareness on the state of the environment and the aircraft without a pilot onboard.

Third-Party Service Providers (TSP) will contribute to the airspace integration of these operations by providing operators with the data services needed to address these challenges.

2.1.1 Evolution of AAM Operations

The AAM operating environment is expected to evolve gradually from its initial integration stage towards a mature state. In the United States, the FAA has proposed that the maturity level of AAM operations can be characterized by six variables[4]:

1. **Operational Tempo**: a measure of the throughput of AAM operations taking place.
2. **Airspace Structure**: a measure of the complexity of airspace constructs and procedures supporting the AAM operating environment.
3. **Regulations**: the availability of rules to address the specific needs of AAM operations.
4. **Cooperative Operating Practices (COPs)**: the availability of industry-defined practices that define how operations interact.
5. **Aircraft Automation**: a measure of the level of automation applied in the conduction of AAM operations.
6. **PIC Location**: whether the pilot in command is physically located onboard the aircraft, or on the ground (e.g., a Remote Pilot or Supervisor).

Based on these indicators, the FAA identifies three distinct AAM maturity phases, which are summarized in **Table 1** below.

	Initial AAM Operations	Midterm Operations	Mature State Operations
Operational Tempo	Low.	Low to medium.	High.
Airspace Structure	No unique AAM structures or procedures.	Flights occur within AAM corridors and share operational intent.	Flights occur within AAM corridors and share operational intent.
Regulations	Existing rules, regulations, and local agreements.	New regulations enable operations within corridors.	New regulations enable higher-density operations within corridors.
COPs	None.	New COPs introduced defining operations within corridors.	More complex COPs introduced defining operations within corridors.
Aircraft Automation	Equivalent to existing aircraft.	New control automation introduced, such as Simplified Vehicle Operation (SVO).	New automation introduced, enabling human-over-the-loop (HOVTL) capabilities.
PIC Location	Onboard.	Primarily onboard, but remote operations introduced.	Onboard and remote.

Table 1. AAM maturity stages proposed by the FAA.

[4] Source: FAA UAM ConOps v2.0.

Other AAM concepts of operations from aircraft developers and regulatory agencies have outlined similar evolutionary approaches to the introduction of AAM operations. Given the FAA's and other similar AAM roadmaps, SkyGrid aims to develop a TSP system with increasing levels of automation and assurance to support all phases of AAM operations, from early airspace integration to mature operations.

2.1.2 Evolution of SkyGrid's Third-Party Services

SkyGrid has identified a similar evolutionary approach to the development of its TSP system, with the intent of eventually offering high-assurance third-party services to support mature AAM operations. In this future state of operations, the SkyGrid system will support the cooperative management of AAM operations without direct ATC involvement, contributing directly to the scaling of operations. In the United States, the FAA has referred to this type of mature TSP system as a Provider of Services for Urban Air Mobility (PSU).

Based on this long-term target, SkyGrid identifies three phases of operation for its system, with earlier phases supporting the integration of AAM operations within the current air traffic system and under existing regulations. As the SkyGrid system matures, specific services provided by SkyGrid will evolve from being informational-only, to providing alerts and advisories, to providing automated decision-making and being delegated responsibility for safety-critical tasks. The three proposed phases of operation, along with their anticipated timelines, are:

- **Phase I (Entry-into-service, 2026-2028):** The SkyGrid system, which is expected to enter service in 2026, will initially provide flight-relevant information to operators. This information will be provided by SkyGrid's Digital Information Services and will offer operators a detailed understanding of their operating environment. During this phase of operations, the SkyGrid system will be used by operators for pre-flight situational awareness, and by operators of uncrewed aircraft as their primary source of information for in-flight situational awareness and decision-making.
- **Phase II (2028-2032):** During this phase, the SkyGrid system will provide AAM operators with additional decision support services to assist them during the planning and execution of flights within the current air traffic system. These services are represented by SkyGrid's Strategic and Tactical Planning Services and will offer alerting and advisory capabilities. The addition of decision support services during this phase of operations will contribute to more efficient AAM flights and reduce the need for ATC intervention in AAM operations, leading to more scalable operations. SkyGrid anticipates that this phase will offer opportunities for gaining experience with PSU functions in a decision support capacity and producing evidence for their future operational approval.
- **Phase III (2032+):** In this phase, the SkyGrid system will support mature AAM operations within corridors, which will be conducted without direct ATC involvement. In the transition to this phase, SkyGrid expects that its system will transition from providing decision support to providing automated decision-making in a responsible capacity, helping to maintain a safe and orderly flow of traffic within AAM corridors as a PSU. Services offered by SkyGrid in this phase will consist of evolved forms of the decision support services offered in Phase II.

Given this incremental development approach, **the remainder of this ConOps focuses on describing the operation of the SkyGrid system during Phase II described above**, during which the system will provide decision support capabilities to help early AAM operators navigate the current air traffic system. A more detailed discussion of Phase III will be the target of future SkyGrid publications.

Table 2 below provides a summary of key differences among the three system phases discussed.

	SkyGrid Phase I (2026-2028)	**SkyGrid Phase II (2028-2032)** **This ConOps**	**SkyGrid Phase III (2032+)**
Characteristics of Operating Environment	No changes to airspace structure and flight rules.	No changes to airspace structure and flight rules.	New AAM corridors. New flight rules tailored for highly automated operations.
Assumed Roles and Responsibilities	*PIC*: No changes. *ATC*: No changes. *SkyGrid*: Provides information for operator situational awareness.	*PIC*: No changes. *ATC*: No changes. *SkyGrid*: Provides information and decision support.	*PIC*: Changes possible. *ATC*: Changes possible. *SkyGrid*: Provides information and automated decision-making to support mature operations.
Services Offered by SkyGrid System	1) Source of digital information for pre-flight and in-flight situational awareness.	1) Source of digital information for pre-flight and in-flight situational awareness. 2) Decision support for flight planning. 3) Decision support for responding to in-flight hazards and constraints.	1) Source of digital information for pre-flight and in-flight situational awareness. 2) Responsible flight planning automation with operator on the loop. 3) Responsible in-flight decision-making automation with operator on the loop.
Benefits of SkyGrid System	1) Provides operators with improved pre-flight and in-flight situational awareness. 2) Provides uncrewed operations with high-assurance traffic surveillance to satisfy Remain Well Clear requirements.	*All previous benefits* + 1) Supports operators in planning flights that are more efficient, acceptable to ATC, and scalable. 2) Reduces workload of Remote Pilots/Supervisors. 3) Reduces need for ATC intervention in AAM operations.	*All previous benefits* + 1) Enables higher-tempo operations. 2) Further reduces operator workload in all mission phases. 3) Further reduces ATC workload. 4) Increases operational efficiency.

Table 2. Summary of SkyGrid's roadmap for its TSP system.

2.1.3 Principles and Assumptions

The remainder of this ConOps provides an overview of the SkyGrid system, its envisioned use, and planned capabilities during Phase II of the SkyGrid system roadmap, summarized in **Table 2**.

Table 3 below summarizes the key assumptions made by SkyGrid with regards to the AAM operating environment during this phase of operations.

Feature of Operating Environment	Assumption
Flight Rules	Crewed AAM operations will take place using existing VFR and IFR rules. Uncrewed AAM operations will take place under IFR only.
Airspace Structure	Existing airspace and sector structure will be retained. Airspace "keyholes" or "carve outs" may be used to omit the airspace above vertiport locations from controlled airspaces.
Air Traffic Services	Aircraft separation and traffic flow management will be provided by Air Traffic Control (ATC) in controlled airspaces. Third-Party Service Providers (TSP) may generate tactical advisories to operators, including flow management advisories.
Separation Standards	Existing separation standards will be retained (e.g., FAA Order 7110.65). Uncrewed aircraft will satisfy *Remain Well Clear* and *See and Avoid* requirements using new airborne and ground-based systems[5].
Routes	Existing VFR corridors and ATC-preferred IFR routes will be leveraged where applicable. New IFR routes may be created to serve AAM operations, such as TK/ZK routes based on the RNP 0.3 Navigation Specification (NavSpec). Routes will provide higher predictability of AAM operations to air traffic controllers.
Instrument Flight Procedures (IFP)	Existing IFPs will be leveraged where applicable. New NavSpecs and IFPs may be created to serve uncrewed AAM aircraft, including approach procedures that support automated landings (similar to ILS CAT III).

[5] Changes to operational regulations may be required to allow this.

Communication Infrastructure	Existing two-way VHF communication between AAM operators and ATC will be retained. Ground-to-ground communication may be established between a Remote Pilot or Remote Supervisor and ATC. Datalink will be leveraged where applicable, such as for Pre-Departure Clearances (PDC).
Surveillance Infrastructure	Existing surveillance infrastructure will be leveraged (ADS-B, ASR-9, ASDE-X, WAM, etc.). New low-altitude surveillance sensors may be installed in the local areas of airports and vertiports to augment surveillance coverage.
Takeoff and Landing Sites	VTOL aircraft will operate from existing airports and vertiports. New vertiports may be built. CTOL aircraft will operate from existing airports. Third-Party Service Providers (TSP) will interface with vertiports and FBOs to reserve departure, arrival, and parking slots on behalf of operators.
Role of Third-Party Service Providers (TSP)	Third-Party Service Providers (TSP) will provide AAM operators with data services and decision support to improve their situational awareness, operational efficiency, airspace access, and throughput. Decision support services offered by TSPs, particularly during flight, will not compete with ATC instructions and will be provided outside of the typical time horizon of ATC actions.

Table 3. Key operating environment assumptions for Phase II of operations of the SkyGrid system (estimated between 2028 and 2032).

Third-Party Service Providers (TSP) will exchange information with operators using dedicated ground connections and cloud-based connections, depending on the criticality of the service being provided. For example, if a TSP provides all traffic surveillance data used by the operator of uncrewed aircraft to remain well clear of other traffic, the need for high assurance and low latency will likely require a dedicated ground-based connection between the TSP and the operator's ground control station. Conversely, the provision of less critical data, such as aeronautical charts, may occur safely through a cloud-based connection.

More than one TSP may support operations within a given airspace. In such a scenario, it is assumed that TSPs will collaborate to some degree by exchanging data to strategically deconflict AAM traffic and increase operational efficiency. For example, TSPs may exchange planned flight schedules when this information is needed to enable them to issue effective traffic flow management advisories to their respective operator-customers.

2.1.4 Roles and Responsibilities

AAM operations will involve several actors, each with specific responsibilities towards ensuring safe and efficient operations. The list below describes their roles and responsibilities.

Operator Roles

- **Pilot-In-Command (PIC):** A person operating an aircraft, who is responsible for the safety of the operation during flight. Based on the physical location of the PIC and the tasks required of them, their role can be further classified as:
  - **Onboard Pilot:** The PIC is physically located onboard the aircraft. Onboard pilots may engage in flight path control, navigation, and contingency management tasks. Onboard Pilots will not interface with the SkyGrid system during flight.
  - **Remote Pilot:** The PIC is physically located on the ground at a Ground Control Station (GCS) and operates a single uncrewed aircraft. Remote Pilots may engage in flight path control, navigation, and contingency management tasks. Remote Pilots will interface with the SkyGrid system during flight to receive in-flight data and decision support services.
  - **Remote Supervisor:** The PIC is physically located on the ground at a Fleet Operating Center (FOC) and supervises one or more uncrewed aircraft. Remote Supervisors may engage in navigation and contingency management tasks. Remote Supervisors will interface with the SkyGrid system during flight to receive in-flight data and decision support services.
- **Operations Manager:** A person (or group of people) who oversees the planning and execution of AAM operations. Responsibilities of the operations manager include flight scheduling, flight planning, crew assignment, and fleet management. Operations managers will interface with the SkyGrid system to plan and monitor flights.

Air Traffic Management Roles

- **Air Traffic Control (ATC):** A facility responsible for providing tactical air traffic services to aircraft operating within a controlled airspace, including clearances, separation provision, and in-flight advisories.
- **Traffic Management Unit (TMU):** A person (or group of people) within an ATC facility responsible for coordinating traffic flow management actions within the assigned airspace, such as the implementation of metering constraints and ground delays.

Service Provider Roles

- **Third-Party Service Provider (TSP):** A commercial entity that integrates a variety of data from the operating environment to provide actionable information and decision support services to AAM operators to facilitate the airspace integration of novel operations.
- **Supplemental Data Service Provider (SDSP):** A commercial entity that provides single-stream data related to specific features of the operating environment to a TSP. SDSPs can include:
  - **Aeronautical Data SDSPs:** Provide aerodrome data, instrument flight procedure data, NOTAM data, terrain data, and obstacle data.

    - **Weather Data SDSPs:** Provide real-time and forecast weather data, including winds, visibility, ceiling, precipitation, and icing conditions.
    - **Global Navigation Satellite System (GNSS) Data SDSPs:** Provide real-time and forecast GNSS performance data to determine the availability of GNSS for navigation (i.e., RAIM).
    - **Command-and-Control (C2) Data SDSP:** Provide real-time and forecast data on the performance and availability of ground- and satellite-based communication links used to monitor and control uncrewed aircraft.
    - **Surveillance Data SDSP:** Provide real-time traffic tracks obtained from cooperative and non-cooperative surveillance sensors, as well as performance data from the surveillance sensors used.
- **Command and Control Communications Service Provider (C2CSP):** A commercial entity that provides a Command and Control (C2) link to operators of uncrewed aircraft.

Infrastructure Support Roles

- **Vertiport Manager:** A person responsible for managing vertiport operations. Duties of the Vertiport Manager will include managing facility reservations, managing surface operations, and overseeing vehicle charging/refueling.
- **Fixed-Base Operator (FBO) Manager:** A person responsible for managing ground operations within a non-movement area of an airport. Duties of the FBO Manager will include managing facility reservations, managing aircraft parking, and overseeing vehicle charging/refueling.

The SkyGrid system will collect and combine data from various sources, including Surveillance Data SDSPs, Weather Data SDSPs, Aeronautical Data SDSPs, and C2 Data SDSPs. All data will be securely received, processed, and distributed, with extra safeguards in place for high-criticality data to ensure security, low latency, and reliability.

Traffic monitoring will benefit from new commercial surveillance sensors installed by Surveillance Data SDSPs, providing enhanced low-altitude coverage near vertiports and airports. Similarly, Weather Data SDSPs will establish new sensor networks to monitor conditions at takeoff and landing sites.

Vertiports and FBOs will share information on their status and capacity with SkyGrid to support AAM flight scheduling and slot allocation. Additionally, updates on airspace and airport resources will come from local ANSP or ATM systems.

2.1.5 Opportunity Space for Third-Party Service Providers

As previously stated, the challenges facing the initial airspace integration of AAM are expected to be two-fold:

1. **AAM operations will require technical solutions to navigate highly complex and constrained operating environments effectively.**

   AAM operations will need to be integrated into existing airspaces that are highly structured and highly constrained. For example, airspaces around major Class B and C airports today are populated with several departure and arrival instrument flight procedures used by jet aircraft to transit the airspace. The airspace around these procedures is often reserved for exclusive use by jet aircraft flying these procedures, which limits the volume of airspace usable by AAM aircraft. Other volumes within these busy airspaces are also reserved by air traffic controllers for the manual vectoring of jet aircraft as they are sequenced to land. These volumes, known as feeder approach sectors and final approach sectors, may likewise not be accessible to AAM operations during busy traffic conditions[6]. To operate effectively, AAM operators will need capabilities that help them anticipate and recognize these constraints.

   Another ATC-related factor likely to constrain future AAM operations in these environments is air traffic controller workload. As the tempo of AAM operations increases, controllers may reach the limit of how many aircraft they are able to safely manage simultaneously with their current procedures and systems. Today, controllers closely supervise helicopter operations in busy airspaces to ensure deconfliction from larger aircraft – a technique that can impose a significant workload burden on controllers. To enable high-tempo AAM operations in the future, mitigations will need to be developed that reduce the need for controllers to tactically intervene in AAM operations and reduce the workload required to manage these operations.

2. **Uncrewed AAM operations will require technical solutions to retain situational awareness regarding the state of the environment and to avoid hazards in flight without an onboard pilot.**

   Uncrewed AAM aircraft will require new information capabilities to maintain the situational awareness needed to understand the state of environment and avoid hazards without an onboard pilot. Hazards typically avoided by onboard pilots today include convective weather, unexpected icing conditions, and conflicting traffic. While this requirement may be satisfied through a variety of means (e.g., ground-based systems or new airborne sensors), the use of ground-based systems can reduce aircraft weight, cost, and complexity. In addition, aircraft relying on the same ground-based system for flight-relevant information can share a common operating picture for decision-making, which can increase the predictability of operations. While several data sources already exist that can be

[6] Sources: Salgueiro, S., *"Increasing Flexibility in the Design and Operation of Instrument Flight Procedures,"* 2024 and Vascik, P. D., Hansman, R. J., *"Assessing Integration Between Emerging and Conventional Operations in Urban Airspace,"* 2021.

leveraged, in some cases the requirement to operate without a pilot onboard may elevate the criticality of the data and require new third-party services with higher assurance, higher fidelity, and lower latency.

To ensure the commercial viability of AAM, the two challenges above must be addressed. In this context, Third-Party Service Providers (TSP) are well positioned to provide AAM operators with the data services they need to better understand their operating environment, plan flights that meet local airspace constraints, and avoid hazards in flight. As a TSP, SkyGrid is committed to helping AAM operators address these challenges by delivering four types of services through its ground-based system:

1. **Digital Information Services**: Services that provide operators with a high-fidelity digital representation of their operating environment for situational awareness, delivered through a high-assurance platform.
2. **Strategic Planning Services**: Services that support operators in planning AAM flights that are safe, efficient, and acceptable to ATC.
3. **Tactical Planning Services**: Services that support operators of uncrewed aircraft in managing new in-flight conditions, hazards and constraints.
4. **Mission Support Services**: Services that provide operators with the ability to track and analyze the performance of their operations.

These services are described in further detail in Section 3.

3 Overview of SkyGrid System

This section provides an overview of the SkyGrid system and the services that it will provide in support of the airspace integration of Advanced Air Mobility.

3.1 System Scope

The SkyGrid system is a ground-based system with a dedicated user interface and output API. The system is designed based on aviation standards to serve as a high-assurance source of flight-relevant information. The system will deliver a variety of digital services to operators to support the airspace integration of novel AAM operations. These will include data services to support an operator's understanding of their operating environment, and decision support services to assist operators in planning and executing AAM flights safely and efficiently.

SkyGrid's data services will provide operators of uncrewed aircraft with a primary source of information for in-flight situational awareness and decision-making.

SkyGrid's decision support services will facilitate AAM operations in the current air traffic system by supporting operators with planning tasks and reducing the need for air traffic controllers to tactically intervene in AAM operations. These services will be offered in an advisory capacity, with operators and air traffic controllers retaining responsibility for the safety of operations.

3.2 System Objectives

The primary purpose of the SkyGrid system is to support the airspace integration of novel AAM operations. To that end, the services to be offered by SkyGrid will achieve this by enabling operations with greater efficiency, ATC acceptance, and scalability.

Objective Statement: The SkyGrid system will enable safe AAM operations with greater efficiency, ATC acceptance, and scalability.

Four system goals are derived from this objective statement:

- **System Goal 1**: Provide a high-fidelity digital representation of the operating environment for operator situational awareness and decision-making.
- **System Goal 2**: Enable uncrewed operations by providing high-assurance traffic awareness needed to satisfy remain-well-clear and collision avoidance requirements.
- **System Goal 3**: Increase efficiency of operations by providing flight planning solutions based on detailed knowledge of the airspace, its structure, hazards, and constraints.
- **System Goal 4**: Streamline airspace access and help scale AAM operations by helping operators execute flights in ways that minimize the need for ATC intervention.

3.3 System Operation

A high-level operational concept graphic (OV-1) for the SkyGrid system is shown in **Figure 1** on the following page.

The SkyGrid system will support both crewed and uncrewed AAM operations within the current air traffic system.

For crewed operations, services will be provided to an Operations Manager in charge of planning, monitoring, and analyzing flights. These services include SkyGrid's Digital Information Services, Strategic Planning Services, and Mission Support Services. Onboard pilots will not interface with the SkyGrid system during flight.

For uncrewed operations, the Operations Manager will be provided the same services as in crewed operations, and additional Tactical Planning Services will be provided to a Remote Pilot or Supervisor responsible for the flight. During flight, the Remote Pilot or Supervisor will interface with the SkyGrid system directly, using it as a primary source of information for their situational awareness and decision-making.

The SkyGrid system will receive and aggregate data from a variety of sources, including Surveillance Data SDSPs, Weather Data SDSPs, Aeronautical Data SDSPs, and C2 Data SDSPs. Data will be received, processed and distributed using secure processes. High-criticality data will have additional requirements for security, latency, and assurance.

Traffic surveillance will be supported by new commercial surveillance sensors deployed by Surveillance Data SDSPs, as well as dependent surveillance broadcasts from aircraft (i.e., ADS-B). In terminal environments (i.e., in the vicinity of vertiports and airports), Surveillance Data SDSPs will provide additional low-altitude coverage. Similarly, Weather Data SDSPs will deploy and operate new sensor infrastructure for assessing weather conditions at new takeoff and landing sites.

Data on the status and capacity of vertiports and FBOs will be shared with SkyGrid by those facilities, for the purpose of AAM flight scheduling and slot allocation. Additional information on the status and capacity of airspace and airport resources will be received from the local ANSP or ATM system.

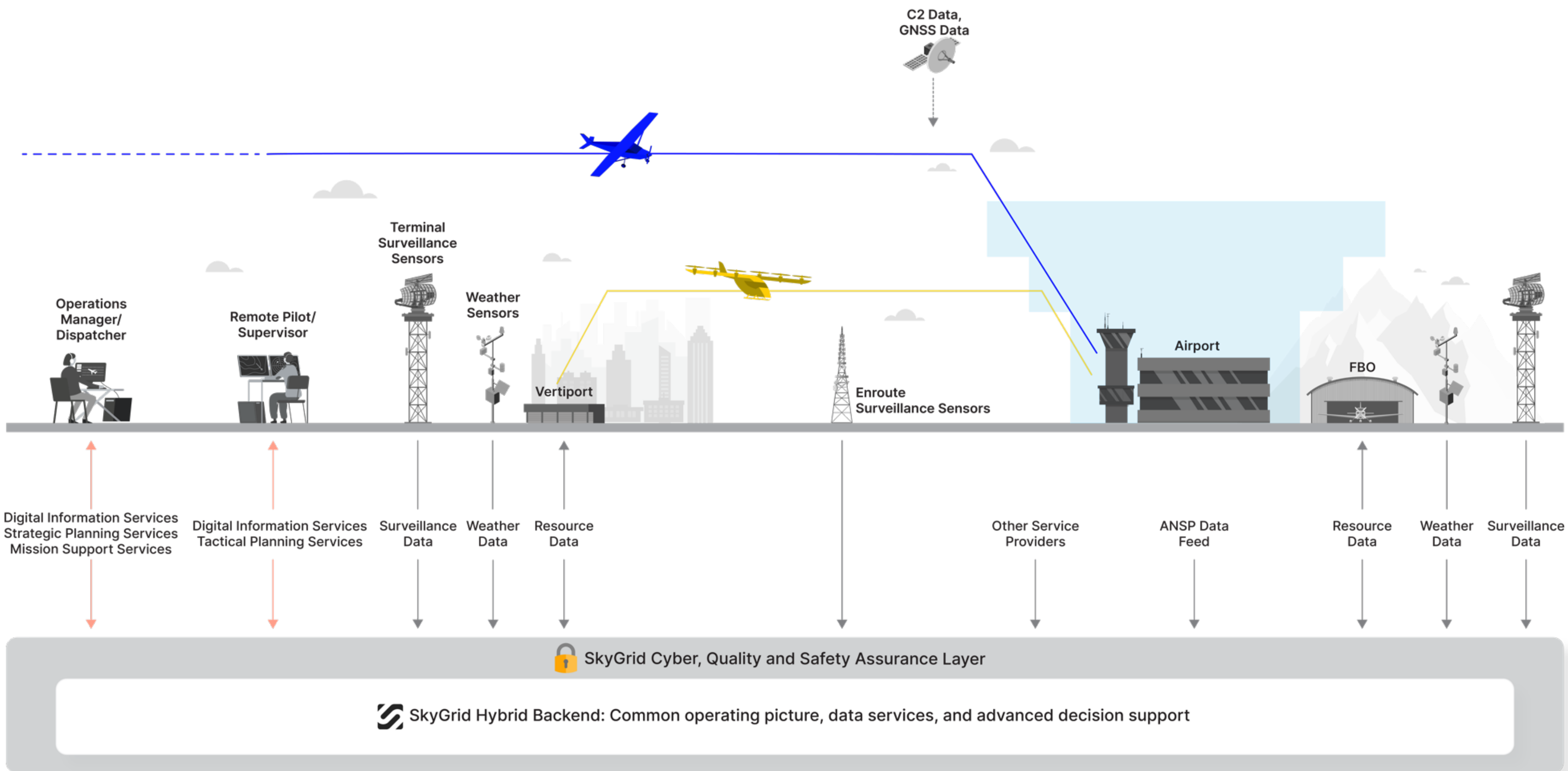

Figure 1. High-level operational view (OV-1) of the SkyGrid system.

3.4 Required Enablers

Successful deployment of the SkyGrid system will be contingent on the following external dependencies:

- **Regulatory Guidance for Approval**: Among its services offered, the SkyGrid system seeks to provide operators of uncrewed aircraft with a primary source of information for in-flight situational awareness and decision-making. Given the criticality of this functionality and the novel aspects of this type of system, SkyGrid will work with the FAA, EASA, and other regulators to identify a proper path to approval.
- **Standards Development:** Where applicable, the development and operation of the SkyGrid system will leverage consensus-driven industry standards. Standards will help determine the required integrity, resolution, and availability of data services provided by SkyGrid, and protocols used by the SkyGrid system to communicate with external systems. New standards may be sought to define protocols for communication between multiple Third-Party Service Providers (TSP), between a TSP and the ANSP/ATM system, and between a TSP and a vertiport or FBO.
- **Ground-Based Infrastructure Deployment**: Operation of the SkyGrid system may rely on the deployment of new low-altitude sensors, including surveillance and weather sensors. This infrastructure, deployed and managed by Supplemental Data Service Providers (SDSP), will provide weather and traffic data to the SkyGrid system to support highly predictable low-altitude AAM operations. For example, new weather sensors will provide high-resolution weather information at vertiports, while new surveillance sensors will provide information on vertiport hazards and local non-cooperative traffic.
- **Command-and-Control (C2) Infrastructure Deployment**: Operation of uncrewed aircraft will rely on a robust communication network for Command-and-Control (C2) services. While not provided by SkyGrid directly, this service is considered a key enabler of the uncrewed operations to be supported by SkyGrid.

3.5 Services Offered

As stated previously, the services delivered by the SkyGrid system are classified under four types:

1. **Digital Information Services**
2. **Strategic Planning Services**
3. **Tactical Planning Services**
4. **Mission Support Services**

Figure 2. List of services to be offered by the SkyGrid system.

Individual services identified under each category represent capabilities that directly support the four system goals previously discussed. Digital Information Services primarily aim to satisfy System Goals 1 and 2, while Strategic Planning Services are derived from System Goal 3 and Tactical Planning Services are derived from System Goal 4. The subsections below describe each individual service shown in **Figure 2**.

3.5.1 Digital Information Services

Digital Information Services include services that will provide operators with high-fidelity and high-integrity information about their operating environment, supporting their situational awareness. The following subsections describe the individual services considered under this category.

3.5.1.1 Terrain and Obstacle Data

The SkyGrid system will provide operators with high-resolution terrain maps and up-to-date information on man-made obstacles (e.g., buildings, cranes). This data may be visualized by operators via the SkyGrid user interface and will be used by the SkyGrid system during flight planning to determine minimum safe altitudes for an operation based on their rules of flight (VFR or IFR).

Terrain and obstacle data will be provided to SkyGrid by a Supplemental Data Service Providers (SDSP) through a process that satisfies applicable standards, which will ensure operators are always provided with up-to-date and untampered data.

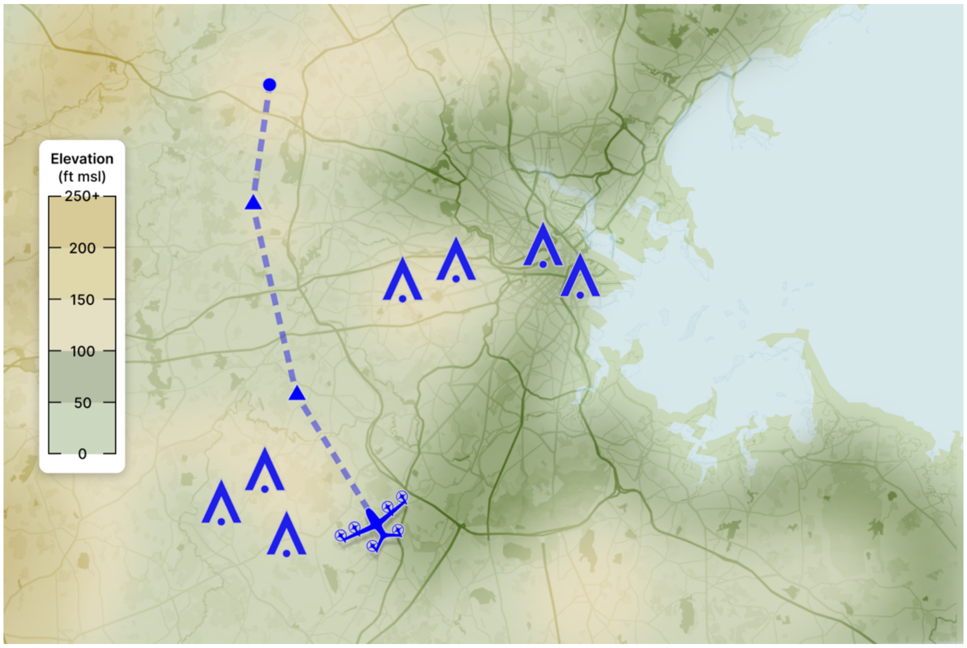

Figure 3. Notional operator view of SkyGrid's Terrain and Obstacle Data service, showing a representative terrain elevation map and obstacles.

3.5.1.2 Weather Data

The SkyGrid system will provide operators with high-fidelity weather data including weather reports, advisories, charts, imagery, forecasts, and observations. Real-time and forecast data may be visualized by operators via the SkyGrid user interface to assess weather conditions within a flight's operating area. Weather information will include atmospheric data such as winds, gusts, visibility, ceiling, temperature, humidity, altimeter settings, and weather hazards such as areas of precipitation, icing conditions, lightning, and wind shear.

SkyGrid's Weather Data service will integrate information from several weather sensors and sources to provide operators with a complete weather picture of their operating environment. Where applicable, SkyGrid will integrate available weather data from local Air Navigation Service Providers (ANSP), such as the Integrated Terminal Weather System (ITWS) and the Digital Automatic Terminal Information Service (D-ATIS) services in the United States. Additional low-altitude weather data from new in-situ sensors, including low-altitude winds and wind gusts, will be provided to SkyGrid by commercial Supplemental Data Service Providers (SDSP) following ASTM standards for micro-weather information where applicable. This data will provide AAM operators with the ability to assess ride quality (i.e., likelihood of turbulence) and control margins for powered-lift aircraft prior to a flight.

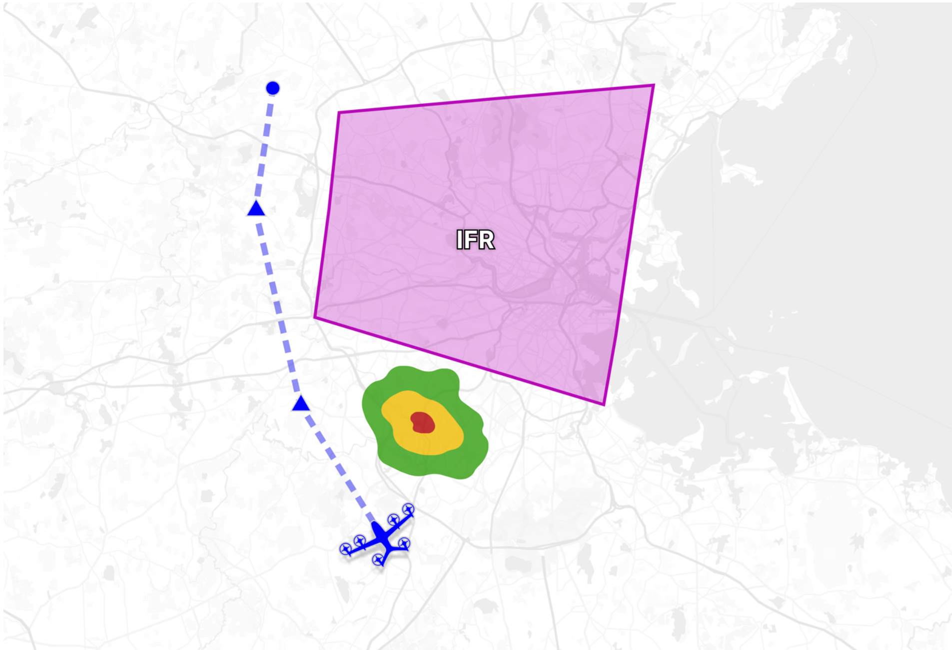

Figure 4. Notional operator view of SkyGrid's Weather service, showing a representative IFR AIRMET and weather radar returns.

3.5.1.3 Ground-Based Traffic Surveillance

The SkyGrid system will provide operators with high-integrity and low-latency traffic surveillance data, including tracks for cooperative and non-cooperative aircraft. In addition to aircraft track data, the SkyGrid system will provide real-time data on the performance of surveillance systems and expected coverage volumes. This data may be visualized in real-time by operators via the SkyGrid user interface.

SkyGrid's Ground-Based Traffic Surveillance (GBTS) service will integrate traffic information from several surveillance sources to provide operators with a complete traffic picture of their operating environment. Where applicable, SkyGrid will receive surveillance data from cooperative surveillance sources including ADS-B and Mode S transponders. Based on the needs of specific operating environments, additional non-cooperative surveillance sources may be integrated by SkyGrid using data received from commercial Supplemental Data Service Providers (SDSP). This data will rely on commercial primary radar systems and multilateration (MLAT) sensors deployed to support low-altitude AAM environments (multilateration in this case detects aircraft with Mode A/C transponders).

SkyGrid's GBTS service will be developed to satisfy RTCA standards and provide the primary means of traffic awareness for uncrewed operations.

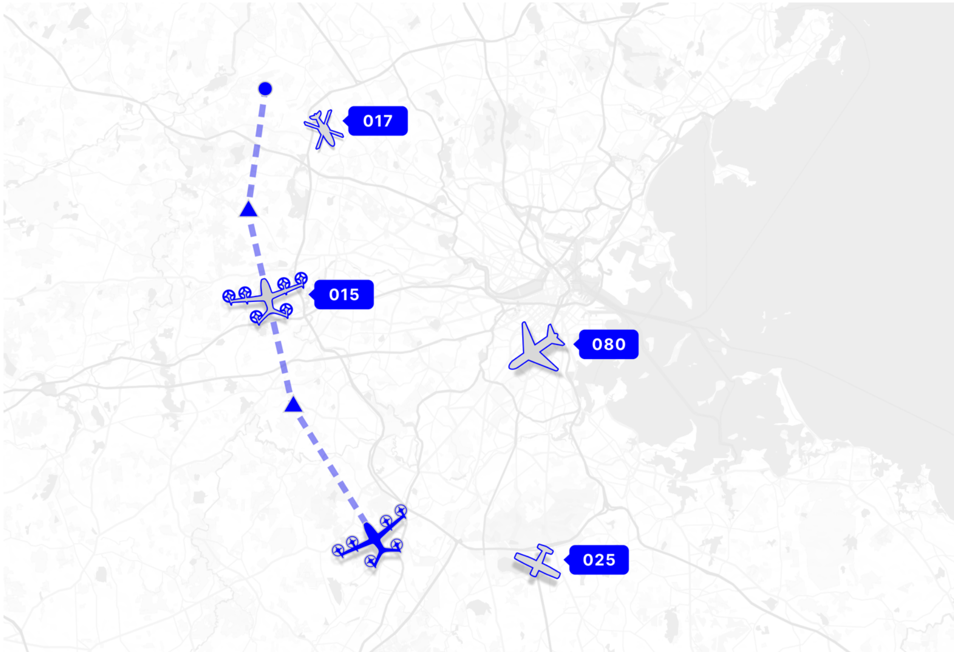

Figure 5. Notional operator view of SkyGrid's Ground-Based Traffic Surveillance service, showing aircraft traffic.

3.5.1.4 NOTAMs

The SkyGrid system will provide operators with digital (i.e., machine readable) Notices to Air Missions (NOTAM) for their operating area. NOTAMs will be viewable via the SkyGrid user interface. NOTAMs that are defined with specific spatial boundaries (e.g., Temporary Flight Restrictions, TFR) will be viewable on the map view of the SkyGrid user interface. NOTAMs that are deemed most relevant to AAM operations within a given operating area will be highlighted.

NOTAMs are officially published by Air Navigation Service Providers (e.g., FAA in the United States), and will be aggregated in the SkyGrid system for operator convenience.

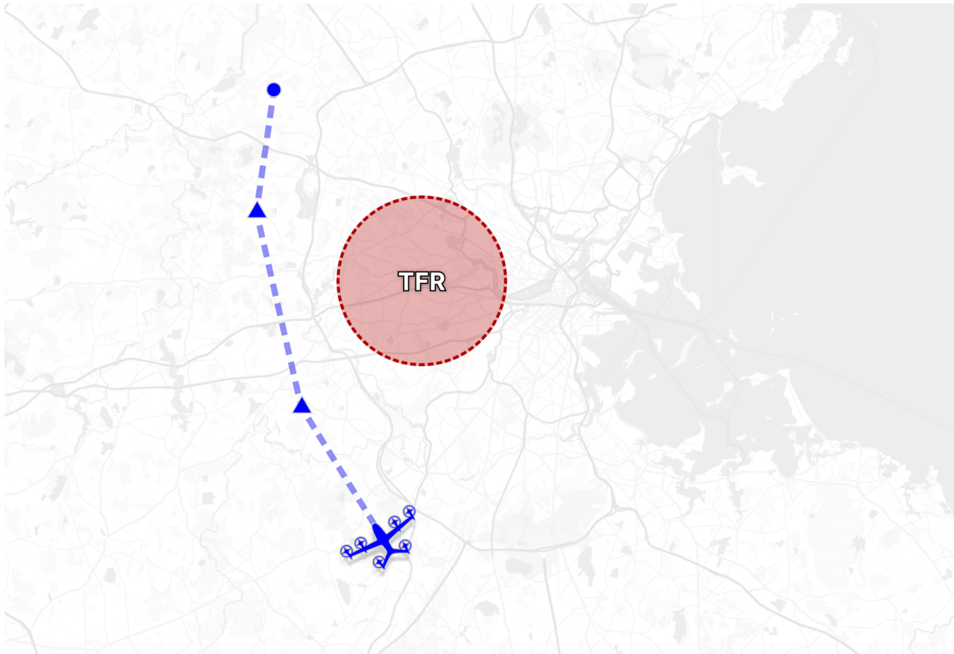

Figure 6. Notional operator view of SkyGrid's NOTAM service, showing a notional Temporary Flight Restriction (TFR).

3.5.1.5 ATM/TSP Integration

Where applicable, the SkyGrid system will interface with local Air Traffic Management (ATM)/Air Navigation Service Provider (ANSP) systems for the purpose of exchanging information relevant to airspace operations. In the United States, for example, SkyGrid envisions receiving data from the FAA's System Wide Information Management (SWIM) system, including airport operational status, non-AAM flight data, status of special use airspaces, and capacity-related airspace restrictions. Integration between ATM and TSP systems will enable AAM operators to consider ATM constraints when planning AAM flights.

3.5.1.6 Aerodrome and Airspace Data

The SkyGrid system will provide operators with viewable data for aerodromes and airspace. Aerodrome data will include airport diagrams, instrument flight procedures (IFP), ATC frequencies, and list of facilities (e.g., FBOs). Airspace data will include airspace boundaries, routes and airways, waypoints, navigational aids, minimum enroute altitudes, minimum safe altitudes, and special use airspace boundaries. Instrument flight procedures, routes and airways coded using the ARINC 424 (or equivalent) standard will also be viewable via the SkyGrid user interface.

Operators may view this data during flight planning to plan their navigation through the airspace, and during flight to monitor conformance to published routes and procedures.

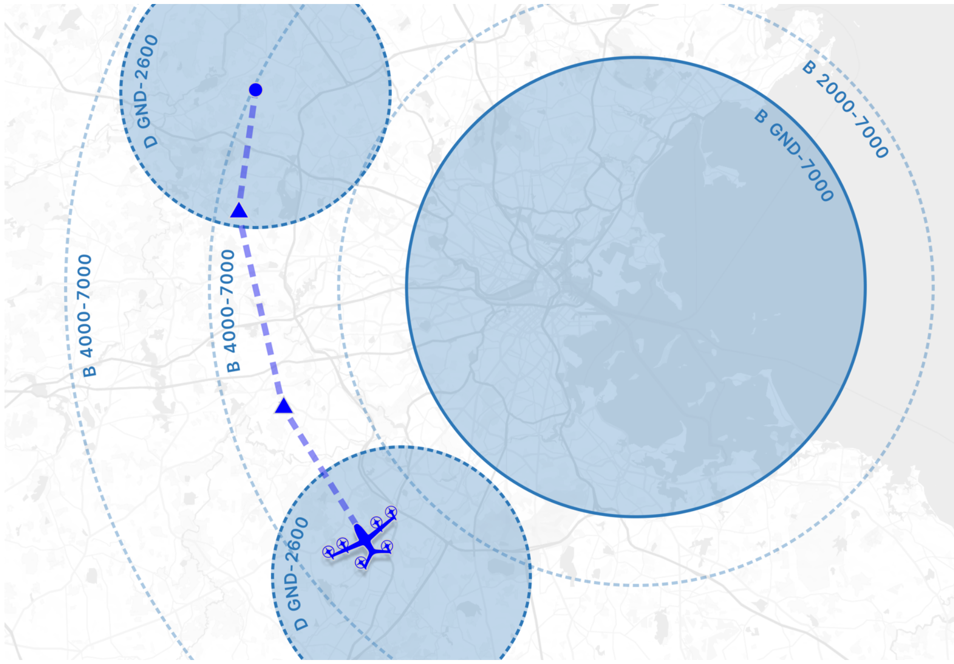

Figure 7. Notional operator view of SkyGrid's Aerodrome and Airspace Data, showing controlled airspace boundaries.

3.5.1.7 C2 and GNSS Performance Data

The SkyGrid system will provide operators with real-time and forecast performance data to assess the quality and availability of satellite-based services, including Command-and-Control (C2) services used to communicate with uncrewed aircraft and Global Navigation Satellite System (GNSS) used by aircraft to navigate the airspace. Note that SkyGrid will not be a provider of these satellite services, but rather will monitor their performance and availability based on data provided by their respective suppliers, direct observations of satellite data, and evaluations of satellite coverage (e.g., RAIM in the case of GNSS).

Operators will be notified of performance degradations and outages (current and forecast) of C2 and GNSS services via the SkyGrid user interface. When outages are spatially defined, regions of service unavailability will be displayed.

3.5.1.8 Resource Status and Capacity Data

The SkyGrid system will provide operators with information on capacity-constrained resources, including vertiports, airport runways, FBO parking stands, and AAM routes. This information will consist of three types of data: the status of resources, the capacity of resources, and the scheduled demand for resources. SkyGrid envisions receiving and integrating data from Vertiport/FBO Manager systems and ANSP/ATM systems as part of this service.

Resource status refers to whether a resource is operating normally, or closed (e.g., unavailable due to a vertiport closure). Resource capacity refers to the total number of available slots at vertiports and FBO parking stands, and to the maximum acceptable throughput of routes and runways. Resource scheduled demand refers to the scheduled allocation of resources to known operations – for example, the allocation of vertiport slots to AAM operations that are currently airborne. This data will be obtained by the SkyGrid system through the integration of scheduled flight plan data, ATM/SWIM data, and vertiport/FBO self-reported data.

Operators will be able to view status and capacity information of relevant resources before filing a flight plan by individually selecting capacity-constrained resources from the SkyGrid user interface. Operators may use this information to identify potential capacity bottlenecks in their intended route of flight.

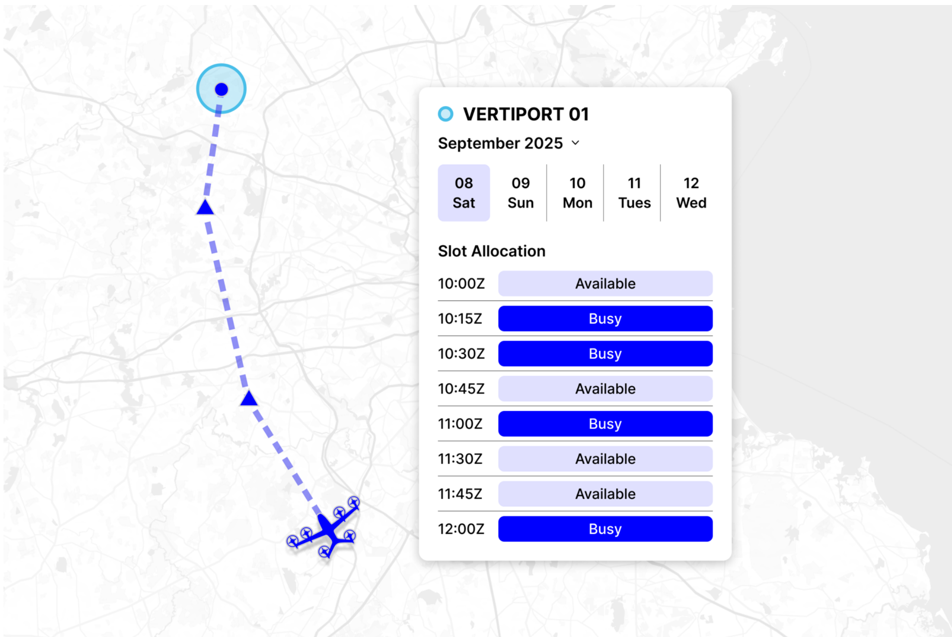

Figure 8. Notional operator view of SkyGrid's Resource Status and Capacity Data service, showing available slots for arrival and handling at a vertiport.

3.5.2 Strategic Planning Services

Strategic Planning Services offered by SkyGrid are decision-support services that will help operators plan AAM flights that are safe, efficient, and acceptable to ATC. These services will leverage the highly detailed digital representation of the operating environment that make up SkyGrid's Digital Information Services. The following subsections describe the individual services considered under this category.

3.5.2.1 Advanced Flight Planning

The SkyGrid system will assist operators in planning a route for an individual AAM operation that meets safety criteria and satisfies operator objectives. Given an origin and a destination input by the operator, the Advanced Flight Planning service will process information on the airspace's structure, weather, capacity-constrained resources, and aircraft performance to identify and suggest feasible flight routes and schedules.

This ConOps assumes that AAM flights will largely occur on pre-determined AAM routes. As such, multiple routes may exist linking takeoff and landing sites. The Advanced Flight Planning service will determine the availability of these routes based on an evaluation of airspace conditions and constraints that are expected to exist at the flight's proposed time of departure. Factors evaluated to determine route availability include:

- **Airspace Configuration**: Class B and C airspaces around major airports typically have several discrete configurations. At any given time, an airspace's configuration is determined by which runways are being used for takeoff and landing at its primary airport. This change in airspace configuration, which normally happens due to changes in surface winds, can affect the availability of airspace as jet traffic is rerouted to different runways. Because AAM routes will likely need to remain spatially deconflicted from jet traffic procedures (i.e., SIDs and STARs), changes in configuration will likely affect what AAM routes are available within the airspace at any given time.
- **Weather Constraints**: Adverse weather conditions may make certain AAM routes unavailable for periods of time. Potential weather hazards include convective activity, precipitation, icing, turbulence, and wind shear.
- **Capacity Constraints**: Certain schedules may be infeasible due to a lack of slot availability at the landing site. Certain routes may be infeasible for certain periods due to their maximum throughput being reached.

When multiple routes are identified as feasible, they will be highlighted to the operator alongside their respective tradeoffs in terms of operator objectives. For example, one route may provide the lowest energy consumption, while another may be identified as the route with the lowest community noise impact. It is up to the operator in this case to select the route that best fits their business needs.

If an AAM operation is conducted between takeoff and landing sites without dedicated AAM routes connecting them, such as in the case of regional fixed-wing operations, the SkyGrid system will additionally consider ATC-preferred routes, terrain and obstacles, forecast winds, and special use airspaces when making route and schedule recommendations.

In each case, the operator is responsible for submitting their flight plan to the ANSP/ATM system using the applicable format (e.g., ICAO) and receiving a clearance from ATC as required. Use of SkyGrid's Advanced Flight Planning service will help operators plan flights in ways that meet their operational objectives (e.g., highest efficiency) and are well integrated within the air traffic system.

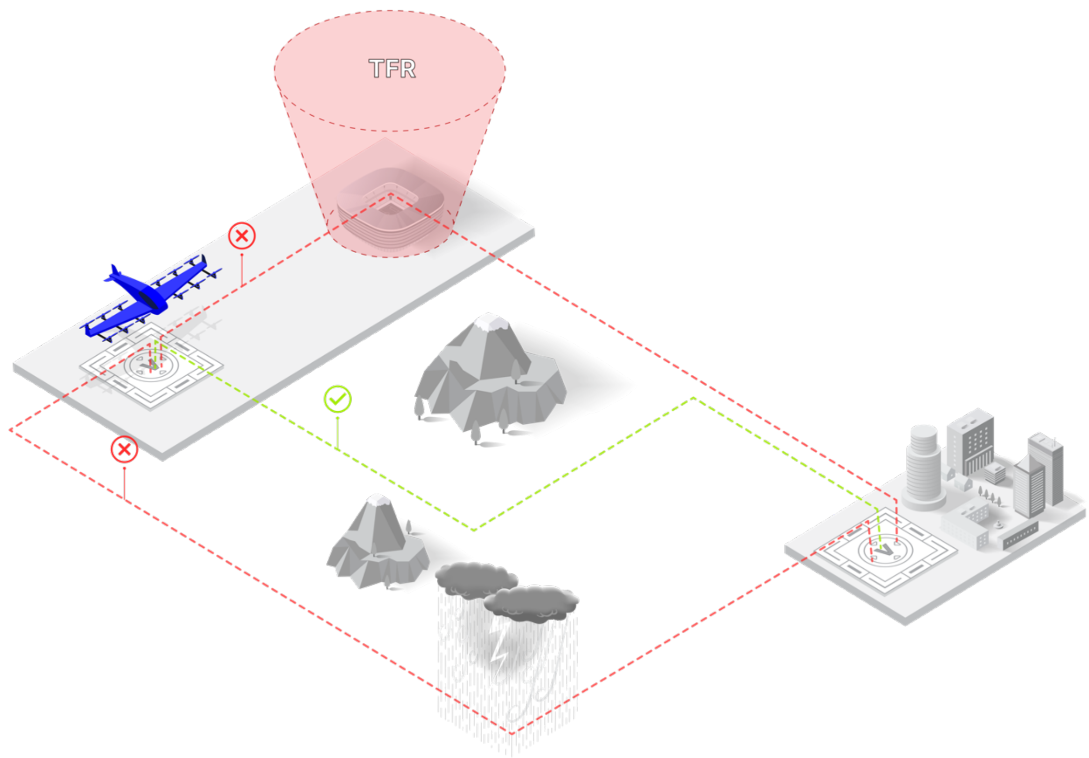

Figure 9. Notional representation of SkyGrid's Advanced Flight Planning service, which will help operators identify feasible flight routes that meet their objectives.

3.5.2.2 Flight Plan Validation

Once a flight plan has been recorded in the SkyGrid system, the system will begin to perform periodic validations of the plan to ensure its feasibility up until the time of departure. The Flight Plan Validation service will monitor hazards and constraints that are considered dynamic (i.e., time-varying) – if a new hazard or constraint is detected that makes the original flight plan infeasible, the operator is notified. Hazards and constraints monitored as part of this service include:

- Airspace closures (e.g., Temporary Flight Restrictions, TFR).
- Availability of C2, GNSS, and surveillance services.
- Hazardous weather, including convective activity, precipitation, icing, turbulence, and wind shear.
- Resource capacity (e.g., availability of vertiport slots).
- Changes in airspace configuration.

Flight Plan Validation will be conducted periodically by the SkyGrid system until a flight's scheduled time of departure. If a constraint violation is detected by the Flight Plan Validation service, then the operator is notified of the constraints violated and advised to adjust the flight route or schedule.

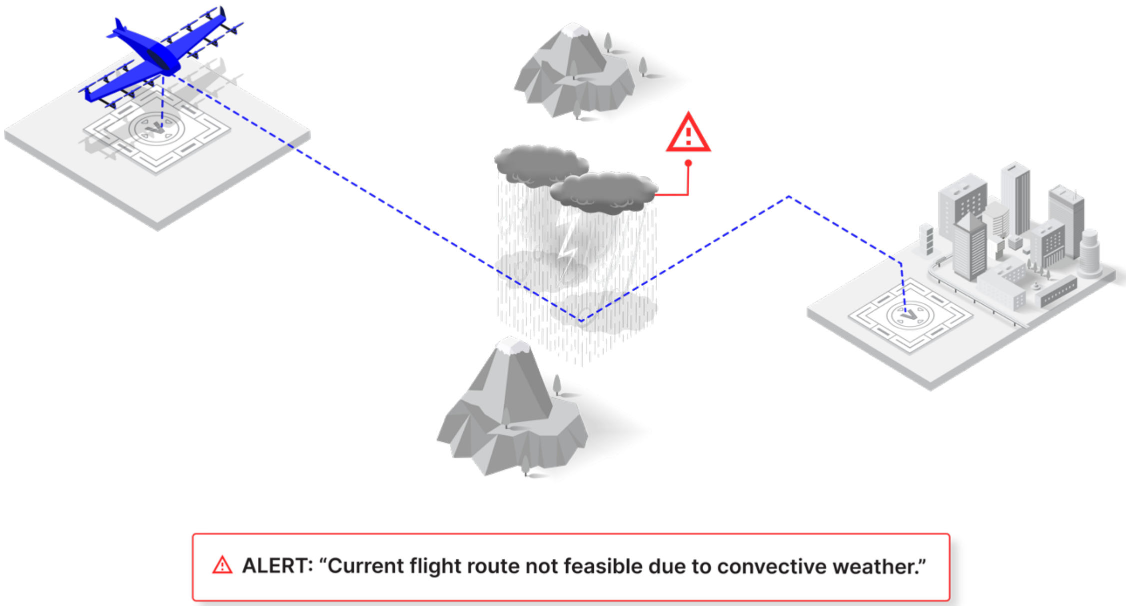

Figure 10. SkyGrid's Flight Plan Validation service will periodically re-evaluate a submitted flight plan and alert the operator if the plan becomes infeasible.

3.5.2.3 Demand-Capacity Balancing

A functionality included in SkyGrid's Advanced Flight Planning but also offered as a standalone service, Demand-Capacity Balancing (DCB) will provide operators with the ability to schedule flights in a way that ensures adequate allocation of ground infrastructure (i.e., vertiports and FBO parking stands) and airspace resources (i.e., routes and merge points) to improve traffic flow.

Upon entering a proposed flight route (i.e., origin and destination) in the SkyGrid system, operators may access the DCB service to identify flight schedules that satisfy capacity constraints along the flight route and at both takeoff and landing sites. If the operator is not using SkyGrid's Advanced Flight Planning service, slot reservations will be possible through the DCB service. Operation within the DCB-reserved slot will ensure that the flight will have access to takeoff and landing facilities at the requested times, thus reducing the likelihood of ground and airborne delays.

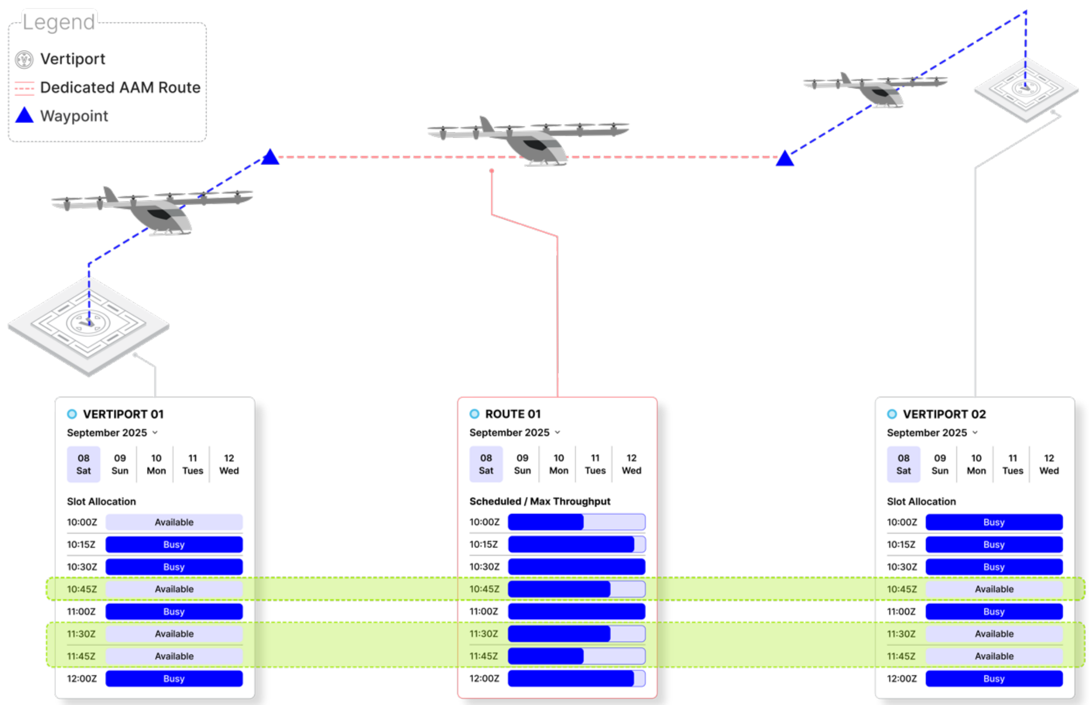

Figure 11. SkyGrid's Demand-Capacity Balancing (DCB) service will highlight feasible flight schedules based on the availability of resources such as vertiports and dedicated AAM routes.

3.5.2.4 Traffic Synchronization

Once a flight route and schedule have been submitted and validated in the SkyGrid system, and once within a pre-defined window of the operation's scheduled time of departure, the Traffic Synchronization service will begin to monitor real-time traffic conditions and the near-term availability of capacity-constrained resources (e.g., vertiports, airports, and waypoints) along the route of flight.

By processing both real-time and scheduled flight data, and by extrapolating the position of other aircraft within the airspace, the Traffic Synchronization service may suggest adjustments to the operation's scheduled clearance release time based on the following factors:

- Requirement to be separated from departing and arriving aircraft at the origin vertiport/airport.
- Requirement to be separated from other enroute aircraft at common route waypoints.
- Requirement to be separated from other arriving aircraft at the destination vertiport/airport.
- Requirement to have an available landing area and parking stand at the destination vertiport/airport.

Departure time adjustments proposed by the Traffic Synchronization service, which will be in the order of minutes, will have the following effects:

- AAM aircraft will call for takeoff clearances at times when the required separation from departing and arriving aircraft is satisfied. This will allow controllers to issue prompt takeoff clearances and not be burdened with departure requests at infeasible times. This, in turn, will reduce the likelihood of workload spikes for controllers handling departure clearances.
- AAM aircraft will achieve more efficient in-trail spacing within AAM routes, reducing the need for ATC to provide manual flow management instructions.
- AAM aircraft will approach their destination in well-timed sequences and at times when the vertiport/airport is ready to receive them, reducing the likelihood of airborne delays and increasing operational efficiency.

After receiving a proposed adjustment to their scheduled clearance release time from the Traffic Synchronization service, the operator will call ATC for takeoff clearance at this new revised time.

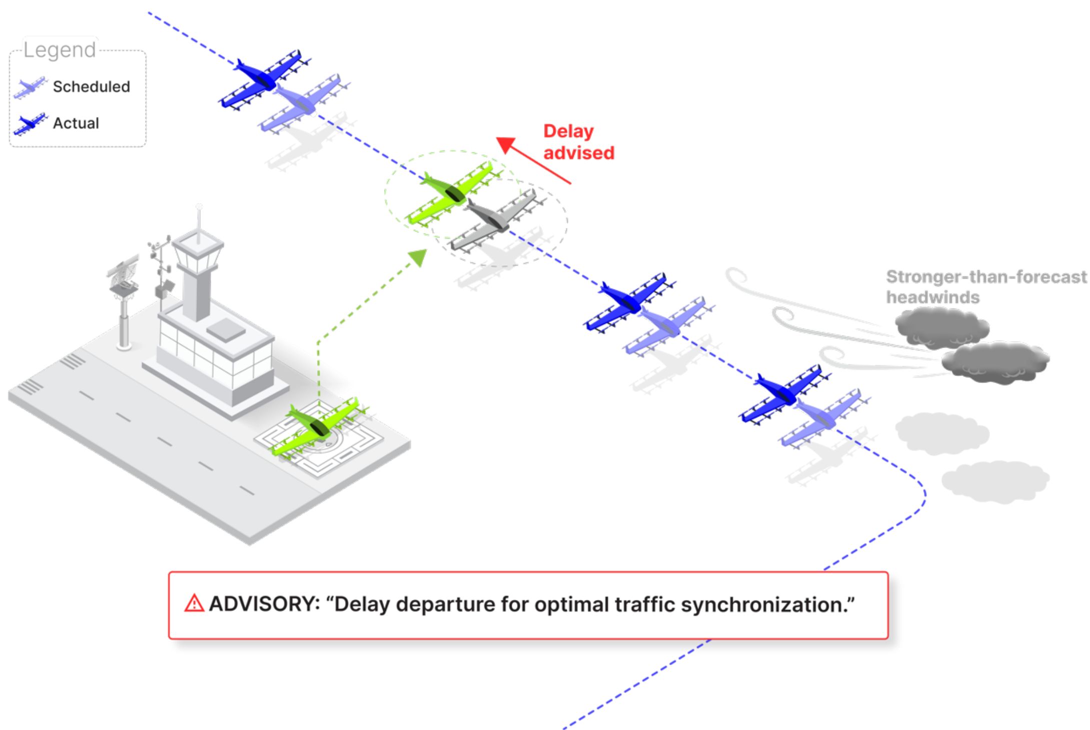

Figure 12. SkyGrid's Traffic Synchronization service will provide departure time adjustments based on current conditions to improve traffic flow.

If a feasible clearance release time that does not compromise the schedule of other aircraft cannot be found, the Traffic Synchronization service may provide additional network disruption functions, including flight rescheduling or cancelation advisories. Network disruption functions are anticipated to be more important in future high-tempo operations.

3.5.2.5 Operational Area Forecasting

In addition to providing services in support of flight planning, the SkyGrid system will provide operators with tools to assess future conditions of their operating area, without the need to specify a flight plan. These tools will be offered under the Operational Area Forecasting service.

Using the Operational Area Forecasting service, operators will be able to define safe operating thresholds for their operation, such as maximum wind speed, maximum turbulence severity, minimum visibility, and minimum ceiling. By monitoring forecasts of these and other operator-selected parameters, the SkyGrid system will notify the operator of times when the conditions of the operator-defined operating area are expected to be favorable for flight.

The Operational Area Forecasting service will assist AAM operators in preemptively identifying future conditions that may require the replanning or rescheduling of multiple flights. In addition, it can be used by operators flying on-demand missions to assess the near-term suitability of their operating area when deciding whether to accept a flight request.

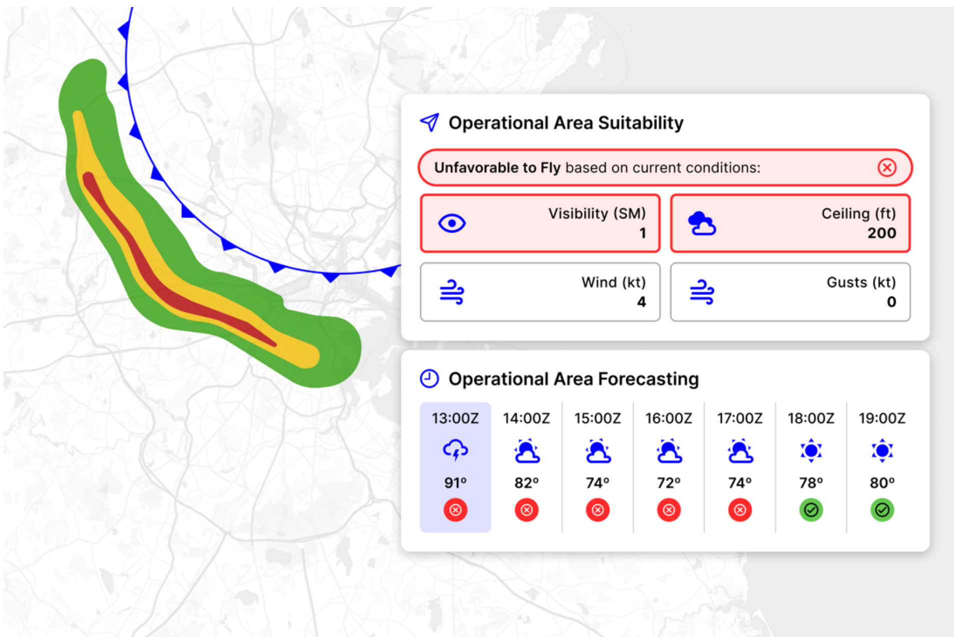

Figure 13. Notional operator view of SkyGrid's Operational Area Forecasting service, showing the current and forecast suitability of the operating area based on operator-selected thresholds.

3.5.3 Tactical Planning Services

Tactical Planning Services offered by SkyGrid are decision support services that will help operators manage in-flight conditions, hazards and constraints safely and efficiently. They include key services that will enable uncrewed aircraft to avoid hazards without a pilot onboard. These services will leverage a high-fidelity and high-assurance digital representation of the operating environment to provide real-time decision support to operators.

Like the Strategic Planning Services described earlier, Tactical Planning Services will be provided in an advisory capacity, with operators and ATC retaining responsibility for the safety of operations. As such, these services are intended to provide useful advisories to operators outside the typical time horizon of tactical ATC actions, potentially reducing the frequency of ATC interactions in AAM operations. The following subsections describe the individual services considered under this category.

3.5.3.1 Dynamic Rerouting

During flight, the Dynamic Rerouting service will assist operators in adjusting their flight route to avoid new hazards and constraints that warrant a deviation from the original plan. The Dynamic Rerouting service will perform three functions: 1) monitoring hazards and constraints in the route of flight, 2) alerting the operator of new flight-relevant hazards and constraints, and 3) suggesting rerouting options to clear new hazards or constraints.

Hazards and constraints monitored by the SkyGrid system during flight will include, but are not limited to:

- Conflicting traffic.
- Airspace closures (e.g., Temporary Flight Restrictions, TFR).
- Change in the availability of C2, GNSS, and surveillance services.
- Hazardous weather, including convective activity, precipitation, icing, turbulence, and wind shear.
- Changes in airspace configuration.
- Vertiport/airport closure.
- Change in the availability of emergency/alternate landing sites.

An alert will be issued to the operator via the SkyGrid system's user interface when a new constraint detected affects the feasibility of the current flight plan, as determined by the SkyGrid system using operator-defined thresholds.

Reroute advisories will either follow the generation of an alert or be prompted by the operator (e.g., in the event of a destination change). In both cases, the SkyGrid system will advise the operator of feasible trajectory options. Two types of trajectory changes are provided:

- **Tactical Reroute**: A proposed modification to the current route to avoid a new localized hazard or constraint between the aircraft and its destination (e.g., a small region of adverse weather).
- **Tactical Diversion**: A proposed change to the flight destination and current route to avoid a new significant hazard or constraint (e.g., a closure of the destination vertiport/airport).

Reroute advisories will be provided as new waypoint sequences and will be displayed to the operator via the SkyGrid system's user interface. Execution of reroute advisories will require coordination between the operator and ATC when the operation is conducted in controlled airspaces.

Figure 14. Notional operator view of SkyGrid's Dynamic Rerouting service, showing a reroute advisory around an area of convective weather.

3.5.3.2 Hazard and Constraint Monitoring

A functionality included in SkyGrid's Dynamic Rerouting service but also offered as a standalone service, Hazard and Constraint Monitoring will provide operators with the ability to be alerted of new flight-relevant hazards and constraints during flight. Hazards and constraints monitored by the SkyGrid system during flight will include, but are not limited to:

- Conflicting traffic.
- Airspace closures (e.g., Temporary Flight Restrictions, TFR).
- Change in the availability of C2, GNSS, and surveillance services.
- Hazardous weather, including convective activity, precipitation, icing, turbulence, and wind shear.
- Changes in airspace configuration.
- Vertiport/airport closure.
- Change in the availability of emergency/alternate landing sites.

An alert will be issued to the operator via the SkyGrid system's user interface when a new constraint detected affects the feasibility of the original plan, as determined by the SkyGrid system using operator-defined thresholds.

Figure 15. Notional operator view of SkyGrid's Hazard and Constraint Monitoring service, showing an alert for a convective cell overlapping the flight route.

3.5.3.3 Flow Management

During flight execution, SkyGrid's Flow Management service will assist operators in maintaining an orderly flow of traffic on AAM routes and at vertiports/airports. To achieve this, the Flow Management service will monitor traffic flow on AAM routes and issue flow management advisories to operators when applicable.

Traffic flow parameters monitored by the SkyGrid system will include: 1) in-trail spacing between aircraft on AAM routes, 2) expected times of arrival of AAM aircraft at waypoints, and 3) expected times of arrival of AAM aircraft at vertiports/airports.

If a traffic flow conflict is identified, such as two aircraft being expected to arrive at a common waypoint at the same time, the SkyGrid system will issue advisories to operators to resolve the conflict. The primary type of advisory to be issued by the Flow Management service will be a speed change, which will change an aircraft's expected time of arrival at future waypoints. Speed adjustments calculated by the SkyGrid system will consider the performance profile of the operator's aircraft.

If a conflict cannot be resolved with speed adjustments alone, the Flow Management service will issue a path stretching advisory. This will consist of a temporary deviation from the original route to lengthen an aircraft's flight trajectory and delay its expected time of arrival at future waypoints.

Advisories provided by the Flow Management service will be displayed to the operator via the SkyGrid system's user interface and may only be executed by the operator following coordination with ATC[7]. By supporting an orderly flow of AAM traffic,

[7] in the United States, airspeed changes of up to 10 knots do not need to be reported to ATC, as per FAA AIM 5-3-3.

SkyGrid's Flow Management service aims to reduce airborne delays, increase operational efficiency, and reduce the need for ATC to tactically intervene in AAM operations.

Figure 16. Notional operator view of SkyGrid's Flow Management service, showing a speed change advisory to maintain in-trail separation between aircraft.

3.5.3.4 Conformance Monitoring

The Conformance Monitoring service will notify operators when either their ownship or other AAM traffic within the operating area may be deviating from their previously announced flight plan. To achieve this, the Conformance Monitoring service will monitor the navigation conformance of in-flight aircraft operating on AAM routes that have discoverable operational intents (i.e., aircraft that have shared flight route, altitude, and schedule). Dimensions of conformance monitoring will include lateral, vertical, and longitudinal (i.e., schedule) conformance. Conformance thresholds will be based on navigation performance requirements for individual AAM routes, such as Required Navigation Performance (RNP) values specifying the required lateral navigation performance.

Upon detection of a non-conformance condition (e.g., a lateral deviation), the SkyGrid system will highlight the non-conforming traffic on the user interface. Non-conforming aircraft will be highlighted for situational awareness, and alerts may be issued for specific aircraft (e.g., ownship) based on operator preferences. Because certain ATC actions will not be visible to the SkyGrid system, such as voice-issued vectoring instructions, a highlighted non-conforming traffic may in some cases be the result of an intentional ATC action.

The Conformance Monitoring service will provide operators with improved tactical situational awareness of the progress of other traffic in their operating environment.

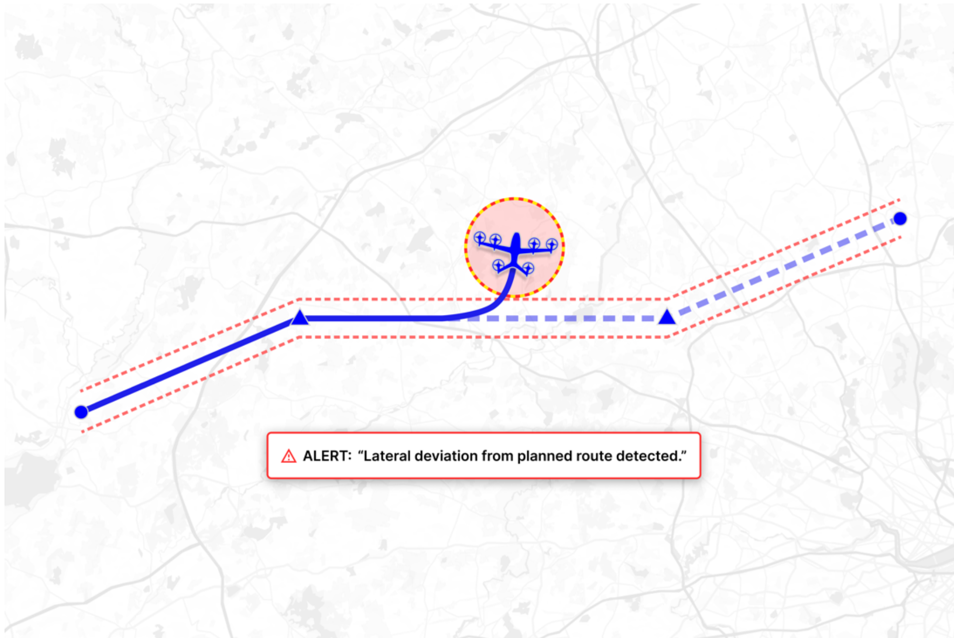

Figure 17. Notional operator view of SkyGrid's Conformance Monitoring service, showing an alert for an aircraft that has deviated laterally from its assigned route.

3.5.3.5 Ground-Based Detect-and-Avoid

SkyGrid's Ground-Based Detect-and-Avoid (GBDAA) service will provide operators with in-flight alerts and advisory guidance to remain well clear of other traffic in both visual and instrument meteorological conditions. In the event of a loss of well-clear separation between the ownship and another aircraft, the GBDAA service will provide collision avoidance advisories to the operator following applicable RTCA standards. During execution of a collision avoidance maneuver, responsibility for the safety of the flight remains with the operator.

Surveillance data used by the GBDAA service will include high-integrity cooperative and non-cooperative traffic data following applicable RTCA standards, as previously described under SkyGrid's Ground-Based Traffic Surveillance (GBTS) service.

The GBDAA service will complement other SkyGrid services supporting *strategic conflict management* (e.g., Advanced Flight Planning and Demand-Capacity Balancing) and tactical *separation provision* (e.g., Dynamic Rerouting and Flow Management) by providing *collision avoidance*, recognized as the last layer of traffic deconfliction in ICAO Document 9854 (Global Air Traffic Management Operational Concept).

SkyGrid's GBDAA service will be a key enabler of uncrewed operations by allowing operators of uncrewed aircraft to satisfy the operational requirement to remain well clear of other traffic without a pilot onboard. SkyGrid's GBDAA may be used in conjunction with an onboard Detect-and-Avoid (DAA) system to validate or augment its output. For instance, in low-altitude environments, such as during an approach to a vertiport, GBDAA may be less susceptible to ground reflections and clutter than an onboard radar system.

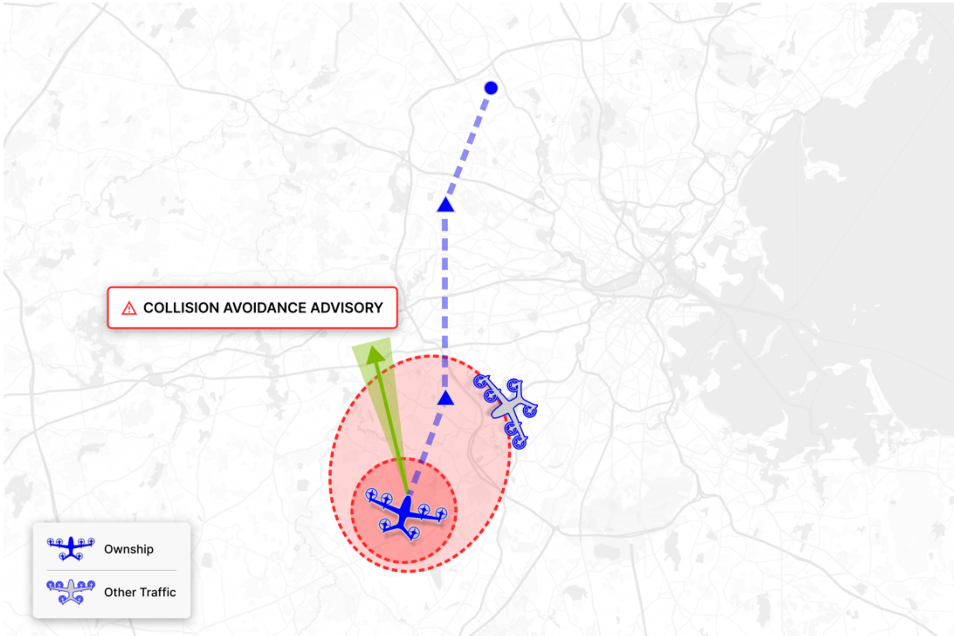

Figure 18. Notional operator view of SkyGrid's Ground-Based Detect-and-Avoid service, showing a collision avoidance advisory.

3.5.4 Mission Support Services

Mission Support Services offered by SkyGrid are informational services that will help operators (remote supervisors, operations managers) track their fleet operations in real-time and analyze flights after they land. The following subsections describe the individual services considered under this category.

3.5.4.1 Flight Tracking

The SkyGrid system will provide operators with the ability to track the status and progress of their fleet during flight through the SkyGrid user interface. The system will be able to display the current position of the fleet alongside a timeline view of each flight. Each flight's timeline will indicate the flight's current conformance to its planned schedule and will allow an operator to quickly identify flights that are delayed.

The Flight Tracking service will provide operators (remote supervisors and operations managers) with improved situational awareness of the status of their active operations.

3.5.4.2 Mission Recording

The SkyGrid system will, for each flight conducted, record the mission data processed by the SkyGrid system, including weather, traffic surveillance, airspace configuration, advisories issued to the flight by the SkyGrid system, and ownship telemetry if shared by the operator.

Operators will be able to download this data within a specified time window following completion of a flight. Recorded mission data may be used by operators to better understand their operating environment and improve future operations as part of their Safety Management System (SMS).

3.5.4.3 Operations Data Management

The SkyGrid system will provide operators with a dedicated interface to manage user-specific operational preferences and restrictions. Using the Operations Data Management (ODM) interface, operators will be able to set up aircraft performance profiles (e.g., climb rate, cruise speed), operational limitations (e.g., maximum wind, minimum visibility), and preferences (e.g., what types of alerts to be enabled). These user parameters will be used by SkyGrid's Strategic and Tactical Planning Services in the generation of alerts and advisories.

The ODM service will also allow operators to create multiple user accounts for their organization, each with specific system permissions. This will enable access to the SkyGrid system by any personnel involved in operations, such as individuals conducting post-flight analyses.

3.6 Flexible Subscription

The SkyGrid system will be developed for use by a diverse set of operators with different mission profiles and use cases, such as crewed VTOL flights and uncrewed CTOL flights. The SkyGrid system will operate on a subscription model. Users may subscribe to available services individually. In some cases, services may be bundled when they share certain functionality. For instance, a subscription to the Dynamic Rerouting service will automatically include all functionality offered by the Hazard and Constraint Monitoring service.

3.7 External Interfaces

The SkyGrid system will interface with outside systems for the purpose of exchanging data needed to support its Digital Information Services, Strategic Planning Services, and Tactical Planning Services. The current set of planned external interfaces includes:

- **SDSP systems**: Supplemental Data Service Providers (SDSPs) represent a major external interface of the SkyGrid system. SDSPs will provide the SkyGrid system with much of the data that is aggregated in its Digital Information Services, including weather, traffic surveillance, and aeronautical data. The required resolution, integrity, and availability of data sets received from SDSPs will depend on their specific use cases and will be determined by SkyGrid based on regulatory guidance.
- **ANSP/ATM systems**: Where applicable, the SkyGrid system will receive digital information relevant to airspace operations from local ANSP/ATM systems. In the United States, for example, the SkyGrid system will receive data from the FAA's System Wide Information Management (SWIM) system, including airport operational status, non-AAM flight data, status of special use airspaces, and capacity-related airspace restrictions.
- **Vertiport/FBO systems**: The SkyGrid system will receive information from vertiports and FBOs on the availability of departure slots, arrival slots, and

parking stands. This information will be made available to operators via SkyGrid's Resource Status and Capacity Data, Advanced Flight Planning, and Demand-Capacity Balancing services. Upon receiving an operator's flight scheduling request through its user interface, the SkyGrid system will interface with vertiport and FBO systems to book slots and parking stands on behalf of the operator.

- **Operator systems**: The SkyGrid system will interface with operator systems to obtain ownship telemetry data when applicable to support uncrewed operations, and when this data provides operational advantages over ownship track data acquired through SkyGrid's Ground-Based Traffic Surveillance (GBTS) service. The SkyGrid system will be installed and used at an operator's Ground Control Station (GCS) and Fleet Operating Center (FOC), where Remote Pilots/Supervisors and Operations Managers are expected to perform their roles.

These interfaces are illustrated in the context diagram shown in **Figure 19** below.

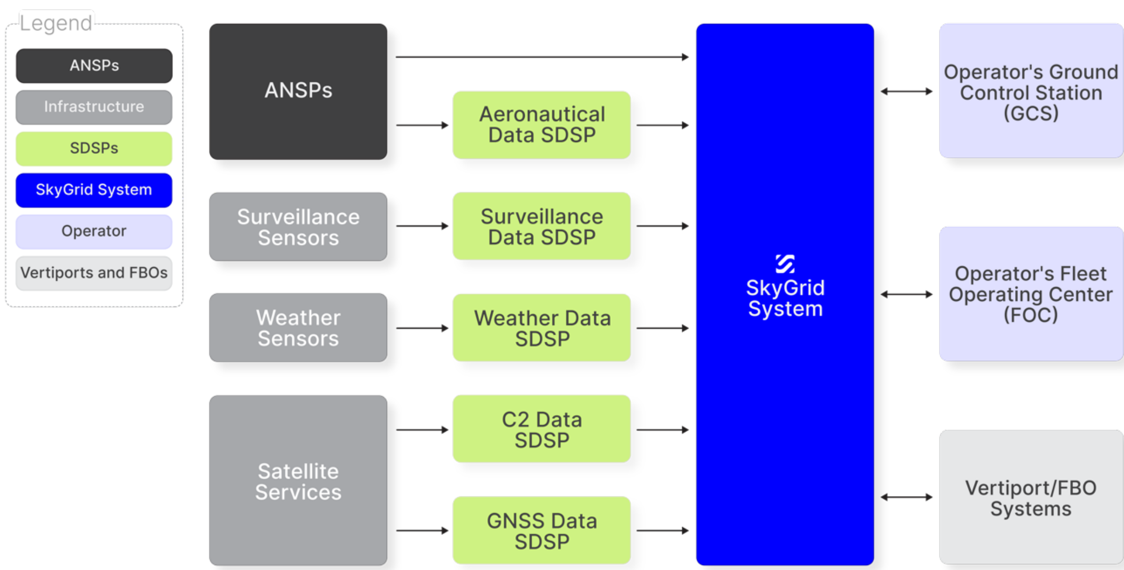

Figure 19. Context diagram of the SkyGrid system, showing external interfaces.

Other external interfaces may be implemented in the future as the AAM ecosystem matures. In particular, new interfaces with ANSP/ATM systems may be developed to support air traffic controllers and ANSPs in managing AAM traffic. For example, the SkyGrid system may alert controllers in the future when an AAM aircraft is deviating from its flight plan, allowing them to respond more promptly to a non-conformance condition that affects other aircraft.

4 Operational Vignette

This section provides a narrative description of a typical Advanced Air Mobility (AAM) operation in the current air traffic system, as envisioned by SkyGrid. **Focus is given to describing how an AAM operator will interact with the SkyGrid system during the mission, and how they may use SkyGrid's services to plan and execute their operation.**

The operational vignette covered in this section is intended to be sufficiently generic to apply to all types of AAM operations supported by SkyGrid, including crewed VTOL, uncrewed VTOL, and uncrewed CTOL operations previously discussed in Section 2. Where differences exist in operations or services provided, they will be highlighted explicitly.

4.1 Pre-Flight

The following subsections describe operator tasks to be carried out before a flight departs. In this example narrative, it is assumed that the operator uses the SkyGrid system to plan and execute a single flight.

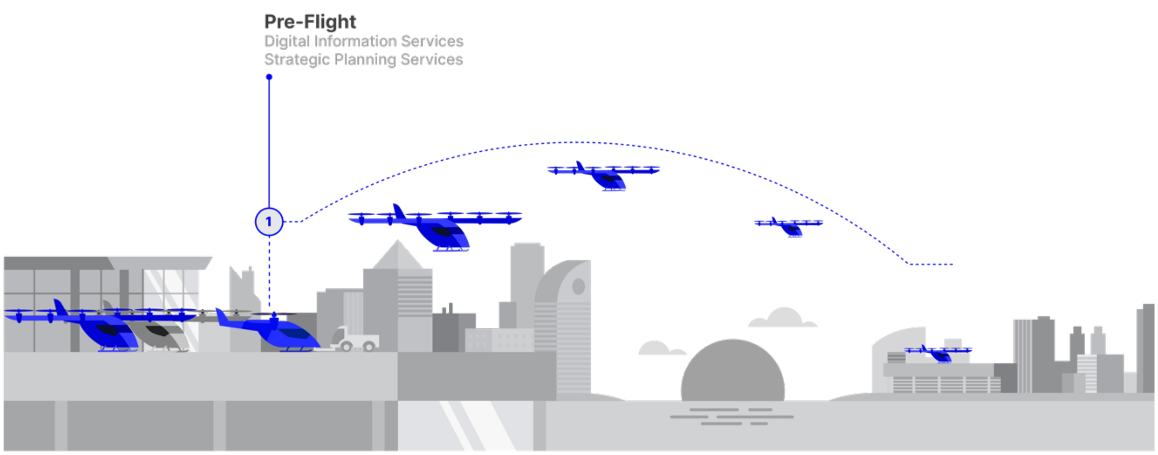

Figure 20. During the Pre-Flight phase, operators will interface with SkyGrid's Digital Information Services and Strategic Planning Services to plan their flights.

4.1.1 Assessing the Operating Area

Before conducting detailed planning of a flight, the operator will assess the general conditions of their operating area for the intended timeframe of operation. This assessment will include forecast weather, airspace closures, and C2 and GNSS availability.

At first, the operator will navigate the SkyGrid system's user interface to develop their initial situational awareness of the operating environment. To achieve this, the operator will select specific data they wish to visualize from SkyGrid's Digital Information Services, which will include **Weather Data**, **NOTAMs**, **C2 and GNSS Performance Data**, and **Resource Status and Capacity Data**.

Following this initial scan, the operator will select SkyGrid's **Operational Area Forecasting** service. This service will consider operator-defined environmental thresholds, if specified (e.g., maximum wind speed, maximum turbulence severity, minimum visibility, and minimum ceiling), to determine the likelihood of the provided operating area being favorable to flight during the intended timeframe.

Upon determining that the conditions of the operating area satisfy the general requirements for operation, the operator will proceed to schedule the flight.

4.1.2 Scheduling Flight and Planning Route

Once the operator has deemed the conditions of the operating area satisfactory, they will specify origin and destination vertiports/airports for the flight in the SkyGrid system. The operator's next task will be to determine a feasible schedule for the flight based on their schedule constraints and the availability of departure slots, arrival slots, and parking stands at their destination. Here, the operator may use SkyGrid's **Demand-Capacity Balancing** (DCB) service to identify how these ground resources are currently allocated to other operations, and to identify feasible schedules for their flight. Based on estimated flight duration, the DCB service will highlight feasible departure windows that meet resource capacity constraints and the operator's schedule constraints.

Once the operator has made a schedule selection in the SkyGrid system, the system will communicate with vertiport and FBO systems to allocate the resources requested. Following confirmation from vertiport and FBO systems, the operator will then be notified of a successful flight slot reservation.

After deciding on a schedule for the flight, the operator will proceed to plan the flight route. To do this, the operator will use SkyGrid's **Advanced Flight Planning** service. Given an origin, destination, and schedule, the SkyGrid system will process information on airspace constraints, weather, terrain, obstacles, and aircraft performance to identify and suggest feasible flight routes.

When pre-determined AAM routes exist connecting origin and destination, the SkyGrid system will determine the availability of these routes based on an evaluation of constraints derived from the information above. If multiple routes are identified as feasible, they will be highlighted to the operator alongside their respective tradeoffs in terms of operator objectives. For example, one route may have the lowest energy consumption, while another may minimize community noise impact. It is up to the operator in this case to select the route that best fits their business needs.

If an AAM operation is conducted between takeoff and landing sites without dedicated AAM routes connecting them, such as in the case of regional fixed-wing operations, the SkyGrid system will additionally consider ATC-preferred routes and special use airspaces to identify feasible routes.

Once a feasible route has been identified that satisfies the operator's objectives, the operator will confirm its selection in the SkyGrid system's user interface. If conducting operations under IFR, the operator will be responsible for submitting a flight plan to the ANSP/ATM system based on this route using the applicable format (e.g., ICAO).

4.1.3 Verifying Flight Plan Feasibility

After a planned flight route and schedule have been recorded in the SkyGrid system, the system will begin to perform periodic validations of this plan to ensure its feasibility until the time of departure. This function will be provided by SkyGrid's **Flight Plan Validation** service.

The operator will be notified if a new hazard or constraint is detected that makes the original route or schedule infeasible.

4.1.4 Preparing for Departure

Once within a pre-defined window of the scheduled clearance request time, the SkyGrid system will begin to monitor traffic conditions and the near-term availability of capacity-constrained resources along the route of flight (i.e., takeoff site, waypoints, landing site). This function will be handled by SkyGrid's **Traffic Synchronization** service.

By processing both real-time and scheduled flight data, the Traffic Synchronization service may suggest adjustments to the operation's scheduled clearance request time to improve traffic synchronization in the air and reduce the likelihood of the flight being affected by airborne delays due to traffic flow management actions. For example, if the original scheduled time of departure would now cause the aircraft to arrive at its destination at the same time as another aircraft, an adjustment to the departure time may be recommended.

Departure time adjustments proposed by the Traffic Synchronization service are expected to be in the order of minutes and will be communicated to the operator via the SkyGrid system's user interface. After receiving a proposed adjustment to their scheduled departure time from the Traffic Synchronization service, the operator will call ATC for takeoff clearance at this new revised time, assuming operation in controlled airspace. Once cleared, the aircraft departs.

4.2 In-Flight

The following subsections describe tasks conducted by the operator using the SkyGrid system after the aircraft departs and is in flight.

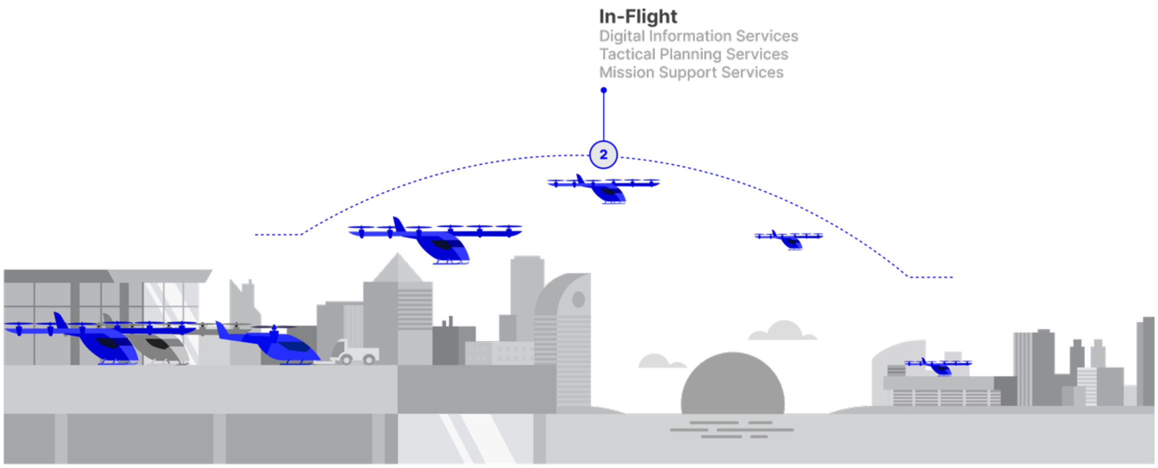

Figure 21. During the In-Flight phase, operators of uncrewed aircraft will interface with SkyGrid's Digital Information Services, Tactical Planning Services, and Mission Support Services to monitor and manage their flights.

4.2.1 Monitoring the Operating Environment

During flight, the operator will continuously monitor their operating environment to identify new conditions, hazards and constraints that may not have been forecast before the flight.

To maintain situational awareness of the state of the environment, the operator will use the SkyGrid system's user interface to visualize real-time data, including **Weather Data**, **Ground-Based Traffic Surveillance**, **C2 and GNSS Performance Data**, and **Conformance Monitoring**. The operator will similarly be able to track the progress of their operation through the **Flight Tracking** service.

While performing this monitoring task, the operator will be supported by SkyGrid's **Hazard and Constraint Monitoring** service. The Hazard and Constraint Monitoring service will issue alerts to the operator through the SkyGrid system's user interface whenever a new condition, hazard or constraint is identified along the route of flight that may require operator action.

Upon being alerted of a new hazard or constraint, the operator must then decide whether a response is required.

4.2.2 Responding to New Hazards and Constraints

After a new in-flight hazard or constraint has been detected, the operator may decide that a change in flight trajectory is needed to ensure the safety of the operation. In this scenario, the operator will use SkyGrid's **Dynamic Rerouting** service to assess rerouting options.

Given a conflicting hazard or constraint, the Dynamic Rerouting service will produce an advisory for a feasible trajectory change to clear it, which will simultaneously satisfy all other known constraints (e.g., airspace boundaries, separation from other flight routes, terrain and obstacles).

Reroute advisories will be displayed to the operator via the SkyGrid user interface. Upon deciding on an adequate response, the operator will coordinate execution of the trajectory change with ATC.

4.2.3 Responding to Traffic Flow Conditions

During the flight, disturbances in the operating environment may lead to traffic on the operator's AAM route no longer being properly spaced or sequenced. For example, an aircraft that is flying slower than expected may disrupt the traffic flow and compromise the planned in-trail separation between aircraft. In such a scenario, the original schedule of the flight may need to be adjusted to maintain proper traffic sequencing and spacing.

In support of this task, the operator will use SkyGrid's **Flow Management** service to monitor for traffic flow conflicts along their flight route and identify possible resolutions. When a traffic flow conflict is identified, such as another aircraft being expected to arrive at an upcoming waypoint at the same time as the ownship, the SkyGrid system will provide an advisory to the operator for resolving the conflict. The primary type of advisory to be issued by the Flow Management service will be a speed change, which will change the aircraft's expected time of arrival at future waypoints. Speed adjustments calculated by the SkyGrid system will consider the performance profile of the operator's aircraft.

If a conflict cannot be resolved with a speed adjustment alone, the Flow Management service will issue a path stretching advisory. This will consist of a temporary deviation from the original route to lengthen the aircraft's flight trajectory and delay its expected time of arrival at future waypoints.

Advisories provided by the Flow Management service will be displayed to the operator via the SkyGrid user interface and may be executed by the operator following coordination with ATC.

4.2.4 Responding to Traffic Encounters

During the flight, the operator will be able to view and track both cooperative and non-cooperative traffic in their operating environment using SkyGrid's **Ground-Based Traffic Surveillance** (GBTS) service. If a nearby aircraft (i.e., an intruder) poses a risk of violating well-clear separation to the ownship, the operator will receive an alert and advisory guidance from SkyGrid's **Ground-Based Detect-and-Avoid** (GBDAA) service to remain well clear.

While collision avoidance maneuvers can be executed without prior ATC clearance, the operator is responsible for informing ATC of their maneuver as soon as possible.

4.3 Post-Flight

Once the aircraft is on the ground, additional Mission Support Services will become available to help the operator analyze past operations and improve future ones.

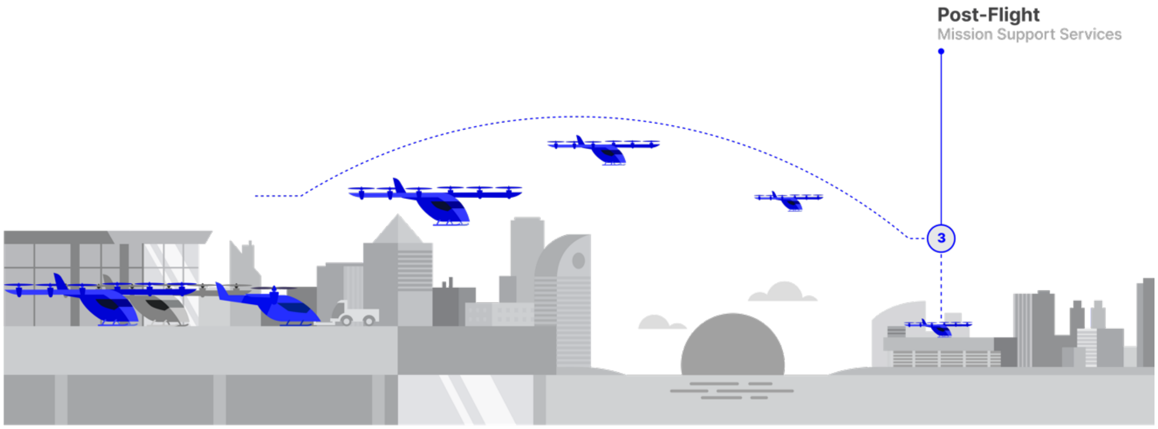

Figure 22. During the Post-Flight phase, operators will interface with SkyGrid's Mission Support Services to analyze their flights.

4.3.1 Recording and Analyzing Flight Data

After the aircraft has landed, the operator will be able to retrieve mission data using SkyGrid's **Mission Recording** service. This service will allow operators to download historical data from the flight that was processed by the SkyGrid system, including weather, traffic surveillance, airspace configuration, and advisories issued to the flight by the SkyGrid system. Recorded mission data will be timestamped and may be used by operators to conduct post-flight analyses of their operation.

5 Working Together

This ConOps aims to stimulate stakeholder engagement around the development of Third-Party Service Provider (TSP) systems, which SkyGrid believes have the potential to provide significant benefits to novel Advanced Air Mobility (AAM) operations. The system capabilities discussed in this document represent SkyGrid's initial vision for supporting crewed and uncrewed AAM operations in the current airspace environment. SkyGrid believes its system will contribute to safe operations that are more efficient, have greater ATC acceptance, and are more scalable to higher throughputs.

Given that TSP systems represent a new addition to the traditional aviation concept of operations, SkyGrid welcomes feedback from industry and regulators as it continues to refine its concept of operations and system architecture.

5.1 Regulatory Engagement

While the SkyGrid system will provide data and decision support services to both crewed and uncrewed operations, its envisioned use as a primary source of in-flight situational awareness by uncrewed operations will require new regulatory guidance. This will include guidance for the approval of TSP systems, as well as guidance to operators on how these systems may be integrated with their operational approval.

Additionally, because the SkyGrid system will integrate data from new ground sensor infrastructure, including commercial weather and surveillance sensors, further regulatory guidance will be needed to enable the use of this sensor data in safety-critical applications such as traffic avoidance.

SkyGrid invites collaboration with regulators and industry worldwide to jointly identify and develop the necessary regulatory framework for the approval and operation of TSP systems in support of AAM.

5.2 Looking Ahead

Industry and regulators worldwide generally acknowledge that the gradual maturation of the AAM ecosystem may eventually drive a need for new technology and operational solutions to support higher density operations. For example, current ATM system constraints such as radar separation rules, ATC workload limitations, and one-to-one voice communications may limit access to airspace and the achievable throughput of AAM operations in the long term. To address these constraints, new airspace management concepts have been proposed by aviation stakeholders worldwide.

In the United States, the Federal Aviation Administration (FAA) has outlined its concept for a future Info-Centric National Airspace System, in which TSPs may be delegated responsibility for providing air traffic services in specific airspaces under a concept known as Extensible Traffic Management (xTM). Among the benefits, this would allow for automated air traffic services specifically tailored to high-density operations such as AAM traffic between vertiports. In Europe, the U-space concept developed by the European Union Aviation Safety Agency (EASA) represents a similar approach to integrating highly automated traffic into the airspace without increasing the load on the current air traffic management system. While differences exist among these concepts, they agree that the provision of air traffic services by TSPs could potentially be a key enabler of future high-density operations, allowing for tailored separation rules, reduced ATC workload, and digital-only communications. Similarly, concepts describing future general airspace operations, such as the Digital Flight concept by NASA, have highlighted the important role that TSPs can play in providing future airspace users with a common operating picture from which they can exercise automated, cooperative decision-making.

While SkyGrid is developing its TSP system for near term and midterm applications within the current air traffic system, it also recognizes the significant long-term potential for its system to unlock value and efficiency in future airspace environments. SkyGrid anticipates that many of its near-term capabilities will be leveraged in the future to directly enable the automation capabilities needed by new airspace concepts such as xTM, U-space, and Digital Flight. To that end, SkyGrid invites open collaboration with industry, regulators, and researchers to shape the future of airspace operations.

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Appendix B Acronyms

Acronym	Definition
AAM	Advanced Air Mobility
ADS-B	Automatic Dependent Surveillance-Broadcast
AGL	Above Ground Level
AIS	Air Information Services
AIM	Aeronautical Information Manual
AIRAC	Aeronautical Information Regulation and Control
ALPA	Air Line Pilots Association
ANSP	Air Navigation Service Provider
API	Application Programming Interface
ARP	Aerospace Recommended Practice
ASR	Airport Surveillance Radar
ASTM	American Society for Testing and Materials
ATAR	Air-to-Air Radar
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATO	Air Traffic Organization
BVLOS	Beyond Visual Line of Sight
C2CSP	Command and Control Communications Service Provider

Acronym	**Definition**
CN	Communication and Navigation
CNS	Communications, Navigation, and Surveillance
CTOL	Conventional Take-off and Landing
DO	Document
DAA	Detect-and-Avoid
DHS	Department of Homeland Security
EASA	European Union Aviation Safety Agency
ED	EUROCAE Document
EFB	Electronic Flight Bag
EIS	Entry-into-Service
ETA	Estimated Time of Arrival
EUROCAE	European Organization for Civil Aviation Equipment
eVTOL	Electric Vertical Take-off and Landing
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FATO	Final Approach and Takeoff Area
FBO	Fixed-Base Operator
FDR	Flight Data Recorder
FIPS	Federal Information Processing Standard
FOC	Fleet Operating Center

Acronym	Definition
GBDAA	Ground Based Detect and Avoid
GBTS	Ground Based Traffic Surveillance
GCS	Ground Control Station
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GUI	Graphical User Interface
HDP	Helicopter Departure Procedure
IAP	Instrument Approach Procedure
ICAO	International Civil Aviation Organization
IFP	Instrument Flight Procedures
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
ISO	International Standardization Organization
JSON	JavaScript Object Notation
KIAS	Knots Indicated Airspeed
LOA	Letter of Agreement
LoS	Level of Service
LRU	Line Replaceable Units
MASPS	Minimum Aviation System Performance Standards
MOA	Military Operations Area

Acronym	Definition
NAS	National Air Space
NASA	National Aeronautics and Space Administration
NAV	Navigation
NIST	National Institute of Standards and Technology
NOTAM	Notice to Air Missions
OEMs	Original Equipment Manufacturers
PIC	Pilot in Command
PinS	Point-In-Space Approach
PSU	Providers of Services for UAM
RAM	Regional Air Mobility
RAIM	Receiver Autonomous Integrity Monitoring
RLOS	Radio Line of Sight
RNP	Required Navigation Performance
RPIC	Remote Pilot in Command
RTCA	Radio Technical Commission for Aeronautics
SAE	Society of Automotive Engineers
SBAS	Satellite Based Augmentation Systems
SC	Special Committees
SDSP	Supplemental Data Service Provider
SFAR	Special Federal Aviation Regulation (SFAR)

Acronym	Definition
SID	Standard Instrument Departure
SMS	Safety Management System
SPO	Single Pilot Operations
STOL	Short Takeoff and Landing
TBO	Trajectory-Based Operations
TC	Type Certificate
TERP	Terminal Instrument Procedures
TFR	Temporary Flight Restrictions
TMA	Terminal Maneuvering Area
TSP	Third-Party Service Provider
TSO	Technical Standards Order
UAM	Urban Air Mobility
UTM	Unmanned Traffic Management
VAS	Vertiport Automation System
VFR	Visual Flight Rules
VHF	Very High Frequency
VLOS	Visual Line of Sight
VMC	Visual Meteorological Conditions
WAAS	Wide Area Augmentation System
xTM	Extensible Traffic Management

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