



EXPLORE FLIGHT

WE'RE WITH YOU WHEN YOU FLY

ATM-X

Air Traffic Management eXploration

Digital Information Platform

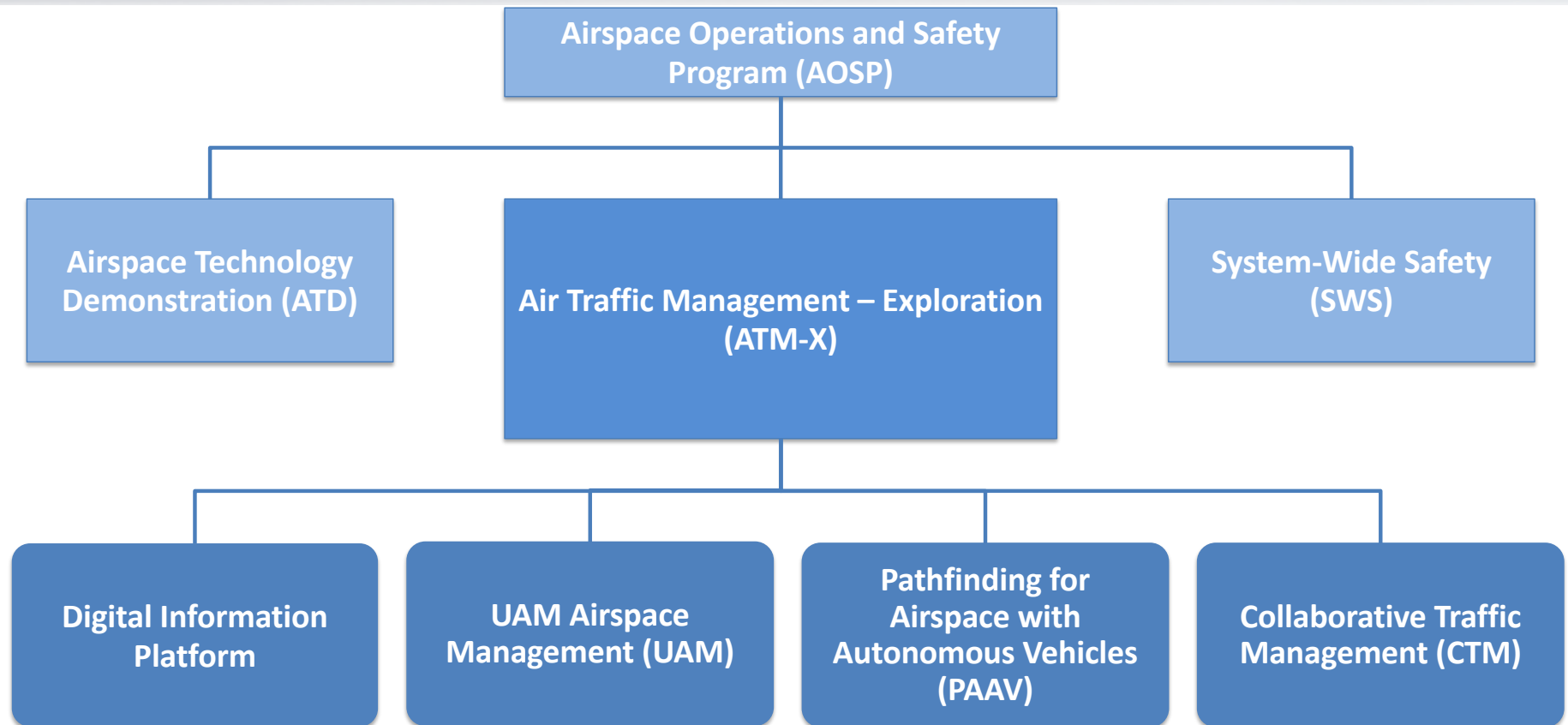
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DIP Vision



Accelerate transformation of the NAS through the development of a **foundation** for advanced, **data-driven, digital services** from **traditional operations and new entrants** to promote **cohesive decision making**



Motivation



- Current day ATM system is segmented by domain, operator groups and solution provider groups
 - A challenge for those who seek holistic (system wide) solutions
 - Very few understand all of the data producing systems and their artefacts
- Aviation community is trending towards wider range of operations types
 - New types of aircraft, and/or at a higher level of operational density
 - Complexity that require higher levels of synchronization
- Traditional ATM system was built in an era when rapid technologies were not available or common
 - Changing the large and complex system-of-systems in the NAS is an overwhelmingly complex integration challenge in which very few innovators can contribute
 - Technology advances—in cloud-based infrastructures and artificial intelligence, for example—that are converging to further streamline access and conduct airspace operations in a more collaborative, integrated, and seamless way.



Formulation Input



From Sep-Nov 2019, NASA collected substantial formulative input from airline operators, airport operators, NBAA, FAA and vendor groups.

- Establish an **environment to rapidly innovate** toward wholesale upgrades to NAS efficiency and safety
- Create an **architecture that allows high reuse of solutions** and serves as a building block for advanced capabilities
- Align NAS data assets to **leverage the explosion in data science technologies** to create an oasis of innovation (i.e. – create clean datasets for training)
- Change the solution evaluation paradigm from large-scale field-based testing requirements to **smaller footprint cloud-based demonstrations**
- Pave the way for a **commercialization methodology for digital services** to be more quickly obtained from the cloud via trusted sources
- Evolve the use of cloud-based computing within the aviation system while increasing the ability to **rapidly collaborate across aviation development teams**



High Interest Data Assets



Getting key data out of ATC's and Operators brain

Important information from ATC and Operators is emerging in digital form such as the System Wide Information Management (SWIM) system.

Additional effort is required to fully extract and utilize this information for greater benefit to the aviation community.

- Specific examples of high interest digital assets (from community interviews)
 - Provide a capability that integrates key flight information from multiple sources for an accurate and reliable nation-wide stream of data in the cloud
 - Create objective measures of data quality that are shared with the community
 - Reduce data access right limitations that prevent broader community innovation

Digital assets are the building blocks of future game changing services



High Interest Services*



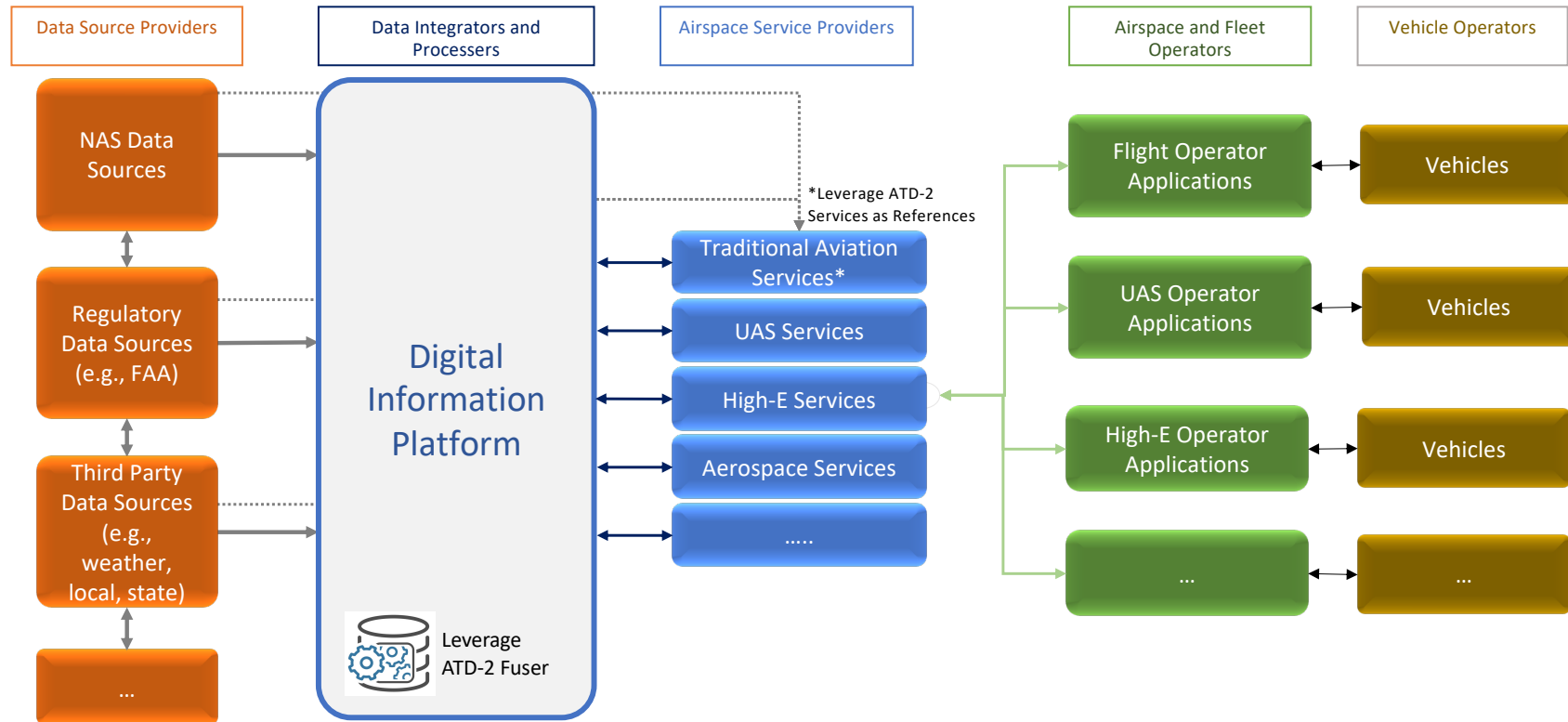
*listed services are subject to change based on stakeholder input

- From Sep-Nov 2019, identified highly reusable services that can be leveraged as building blocks for more advanced capabilities for both traditional and new entrants:
 - **Digitize the re-routing process (TOS)** to make better use of existing capacity
 - Provide a multi-system, multi-domain view of **impacts to their flights from gate-to-gate**
 - Create services **that promote system-wide safety (SWS)** related to new entrants
 - Provide services to help **reduce impact of space launch** (current day problem)
 - Create **disruption management services**. Faster recovery to nominal operations
 - NAS-wide **wind miles prediction** service
- Opportunities to apply Machine Learning and develop core data sets

Continue Partnership Input to prioritize services to enable for innovation



Notional Digital Information Platform



Common, simplified interface to integrated, processed information of high-interest



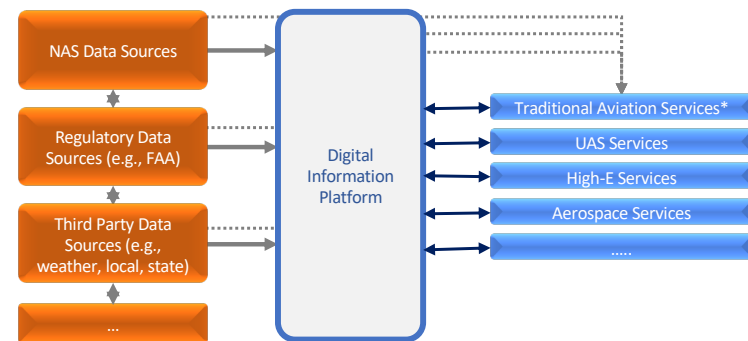
Leveraging Previous ATD-2 Work

- Collaboration with SWIFT and CDM led NASA and Industry to realize that the SWIM-based services NASA used to build the ATD-2 system have value above and beyond their use in the ATD-2 Field Demo
- **Fuser**
 - Ingests voluminous air traffic data from disparate sources and intelligently organizes it to deliver the **right data, at the right time**
- **Fuser-to-Cloud Connection**
 - Connects NAS-wide Fuser to Consumers via Cloud
- **Re-Route Digitization Service**
 - Digital rerouting of departure flights that accounts for real-time demand/capacity imbalances and incorporates flight operator preferences via Trajectory Option Sets (TOSs)
 - multiple flight operators from multiple airports used the system to intelligently identify and execute reroutes in coordination with FAA traffic managers



Benefits of Digital Information Platform

- Enable more and new types of operations by creating a scalable and resilient airspace system
 - Market place of digital services ecosystem open to all
- Increase the use of NAS Information powered by Advanced Technology
 - Integrated and fused data from FAA, airlines and other sources
 - Common, simplified API to access the fused information
- Improve Operational Flexibility with the development of user-informed Airspace Management Services
 - NAS-wide available services using high quality information from DIP
 - Establish new partnerships with solution providers with the goal of industry building the technologies
- Leverage Third Party Services and continue progress towards a service-oriented architecture





DIP Sub-Project Objectives

- **Stakeholder-Informed Platform:** Create a stakeholder informed requirements for a digital data platform to improve the deployment and access of services.
- **Validated Reference Implementation:** Develop a reference implementation or minimally viable product of DIP to validate stakeholder-informed requirements
- **Data Needs for Services:** Evaluate a variety of services to identify data needs for the DIP architecture.
- **Demos with Partner Collaboration:** Coordinate demonstration with stakeholders of reference technologies, new service(s) and DIP framework
- **Recommend Processes:** Share best practices for sharing data and data handling among stakeholders in the DIP community



NASA's Role



- NASA has a congressionally mandated charter to help keep the U.S. #1 in the world in Aeronautics
 - includes both industry and government agencies
- NASA has contributed to the aviation system for many years
 - TBFM (TMA, part of CTAS suite)
 - ATDs (ATD-1 TSAS, ATD-2 IADS, ATD-3 NASCENT)
 - Hundreds of research contribution
- NASA's leadership on Unmanned Airspace System Traffic Management (UTM) unveiled **design patterns and partnership collaboration** that it believes are **necessary for rapid technology adoption** in commercial aviation



DIP Stakeholders



DATA SOURCES

FAA Sources/SWIM
Airline
Airport
Vehicle
Weather



DATA INTEGRATION & PROCESSING

Industry
Academia



SERVICE PROVIDERS

Service Developers
Industry
Academia



FLEET OPERATORS

Service Consumers
Airlines
Airports
UAS Ops
AAM Ops
Space Ops
FAA
Research Orgs



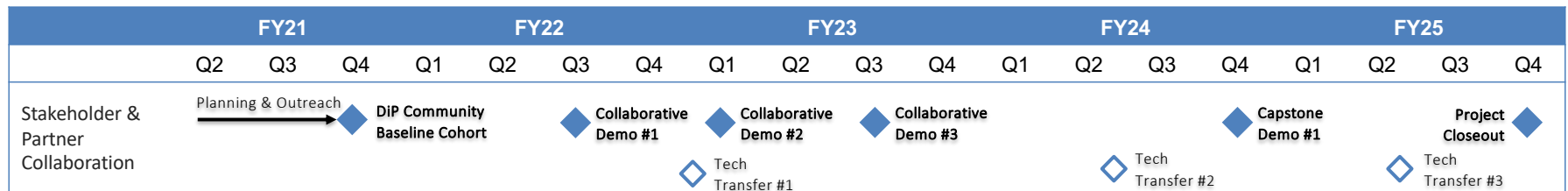


Seeking Information and Feedback

- Challenges and Pain Points:
 - Problems, challenges, benefits, priorities, scenarios, and use cases related to data feed usage, data availability and accuracy, types of services.
 - Identify things to consider when further defining the notional architecture (previous figure).
- Operational Concept:
 - Partner's operational view regarding the integration and use of DIP framework
 - If known, identify and define metrics that would be valuable to measure effectiveness and performance.
- Concept Adoption Feedback:
 - Information outlining opportunities and anticipated obstacles (business and technical) to adopting DIP, other considerations for investing and prioritizing DIP or related services
- Data and Services Needs:
 - Data sources that would be beneficial to fuse and mediate. Services that are of high priority that face data integration challenges and would be of high value to traditional and emerging fleet operators.



Collaborative Approach*



- DIP is under project planning, team formulation and initial concept development
- Stakeholder outreach to create a DIP community to participate in architecture feedback and validate interface requirements between data sources, DIP, and services
- Partnerships to contribute and participate in multiple collaborative demonstrations to validate concept and mature requirements
- Demonstrations to include minimal viable products with more frequent feedback cycles
- Scope to balance demonstration value and resources to support
- **Next Steps: Community input to reassess highly desired data assets, services, and metrics**

*schedule is subject to change



Potential Partner Contributions

- Provide and share **current (or future) operational needs** and **pain points** to current system
- **Identify data** and define data elements upon which services can be built
- **Share APIs** to access and retrieve data
- **Apply model/logic to transform and integrate** data into airspace management services
- Provide **data and cloud infrastructure value-added services** for DIP Collaborative Demo implementation
- Provide **advanced big data, machine learning, artificial intelligence solutions**
- **Test requirements to standardize API** between DIP and connected services
- Identify **stakeholder performance metrics and validate metrics** to evaluate DIP performance
- Identify **reporting and performance requirements** for data information and services to characterize against expectations
- Provide and share **current (or future) regulatory needs** as applicable to data sharing
- **Test and validate components of DIP** including interfaces, services, data inputs and outputs



Potential Partner Contributions – Airline Operators

- Provide and share **current (or future) operational needs** and **pain points** to current system
 - Reassess Fall 2019 input of highly desired services and data assets
- **Identify data** and define data elements upon which services can be built
- **Share APIs** to access and retrieve data
- **Apply model/logic to transform and integrate** data into airspace management services
- Provide **data and cloud infrastructure value-added services** for DIP Collaborative Demo implementation
- Provide **advanced big data, machine learning, artificial intelligence solutions**
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- **Identify stakeholder performance metrics and validate metrics** to evaluate DIP performance
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