NASA-FAA Technical Interchange Meeting

Aug 31, 2021

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https://nari.arc.nasa.gov/atmx-dip

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 Community*

- Increased access to NAS information to leverage explosion of data
- Improved data quality with objective measures for airspace management
- Commercialization methodology for digital services
- Scalable and adaptable integration of services as building block for advanced capabilities
- Architecture that supports high-reuse services
- Small-footprint cloud-based demos and rapid collaboration
- Deliver reduction in emissions, noise, and fuel of aviation operations through digital service-oriented

*[Fall 2019] NASA AOSP collected substantial formulative input from **airline operators, airport operators, NBAA, FAA and vendor groups**.

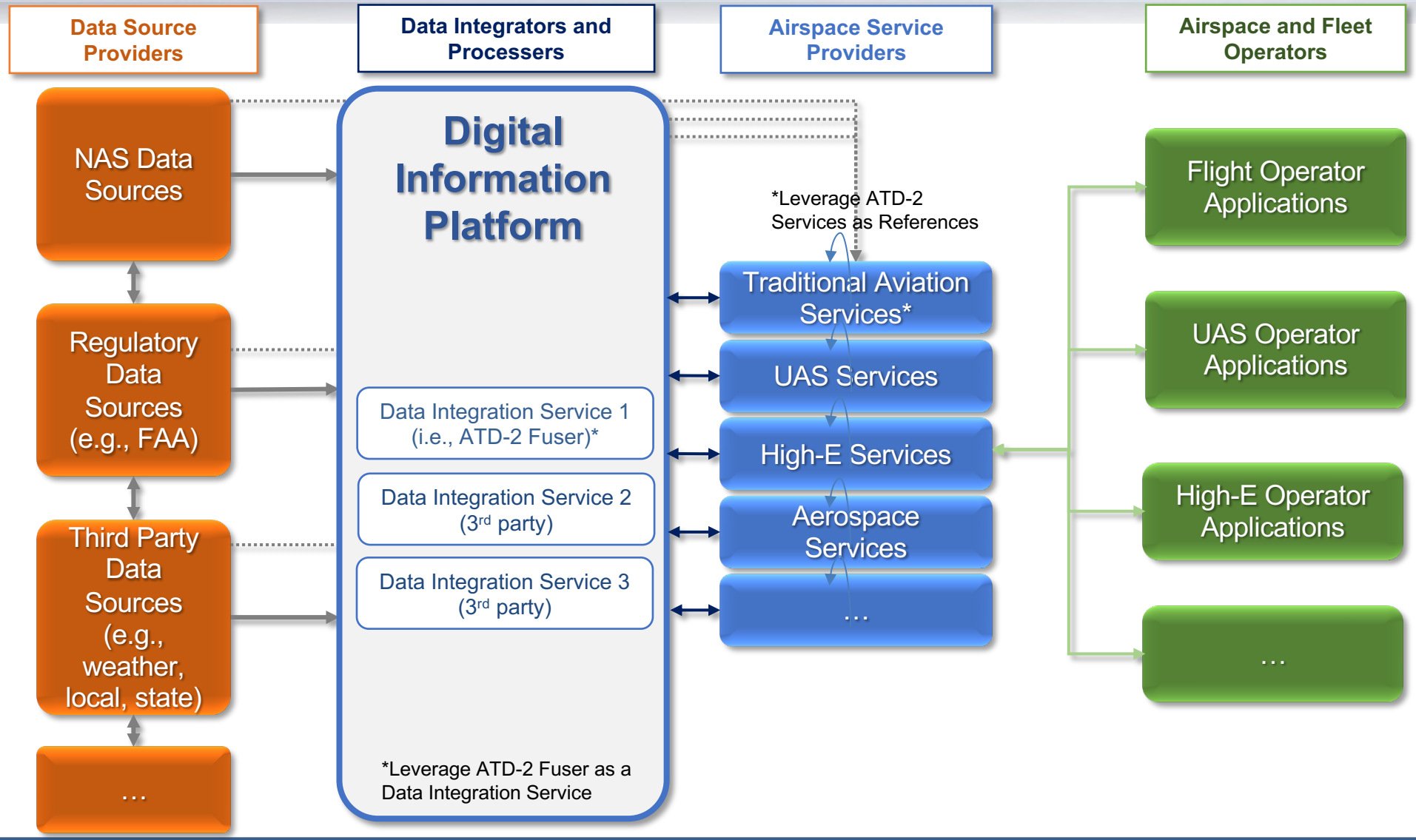
*[March 2021] DIP published a **Request for Information** and received over 40 responses from flight operators, service providers, data integrators from traditional and emerging operations community

What should we do?

Accelerate transformation of the NAS through the development of a **platform** for advanced, **data-driven, digital services** for **flight operators** to promote **efficient aviation operations**

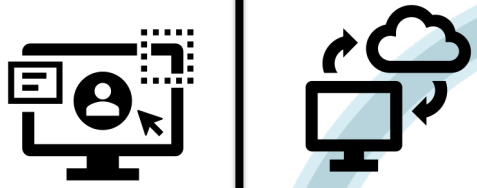
- Pave the way for **high-reuse digital service solutions** to be more **quickly discovered**
- Improve data accessibility to enable machine-learning based services to scale services
- Develop MVP prototypes of services improving predictability and efficiency
- Enable NAS-wide implementation of digital services that supplements FAA investments

Notional Digital Information Platform Ecosystem



Common, simplified interface to integrated, processed information

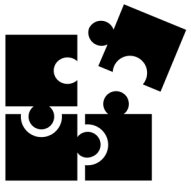
Platform and Services Features



Search & Discover
Expanded Use of Services

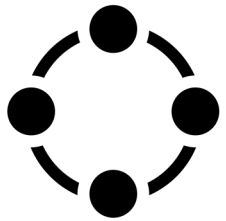
Service Providers Ecosystem
Larger airspace community to provide services

Advanced Technologies
Accelerate Innovation to improve adaptability and extensibility of services



Reusable APIs
Building blocks for configurability and adaptability

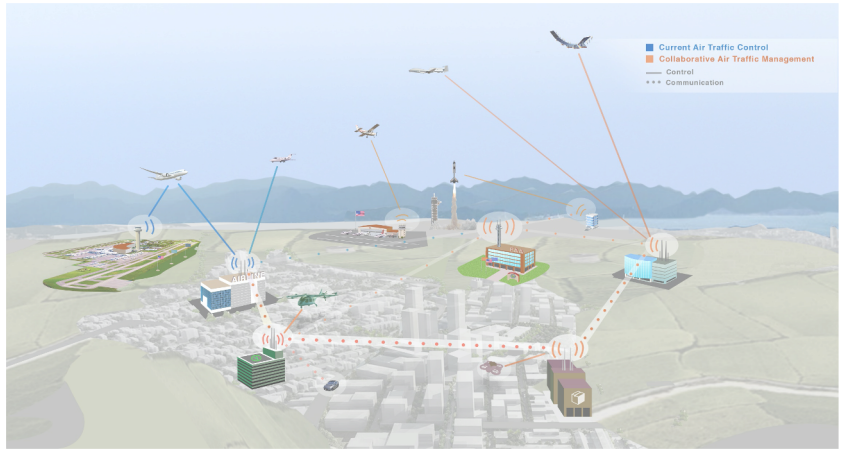
Performance Monitoring
Reliable quality information

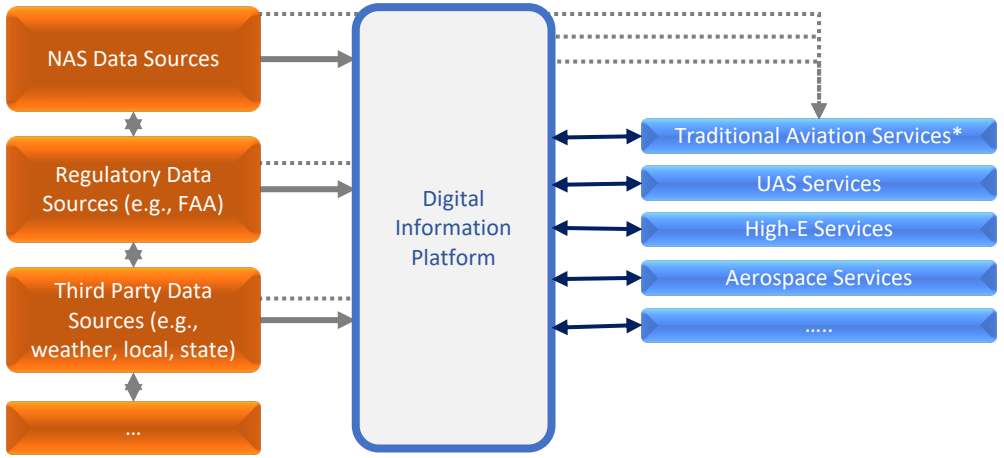


Data Integration
Faster Service development with fused data for scalable integration

Benefits and Impact of DIP

- Faster innovation of services and advanced analytics from better data quality
- Economic incentive through a marketplace of high-reuse services, rather than custom solution;
- More developers to build advanced services due to easier discovery of modular microservices
- Increased access to quality NAS information and ready-to use solutions
- Better standardization and adoption of services to enable federated solutions





Why NASA?

NASA is one of very few that understand all the data producing systems and their artifacts

NASA is a leader in contributing to ATM systems (TBFM, ATDs) for many years

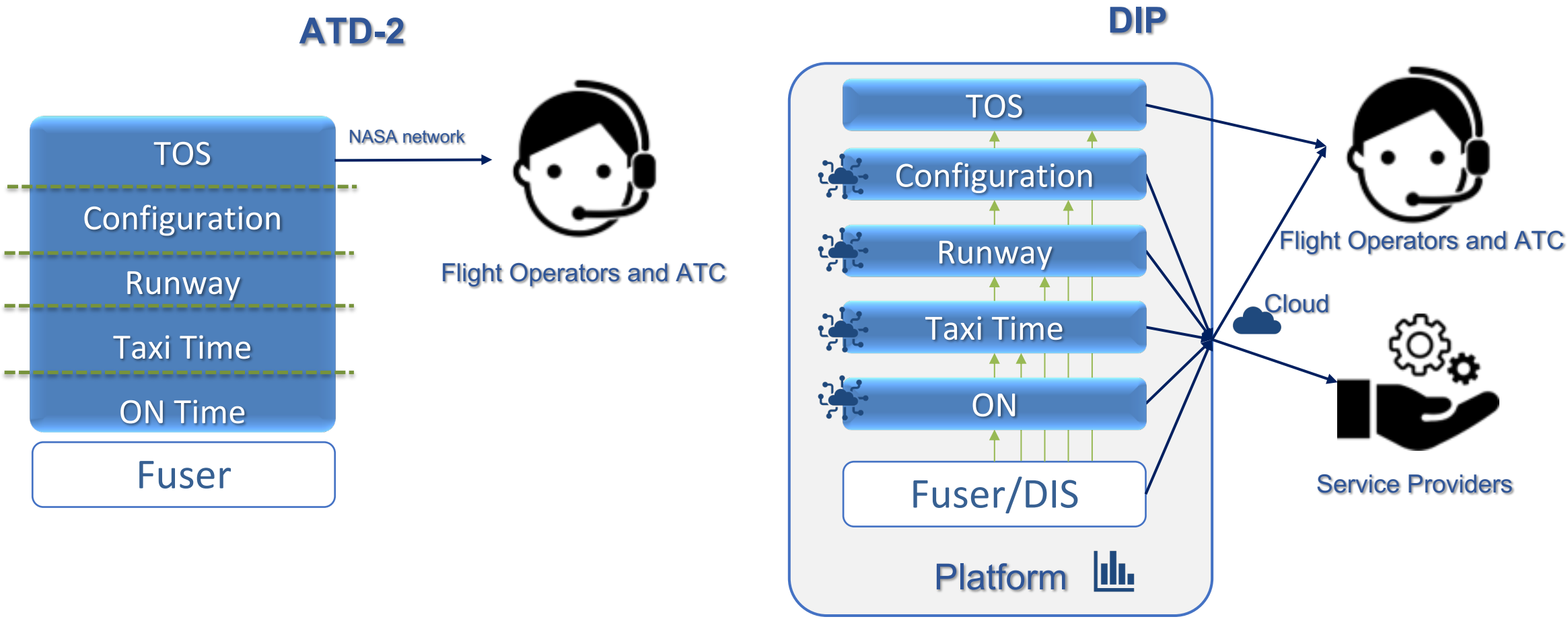
NASA has a congressionally mandated charter to help keep the U.S. #1 in the world in Aeronautics, both industry and government agencies

NASA has a strong relationship with the FAA, airlines, airports, and commercial industry

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 – Data Integration Service**
  - Ingests voluminous air traffic data from disparate sources and intelligently organizes it to deliver the **right data, at the right time**
- **Collaborative Digital Departure Re-Route (CDDR) 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
  - Prediction Microservices supporting CDDR: **Airport Configuration, Runway, Taxi Time, ON Time**

Transformation of ATD-2 TOS for DIP



Break up monolithic TOS; Apply ML; Microservices as building blocks

High-Need Services per Community Input*

- Flight Information Data Integration
- Weather Data Integration
- Expansion of TOS
- Surveillance Data Integration
- NAS-wide Wind Miles Prediction
- NAS simulation and Playback
- NAS-wide TMI Service
- EOBT Generation
- IROP Disruption Management
- Surface Congestion Prediction

Services geared towards: Efficiency | Predictability | Reliability

Sustainable Aviation Operations Goals and Approach

Deliver reduction in emissions, noise, and fuel of aviation operations through digital service-oriented technology demonstrations

- NASA demonstrations for high-impact services with broad stakeholder appeal
- Provide impactful high-TRL products to enable industry cost-share partnership
- Develop Digital Information Platform to support Cloud-based ground and flight-deck based flight demonstrations while also being extensible to new entrants
- Partner with FAA and aviation and non-aviation industries to conduct demonstrations

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DIP-Enabled Services for Sustainable Aviation (SA)

SA-1: Collaborative Digital Departure Re-Route
Demonstrate CDDR via Trajectory Option Set (TOS) in high density operations by rerouting flights and departures

Benefits:
Reduced fuel burn and emissions through reduced surface departure delay. Benefits rerouted flight as well as all departures

SA-2: Multi-regional TBO
Demonstrate digitally connected flight deck service for efficient trajectories and scheduling in multi-region/oceanic airspace leveraging surveillance and navigation

Benefits:
Reduced emissions and fuel-burn on long-haul oceanic flights

SA-3 IROP Recovery/Disruption Management
Develop and demonstrate predictive analytics services for recommending intelligent IROP recovery strategies

Benefits:
Reduce wasteful fuel-burn due due to long taxis, returns to gate, diversions, etc. during IROP events

SA-4: 4D Trajectory Optimization
Demonstrate digitally connected flight deck services to optimize en-route 4D trajectories based on traffic and weather constraints.

Benefits:
Reduced fuel burn and emissions while motivating the development of the flight deck of the future

Ground Services
Flight Deck Services

DIP Collaborative Demos with SA Services

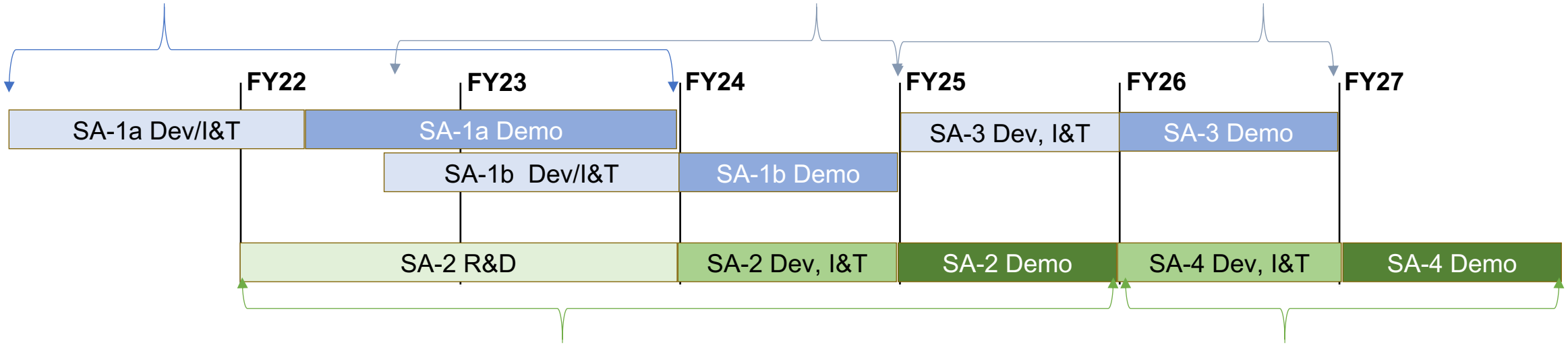
Ground Services

Flight Deck Services

SA-1a: CDDR at NTX (FY22-23)
Build up CDDR in a familiar operational environment

SA-1b: CDDR at Complex Airspace (FY23-24)
Demonstrate CDDR via Trajectory Option Set (TOS) in high density operations by efficiently rerouting flights and departures

SA-3: IROP Recovery (FY25-26)
Develop and demonstrate predictive analytics services for recommending intelligent IROP recovery strategies



SA-2: Multi-regional TBO (FY24-25)
Demonstrate digitally connected flight deck service for efficient trajectories and scheduling in multi-region/oceanic airspace leveraging surveillance and navigation

SA-4: 4D Trajectory Optimization (FY26-27)
Demonstrate digitally connected flight deck services to optimize en-route 4D trajectories based on traffic and weather constraints.

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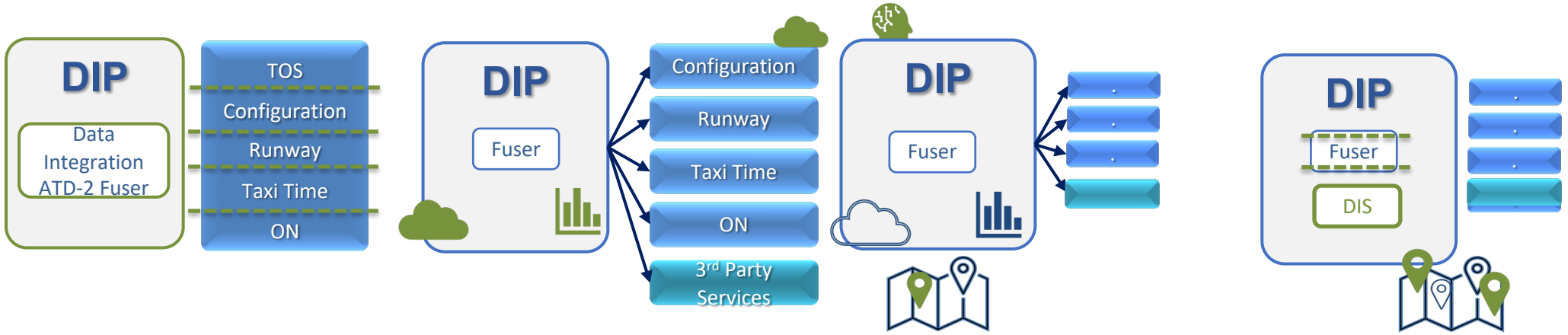
Platform Progression with Partner Services



Dimension	FY22	FY23	FY24	FY25++
OBJECTIVE	**Build up and Partner Integration**	**Demonstrate ecosystem with additional 3rd party aviation services**	**Demonstrate ecosystem is extensible and adaptable to new services with standardized APIs**	**Demonstrate extendibility of DIP to additional environments**
PARTNER ENGAGEMENT	Build up for NEW Partners: Establish connection to Fuser and CDDR-related micro services Run CDDR @ NTX;	Partner Services use DIP platform and consume from Fuser and NASA reusable services	Services build on other DIP-available services to validate standardized APIs; Run CDDR @ more complex airspace	Partner-led demo of DIP; support additional data sources and data integration services
INDUSTRY SERVICES	TBD via ACO	TBD via ACO	TBD via ACO	TBD via ACO

Partnership Approach

Leverage Existing Partnerships with airlines and airports

American Airlines

Southwest

DFW

Publish RFI & ACOs to *EXPAND* Engagement with stakeholders

Community to collectively contribute to DIP ecosystem as data and service providers for use by flight operators for evaluation

Collaborative Workshops & Demos with Partners

Opportunities for partners to collaborate on standards definition and validate concept. Demonstrate their services and capabilities in DIP ecosystem

University Challenges

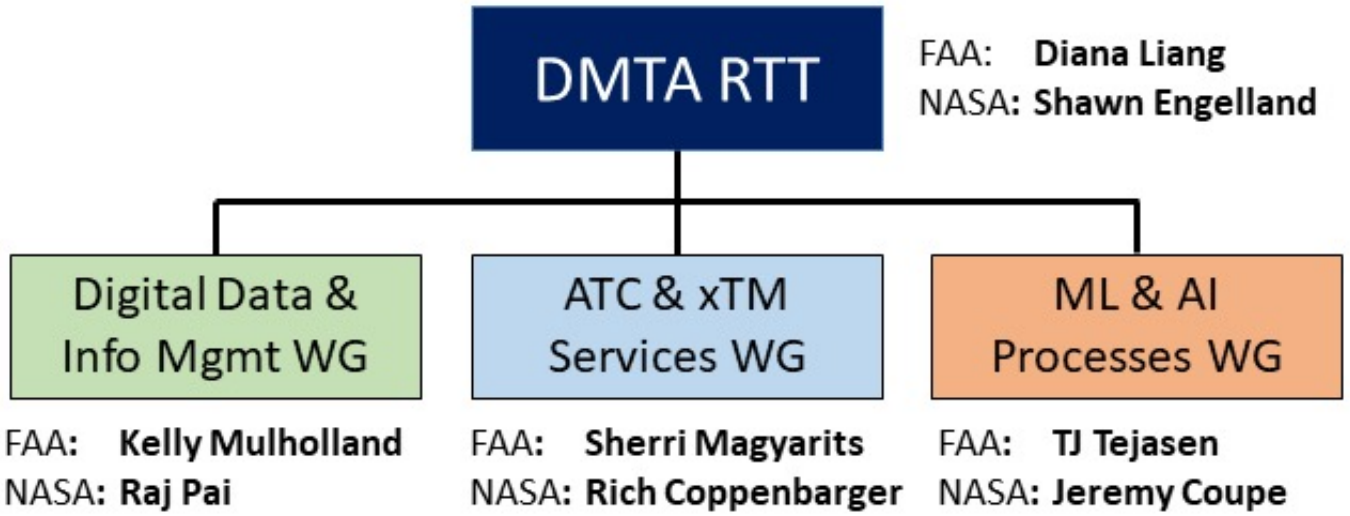
Leverage forward-looking research from Universities to propel early AI/ML service concepts and prototypes

NTL NASA Tournament Lab

DMTA RTT – Objectives and Structure

Digital Mesh Technology & Applications (DMTA) RTT will

- Research best practices for the evolution from today's hybrid environment to a **fully service oriented architecture**, with full **digital data backbone (**big data pool), and **enhanced information management**;
- Research the use of **Machine Learning (ML)/Artificial Intelligence (AI) algorithm enabled systems** to deliver tailored services to users;
- Engage in research to develop the **framework/processes to certify third party services** that incorporate ML/AI;
- Research the use of commercial technologies, algorithms, and services for digital mesh applications, ML/AI and SOA/digital backbone solutions where possible; and
- Explore framework, concept, and services for ATC and xTM operations



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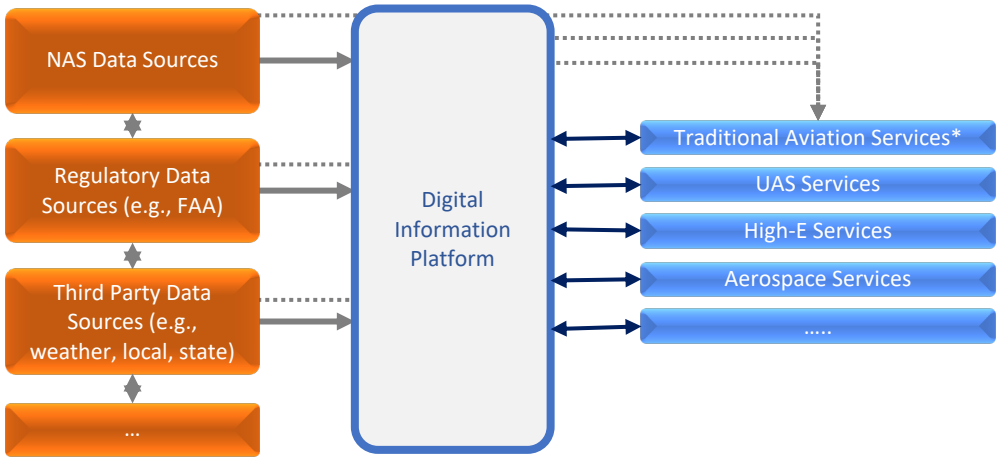
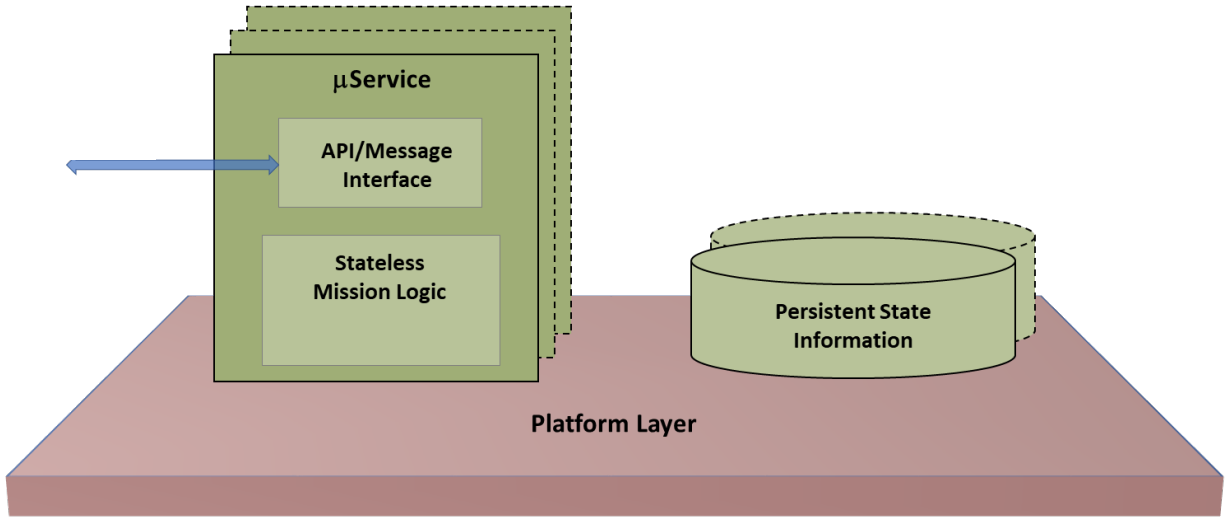
Align with NAS2035

NASA seeks to collaborate with FAA to align and complement NAS2035 Vision of a Platform for Microservices

Digital Information Platform



NAS2035 Microservice Concept



THANKS FOR JOINING!

FAA Breakout Session Topics

- Discuss next steps regarding field demo opportunities with partners (FAA and airlines) engagement for the DIP SA-1 demo (FY22-24)
- Identify how NASA can further FAA objectives of FF-ICE/CSS-FD via DIP SA demos
- Learn more about Multi-Regional TBO: many questions here! To help guide planning for DIP SA-2 demo

BACK UP

DIP Collaborative Sustainable Aviation Demos

Ground Services

Flight Deck Services

SA-1a Risk Reduction: CDDR at NTX (FY22-23)
Build up capability to enable flight operators to intelligently select collaborative digital departure rerouting (CDDR) and request efficient reroute from ATC

SA-1b: CDDR at Complex Airspace (FY23-24)
Demonstrate CDDR via Trajectory Option Set (TOS) in high density operations by rerouting flights and departures

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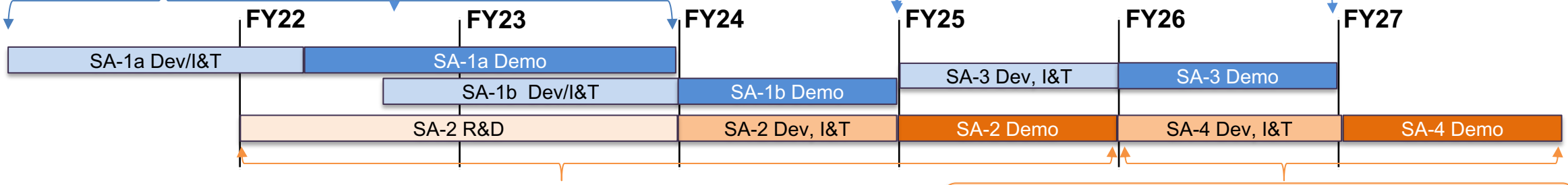

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