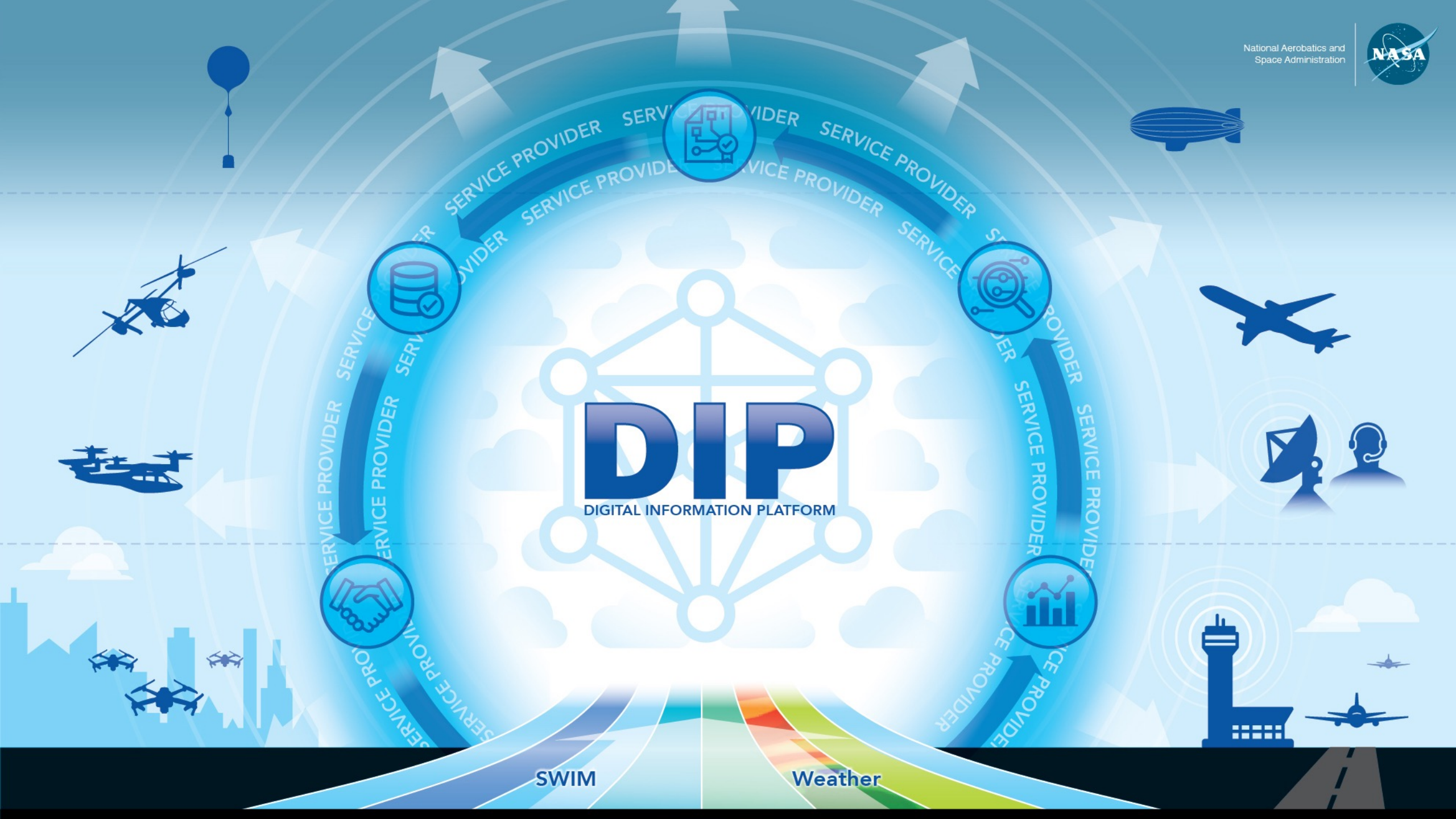






Ground Rules



- Please **turn off your mic and camera** (for bandwidth issue)
- There will be Q&A forum throughout the session and at the end
 - Encouraged to use the Conferences.io link to post questions: <https://arc.cnf.io/sessions/nedn/#!/dashboard>
 - You may also post questions in the chat box
- This workshop session will be recorded, and the recording & slides will be available on DIP website after the workshop
- There will be no break



DIP Workshop Series: #1

DIP Architecture and Data Integration Services

November 17, 2021



Goals of Workshop Series



- **Objective**

- Obtain informed technical feedback to DIP design
- Prepare participants for what they could expect for the demo

- **Target Audience**

- Flight Operators and Service Providers interested in partnering by adding their services to DIP and/or consuming data and services
- Technical enough to understand DIP system requirements and how they would be applied to their own services and business model

- **Approach**

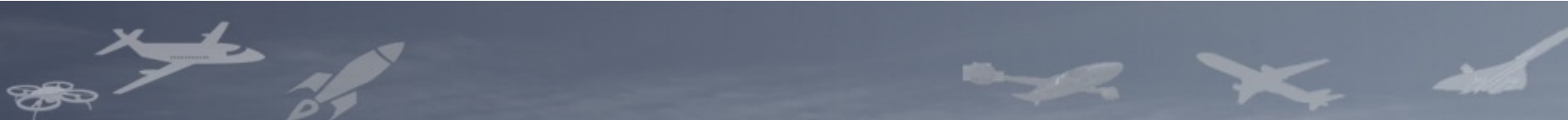
- Present DIP at a more detailed level of what it "actually" looks like
- Walk through the capability and ask prompting questions



Agenda

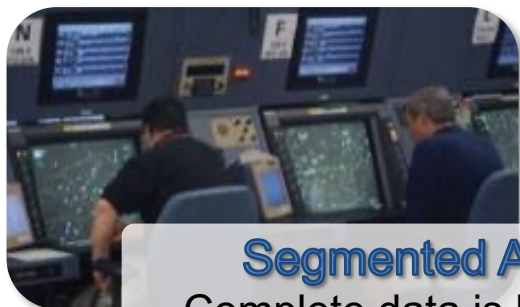


- DIP Overview
- DIP Ecosystem
- DIP Architecture
- DIP Data Integration Services
- Q&A Discussion Session
- Next Steps and Closing Remarks



Digital Information Platform (DIP) Overview

Mirna Johnson
DIP Sub-project Manager
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Segmented ATM Systems

Complete data is hard to access which limits data-driven solutions from entering the market

Inconsistent Data Quality

Hard to decipher data and thus consume which prevents from developing innovative advanced solutions



Hard to access and decipher data to provide advanced digital services for digital NAS transformation

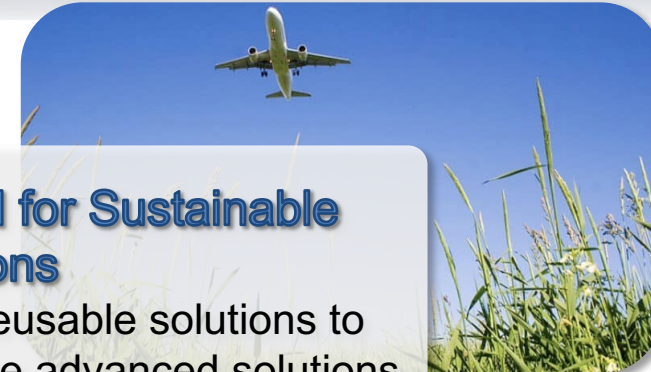
More Complex Operations

require higher levels of synchronization and holistic solutions for fully informed decision making



Demand for Sustainable Operations

Lack of reusable solutions to build more advanced solutions that can optimize efficiency



Limited Paths to Enter Market

Hard-to-deploy solutions which limits market entry



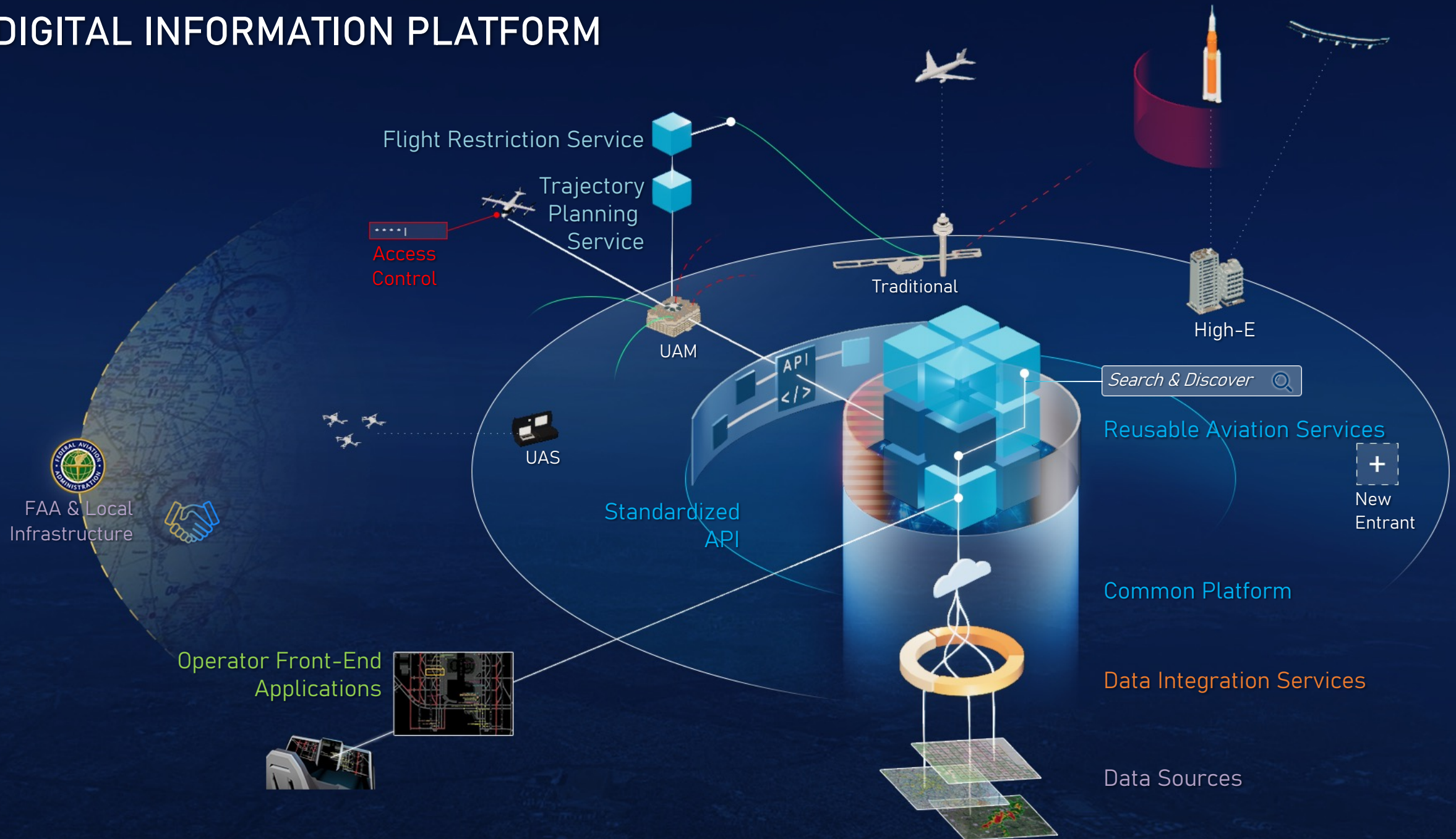


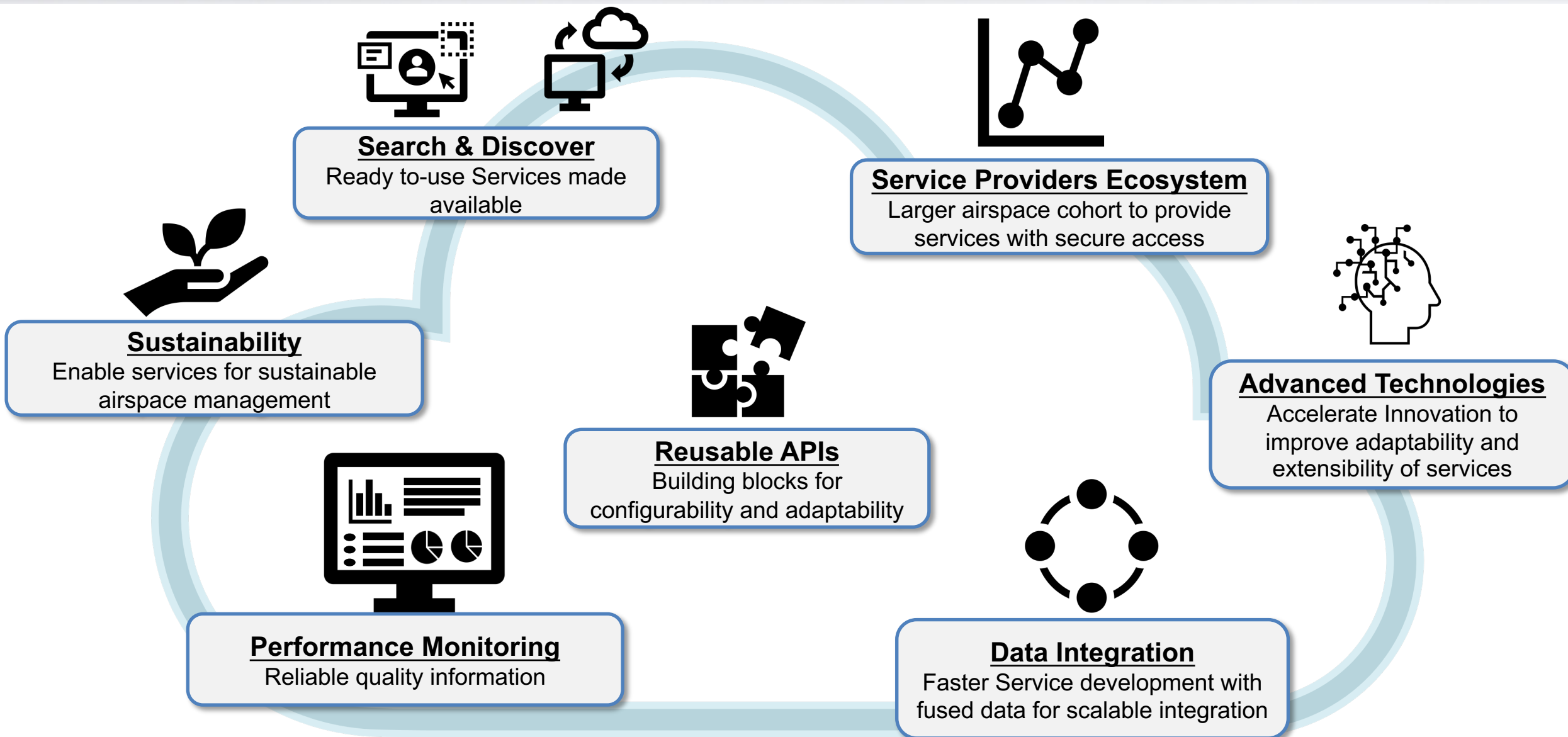
DIP Goal & Objectives

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

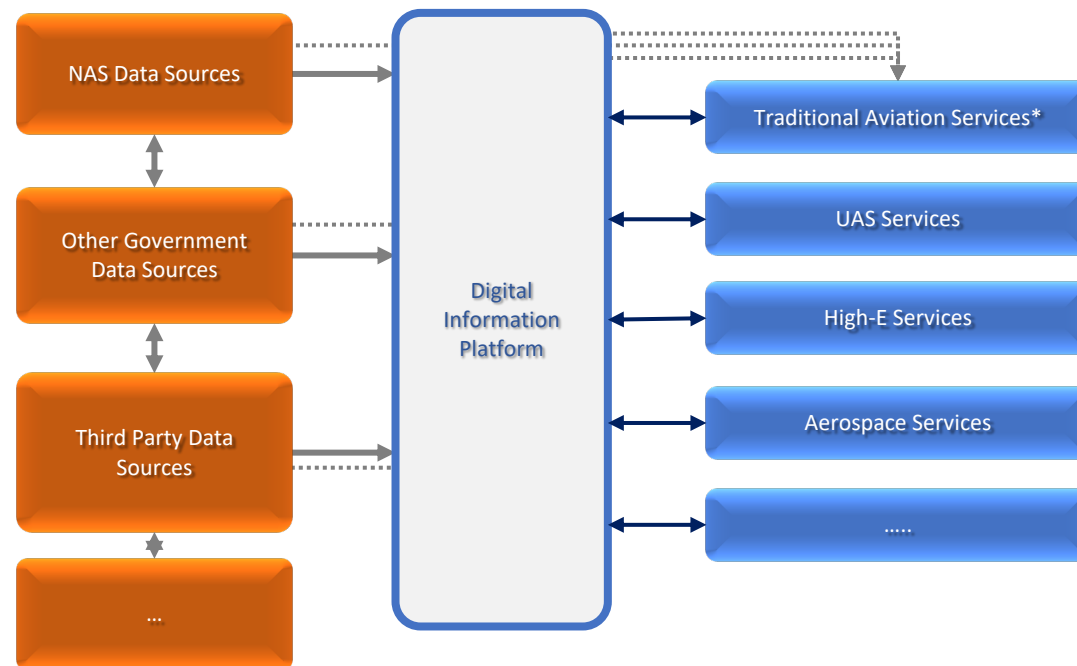
- Pave the way for **high-reuse digital service solutions** to be more **quickly discovered** on the platform
- Improve **data accessibility** to enable machine-learning based services to **scale services**
- Develop **MVP prototypes** of services improving **predictability and efficiency**
- Enable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

DIGITAL INFORMATION PLATFORM





- **Faster innovation of services** and advanced analytics from better data quality and increased access to NAS information
- **Economic incentive through a platform** of highly-reusable services, rather than custom solutions, for centralized and federated solutions
- **More developers to build advanced services** due to easier discovery of modular microservices and standardization

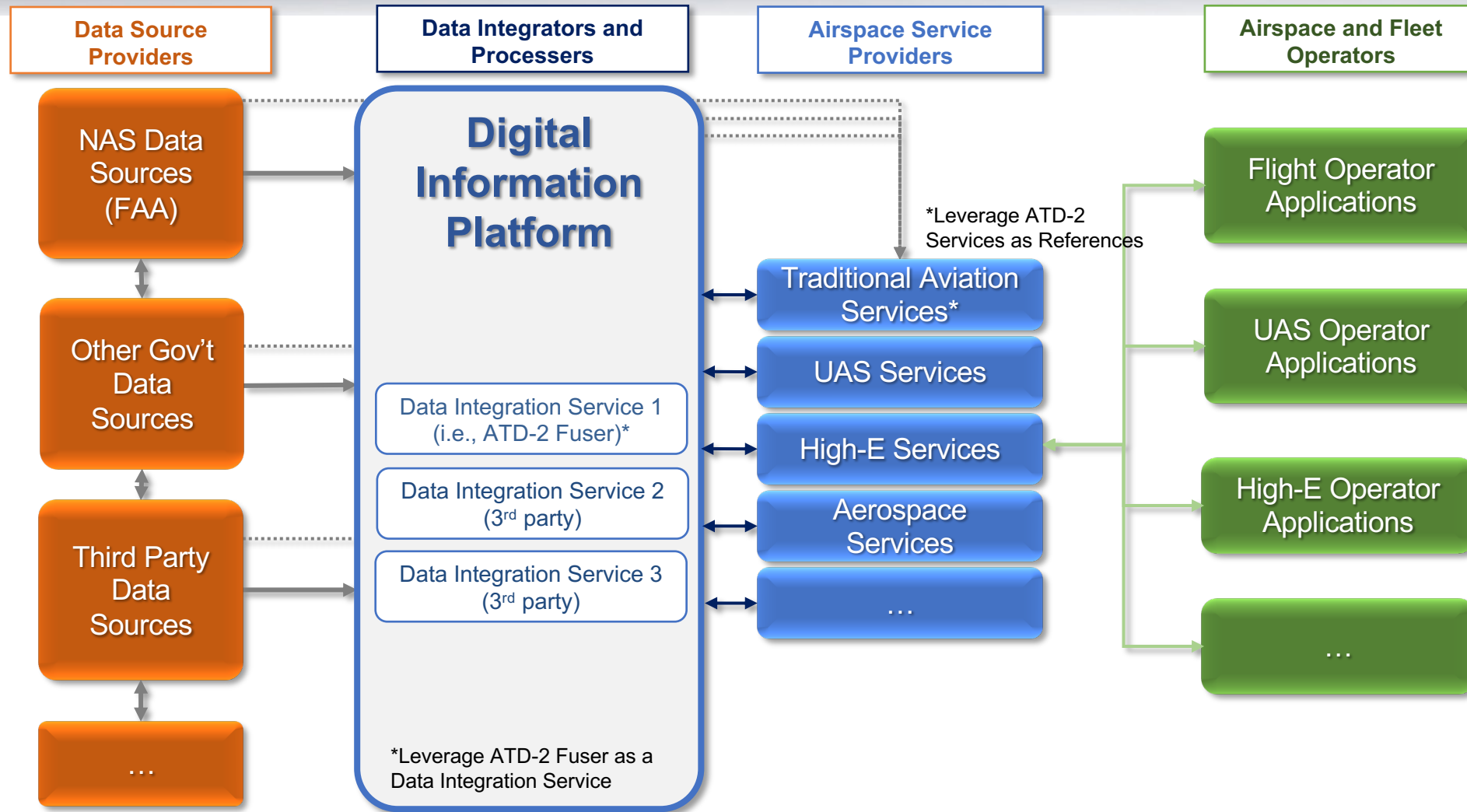




DIP Ecosystem



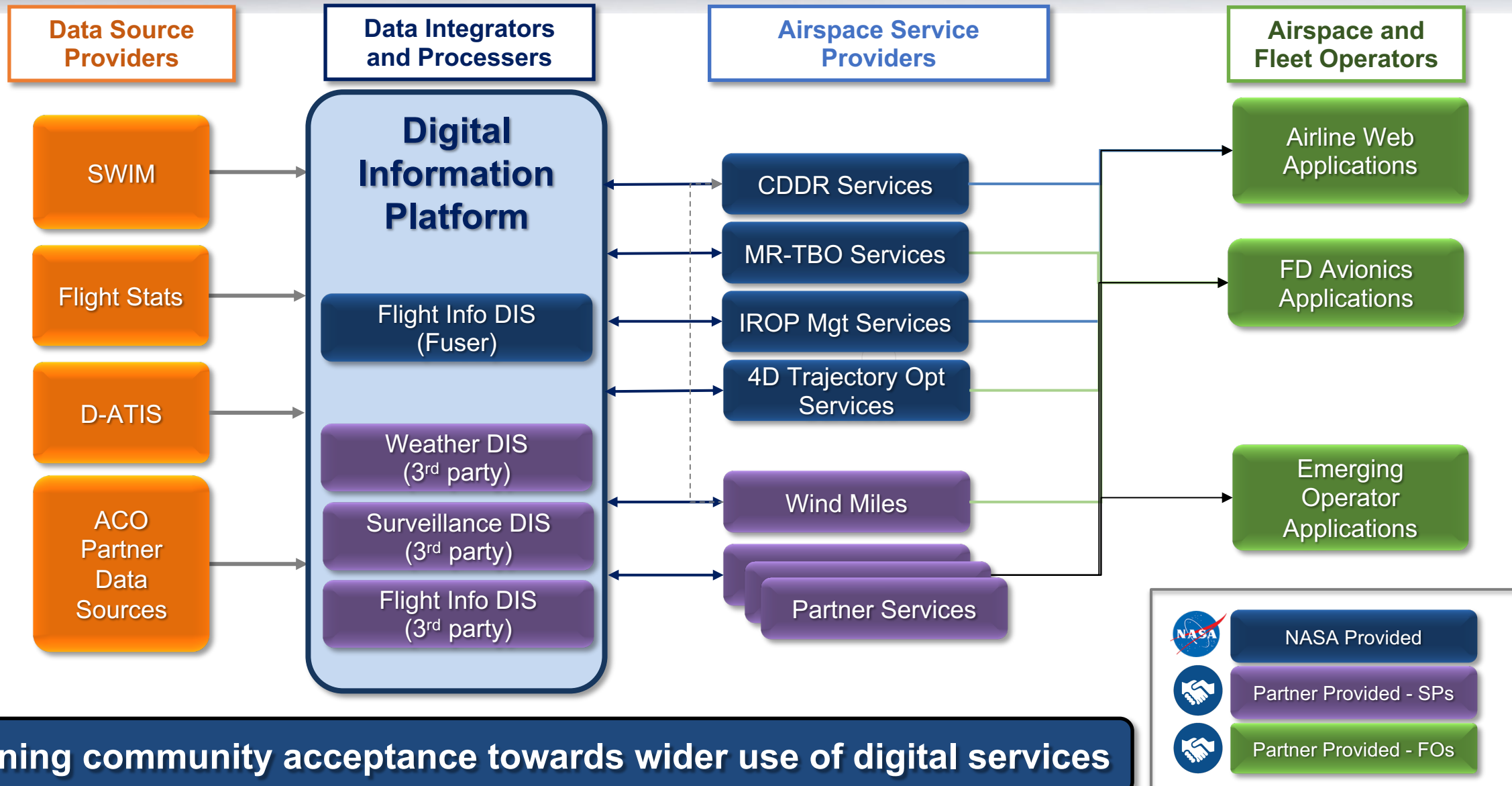
Preliminary DIP Ecosystem



Common, simplified interface to integrated, processed information



Building DIP with Partners





DIP Architecture

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DIP Platform Vision



Service/Data Providers

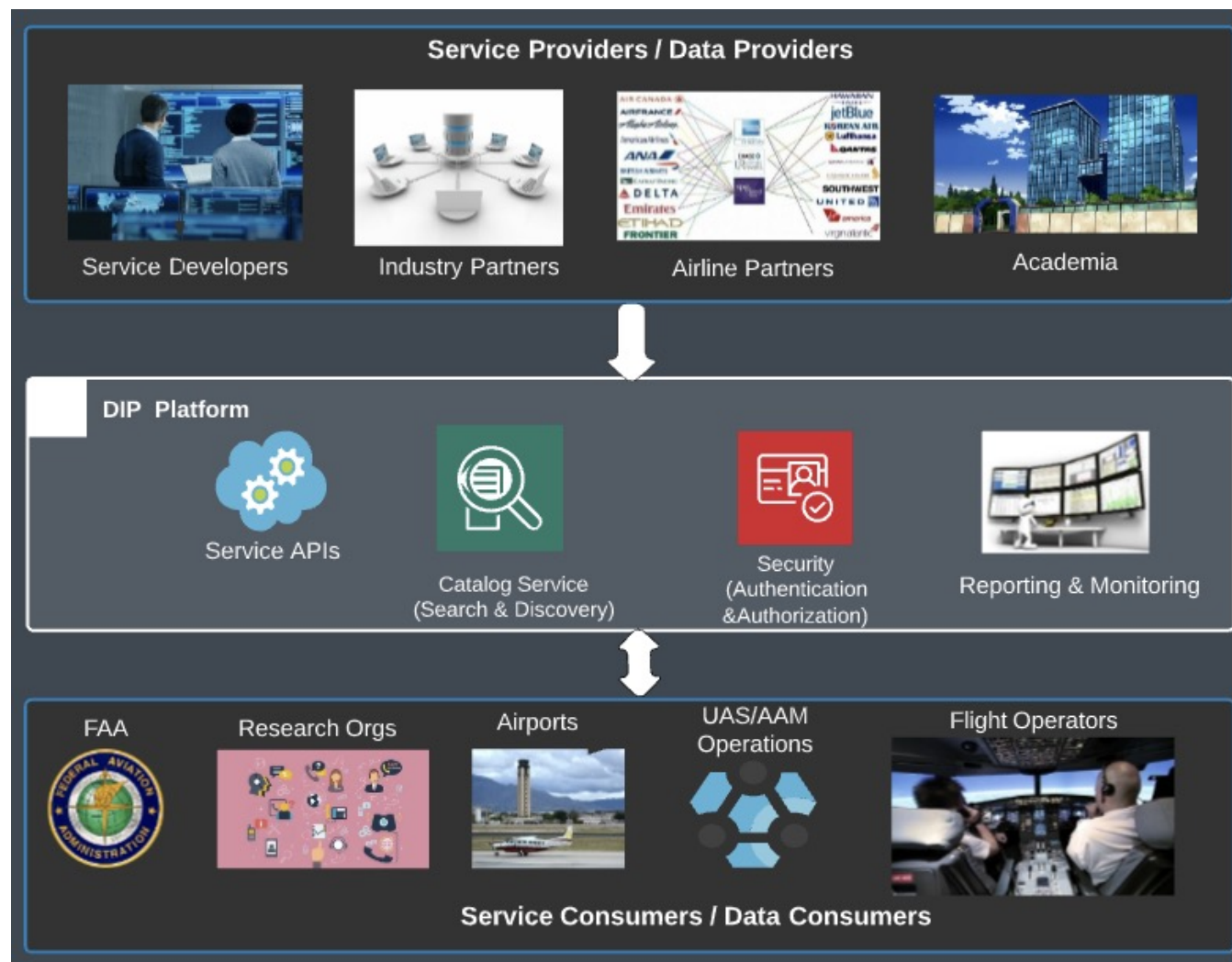
- Service/Data Providers register services with DIP Platform

DIP Platform

- Platform offers Secure access, Catalog Service, NASA-developed services, NASA data access APIs & Reporting/monitoring services

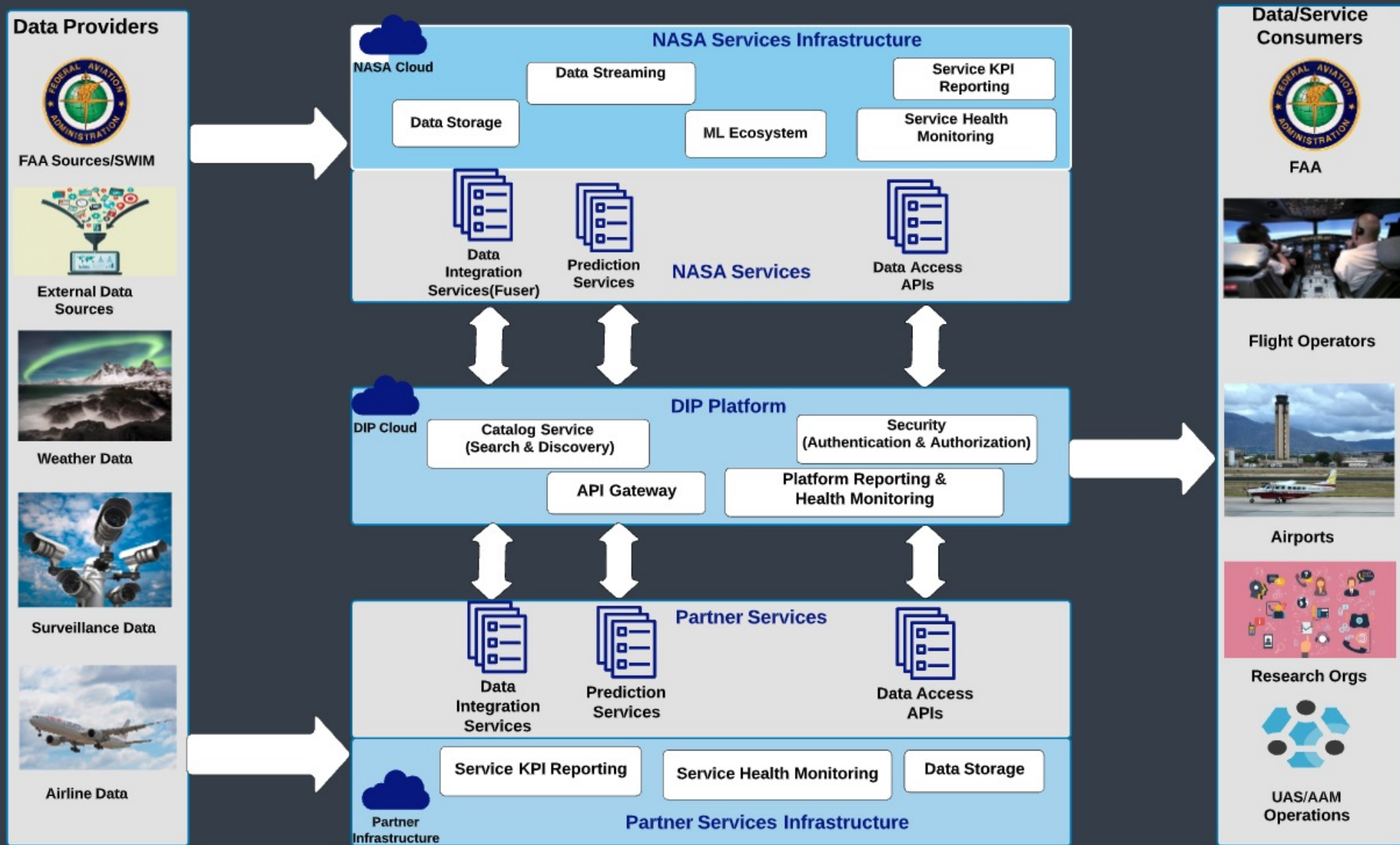
Service/Data Consumers

- Partners can search & discover Platform registered services





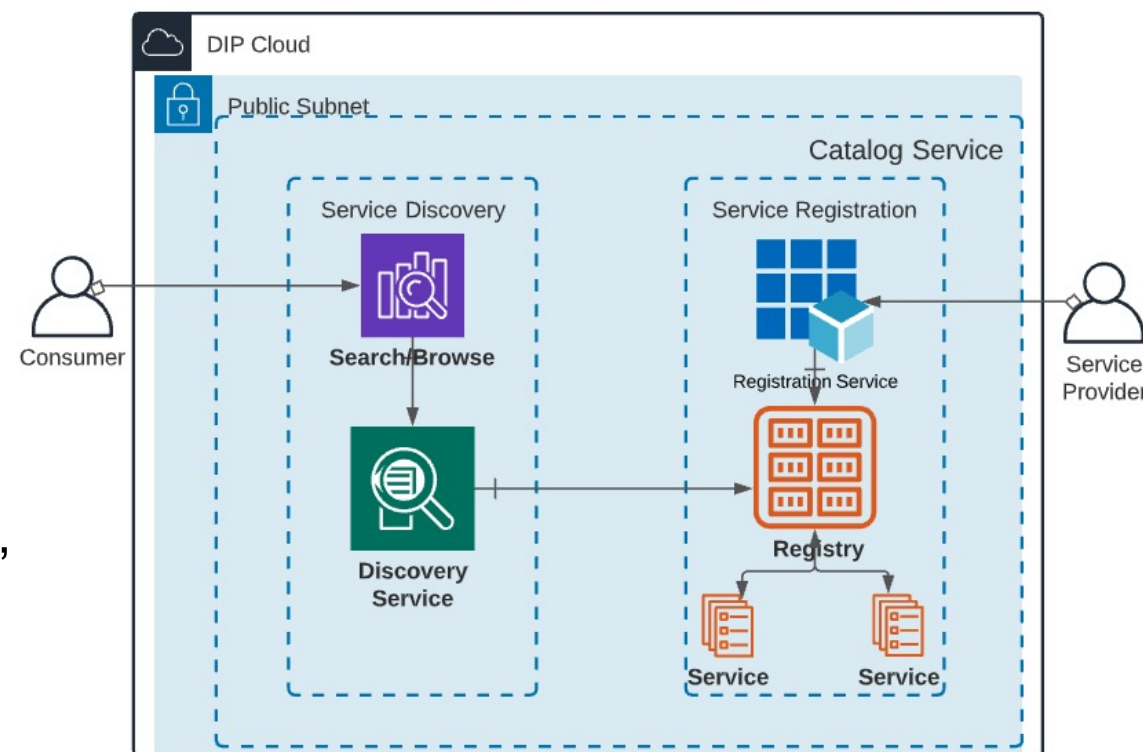
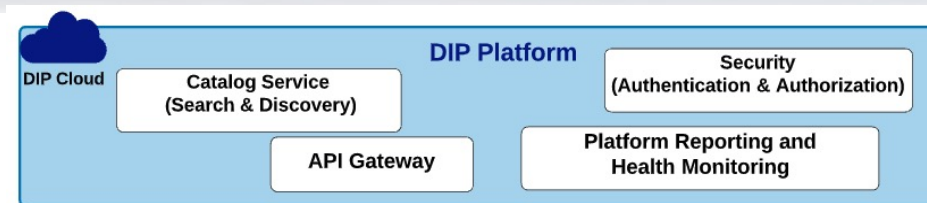
DIP Platform Functional Architecture



Common, simplified interface to integrated, processed information

Catalog Service

- Registration, search, and discovery
- Provide an avenue for simplified discovery of services and data
- A central 'Catalog' of Service helps partners find the services that serve their business goals
 - Service providers register their services with DIP, providing metadata that inform potential clients
 - Partners search or browse through DIP's 'catalog' of services to identify a service of interest
 - Partners acquire connection information from the discovery feature of the catalog service



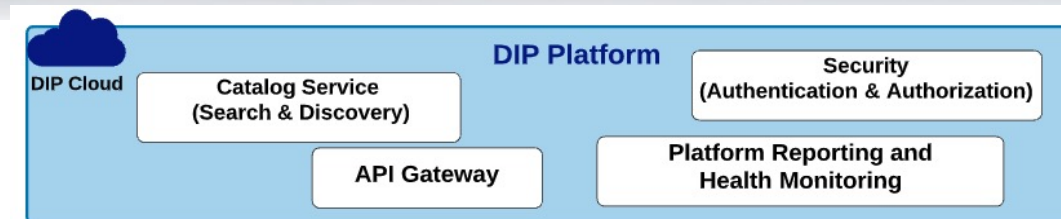


DIP Platform Features



Security (Authentication & Authorization)

- Secure authentication and role-based token authorization using Amazon Cognito
- Amazon Cognito is a cloud-based service that offers authentication, authorization and user management for applications



API Gateway

- Centralized API gateway to redirect services
- An API gateway functions to accept incoming requests (traffic), routes them to the appropriate service based on a set of rules and policies defined by the organization, and then returns the appropriate result to the end user

Platform Reporting and Health Monitoring

- Platform provides a dashboard to showcase service-provided KPI reporting and health monitoring status



NASA Services Infrastructure

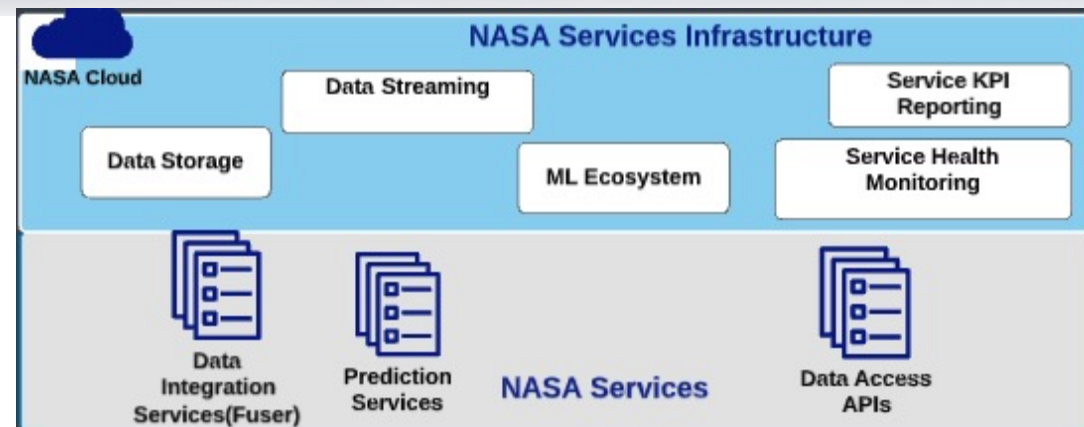


Data Streaming

- Fuser data is available for streaming from the pub-sub system

Data Storage

- Fuser data is stored in RDS Database and S3 bucket



ML Ecosystem

- NASA-developed NAS ML Ecosystem will be running on the Cloud

Service KPI Reporting

- Services to measure Key Performance Indicator (Self Scoring) will be deployed in the Cloud

Service Health Monitoring

- Health check services to monitor system health will be deployed in the Cloud



NASA-developed services are registered and discoverable in the Platform

Data Integration Services (Fuser)

- Flight info data fused and mediated from multiple sources such as SWIM data, airline specific data and other sources

Data Access APIs

- APIs to query data will be available in the Platform
- These services can be used for real-time decision making and collaboration, post-operations analysis, and understanding



Current Configuration for a flight



Predictions Configurations for a flight



Predicted Departure or arrival runway for a flight



Unimpeded Off time for a flight



Unimpeded taxi time for a flight



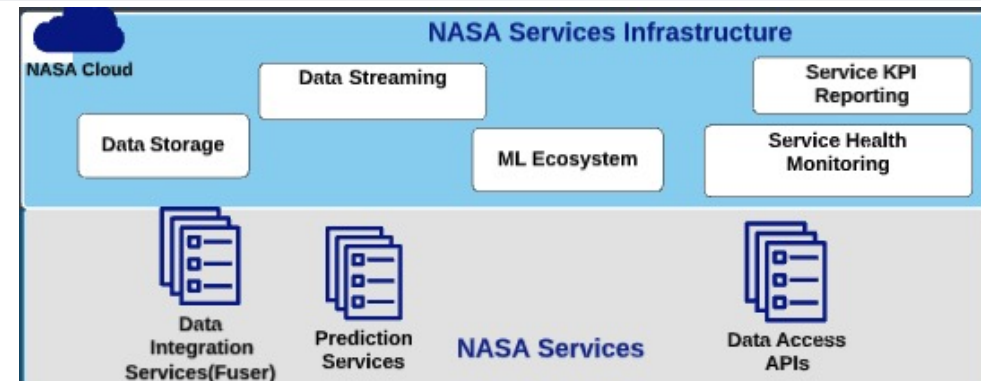
Estimated On Time for a flight



TMI Service



Weather Service



Prediction Services

- These re-usable microservices were developed using machine learning approaches without the need for heavy adaptation
- These services can be used for real-time decision making and what-if analysis



Configuration Prediction Service



Runway Predictive Service



Unimpeded Taxi Time Service



Estimated On Time Service



Partner Services and Infrastructure



Data Integration Services

- Partners may develop data integration services and register with DIP Platform to make it discoverable by other Partners

Prediction Services

- Service Providers may develop Prediction services and register with DIP Platform

Data Access APIs

- Partners may provide APIs to access data



Service KPI Reporting

- Partners need to provide Self Scoring of the services

Service Health Monitoring

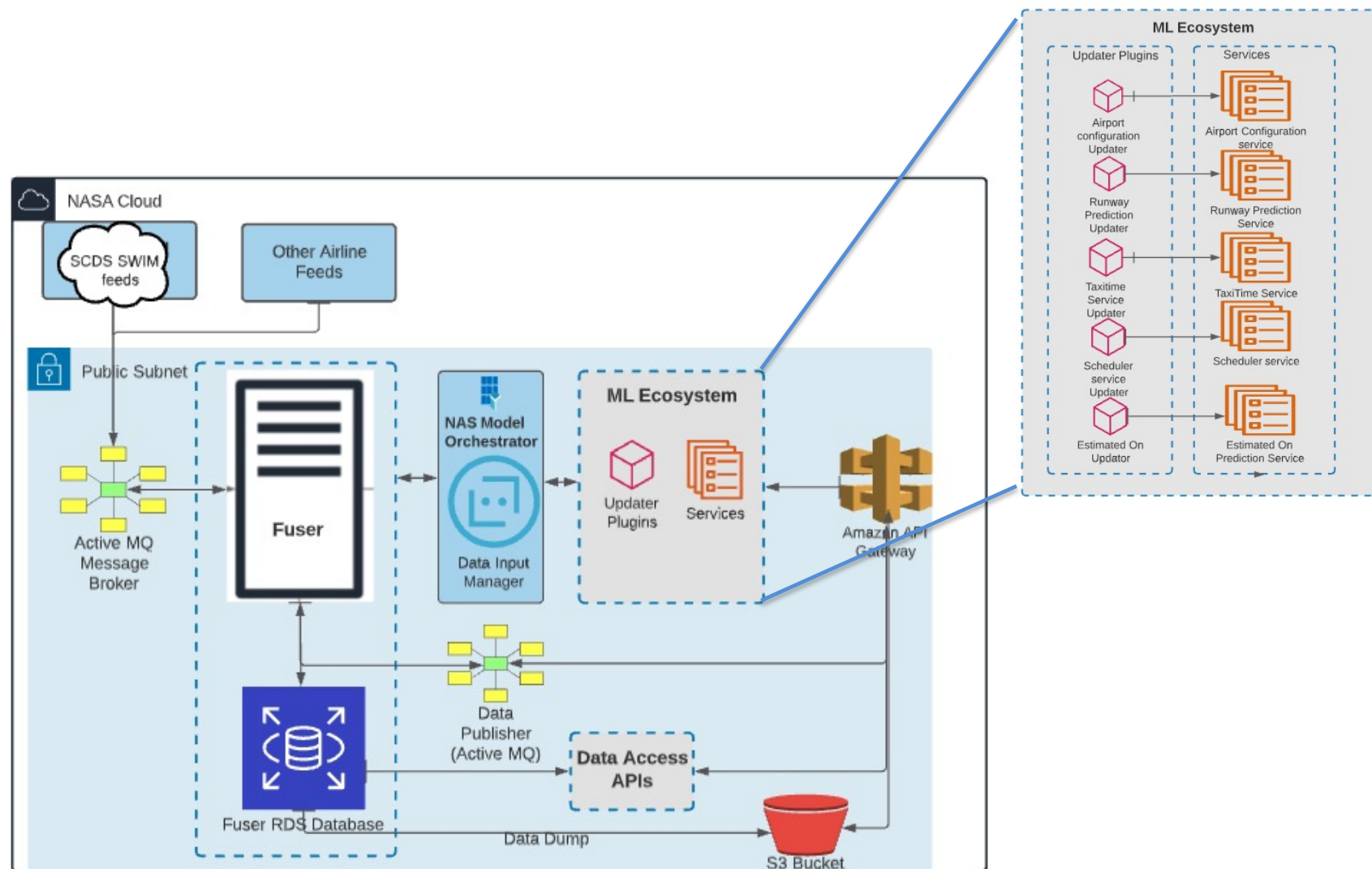
- Partners may develop Health check services to monitor health of the services

Data Storage

- Partner data will be persisted in Partner Infrastructure and services to make the data available will be registered with DIP

Note: Partner services are in the Partner Infrastructure

- A Fuser instance will process data from the FAA SWIM Cloud Distribution Service (SCDS), along with other airline data feeds, and populate a database implemented via the AWS Relational Database Service (RDS).
- A NAS Model Orchestrator will manage formulating inputs for reusable ML microservices in the ML Ecosystem.
- An API Gateway will enable consumer access to these micro-services.





Data Integration Services

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Shawn Gorman

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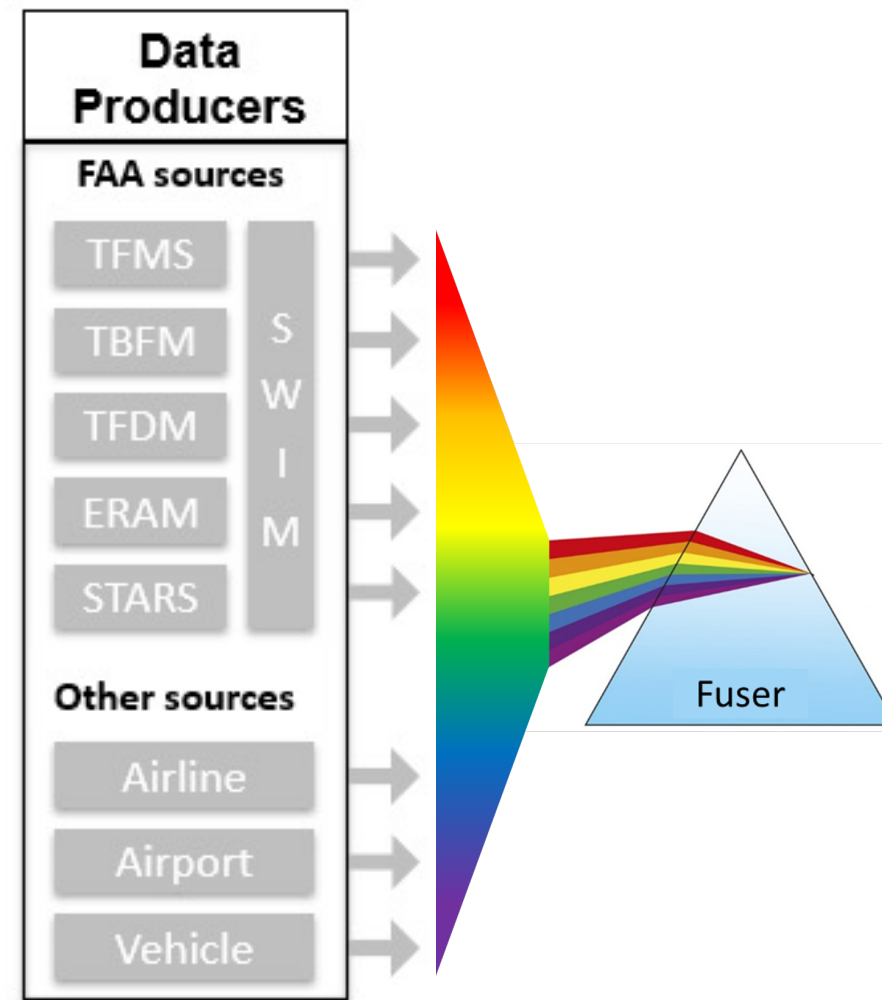


Data Integration Services



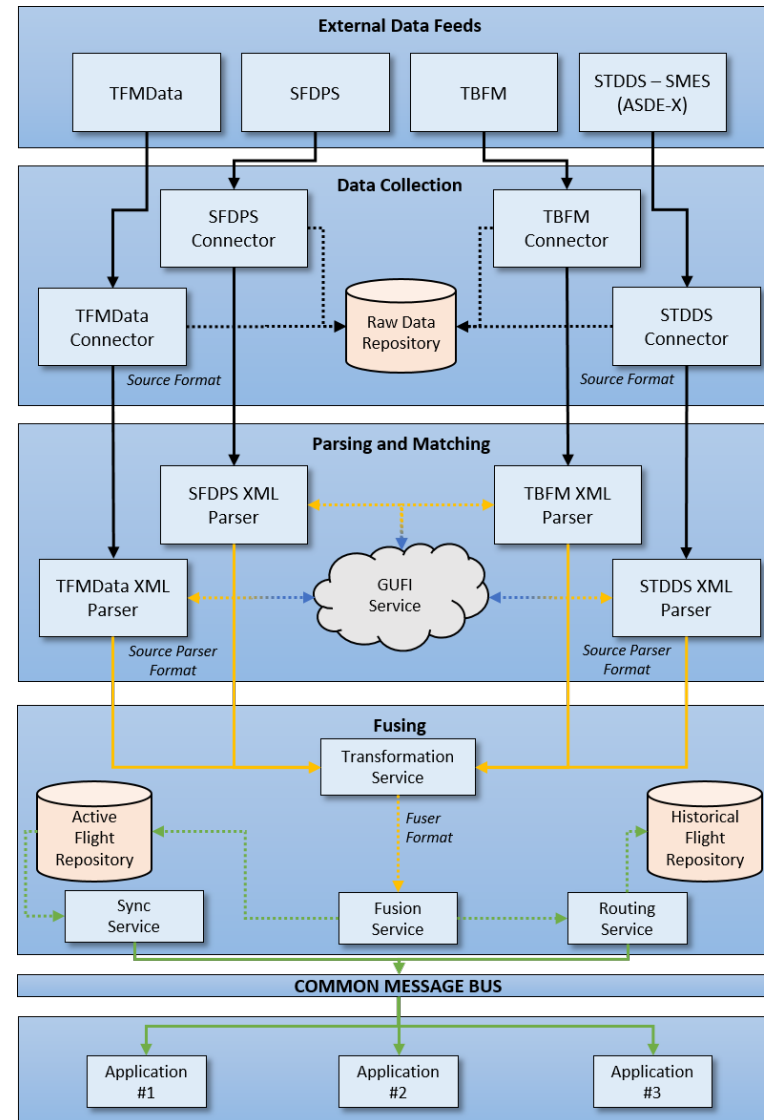
- NASA planned data integration services
 - Flight data integration (Fuser)
 - Does currently include surveillance data from SWIM sources
 - TMI data integration
- Future/potential data integration services
 - Weather data integration
 - Surveillance data integration
 - Potentially could be a feed into a flight data integration service
 - Other data integration

- System that can mediate between disparate sources of data, pulling in the *right data, at the right time*
- Composed of multiple components providing
 - Parsers for various data sources
 - Matching Services providing a global unique identifier (GUFI)
 - Fusion Services
 - Transformation
 - Filtering
 - Updating
 - Mediation
 - Common well-defined schema





Fuser High Level Architecture





Additional Fuser Information



- [SWIFT full day presentations \(consolidated deck\)](#)
- [NASA ATD-2 Industry Workshop Slides and Recordings](#)
- [Fuser Online Documentation from ATD-2 Industry Workshop](#)



Overview of Fuser Flight Model



- Standard naming convention used with most data elements in the Fuser Flight
- Naming convention is based on a flattened version of the Flight Object Data Dictionary (FODD) and Flight Information Exchange Model (FIXM) Schema
- Named so that related elements are close together alphabetically
- Self-documenting for the most part
- Each name consists of three parts
 - Information category
 - Resource Type
 - Source Type
- Naming convention: `category_resourceType_sourceType`
- Examples:
 - `arrival_runway_actual_time`
 - `departure_stand_airline` (departure gate from an airline source)



Aligning with FIXM/FLXM



FIXM/FLXM Alignment Objective:

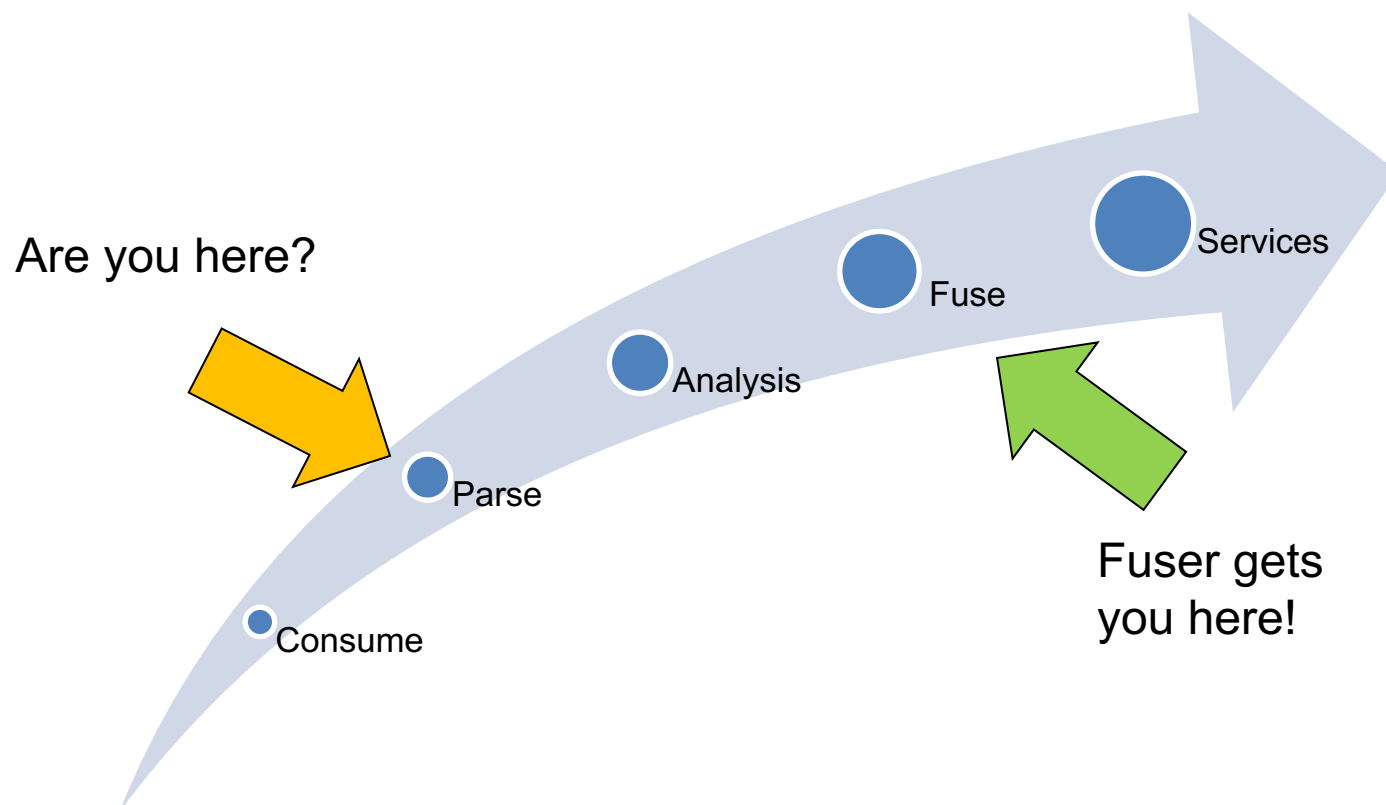
- Align DIP streaming Fuser data feed with FAA FIXM/FLXM standards

Approach:

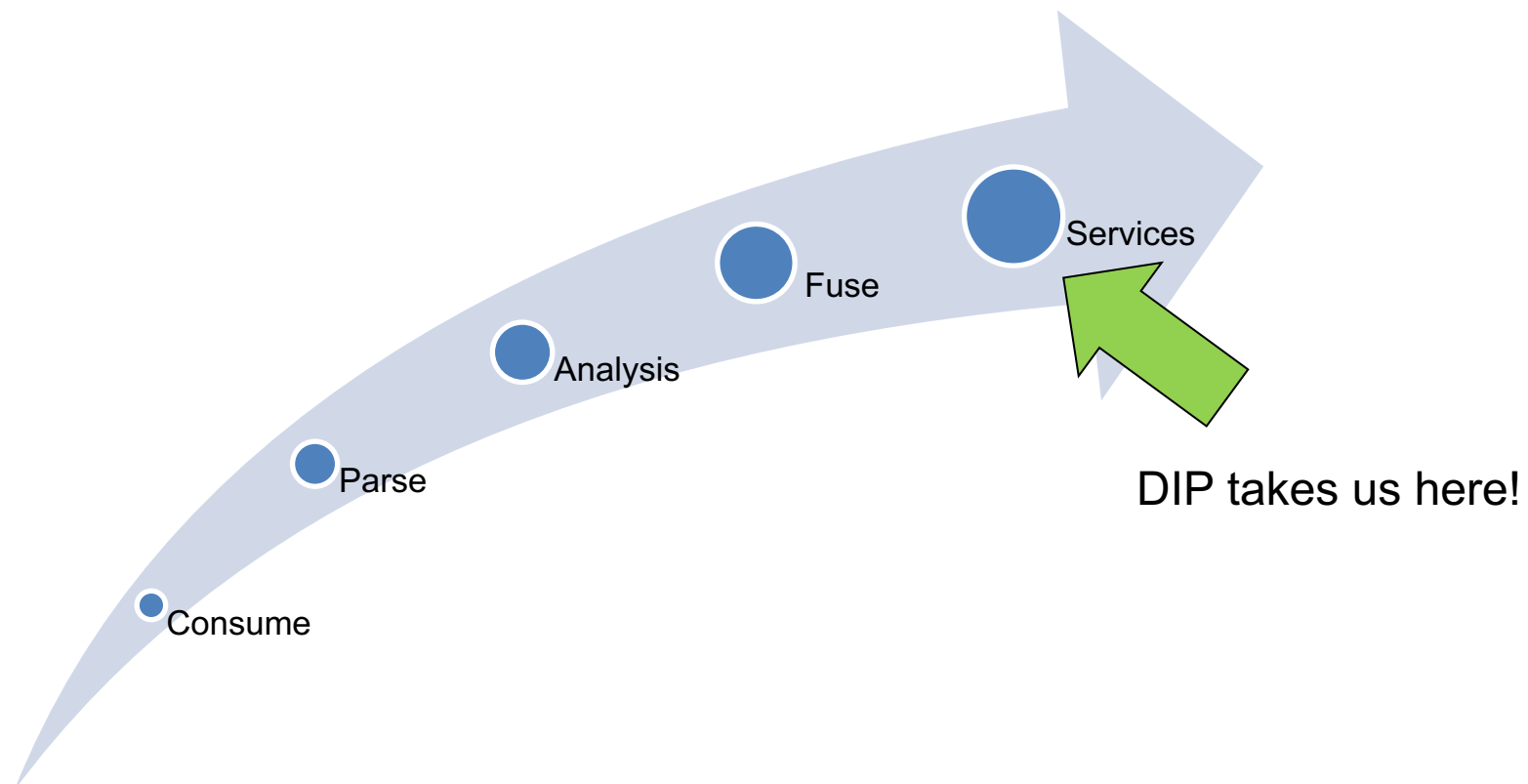
- Multi-year crawl, walk, run approach to alignment in collaboration with FAA and Flight Operator community
- FIXM Alignment:
 - FY22 adopt FIXM standard for streaming Fuser data elements in FIXM core and US Extension. Exclude additional data elements that are not currently part of FIXM core or US Extension
 - FY23 adopt FIXM standard for additional Fuser data elements and use FIXM extension. NASA will work with FAA and Flight Operator community to adopt appropriate standards for an additional FIXM extension
 - FY24 align Fuser standards with CSS-FD standards. NASA will work with FAA and flight operators to define scope of alignment (could a version of Fuser act as CSS-FD fused data feed prototype?)
- FLXM (Flow Information Exchange Model) Alignment:
 - Leverage NASA TMI service to help FAA define requirements for restriction data feeds
 - Adopt FLXM requirements in NASA TMI service once matured



- Fuser gets you closer to where you want to be faster

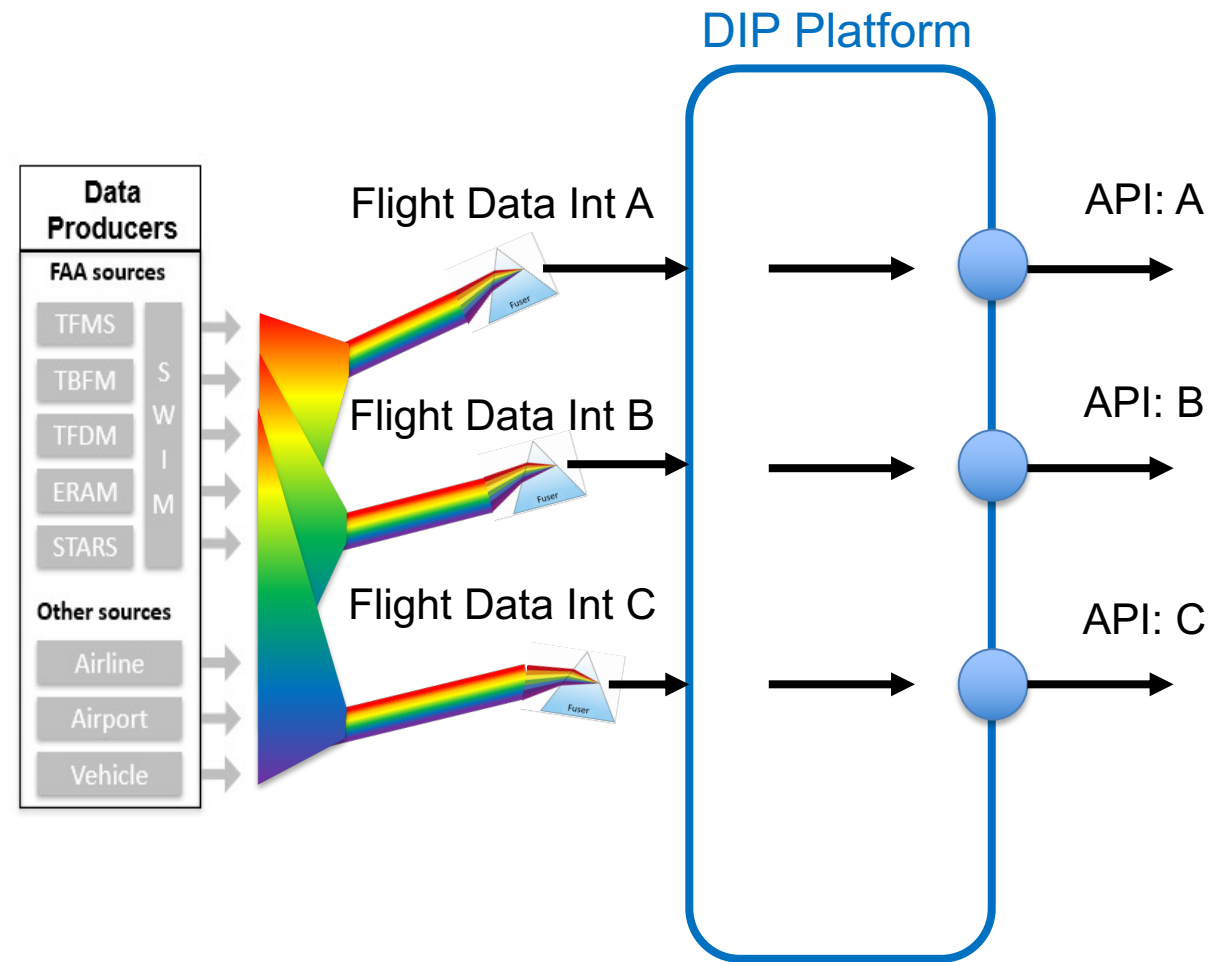
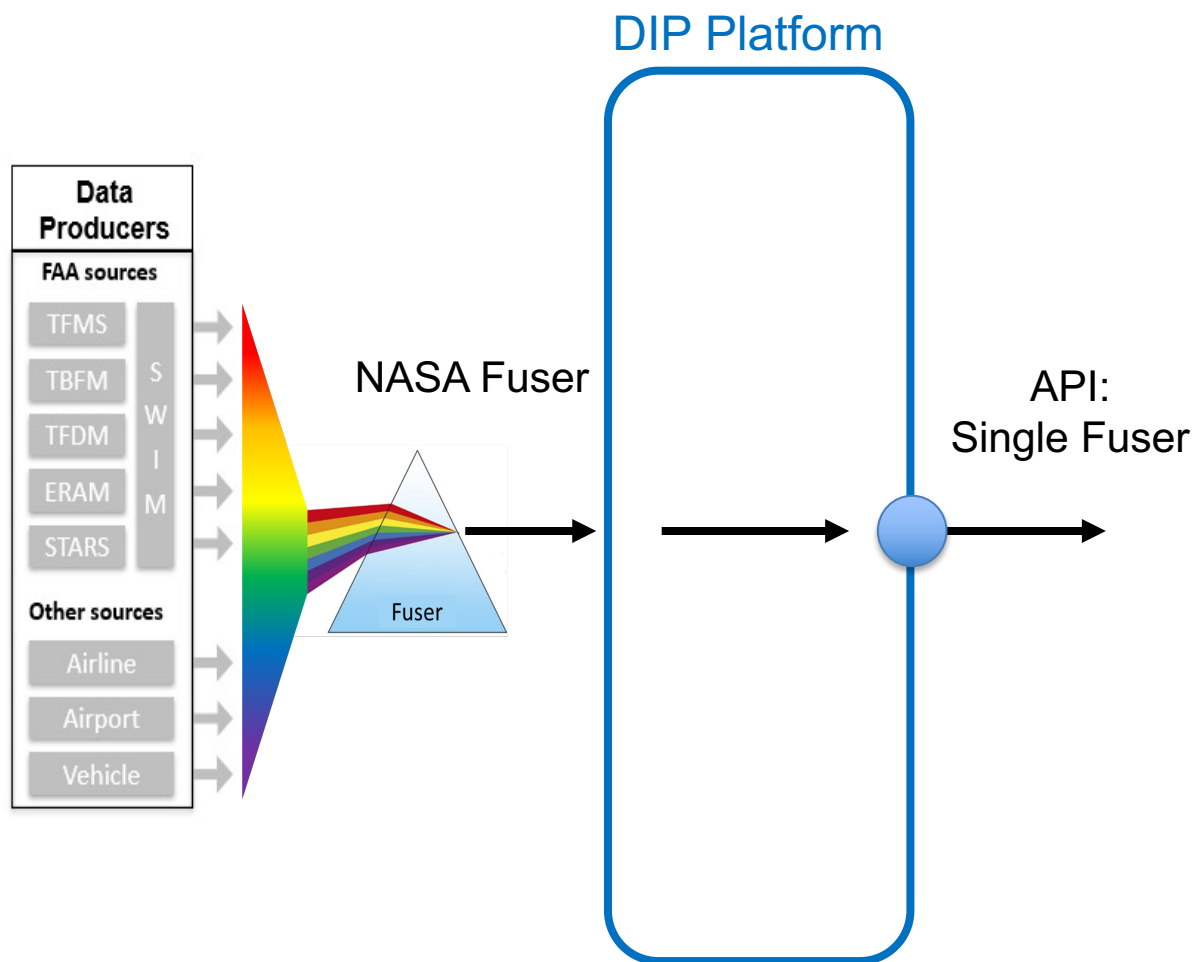


- Build data services on top and make them available



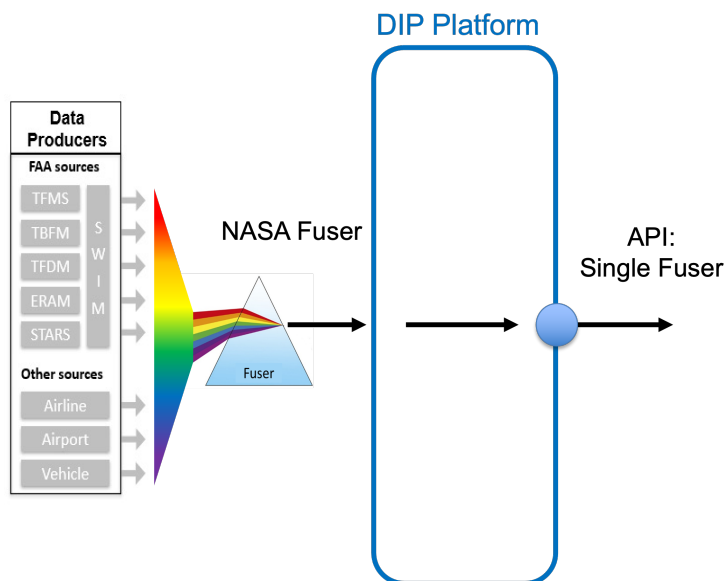


Single NASA Flight Data Fuser vs. Marketplace of Flight Data Integration Services



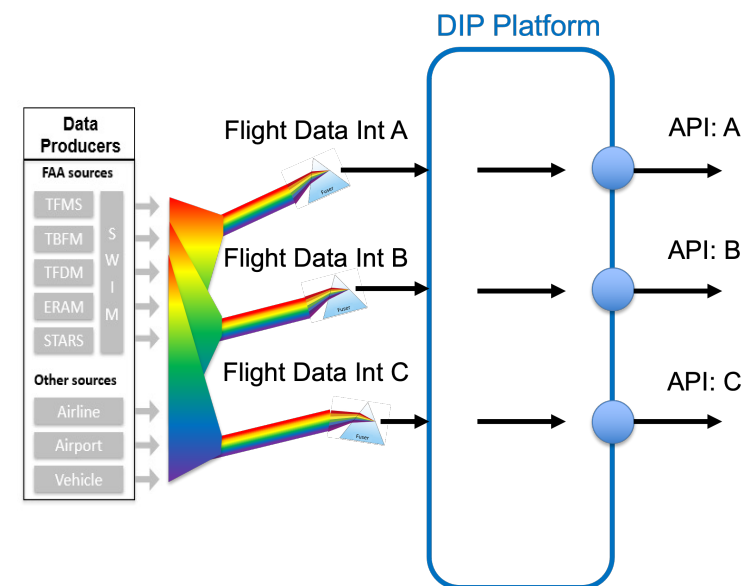


Single NASA Flight Data Fuser vs. Marketplace of Flight Data Integration Services



Pros:

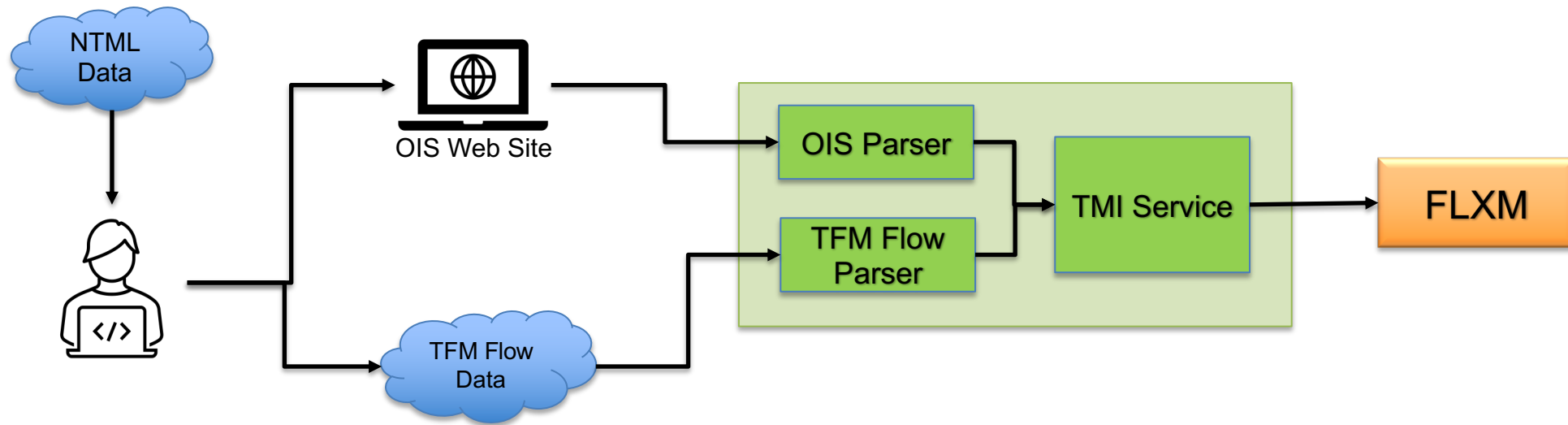
- Provides a single, unified, authoritative source of data that is foundational to the platform
- Ensures data consistency between 3rd party services developed using platform data
- Any improvements or updates to Fuser rules or heuristics automatically reflected across the platform



Pros:

- Allows 3rd party service providers to compete to deliver fused data to the community
- 3rd party service providers with different data elements specific to different use cases
- Data integration services don't have to be singular data feed and can be more targeted to specific needs or use cases

- TMI Data Integration (TMI Service)
 - Authoritative TMI repository
 - Parses, transforms, de-conflicts, fuses, and distribute TMI's
 - Align with FLXM exchange model





Questions and Answers

Please post your questions either in the chat box or
the Conferences.io link

<https://arc.cnf.io/sessions/nedn/#!/dashboard>



Next Steps



Schedule & Contact Info



- Schedule
 - DIP Workshop Series #2: DIP for Service Providers: TBD
 - DIP Workshop Series #3: DIP for Flight Operators: TBD
 - Flight Operator Announcement for Collaborative Opportunity: TBD
 - Service Provider Announcement for Collaborative Opportunity: TBD
- Visit <https://nari.arc.nasa.gov/atmx-dip> for more information regarding DIP sub-project and previous & future events
- Please email to ARC-DIP-EXT@mail.nasa.gov for questions or comments



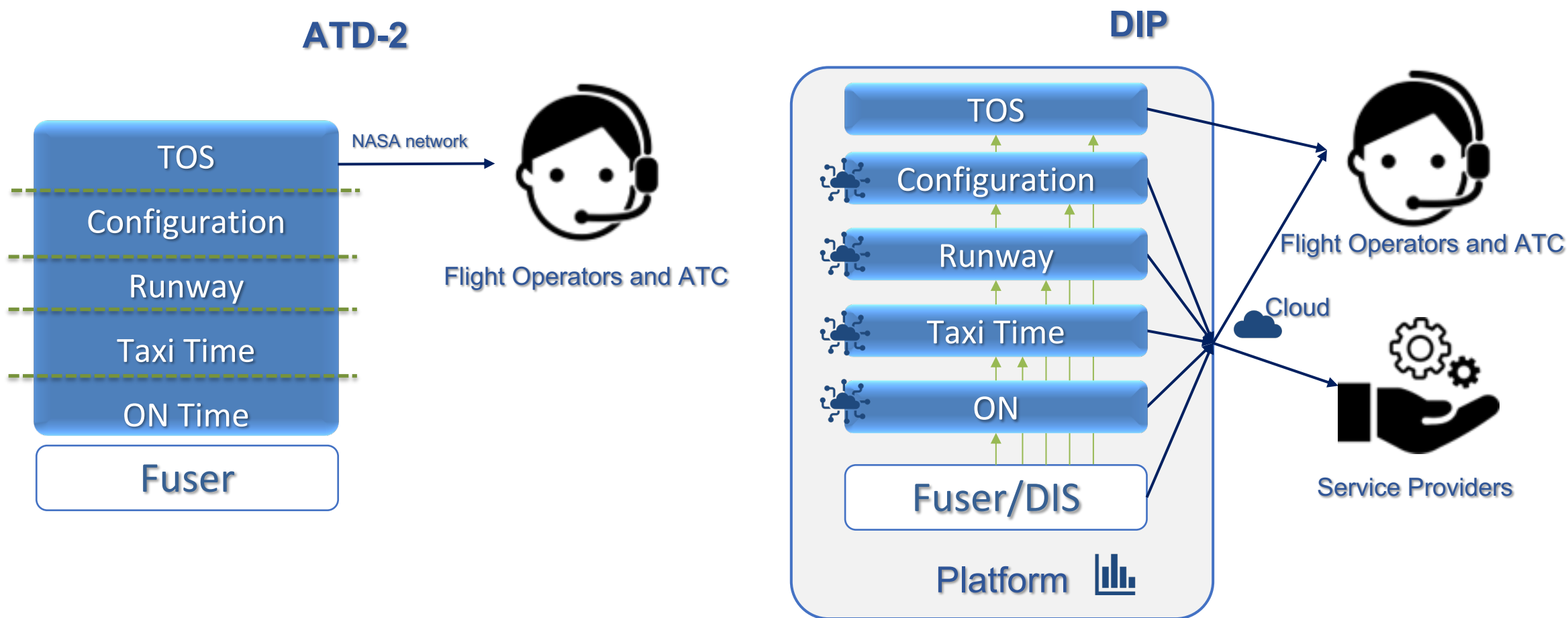
Closing Remarks



Thank you!



Back Up



Services available from ATD-2: Fuser and Prediction Services



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 artifacts
- **Aviation community is trending towards wider range of operation types**
 - New types of aircraft, and/or higher level of operational density
 - Complexity that requires 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