- 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

- **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

DIP Workshop Series: #2
DIP for Service Providers

January 12, 2022

- Recap of Workshop #1 – DIP Architecture and Data Integration Services
- Onboarding Process
- Catalog Service Capabilities
- API Requirements and Service Specifications
- NASA Services and Access Points
- Data Requirements for Service Providers
- Technology Plan and Schedule
- Q&A
- Next Steps & Closing Remarks

Recap of Workshop #1:
DIP Architecture and Data Integration Services

Shawn Gorman
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Pallavi Hegde
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- DIP architecture
- DIP data integration services
- Alignment with FIXM

DIP Workshop Series: #1
**DIP Architecture and Data Integration Services**

November 17, 2021

3

- 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
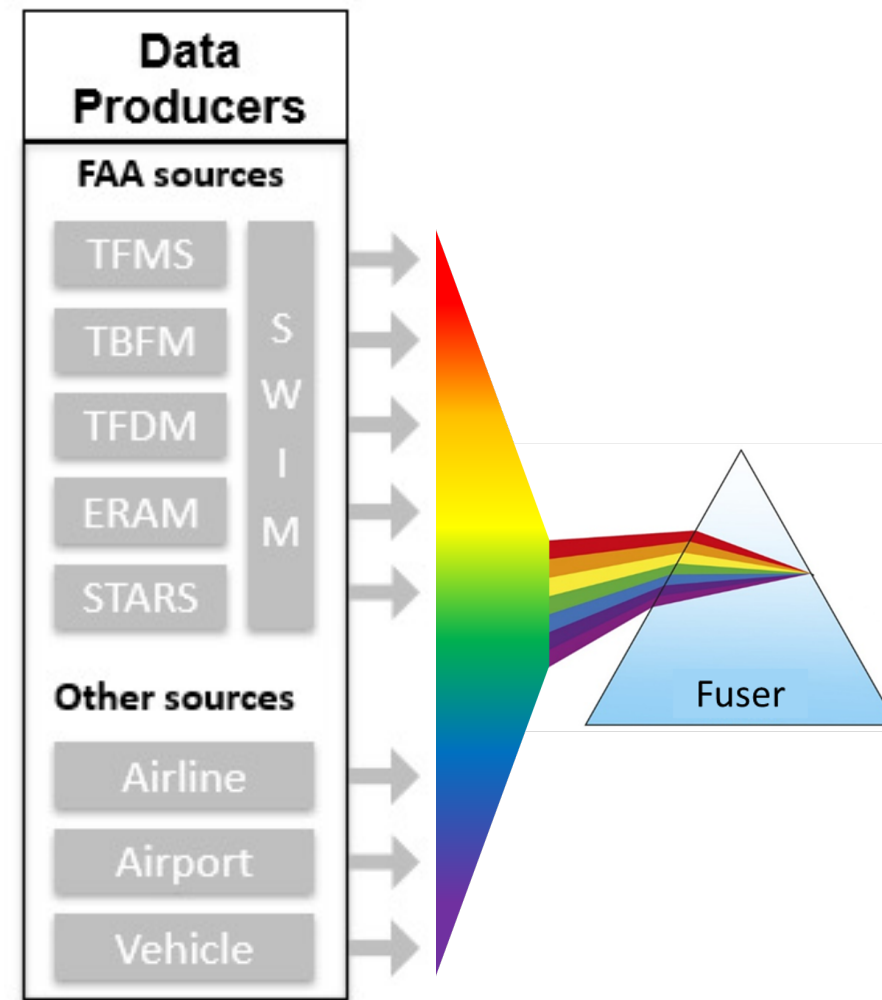
- Fuser gets you closer to where you want to be faster
- Build data services on top and make them available

Are you here?

Consume
Parse
Analysis
Fuse
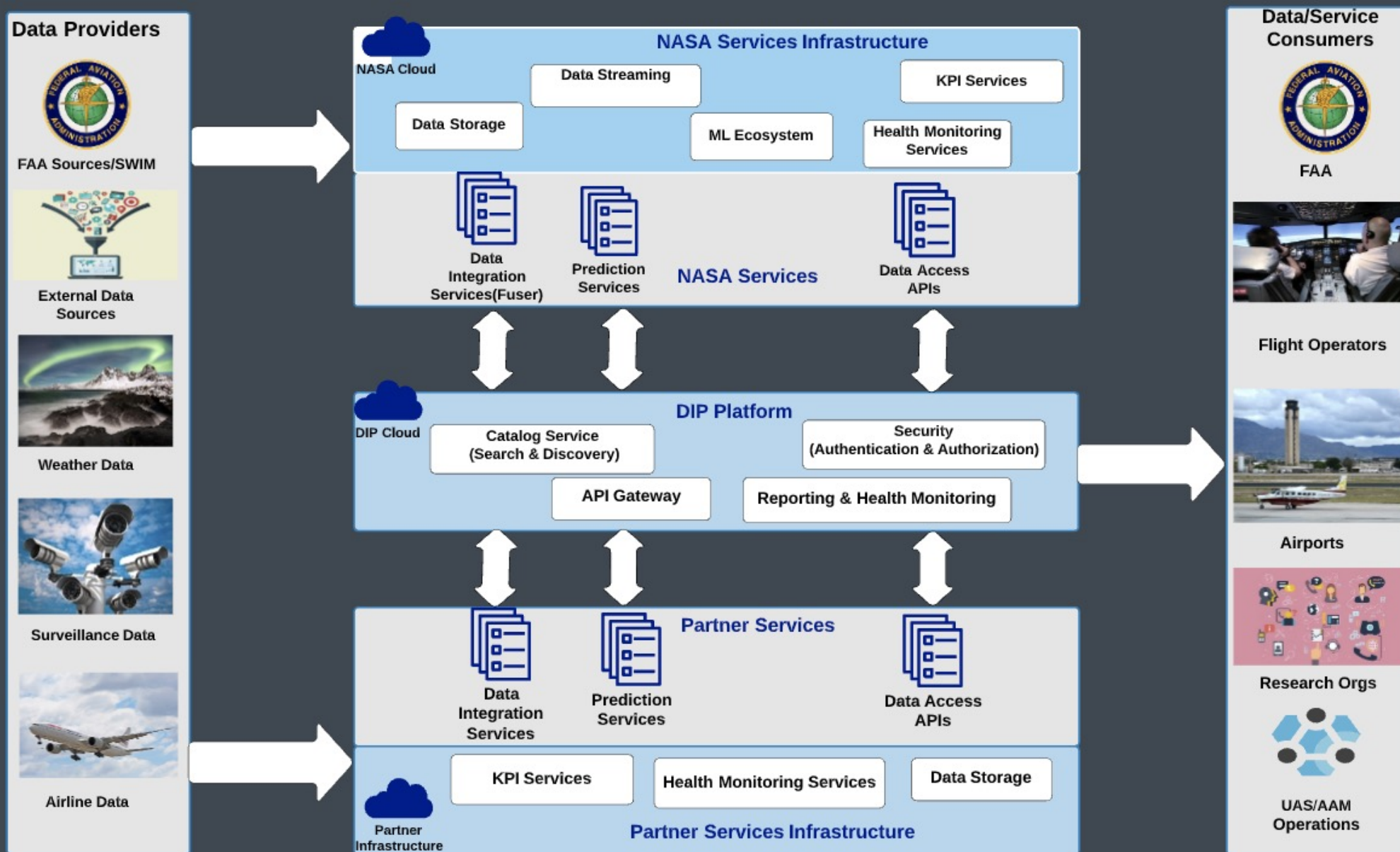Services

Fuser gets you here!

DIP takes us here!
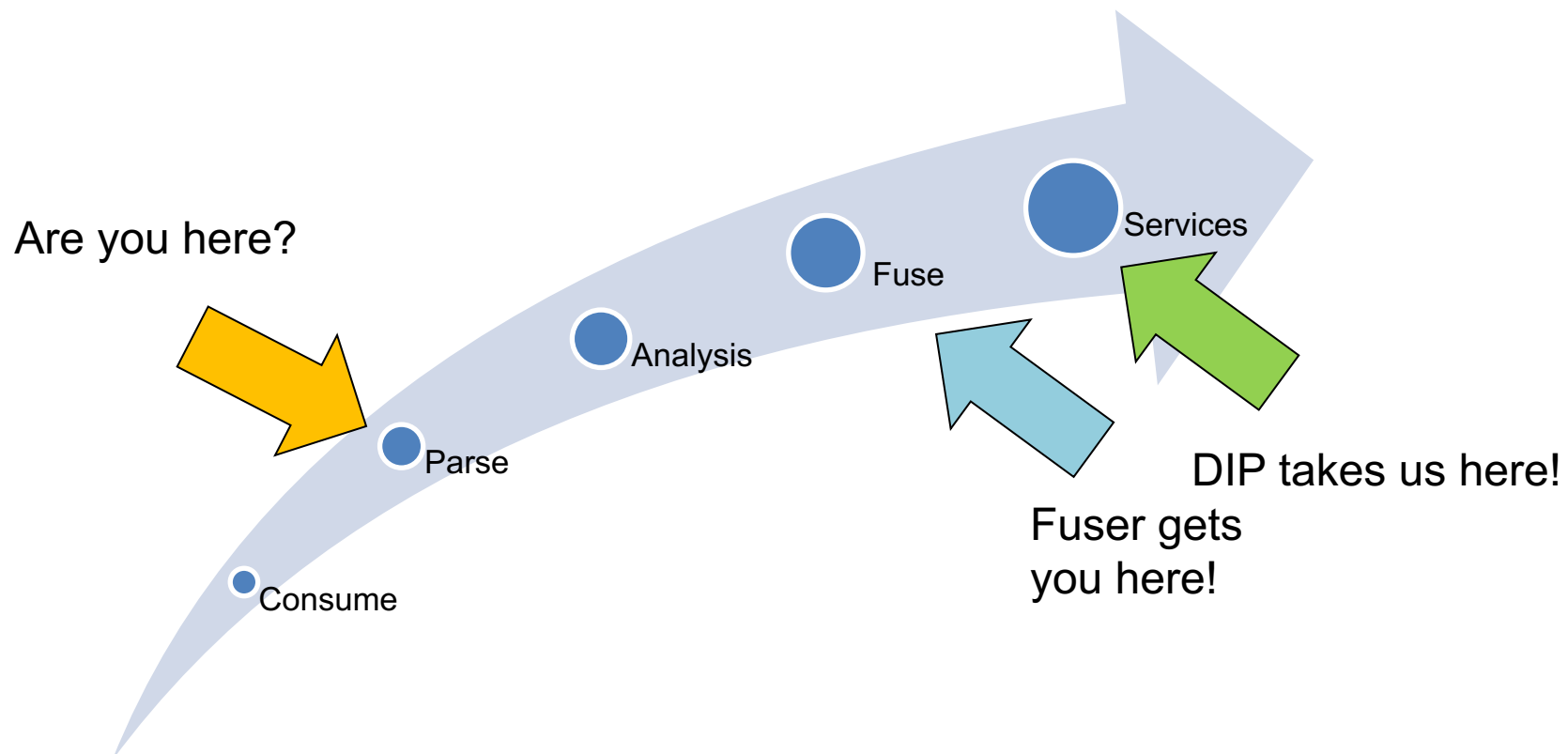
Goal: Align DIP streaming Fuser data feed with FAA FIXM standards

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?)

DIP Platform Functional Architecture

Data Providers
- FAA Sources/SWIM
- External Data Sources
- Weather Data
- Surveillance Data
- Airline Data

NASA Services Infrastructure (NASA Cloud)
- Data Streaming
- KPI Services
- Data Storage
- ML Ecosystem
- Health Monitoring Services

NASA Services
- Data Integration Services(Fuser)
- Prediction Services
- Data Access APIs

DIP Platform (DIP Cloud)
- Catalog Service (Search & Discovery)
- Security (Authentication & Authorization)
- API Gateway
- Reporting & Health Monitoring

Partner Services
- Data Integration Services
- Prediction Services
- Data Access APIs

Partner Services Infrastructure (Partner Infrastructure)
- KPI Services
- Health Monitoring Services
- Data Storage

Data/Service Consumers
- FAA
- Flight Operators
- Airports
- Research Orgs
- UAS/AAM Operations

Common, simplified interface to integrated, processed information

Partnership & Agreements

George Szatkowski

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1. **Announcement of Collaboration Opportunity (ACO) for Conventional Flight Operators for Sustainable Aviation (SA) demos**
   – Participate to define, test and evaluate NASA reference airspace management services beginning in FY22
   – Each partner will <u>sign a non-reimbursable Space Act Agreement</u> (SAA)* included in the ACO response to cover 5-year partnership with NASA

2. **ACO for Partner Services Demos with Data Integrators, Service Providers, and Cloud/Infrastructure Providers**
   – Participate in the design, development, demonstration and validation of the Partner Services (PS) demonstrations. Solutions for traditional flight operations, advanced air mobility and urban air mobility operations are encouraged
   – Each partner will <u>sign a non-reimbursable 5-year Umbrella SAA and 2-year initial Annex*</u> included in the ACO
   – The partners will also be required to <u>submit an ACO questionnaire</u> which describes the respondent's intended contributions to the requirements and PS demonstrations with NASA

3. **Interconnection Security Agreement (ISA) for all Partners**
   – The ISA specifies the technical and security requirements for establishing, operating, and maintaining an interconnection between two or more systems. ISA supports a Memoranda of Understanding/Agreement (MOU/A) between the organizations.
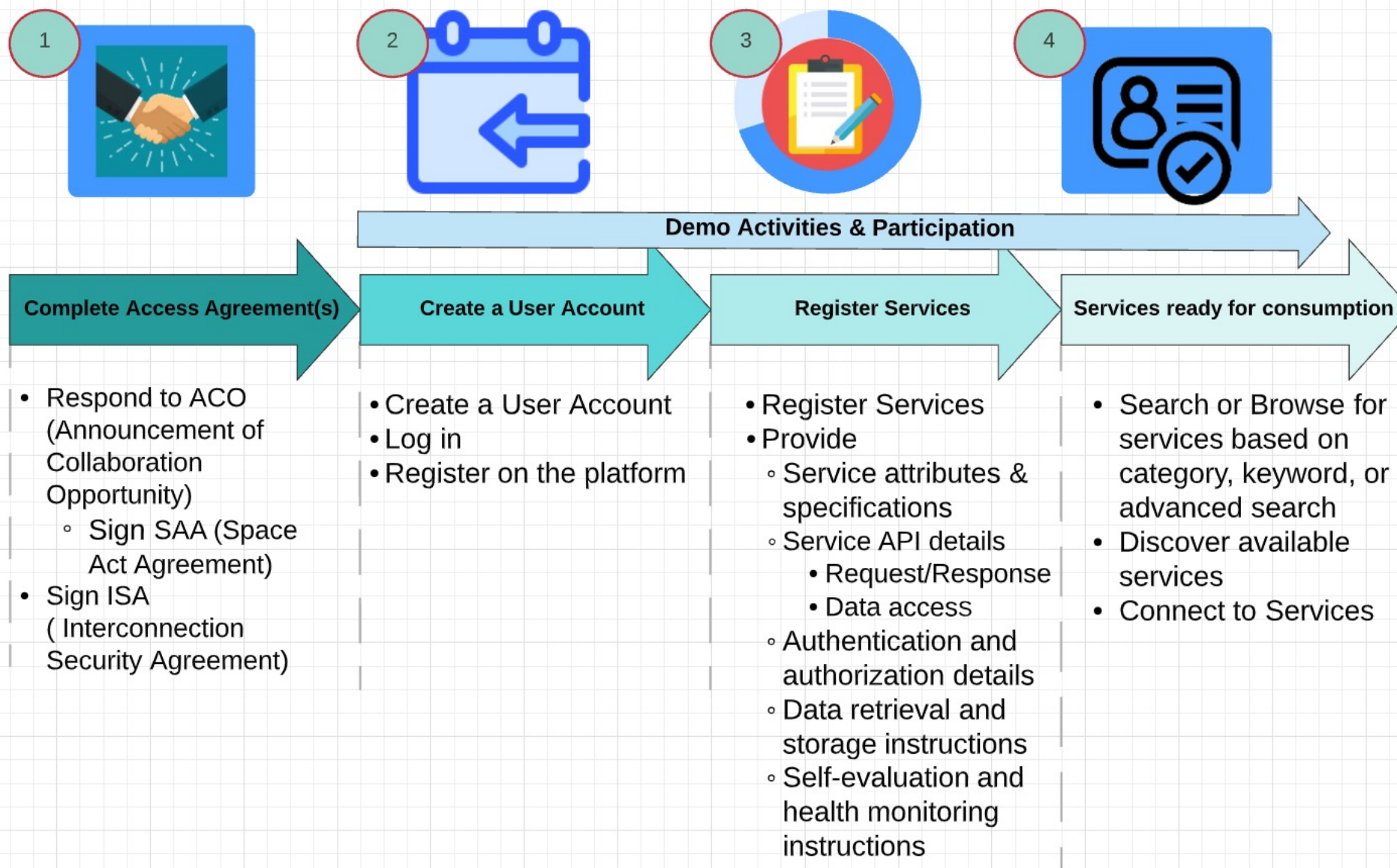   – ISA is required prior to connecting to DIP system and will be completed after the ACO/SAA process

*Signed agreements are required prior to connecting to DIP system. Proposed changes to the SAA or Annex may be considered and may delay your ability to access DIP

Onboarding Process & DIP Portal Preview

Pallavi Hegde

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Demo Activities & Participation

1	2	3	4
Complete Access Agreement(s)	**Create a User Account**	**Register Services**	**Services ready for consumption**

- Respond to ACO (Announcement of Collaboration Opportunity)
  - Sign SAA (Space Act Agreement)
- Sign ISA (Interconnection Security Agreement)

- Create a User Account
- Log in
- Register on the platform

- Register Services
- Provide
  - Service attributes & specifications
  - Service API details
    - Request/Response
    - Data access
  - Authentication and authorization details
  - Data retrieval and storage instructions
  - Self-evaluation and health monitoring instructions

- Search or Browse for services based on category, keyword, or advanced search
- Discover available services
- Connect to Services

Explore the leading platform
of aviation service and data offerings

Sign Up ›

Digital Information Platform

National Aeronautics and
Space Administration   NASA

Get Started

Need Help? ›

LEARN MORE

Learn more about the
Digital Information Platform

CATALOG SERVICE

Discover available services
Connect to services

UPCOMING EVENTS

Updates on the latest
industry events

Register   Documentation   Advanced Search   Try It Now   Usage Reports   Support   Recently Viewed

Keyword search: e.g., "Data Fusion"

Filters   Clear   X

☐ Capability   ⌄

☐ Category   ⌄

☐ Data Type   ⌄

☐ Domain   ⌄

☐ Features   ⌄

☐ Provider   ⌄

☐ Users   ⌄

SEARCH

NEW THIS MONTH

Surveillance Data
Updates

Uploaded On:
03/10/1987

View provider

HI   CES

...way Prediction

...users per month

...e prediction of real-time runway
...s key to enabling safe and
...air traffic planning services

Registered Services by Category

Flight Data Services

Traffic Management
Initiative(TMI) Services

Fuser Services

TOS Services

Surface Management

Weather Services

Conflict Detection Services

Request Help | Submit Feedback

Discover More APIs ›

Configuration
Prediction
Service

Weather
Service

TMI
Service

Unimpeded
Taxi Time
Service

Runway
Prediction
Service

Estimated
On Time
Service

Conflict
Detection
Service

Recommended   All Recommendations ›
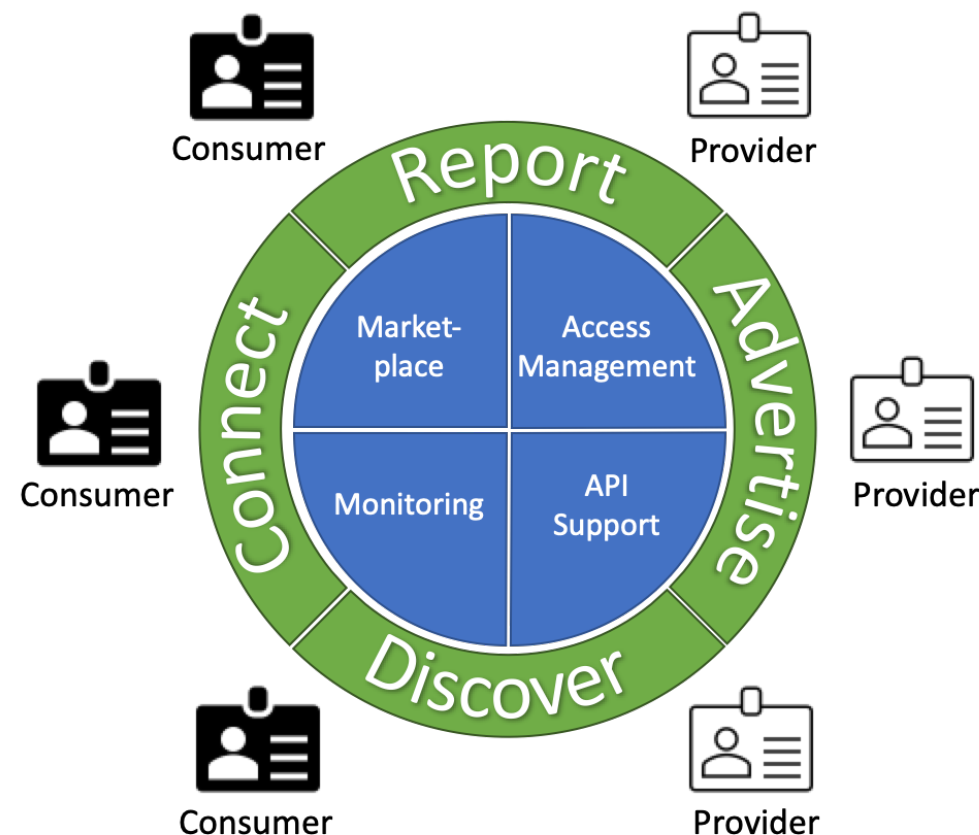
My Reports
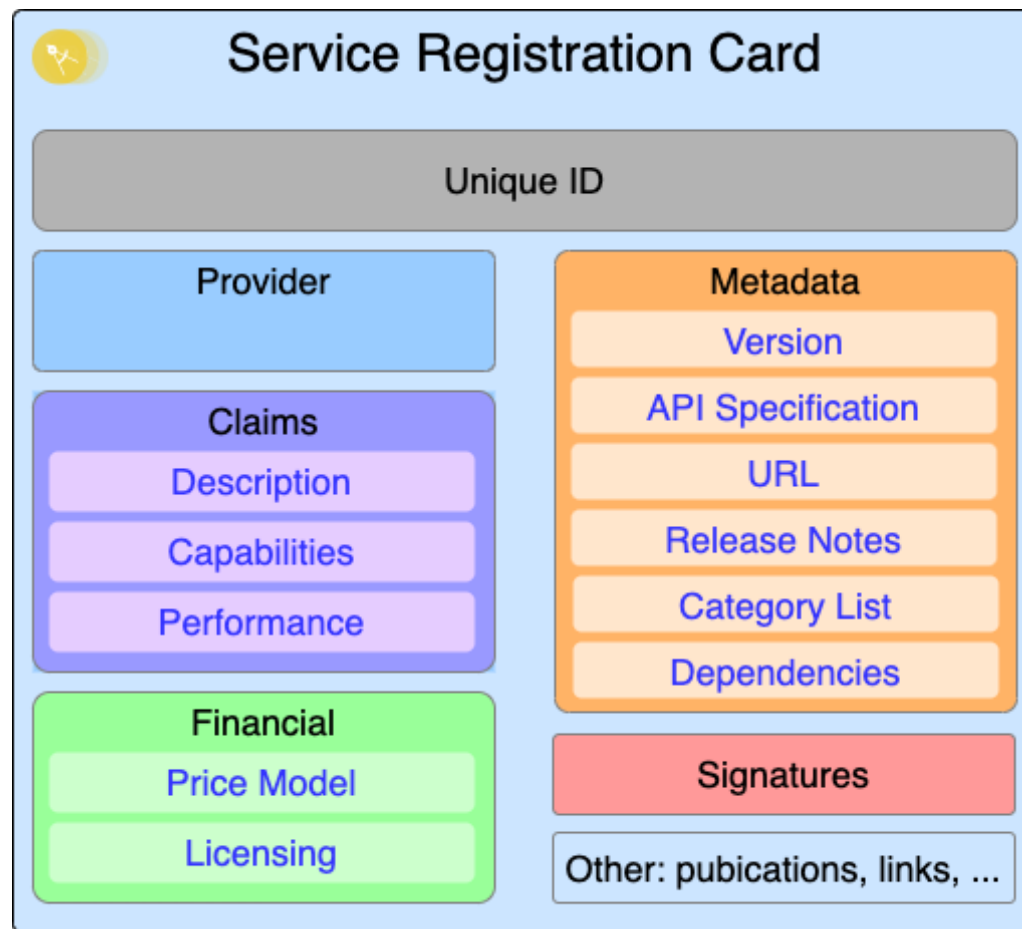
Catalog Service Capabilities

Mohamad Refai

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'Marketplace' for service and data offerings

- Service Providers
  - List service and data offerings
  - Specify who can view offerings

- Service Consumers
 - Discover available services
  - Connect to services

Service Registration Card

Unique ID

Provider

Claims
- Description
- Capabilities
- Performance

Financial
- Price Model
- Licensing

Metadata
- Version
- API Specification
- URL
- Release Notes
- Category List
- Dependencies

Signatures

Other: pubications, links, ...

- Search by Category
  - Scope of search: service category list
  - Analogous to a database query on category column

- Categories
  - Curated key phrases: flat list
  - Descriptive of area of interest
  - Collaboratively defined
  - e.g.: ATM, AAM, Wx, CD, CR, Surface Management, …

- Advanced Search
  - Multiple criteria search
  - Scope: all metadata
  - Analogous to a library search

- Search by Random Keyword or Phrase
  - Scope of search: all metadata (structured and unstructured)
  - Analogous to a web search

- **Enter service information into a registration form/document**
  - Entered by DIP team (initially)
  - A UI will be provided to allow providers to register
  - Automation is under consideration
- **DIP**
  - Verifies the document
  - Persists the information
  - Confirms registration
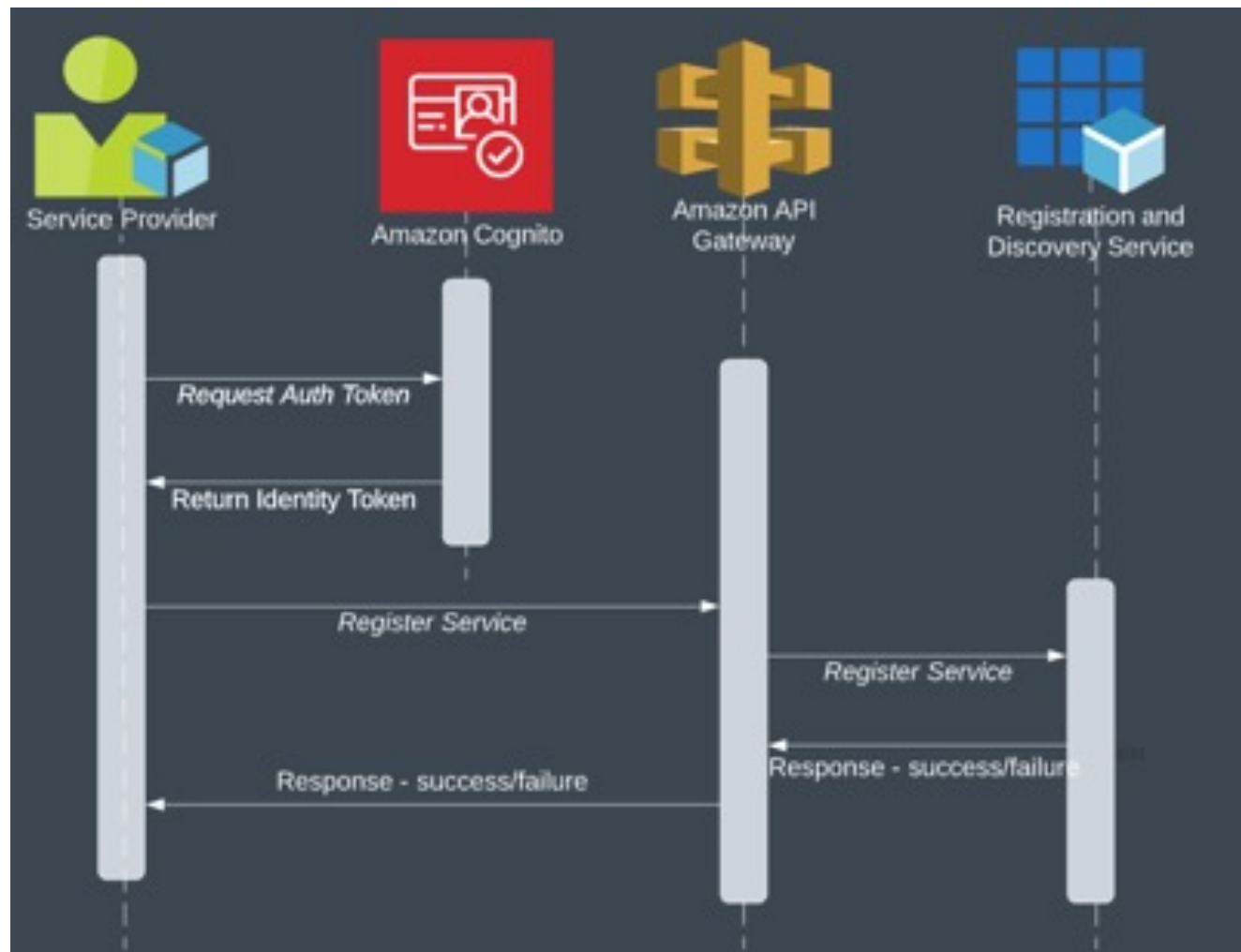
- ## Category Search
  - Results limited to category list

- ## Keyword Search
  - Search scope includes unstructured data
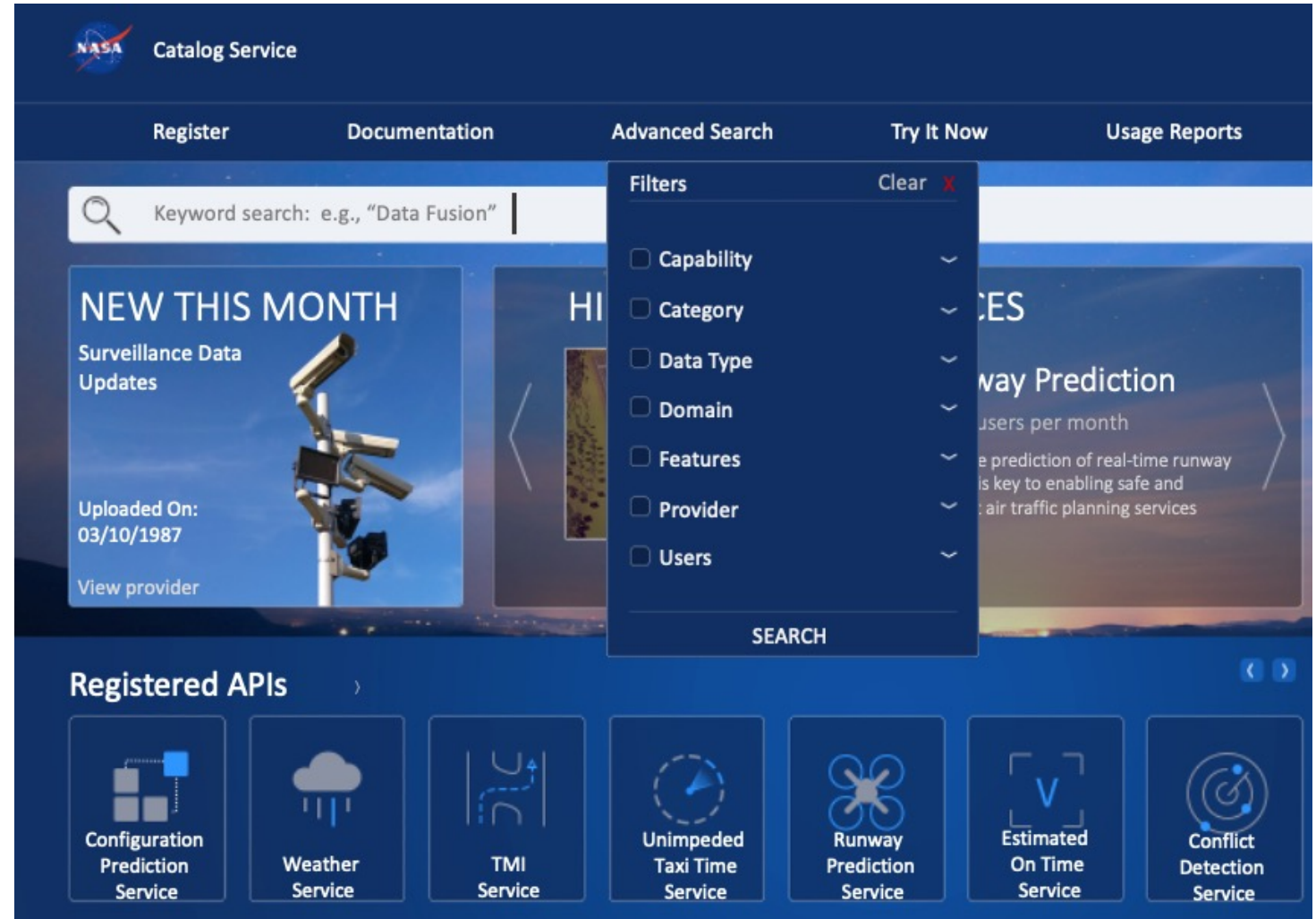
- ## Advanced Search
  - Multiple criteria search
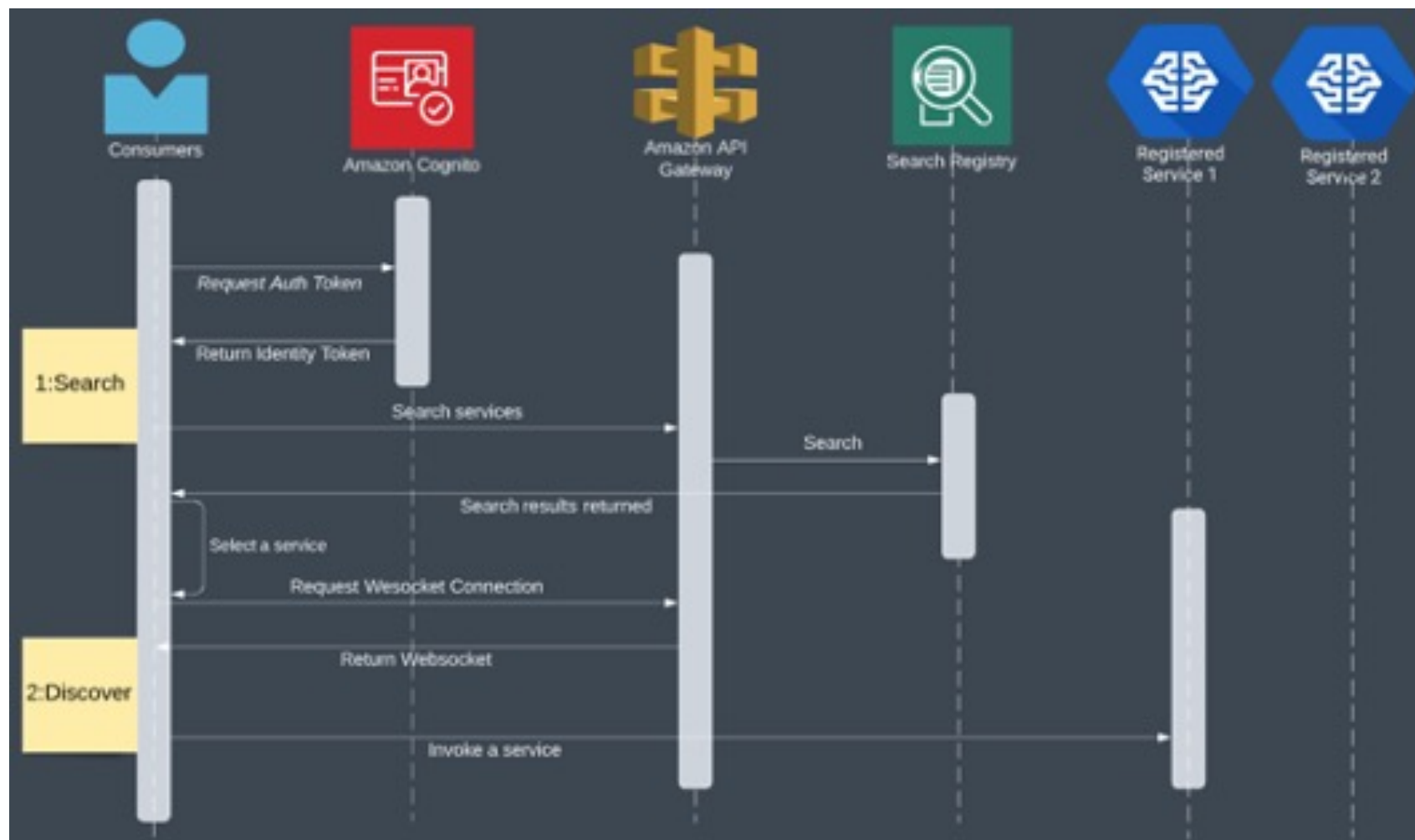
- Sortable list of services

- Grouping capability (provider, category, etc.)

- Catalog Service landing page presents the browse view

Try It Now

- Only if provider opts in
- Allows a limited number of invocations through a DIP UI
- How it works:
  - Populate the request form
    - DIP will populate sample request
    - User can modify request
  - Send the request
  - Inspect the response

- Any additional clarification for registration, or any suggestions for improvement?

- What are the governance processes and rules that are needed to ensure the quality and privacy of data and service offerings? For example, how do we ensure that a provider is a valid entity and that the services offered do not violate secure and private access to data?

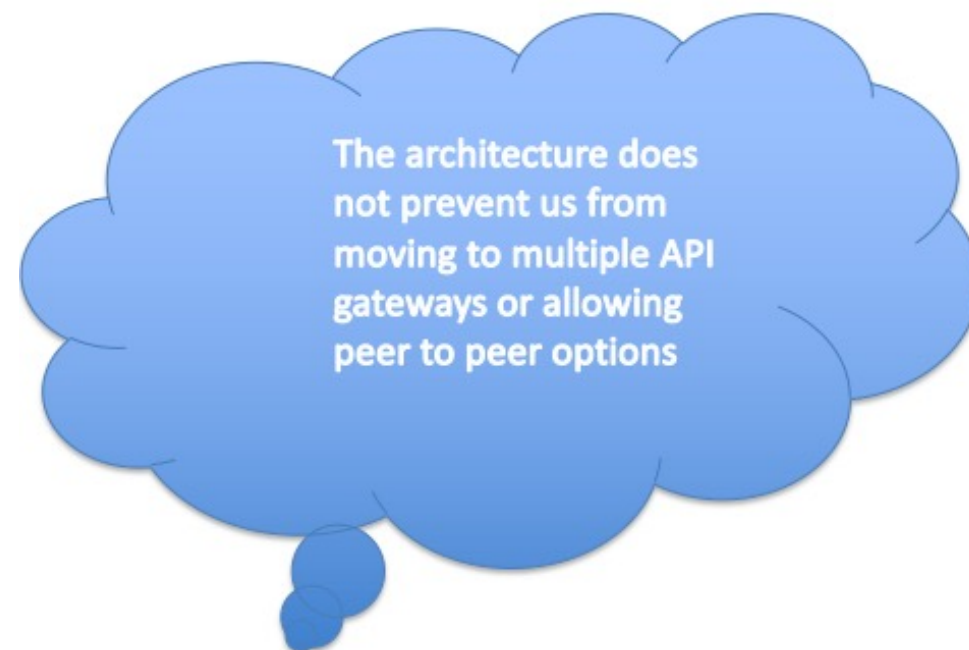# API Requirements and Service Specifications

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Daniel Mulfinger

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API Management Benefits:

- Centrally managed but
  - Services are not centrally hosted
  - Ownership is decentralized and partners completely own the administration of their own services
- Hybrid or multi-cloud
- Proxy services
- Secure regardless of where hosted
- Manage client access
- Monitoring
- Consistent process to access services
- Cons:
  - API Gateway does provide a single point of failure

The architecture does not prevent us from moving to multiple API gateways or allowing peer to peer options

- ## DIP Platform Authentication
  - AWS Cognito Service
  - OAuth2 Client Credentials flow
    - Client submits credentials to OAuth2 server
    - Server returns time-sensitive token
    - Client presents token with all requests to DIP platform

- ## Credentials issued
  - After SAA and ISA completed
  - Client ID and secret (machine->machine)

aws DIP Platform

1. Client/ID/Secret
2. Access Token

Amazon Cognito Server
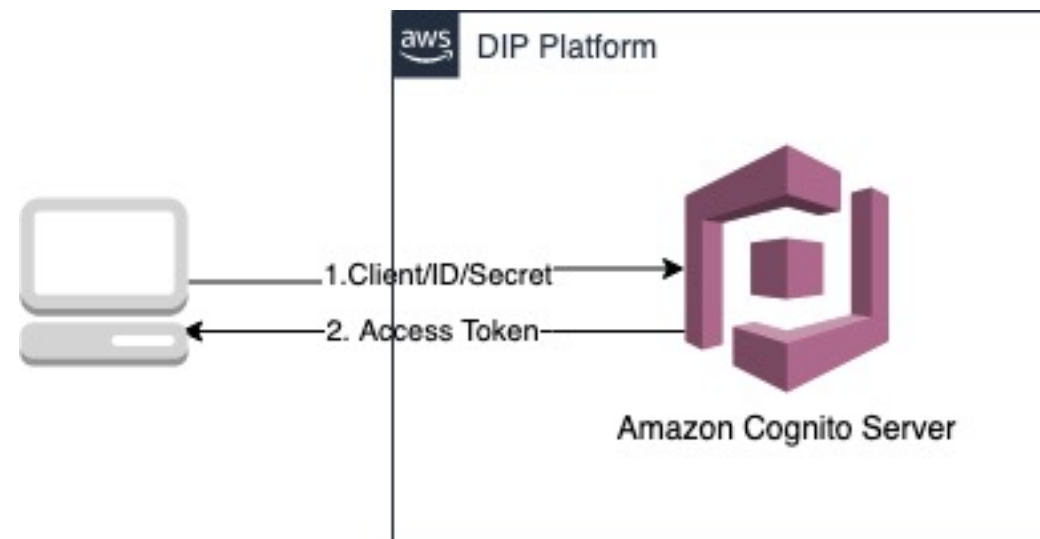
- Partner Service APIs available to clients through DIP Platform
  - Matching API endpoints created in DIP platform
  - Calls are proxied to partner service
  - Usage plan(s) created for each API

- Client-Side Authorization: API Keys
  - API Key controls access to APIs
  - Each user issued a unique API Key
  - Access enabled when API Key is added to API Usage Plan

- Server-Side Authentication/Authorization
  - API Key
  - OAuth2 Client Credentials Flow
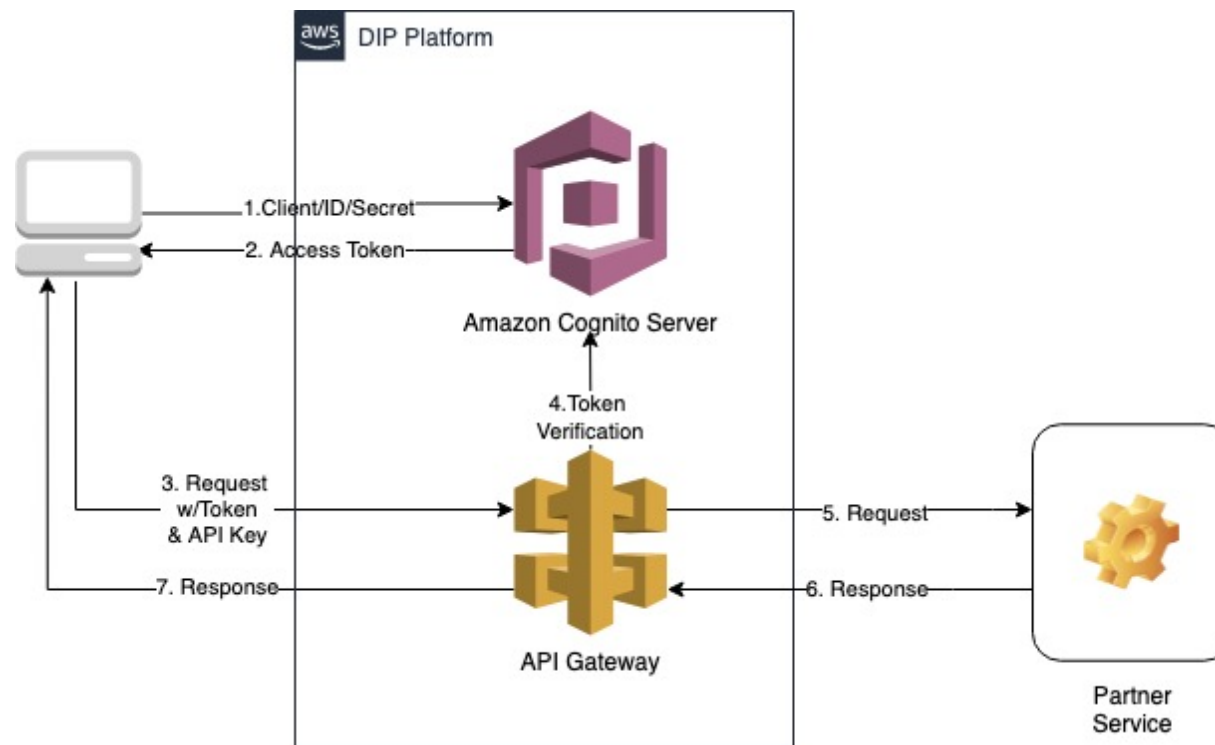
API Gateway REST API with Lambda integration to Target endpoint

- Proxy to existing services
- Caller authenticates with DIP Cognito
- API Gateway authorizer validates tokens
- API Gateway lambda handles authenticating with provider and caching credentials
- Lambda makes the http call and returns response
- Target endpoint may be a NASA hosted service, or a partner hosted service
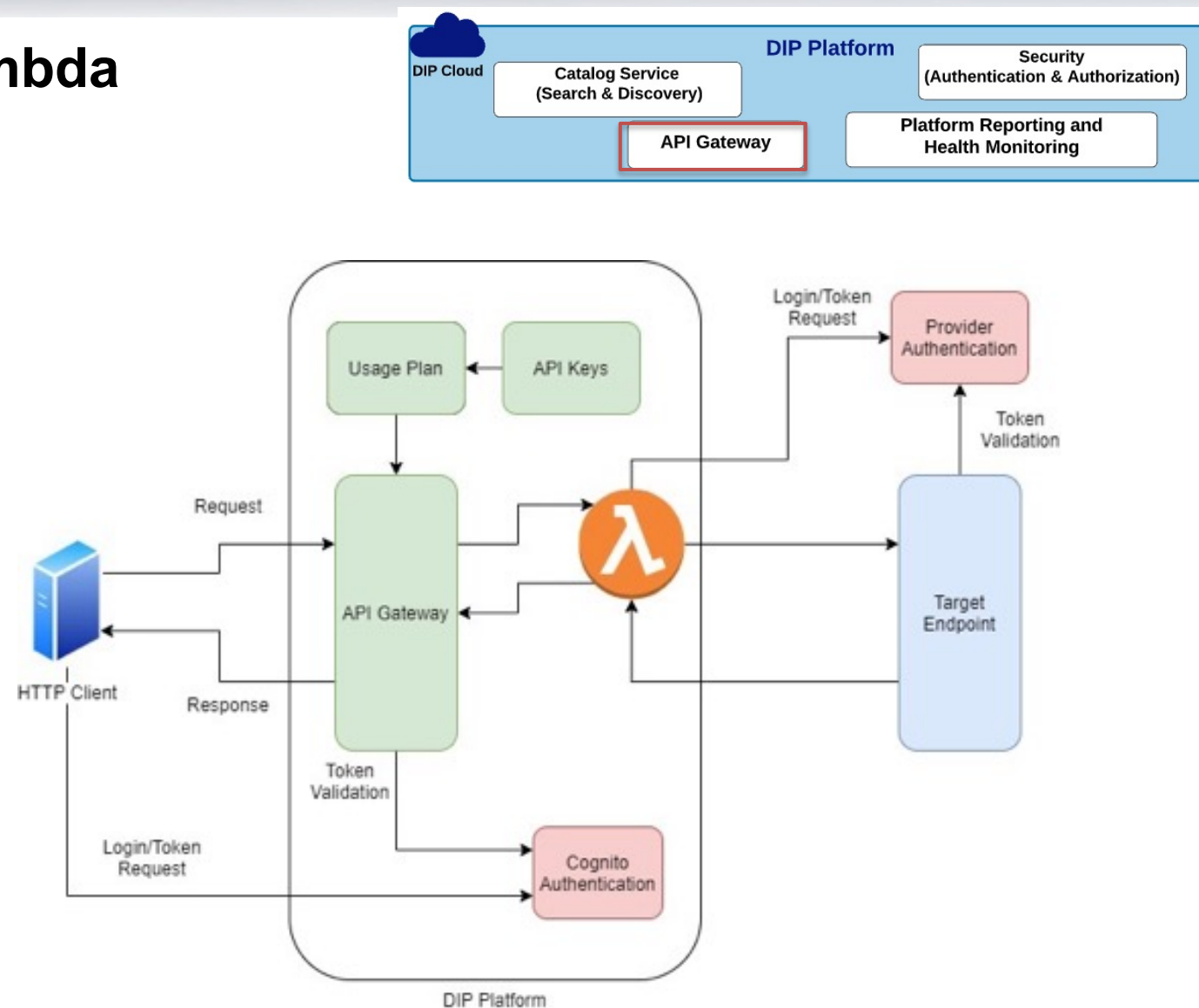
NASA Services and Access Points

Shawn Gorman

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- REST API endpoints defined on the API Gateway

- Data access code executed via Lambda function

- Provide access to:
  - Fused data
  - ML model output orchestrated by the Airport Surface Model
  - Counts and metrics

- Available in near real time and post operations

- Examples:
  - Predicted departure runway
  - Landing time prediction
  - All current ML predictions
  - Departure runway utilization
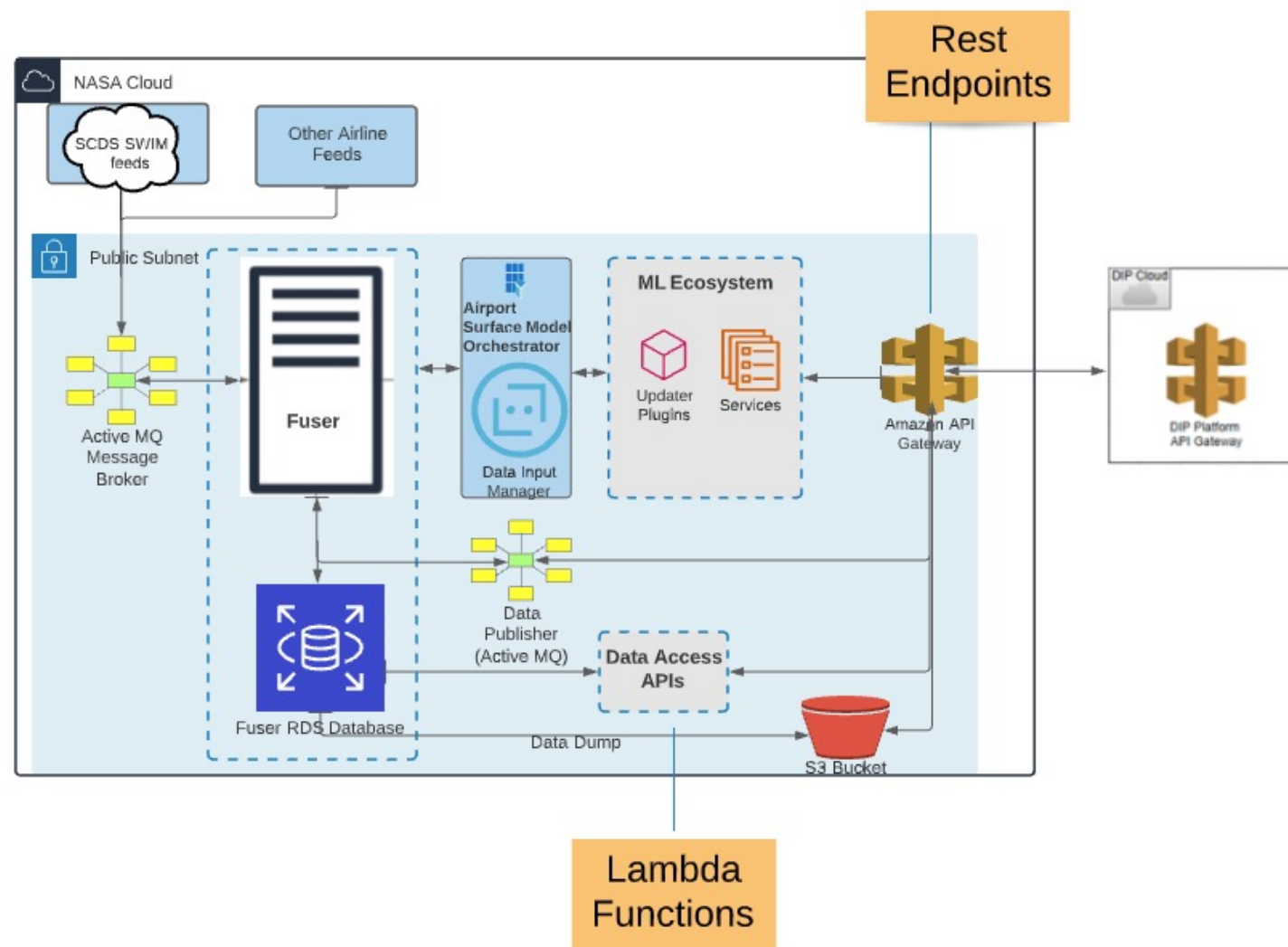
Data Access APIs vs ML Prediction Services

Data Access APIs

- Returns data produced by the NASA services infrastructure
- Minimal inputs required
- Inputs needed to produce a prediction were provided and orchestrated by the NASA service infrastructure

Departure Runway (Data Access API)

Inputs	Outputs

• Flight Ids
  • Call sign
  • Departure airport
  • Arrival airport
  • Departure time
    • or
  • GUFI
• Departure Time
	• Flight Ids
	• Runway (Predicted or Actual)

ML Prediction Services

- Can be used to what-if different combinations of inputs
- More inputs required
- Returns a prediction based on those inputs
  - beware: Garbage in/Garbage out

Departure Runway ML Service

Inputs	Outputs
• Flight Ids • Aircraft Engine Class • Airport Configuration • Departure Fix • Filed • Lookahead • Wake Turbulence Category	• Flight Ids • Predicted Runway

- API specifications using the Open API Specification (OAS)
- REST or HTTP API
- Target endpoint accessible via DIP API Gateway
- Use SSL/TLS
- Support standard authentication approaches like API Keys, OAuth 2.0
- Store results of service for analysis

- Recommended
  - JSON output preferred
  - Provide health endpoint
    - Provide service health status
    - Status should include status of downstream dependencies (ex. database connection)

OAS	Rest or HTTP API
SSL/TLS	Authentication
Store Data	

- **Vendor neutral** description format for HTTP-based remote APIs
- An **API description file** (sometimes called Contract) is a **machine-readable** specification of an API.

Key Fields:

- **Info** – Provides general information about the API
  - Title, version, description
- **Servers** – Provides server information and various environment URL of API
- **Security** – Provides details about how API is secured, API keys, Authorization information
- **Paths** – Describes all the endpoints of the API
- **Tags and external docs** – Tags that could be grouped for API operations
- **Components** – Set of reusable objects which could be used during API definition

OpenAPI 3.0
- openapi
- info
- servers
- paths
- components
- security
- tags
- externalDocs
- ^x-
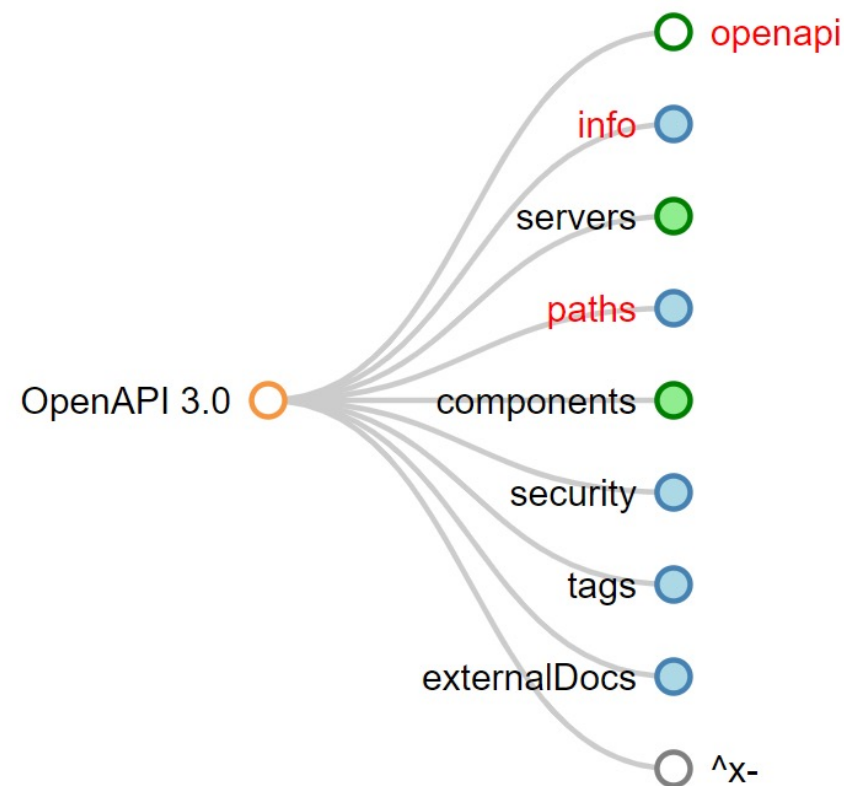
- **Data Storage**
  - Types
    - Fuser Flight Data
    - TMI Data
    - Lamp Weather Data
    - D-ATIS Airport Configurations
  - Process
    - Postgres
      - Loaded continuously
      - Data will roll off after 1 month
    - S3 Buckets
      - Nightly process to export from Postgres, convert to parquet, load to S3
      - Data will roll off after 3 months
    - Sherlock
      - Process to copy from S3 buckets and store in Sherlock

- **Data Access**
  - Access via Data Access APIs
  - S3 bucket access
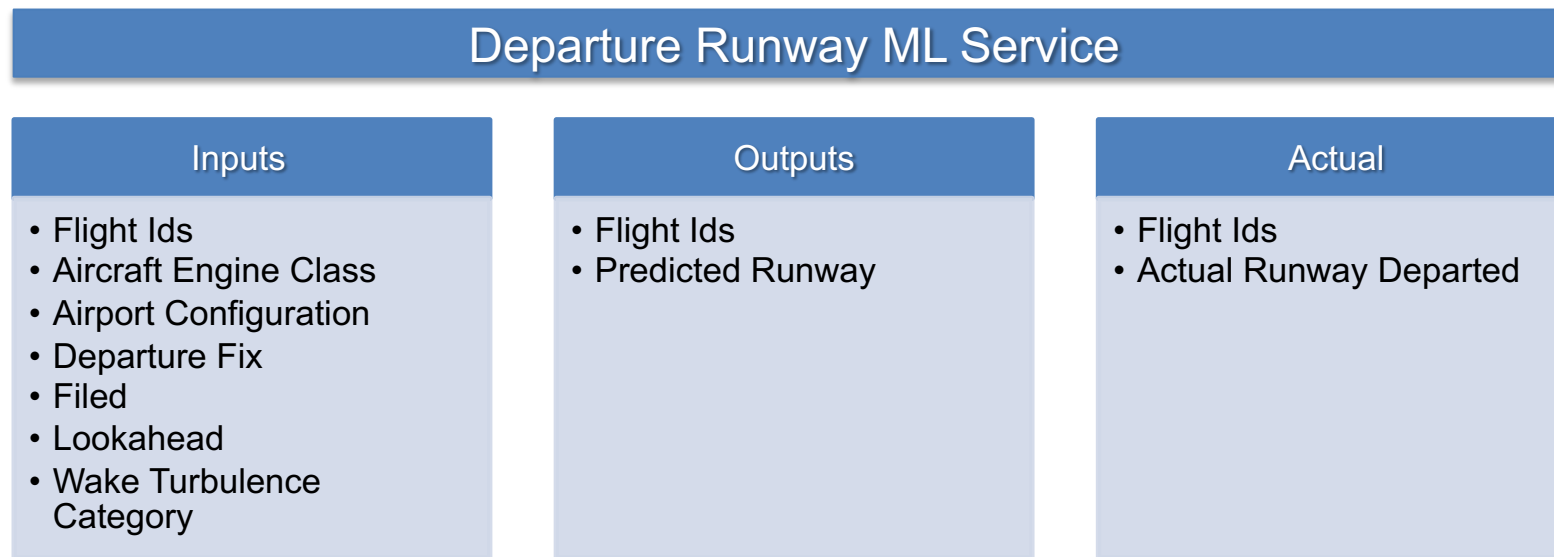 - Sherlock (requires NASA identity and access)
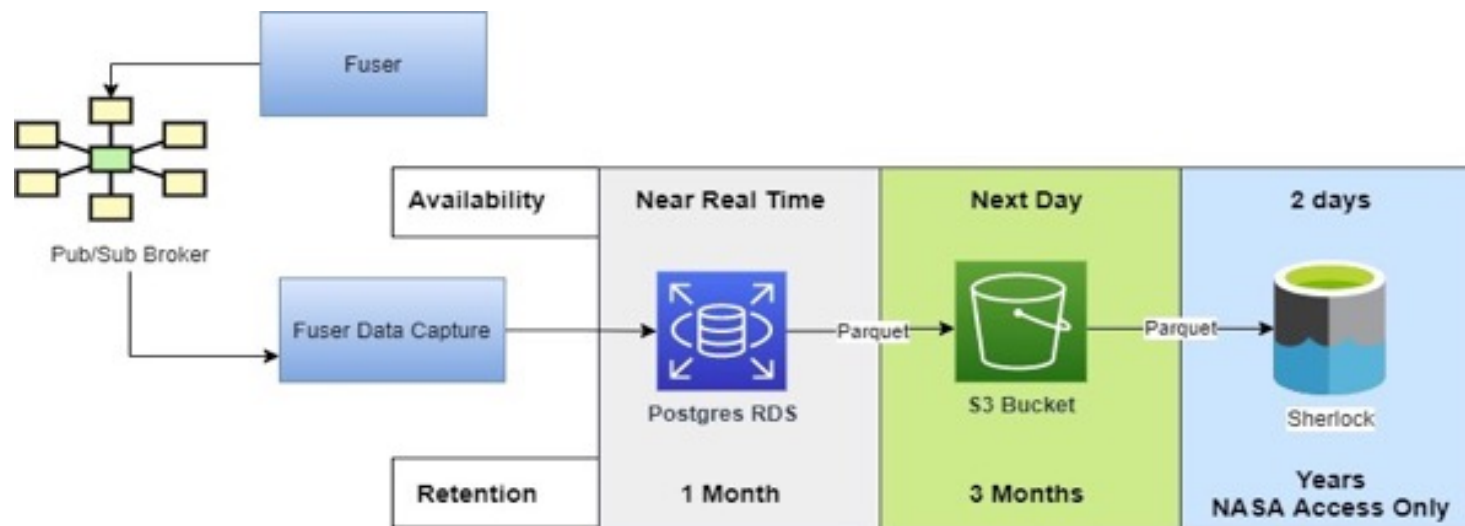
Data Requirements for Service Providers

Shawn Gorman

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- Store and expose data to support the performance of your service
  - Include inputs, your prediction/result, and the actual value that occurs

Departure Runway ML Service

Inputs	Outputs	Actual
• Flight Ids • Aircraft Engine Class • Airport Configuration • Departure Fix • Filed • Lookahead • Wake Turbulence Category	• Flight Ids • Predicted Runway	• Flight Ids • Actual Runway Departed

- Minimum 3 months' worth

- ## Challenges
  - Cost $$
  - Accessibility

- ## NASA approaches being considered
  - Data Access APIs
    - Good for accessing small amounts of data
  - S3 access
    - Requestor pay access
    - S3 DataSync
    - S3 Data replication

Source Bucket → Destination Bucket
Amazon S3 Replication

AWS

Asia Pacific (Mumbai) | ap-south-1
US East (N. Virginia) | us-east-1

Source Bucket
Destination Bucket

Amazon S3 Cross-Region replication
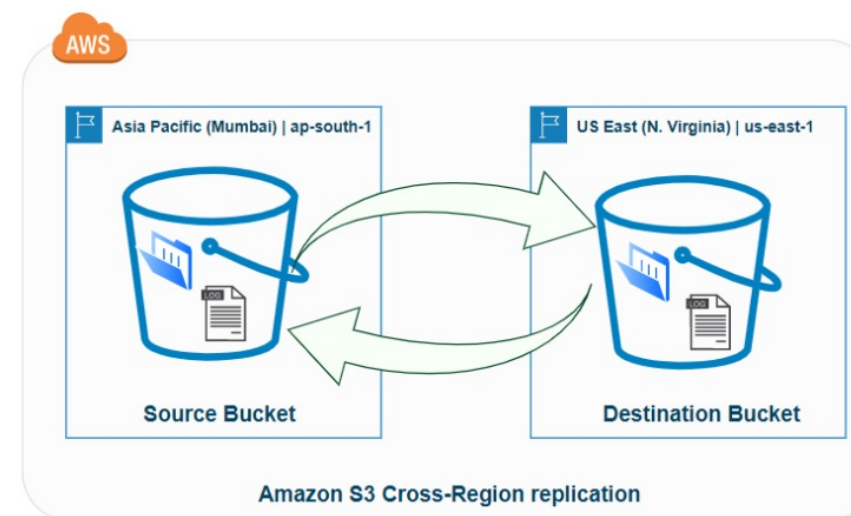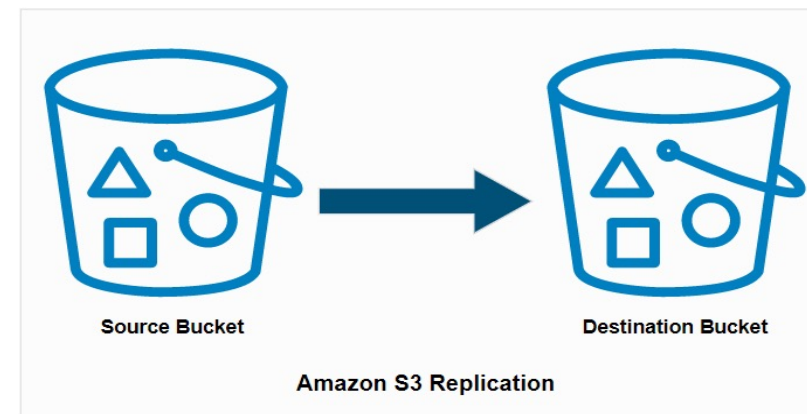
- Fuser system in the cloud
- ML Services deployed in the Cloud
- Prototype development -Congnito authentication, Websocket data streaming

·Services avaiable for integration testing
   ·FIXM Fuser Stream
   ·Data Access Services
   ·ML Services

- Catalog service deployed
- Service creation and registration
- Search capability
- Try it now (sample)
- API Gateway endpoints
- Centalized API gateway for service routing

- Automation of Service registration
- Expand Catalog service Capabilities
- Point-to-point service support

Oct 2021   **Feb 2022**   **Apr 2022**   **May 2022**   **June 2022**   **July 2022**   **Oct 2022**

- Documentation on services and Capabilities
- Open API Spec

- Partner services manual setup & support

- Partner 22 Demo
- Partner Onboarding support

Questions and Answers

Please post your questions either in the chat box or
the Conferences.io link
https://arc.cnf.io/sessions/nedn/#!/dashboard

- Is three months of data a reasonable target?

- What are other cost-effective ways to store and share large volumes of data that should be considered?

- Other concerns related to storing and exposing data?

- What feature is missing in our development plan that is important to you?

- In the initial year of DIP (FY22) the platform will not have a built-in capability to allow for the monetization of services and data. This is a planned capability to be considered in FY23. We would like to explore your willingness to engage with the DIP platform with the understanding a monetization capability will not be ready in FY22. Additionally, we are interested in hearing your thoughts on long term monetization capabilities the platform should support or enable.

- We will present our initial approach to securing the services using Amazon Cognito and API keys. We would like to understand what authentication approaches you think need to be supported by the platform to access your services.

- Help DIP determine service specification needed for the catalog service. If you wanted to find a "taxi time prediction service" for example, how would you search for it.

Next Steps and Closing Remarks

Mirna Johnson

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- Schedule
  - DIP Workshop Series #3: DIP for Flight Operators: TBD
  - Flight Operator Announcement for Collaborative Opportunity: TBD
  - Service Provider Announcement for Collaborative Opportunity: TBD

- Please email to ARC-DIP-EXT@mail.nasa.gov for questions or comments

- Visit https://nari.arc.nasa.gov/atmx-dip for more information regarding DIP sub-project and future events

Thank you!