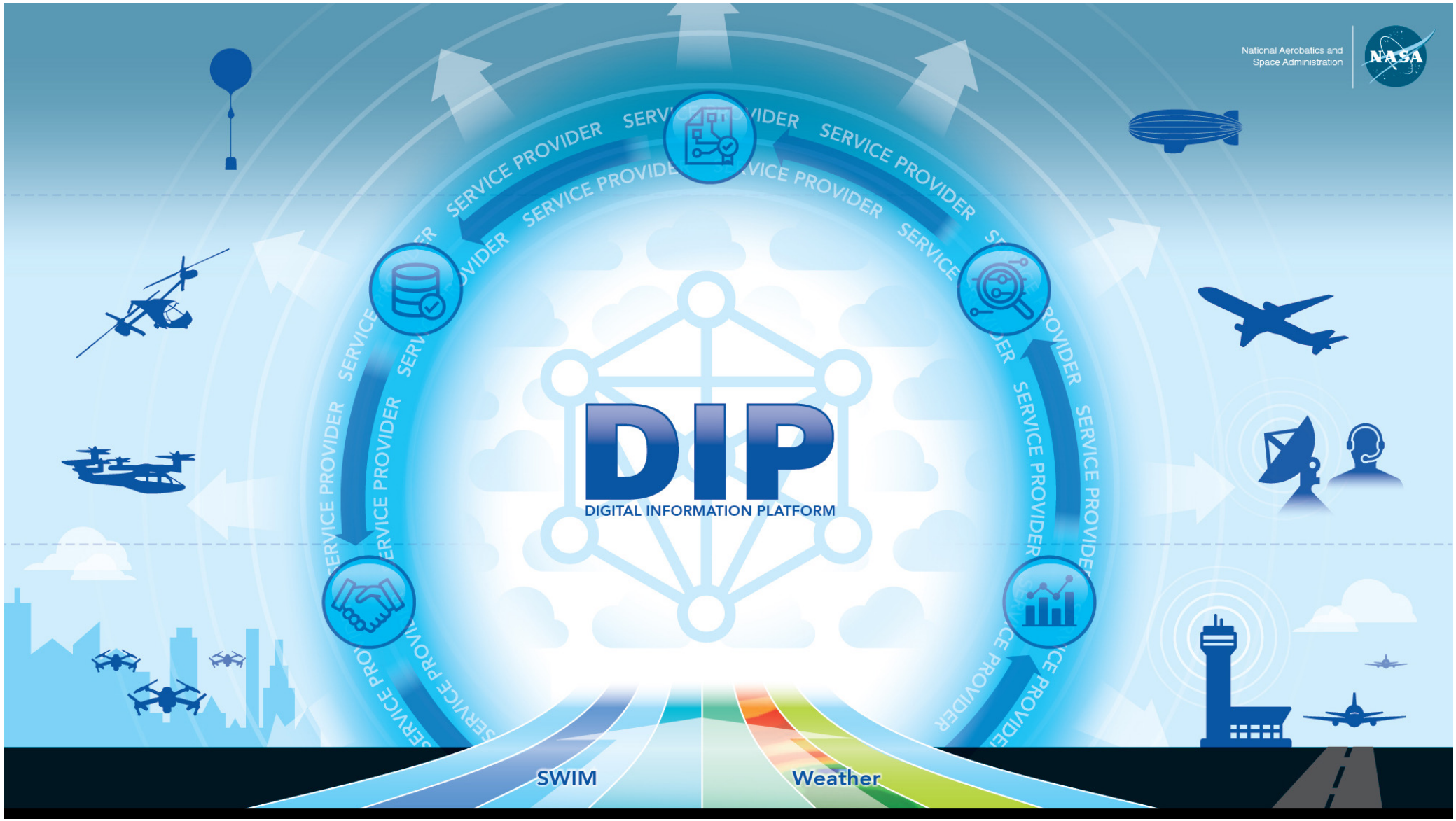
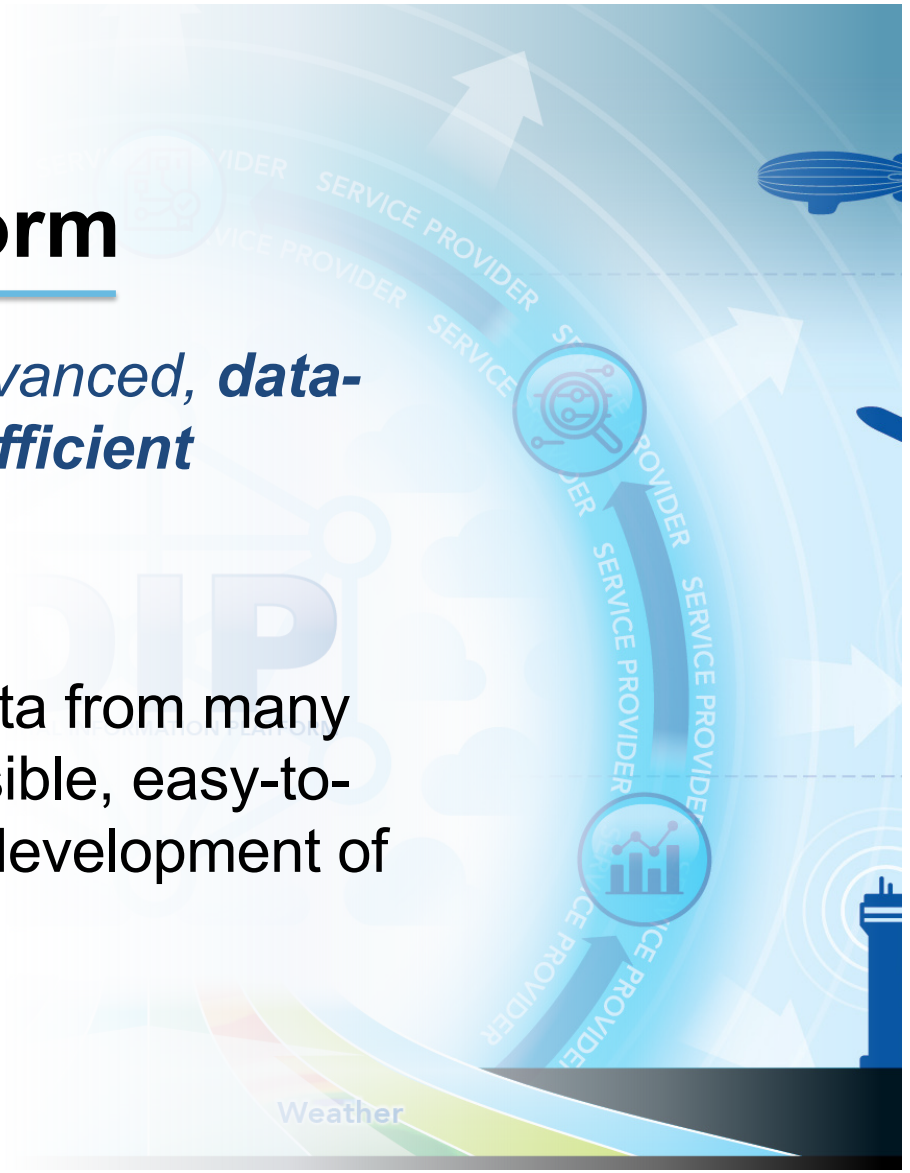
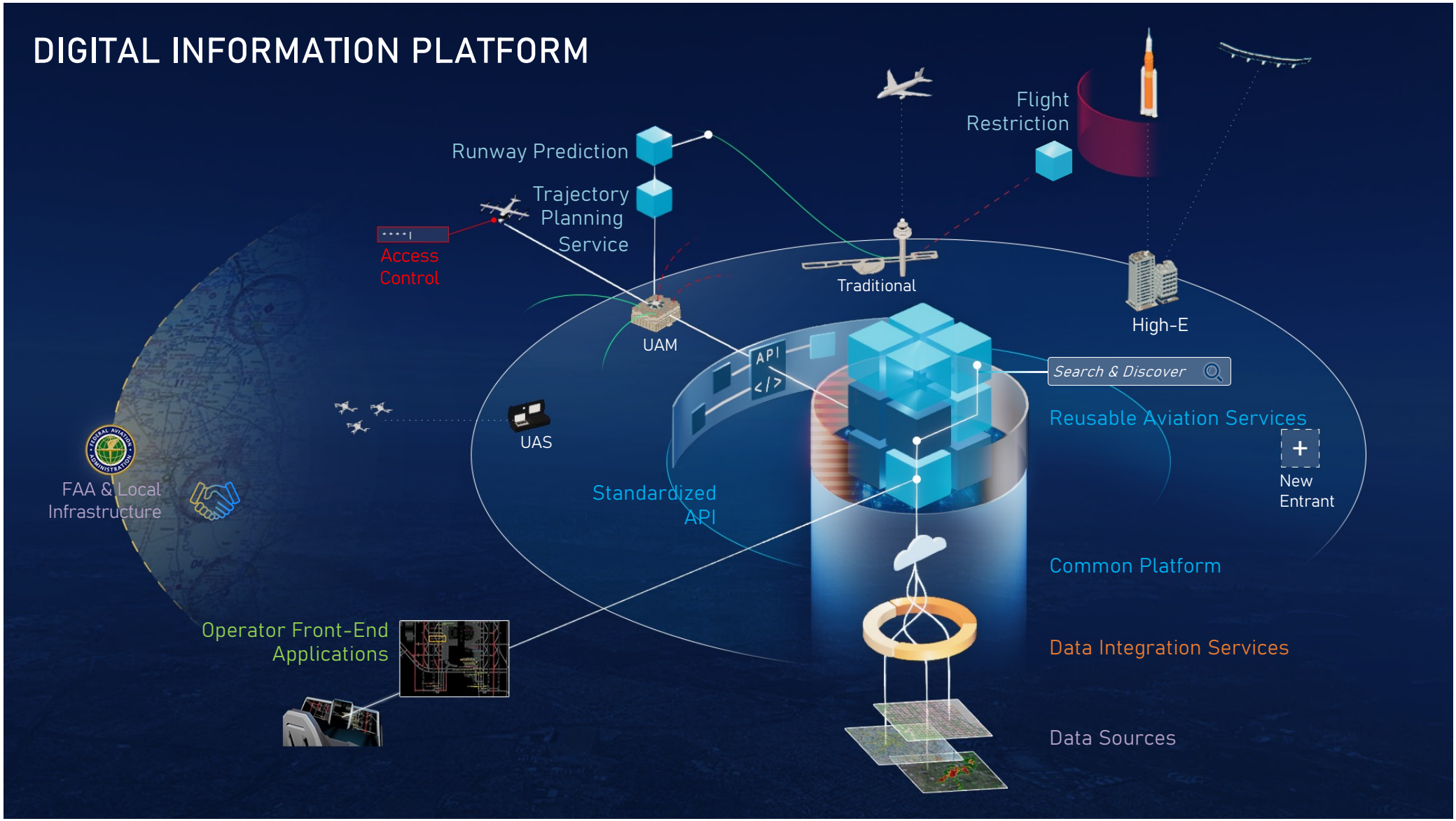

National Aerobatics and Space Administration
NASA
SERVICE PROVIDER
DIP
DIGITAL INFORMATION PLATFORM
SWIM
Weather

Digital Information Platform

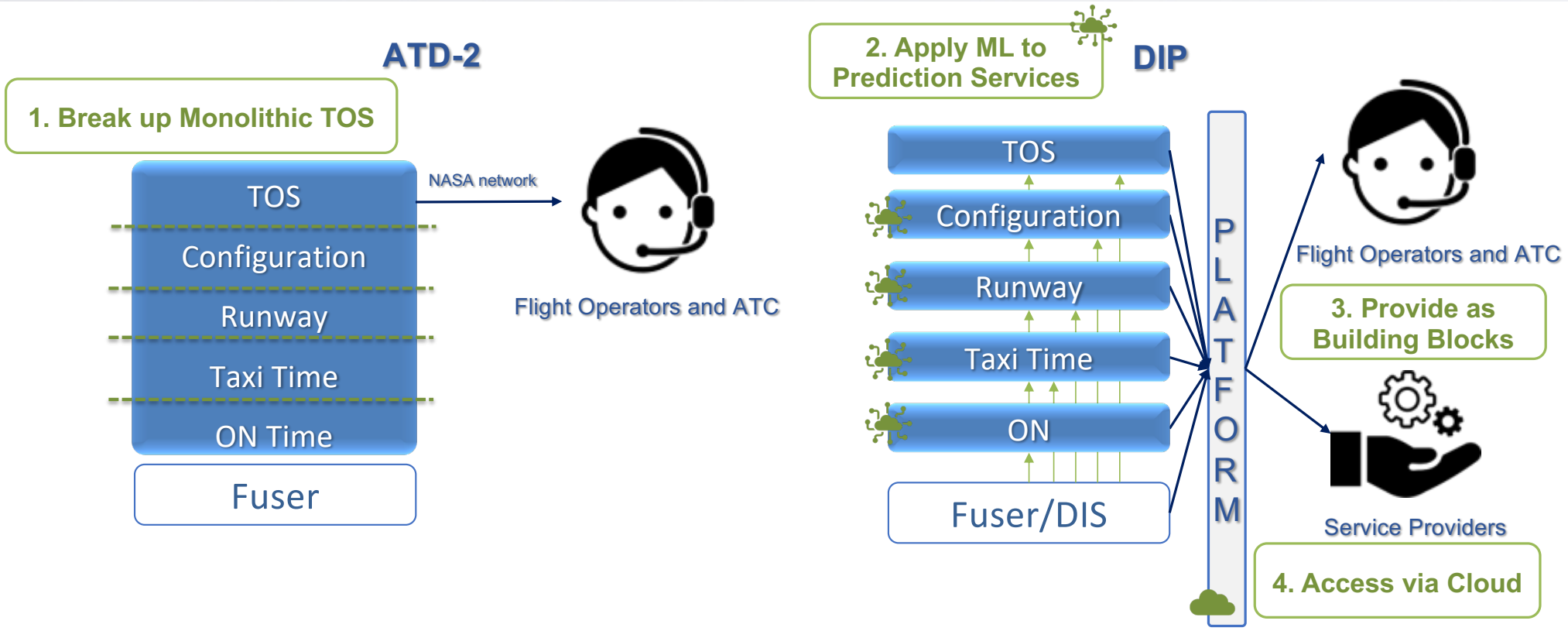
Accelerate NAS transformation for advanced, ***data-driven, digital services*** *to promote* ***efficient aviation operations***

Cloud-based ecosystem that takes data from many sources and turns it into easily accessible, easy-to-use digital information to expand the development of airspace management services




DIGITAL INFORMATION PLATFORM
Runway Prediction
Trajectory Planning Service
Access Control
Flight Restriction
Traditional
High-E
UAM
UAS
API
Search & Discover
Reusable Aviation Services
New Entrant
FAA & Local Infrastructure
Standardized API
Common Platform
Operator Front-End Applications
Data Integration Services
Data Sources

Leveraging ATD-2 MicroServices



"DIP-itize" – Scalability towards NAS-wide implementation

DIP Research Areas

NASA Led DIP-Enabled Services for Sustainability

Ground and flight deck services focused on improving the sustainability of aviation operations

Industry Led Partner Service Demonstrations

Integration and demonstration of Partner services with DIP for validation of the platform

University Challenges

NTL NASA Tournament Lab

Development of innovative solutions and advanced algorithms for aviation services

Reference Digital Information Platform (DIP)

Development of a platform for advanced, data-driven, digital services for flight operators and service consumers

NASA Led DIP-Enabled Services for Sustainability

Ground Services

Flight Deck Services

SA-1

Collaborative Digital Departure Re-Route

(FY22 - 24)

SA-2

Multi-regional Trajectory-Based Operations

(FY25)

SA-3

IROP Disruption Management

(FY26)

SA-4

4D Trajectory Optimization

(FY27)

Ground and flight deck services focused on delivering reduction in emissions and fuel of aviation operations through digital services technology

CDDR Sustainable Aviation Benefits

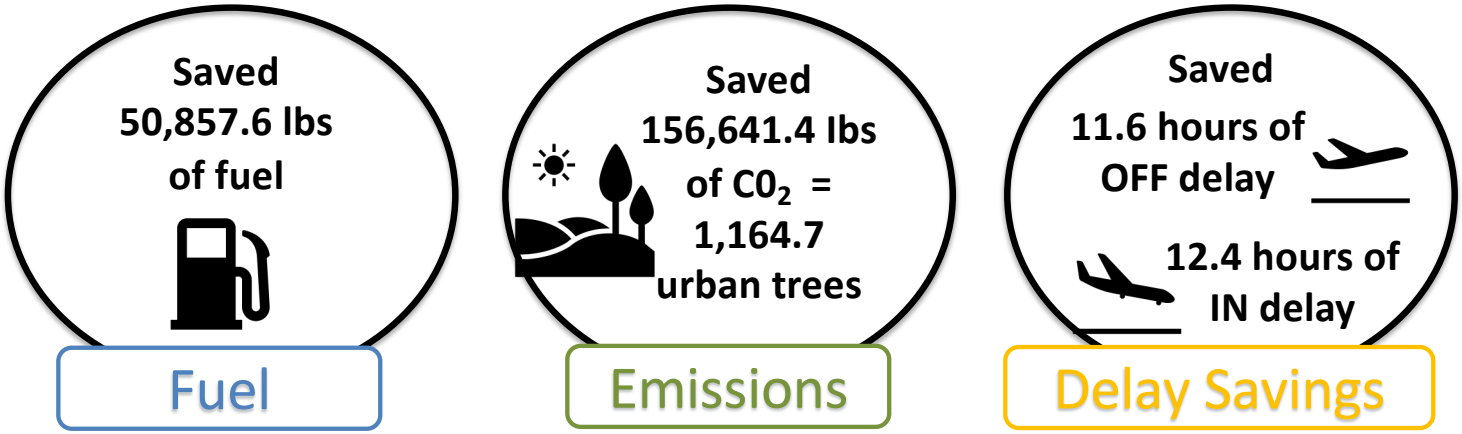
SA-1: Collaborative Digital Departure Re-Route (FY22 - 24) Demonstrate CDDR via Trajectory Option Set (TOS) by rerouting flights and departures starting at NTX towards a high-density operational area

Benefits:

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

Benefits totals from Phases 3 of the ATD-2 field demonstration

at **D10 North Texas Metroplex** (22 Nov 2020 – 17 Sep 2021)

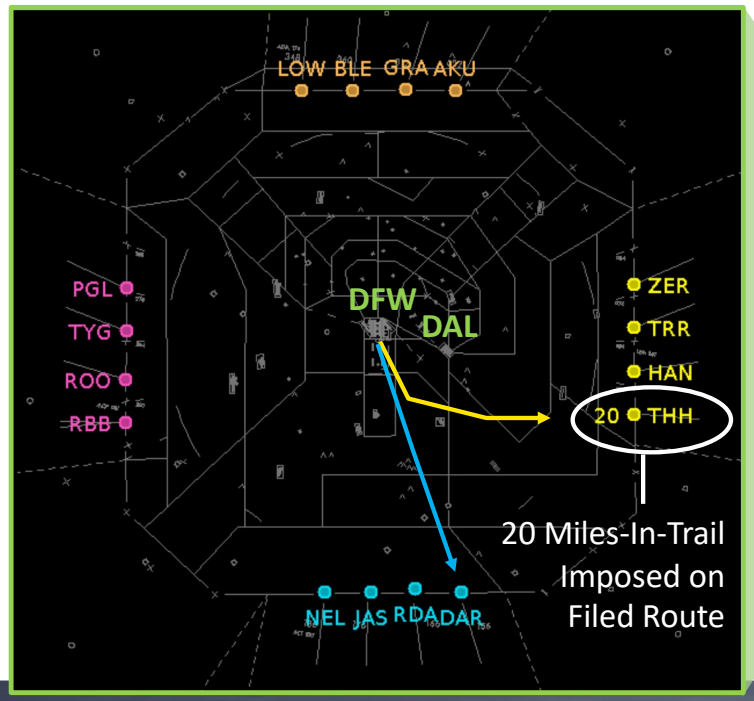


DIP will scale these savings across the NAS* validating in SA-1 @ Complex Airspace

*NAS-wide potential benefits analysis in task plan

Collaborative Digital Departure Reroute (CDDR)

On March 26, 2021, American Airlines 1822 flew Dallas/Fort-Worth (DFW) to Fort Myers (RSW) on a reroute recommended by NASA



- American Airlines 1822 was initially filed on the **yellow route**
- ATD-2 projected surface delay due to constraints on the East departure gate
- Based on American TOS preferences, ATD-2 recommended the **blue reroute** out the south gate
- Even though the blue route was 42nm longer, by flying this TOS alternate reroute, American Airlines flight 1822 saved:
  - 16 minutes of surface delay (at takeoff)
  - 20 minutes of surface delay including subsequent departure flights in the American fleet (aggregate system savings)
  - 11 minutes of arrival delay (at the destination's parking gate)

Sustainable Aviation Demo Plan

- **Overall Goal:** Demonstration of sustainable aviation fuel and time benefits of Collaborative Digital Departure Reroute (CDDR) via a cloud-based and service-oriented architecture for both Flight Operators (FOs) and FAA facilities

- **Demo Objectives**
  - Transition ATD-2 system at N TX into a scalable CDDR capability
  - Deliver cloud-based CDDR capability to complex airspace environment outside of N TX
  - Deliver predictions of delay at the runway and terminal boundary

- **Ecosystem:** DIP Platform and real-time services, including interfaces on AWS cloud architecture

- **Real-time Services**
  - Machine-Learning Airport Surface Model: configuration prediction, runway prediction, unimpeded taxi prediction, estimated ON time prediction
  - NAS terminal scheduler incorporating constraints at the terminal boundary and each airport surface within the Metroplex
  - TMI service providing real-time and historical archive of NAS constraints
  - TOS-Reroute Request Submittal Service (enabling (FOs submissions to FAA TFM system)

- **Partnerships:** existing partners, such as FAA, NATCA, NBAA, CDM, AAL and SWA, as well as potential new air carriers, and eventually 3rd parties which are consumers and producers of data within the DIP platform

Sustainable Aviation Engineering Plan

- SA demos follow a crawl, walk, run approach to build up and validate capabilities in North Texas before deploying to new more complex airspace:

- **SA1a Operational Evaluation 1 FY22 in North Texas with ML technology**
  - System deployed on existing NASA NTX network with no cloud deployment
  - Validate service-oriented architecture leveraging micro-services
  - Validate ML micro-services as replacement for legacy adaptation-based surface model
- **SA1a Operational Evaluation 2 FY23 in North Texas with cloud deployment**
  - Validate system with AWS cloud deployment in North Texas
  - Validate 'last mile' services with Flight Operator consuming from AWS cloud environment
  - NASA network continued to be used to deliver User Interface to FAA
- **SA1b Operational Evaluation in FY24 in more complex airspace**
  - Validate cloud-based approach used in North Texas is scalable to other facilities
  - Validate new interfaces for Flight Operator to submit reroute requests to FAA (CSS-FD?)

Introduce Capabilities in Phased Approach towards new airspace