SWIFT Developer Series

Trajectory Deviation Study & Developer Workshop Logistics

August 16, 2022

Introductions

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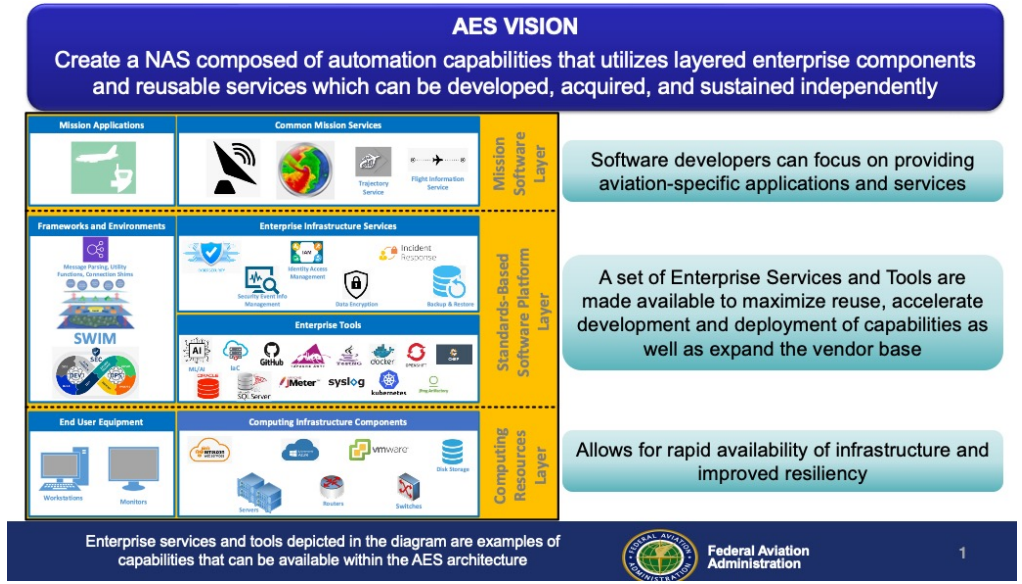
Recap of the SWIFT Developer Series

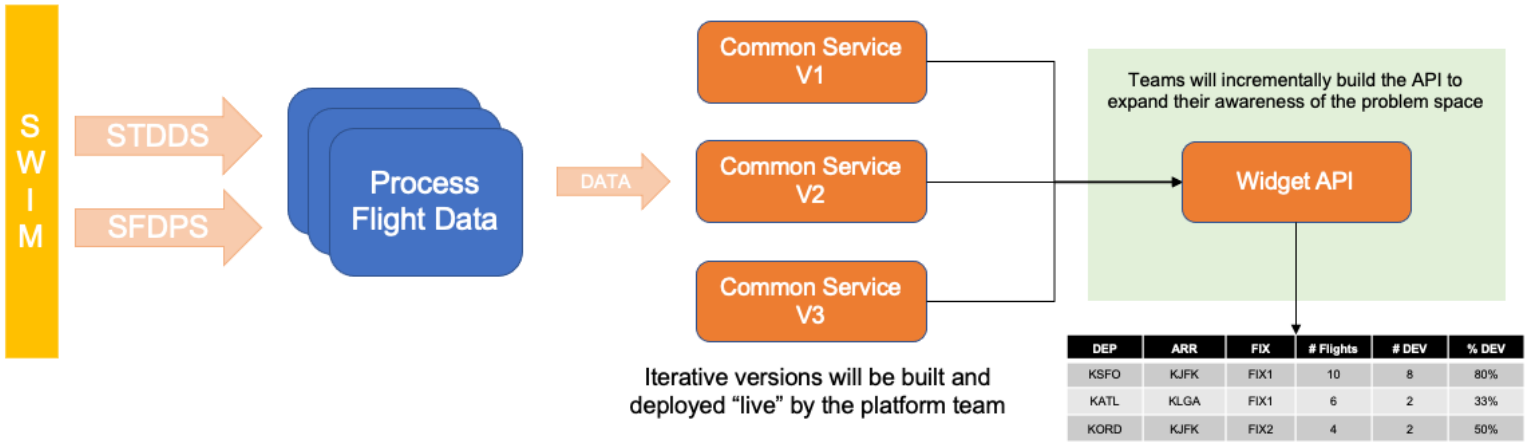
SWIFT Developer Series: Objectives

- **Review the basics of connecting and consuming SWIM data**

- **After the series, participants will:**
  - Have a deeper understanding of integrating SWIM data and be empowered to develop solutions to address a problem space
  - Understand how the Automation Evolution Strategy concept will enable iterative development and common services to meet the needs of the users (internal and external)
  - Appreciate how capabilities can be collaboratively built and evolve over time



Developer Workshop Overview



- Participants will create an Application Programming Interface (API) that will drive an analytics chart
  - Consume data from a common data service
  - Process the data to make it available for table using a known schema
  - API will be deployed via pipeline
- As the exercise progresses – new versions of common service will become available with more extensive data.
  - Participants will update their applications accordingly
- Participants will have some level of language choice
  - Java, Python, JavaScript

Preparing for the In-Person Developer Workshop

- **Webinar 1**
  - Experience building and running containerized software
  - Familiarity with deploying containerized software

June 21, 2022
Check your email for links to the videos!

- **Webinar 2**
  - Experience connecting to SWIM and consuming data
  - Some SWIM data knowledge

July 19, 2022
Check your email for link to the video!

- **Webinar 3**
  - Background on the operational problem space (Trajectory Deviation Study)

HAPPENING NOW!

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Any lingering questions from Webinar 2 or the hands-on exercise?

Trajectory Deviation Study

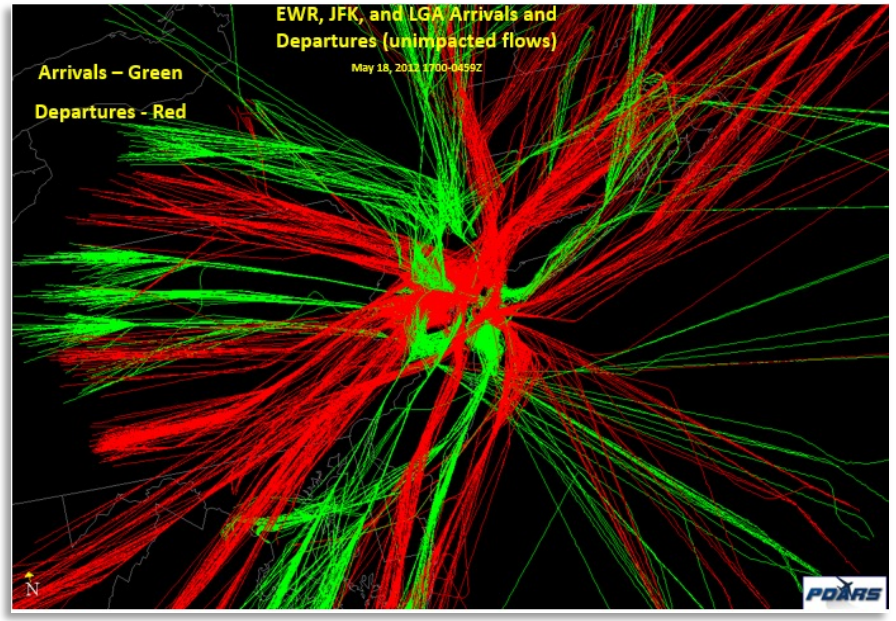
Overview

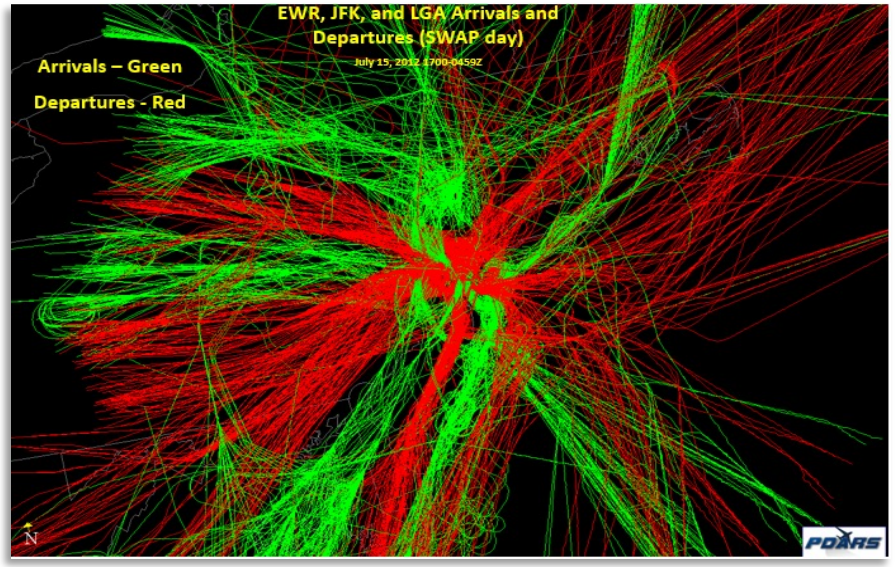
- Background & Problem
- Operational Insight
- Leveraging SCDS to gain awareness

Case Study Executive Summary

- Operations Problem Statement:
  - Determine departure delay impacts resulting from aircraft deviation along flight trajectory.
    - There is no clear way to readily identify aircraft deviation indicators (e.g., weather, traffic volume) and anticipate ground delays
    - Lack of available post-ops data analysis to determine threshold boundaries for traffic deviation and where disruptions are severe
    - This limits the operational community from effectively planning or implementing work-arounds for airspace condition changes and resource constraints drive

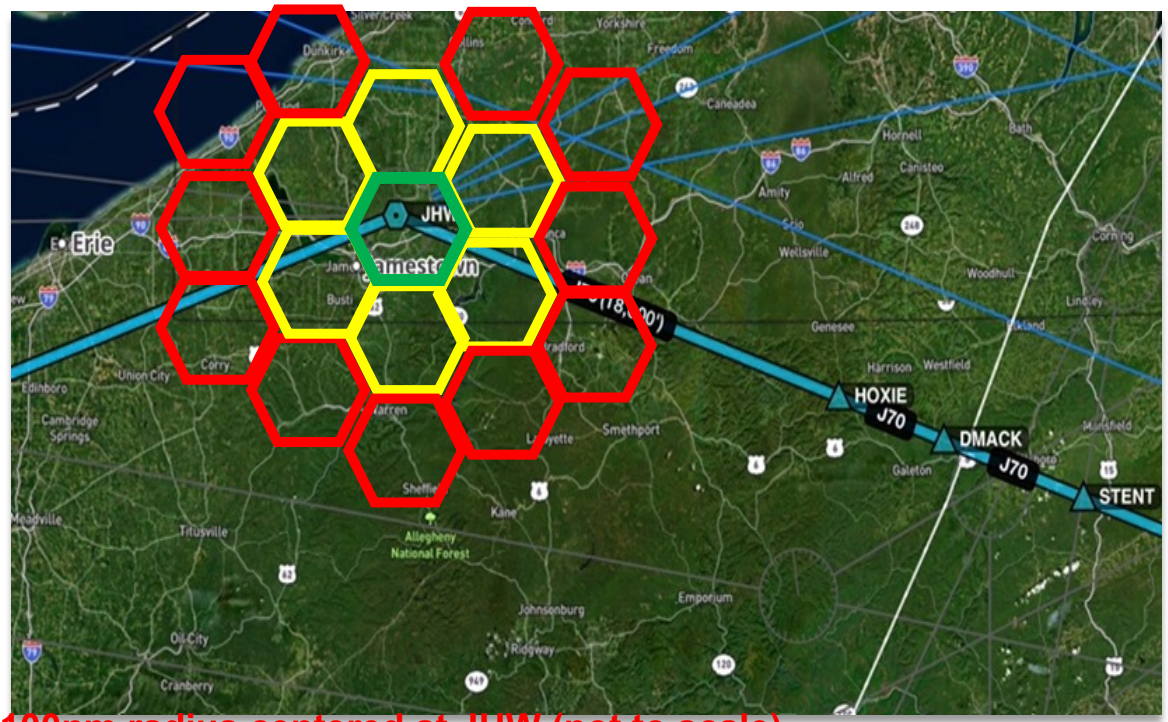
- Operational Environment:
  - New York and Cleveland Center: ZNY and ZOB
  - North Texas Region and Adjacent Centers: ZFW, ZHU,ZAB, ZMP
  - Airports: JFK and DFW
  - Airways and jet routes impacted by Traffic Management Initiatives (TMI) events or closures





New York Perspective – Analyzing Trajectory Deviation

- **As convective weather develops west of N90, arrival aircraft may transit enroute sectors from multiple directions, deviating off the anticipated course (primarily due to pilot requests).**
  - *A* controller *may request traffic management restrictions to help manage traffic complexity*
  - *If the workload or complexity is not mitigated, a stop on departures may be requested*
- **We want to explore ZNY requests for arrival vectoring, in which we observe arrival deviation into departure sector airspace.**
  - *Arrivals that deviate into departure airspace can potentially cause volume and complexity issues in the impacted departure sectors.*
  - *Consequently, this pushes delays/stops back to the surface at the departing airport.*

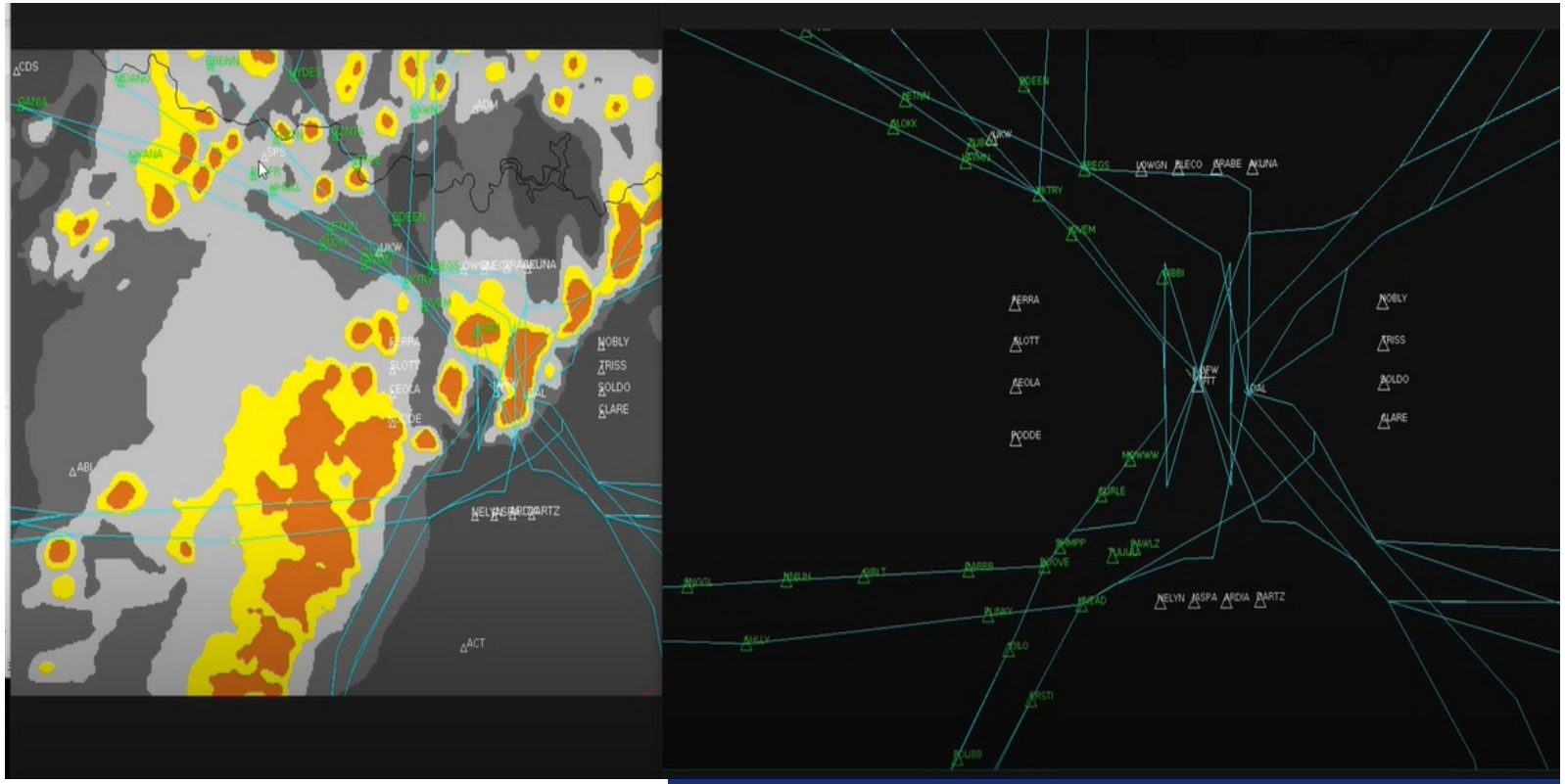


100nm radius centered at JHW (not to scale)

***Capturing deviations from planned trajectory**: We focus in the vicinity of Jamestown VOR (JHW) on any of the J,Q or other trajectory cleared through that area, in which, local convective weather forces N90 arrivals north. Downstream, this prompts N90 arrivals to approach from the north instead of the west.*

North Texas Perspective - Analyzing Trajectory Deviation

- **From June 21, 2021 convective weather has severely limited DFW available runway resources for arrivals**
  - *In this scenario, arrivals must be funneled in at Wichita Falls (SPS) to mitigate disruptions in operations*
  - *Convective Weather around DFW impacts westbound departures (e.g. FERRA fix open)*
- **We want to indicate the likelihood of needing to swap gates out and restrict westbound DFW departures to accommodate heavy arrival streams, due to deviation.**



Graphic captured from https://cospa.wx.ll.mit.edu/

***Capturing deviations from planned trajectory**: Typically, controllers will align inbounds at FL240 near Wichita Falls Navaid (SPS). This gives D10 controllers the spacing needed to manage flights for RWY 13R - leaving remaining runways of other corners. Depending on DFW configuration, controllers will seek gaps in the convective weather and coordinate north/west departures to mitigate impacts to arrivals.*

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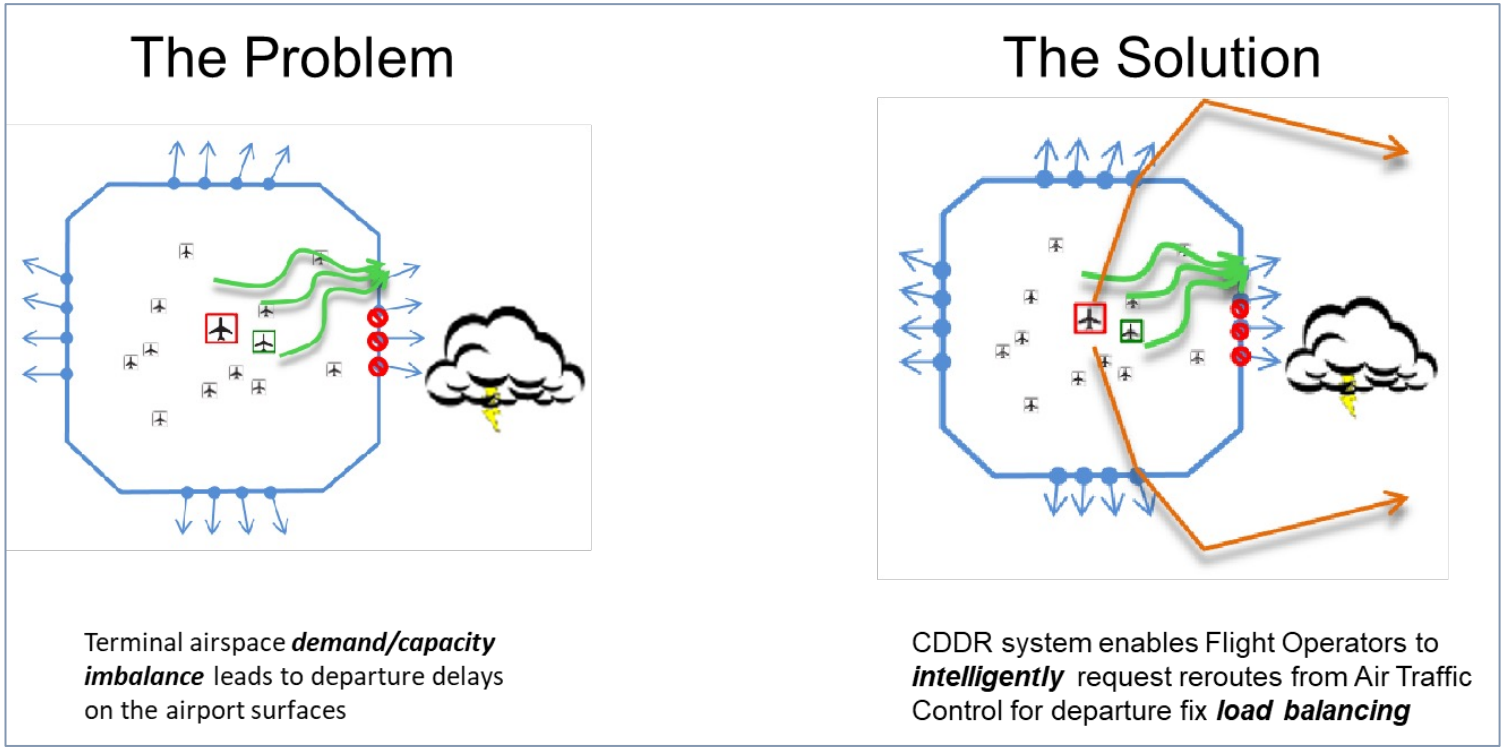
Problem Space: NASA Digital Information Platform (DIP)

DIP Problem Space:
- Monolithic service for single application, using adaptation-based algorithms to generate trajectory predictions as input to terminal scheduler; requiring site-to-site deployment

DIP Solution:
- Transformed into service-oriented architecture of highly reusable digital services accessible on the platform to support many advanced applications; upgraded to machine learning-based algorithms for predictions to enable NAS-wide scalability



Applying advanced techniques designed to scale and adapt for the NAS

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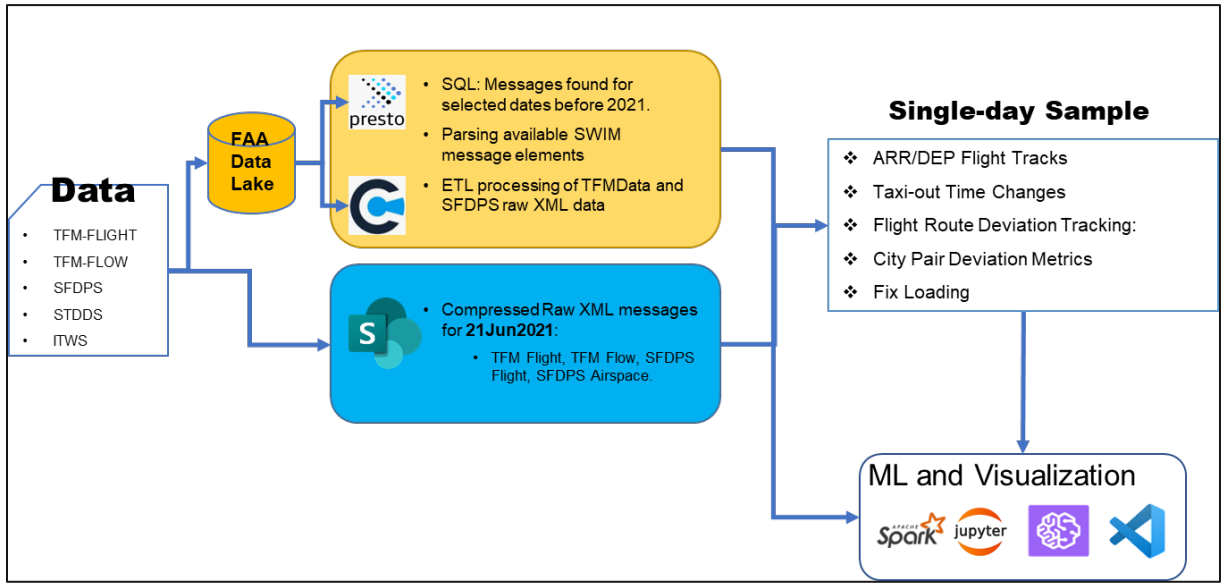
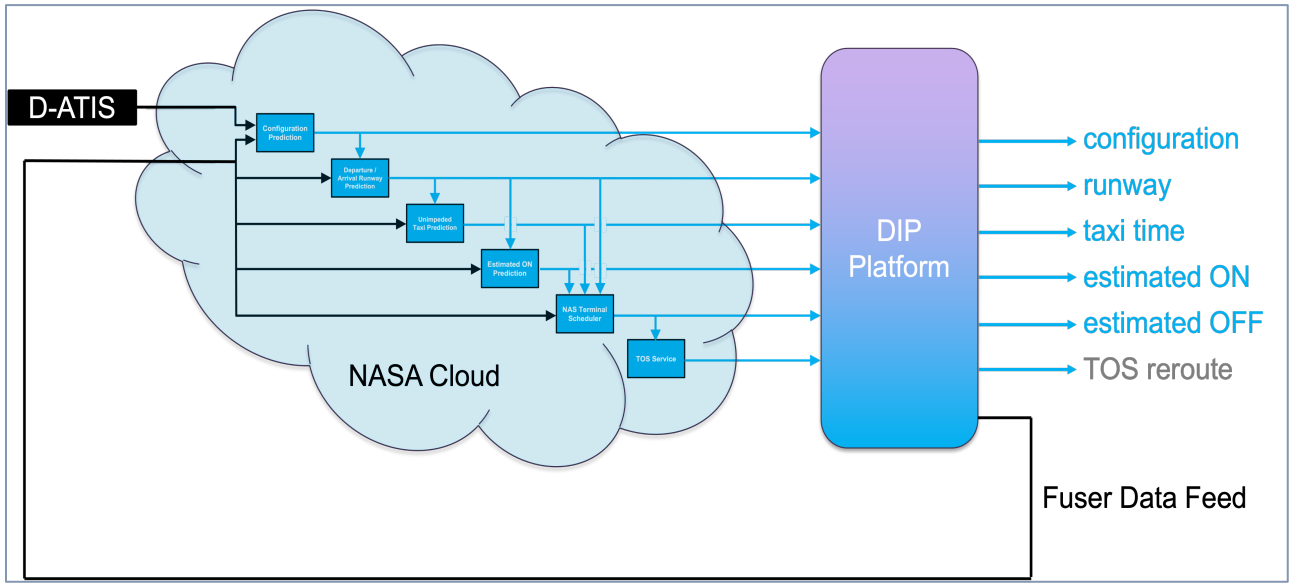
Case Study vs DIP Perspective

Convective Weather Case Study



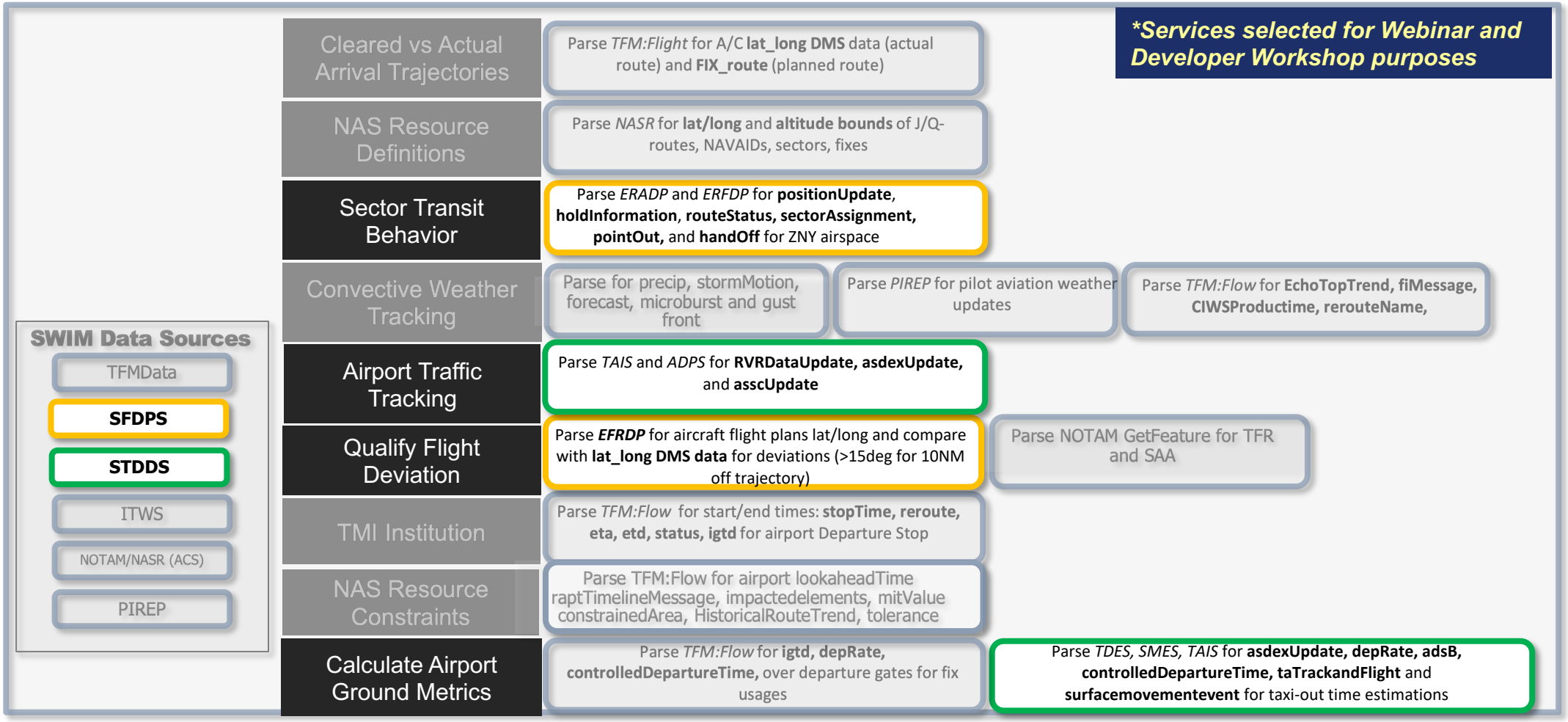
Monitor Changes in Density of Airspace Deviation from SWIM Data

Digital Information Platform



Monitor Unimpeded Taxi-Times through ML Services

Webinar & Developers Workshop Perspective: Analyzing Problem Space



Data Analyst

Handling the Data

- Jumpstart Kit consumes SWIM data from SWIM service subscriptions
- Containerize software for rapid deployment needs

Data Visualization

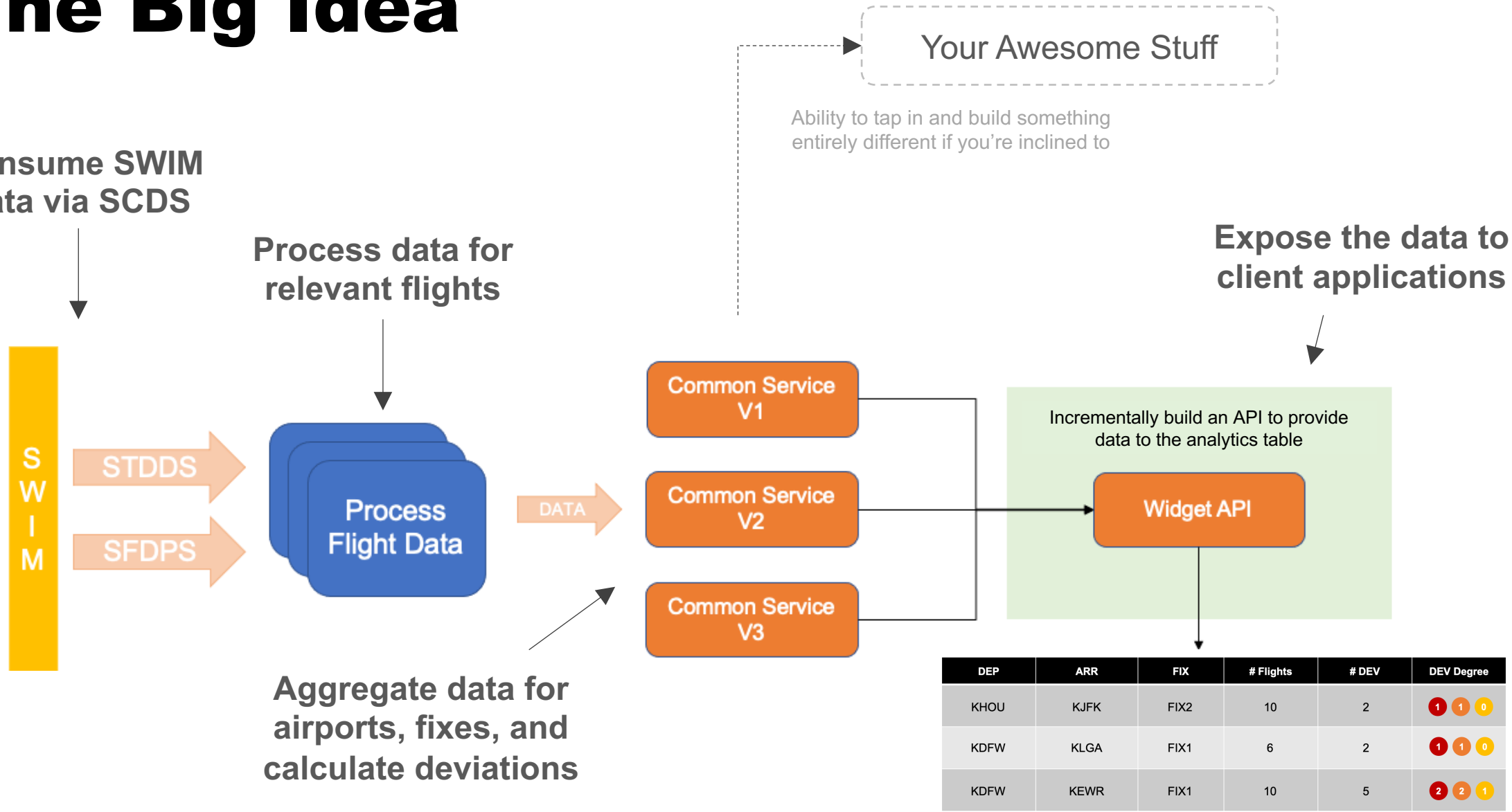
Visualizing the Data

- View data in the database
- Use dashboards to query database and visualize data

Questions?

Gaining Awareness with SCDS

The Big Idea



DEP	ARR	FIX	# Flights	# DEV	DEV Degree
KHOU	KJFK	FIX2	10	2	1 1 0
KDFW	KLGA	FIX1	6	2	1 1 0
KDFW	KEWR	FIX1	10	5	2 2 1

Iterative Situation Awareness

FIX	DEP	ARR	# Flights	# DEV	DEV Degree
FIX1	KDFW	KEWR,KLGA	10	2	1 1 0
FIX1	KDAL	KBOS,KLGA	6	2	1 1 0
FIX2	KDFW	KSFO	3	1	0 0 1

- How many flights are scheduled out of airports of interest?
- How many of these flights are experiencing deviations?
- What is the degree of the deviations?

Logistics for Developer Workshop

August 29th and 30th

Pre-Arrival Developer Checklist

- Install Necessary Software
  - VS Code
  - Docker Desktop
  - Terminal Application
  - Git
- Access to MITRE CoDev Environment
  - Access credentials provided via email
  - Ensure successful `git clone` of “Test Repo”
- Connected to Shared Slack Channel (ext-mitre-faa-swift-dev-2022)
  - Slack Desktop App is optional, but might be better than browser app

August 29, 2022 • 1300-1700

- This session is **voluntary, but encouraged**
- During the session we will assist with:
  - Security Issues
  - Network Connectivity
  - Development Environment Configuration (e.g., software tools, credentials, Slack, etc.)
  - Completing pre-workshop test checklist

August 30, 2022 • 0830-1600

- 0830-0900 – Introductions and Logistics for the Day
- 0900-0930 – Development Approach & Building Blocks
- 0930-1000 – Development Session (Baseline)
- 1000-1015 – Break
- 1015-1115 – Development Session (Iteration #1)
- 1115-1130 – Webinar #2 “Homework” Showcase
- 1130-1300 – Lunch (MITRE 1 Whirlwind Café)
- 1300-1315 – Morning Recap, Check-In, & Afternoon Plan
- 1315-1415 – Development Session (Iteration #2)
- 1415-1430 – Break
- 1430-1530 – Development Session (Iteration #3)
- 1530-1600 – Wrap Up & Farewell

Questions?

Homework Assignment

- You'll be receiving an email with guidance on configuring your development environment
- **Please** take moment to get that configured as it will make getting situated at event much easier
- If you run into problems, please reach out
- Unresolved issues can be addressed on 8/29 from 1300 to 1700

Upcoming Schedule

- **Developer Workshop – August 29-30, 2022**
  - *In Person Event at MITRE McLean Campus*
  - ~~*Registration Deadline was August 15th!*~~

If you didn't register by to original deadline of August 15th, you have until this evening at 5PM EDT to submit your registration.

Thank You!