SWIFT:

SWIM Industry Collaboration Workshop #7

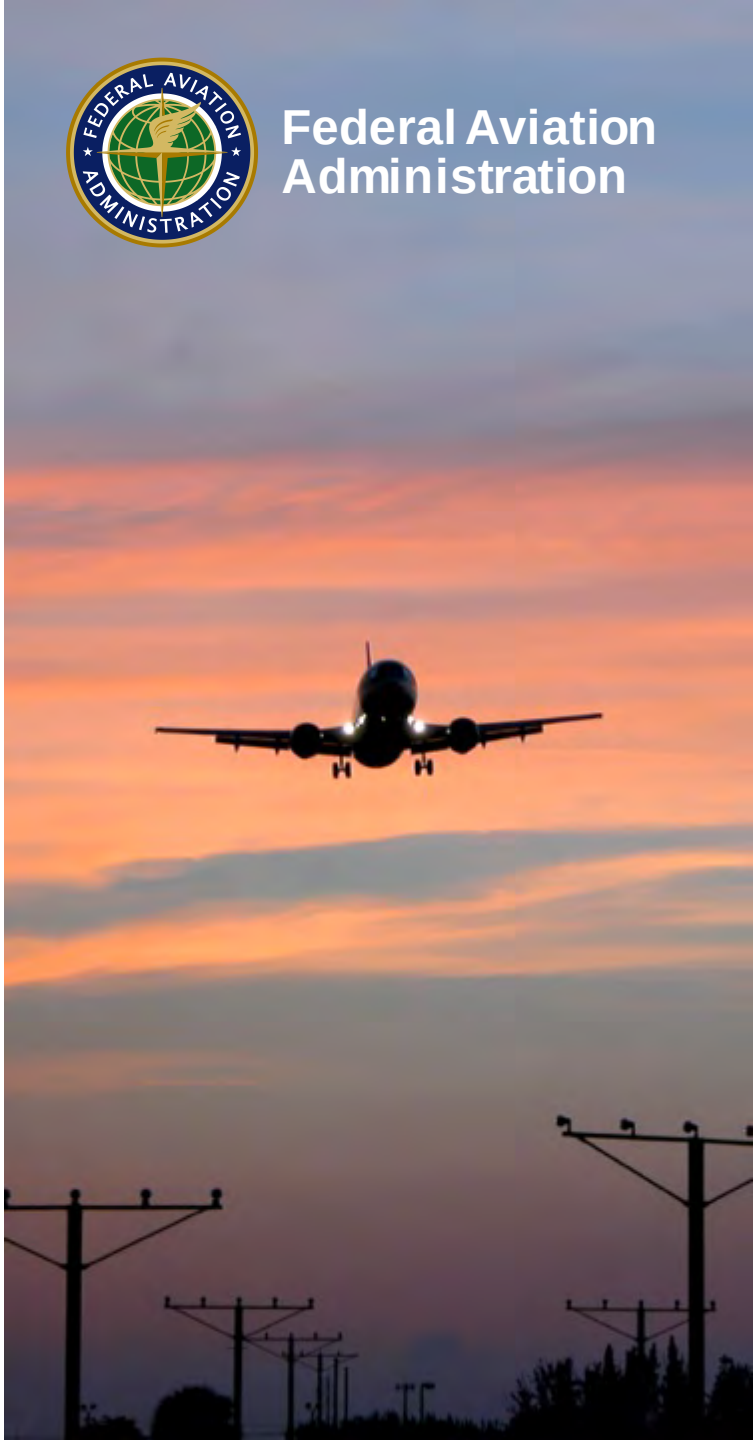
SWIM, Services & SWIFT (SWIM Industry-FAA Team)

FAA SWIM Program

Communications, Information and Network Programs

August 8, 2019

Federal Aviation Administration



SWIFT Participants

Welcome to United Airlines Flight Training Center

Logistics and Safety Protocol

- Coffee!
- Wash Rooms
- Fire plan
  - Exit locations
  - Extinguishers
  - Rally Point
- Life Saving
  - 911
  - CPR
  - AED
- Natural Disaster
- Active Shooter
- Lunch Plans

UNITED

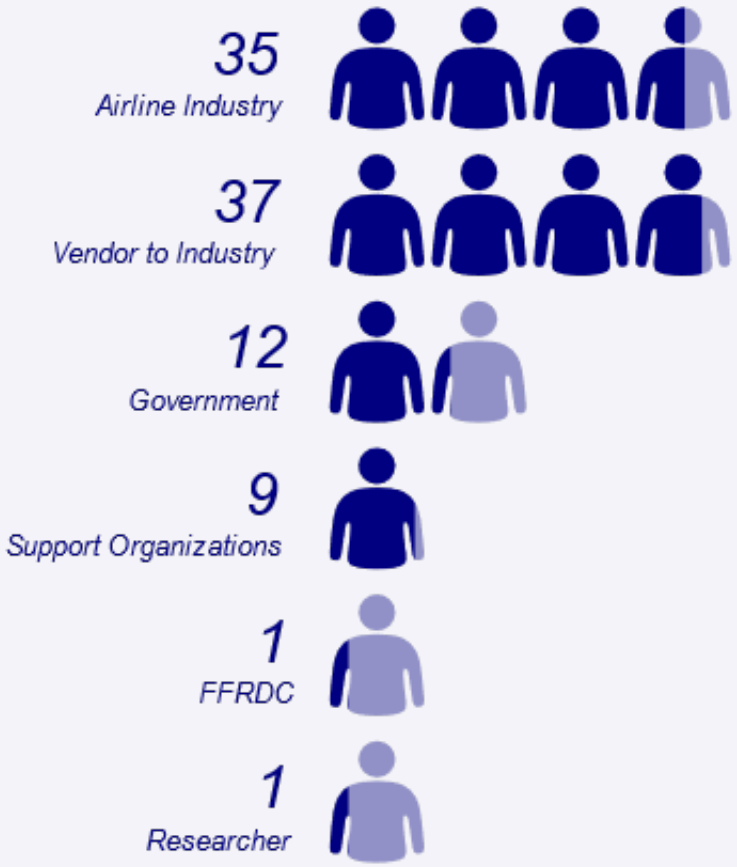
SWIFT Collaborative Workshop #7 Agenda

- Start @ 8:30: Introductions
- SWIM Program Updates
- Update on SWIFT Focus Groups
- Special Topic: United Airlines: Leveraging SWIM to Improve Operations
- **Break**
- NBAA Case Study: Refining Airspace Restrictions with SWIM
- Special Topic: MITRE and NBAA: General Aviation Departure Readiness Time Submission Using Mobile Technology
- Producers Corner: STDDS: SMES and More!
- **Lunch 12pm – 1:15pm**
- What's next? Facilitated Discussion on Industry Priorities
- Special Topic: Southwest Airlines SWIM Process Approach Discussion
- **Break 2:45pm – 3:00pm**
- SWIFT Update: ACS Customer Testbed
- Special Topic: Widget Case Studies
  - United Airlines: SWIM-Enabled Web Application
  - SWIM Widgets Update
- Special Topic: New SWIM Capability – Lost Message Retrieval
- SWIFT Update: Feedback on Enhanced SWIM Cloud
- Close @ 4:30PM

SWIFT Stakeholders

Who is at SWIFT #7?

SWIFT #7 Attendees



Attended a SWIFT Meeting Before?

SWIFT

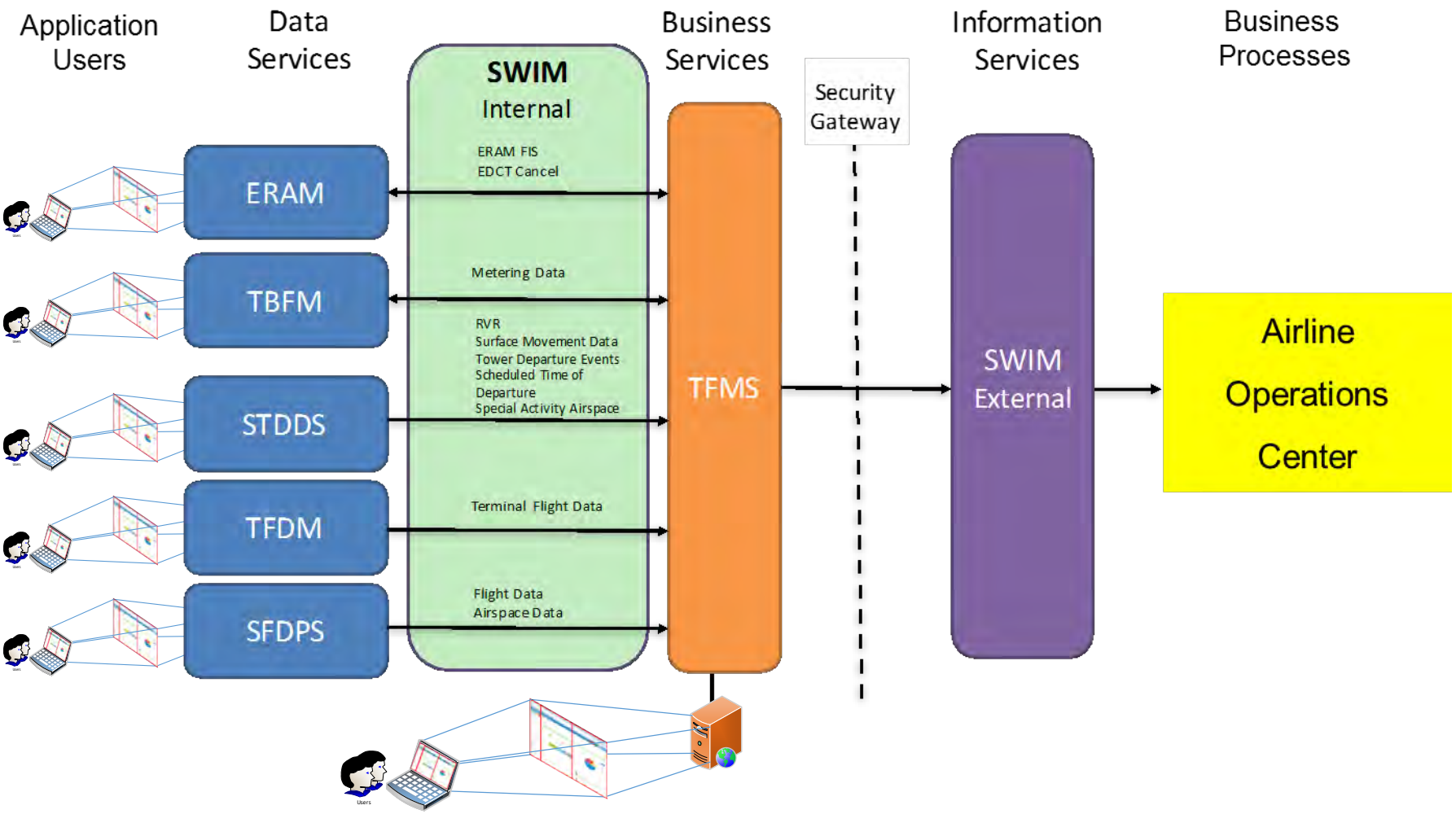
*Registered attendees as of 8/7/19

SWIM Industry FAA Team (SWIFT)

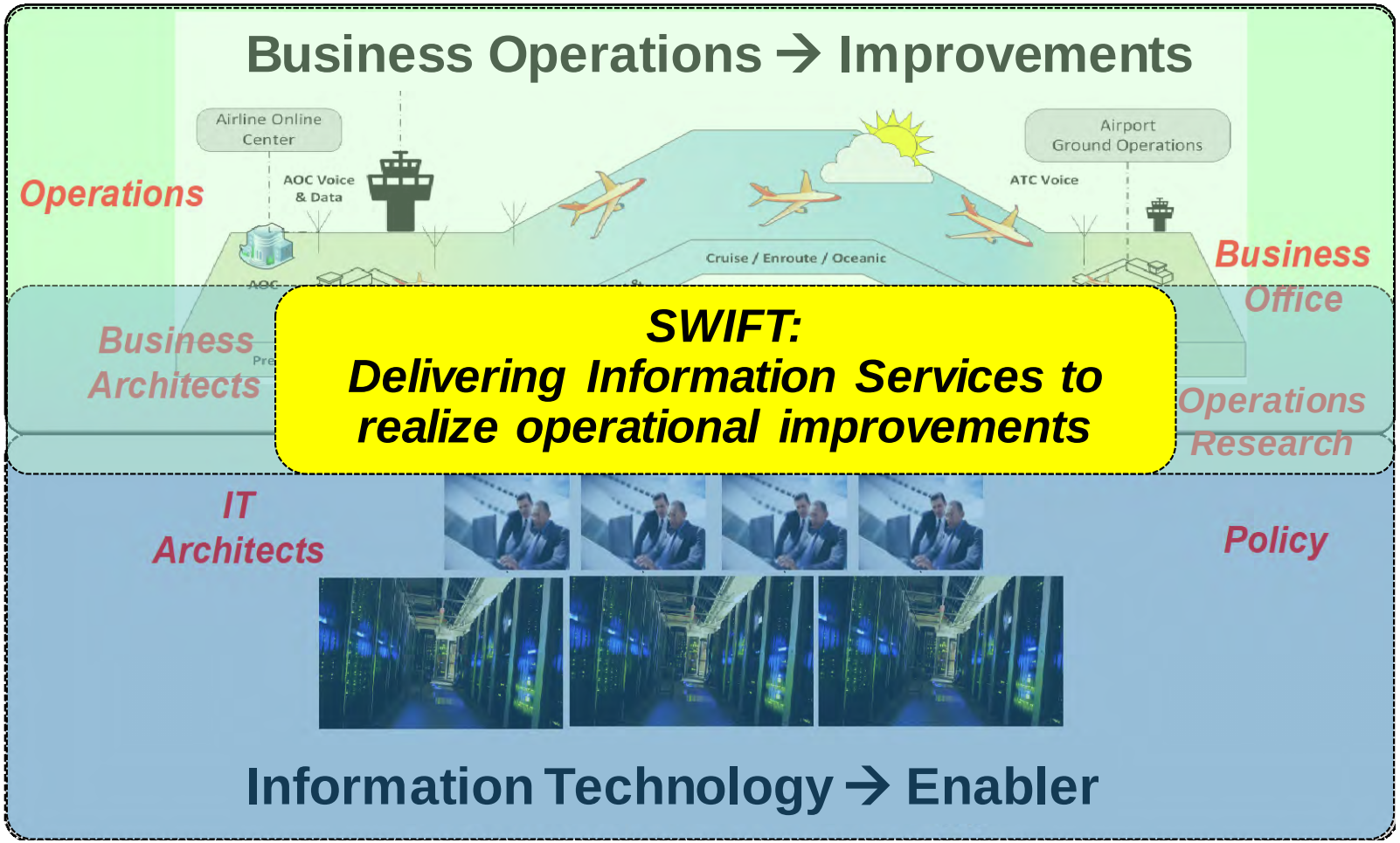
- **SWIFT addresses industry recommendation to:**
  - Establish a community forum that acts as a single environment for collaborative engagement around NAS information and data sharing
  - **Communicate**: Inform community about SWIM and NAS programs
  - **Educate**: Synchronize community on information services
  - **Stimulate**: Openly discuss issues most relevant to community
  - **Collaborate**: Structured as a workshop to drive sharing information

- **Industry partners**
  - Subject matter expertise in airline, airport or FAA operations, processes, procedures and related systems
  - Open to public: meeting notes, presentation material posted on a publicly accessible web site.
  - Anyone can join, anyone is invited.

Aligning Common Terminology



Technology: Enabling Operational Improvements



SWIFT Meetings: Typical Workshop Agenda

- **Quarterly meetings to present updates on:**
  - Focus Groups
    - FAA and industry subject matter experts meet monthly to collaborate in addressing clearly scoped items
    - Develop Operational Context and Use Case documentation to help explain the operational uses of the various SWIM services
  - Airspace User Case Studies
    - Current problems and how they could be addressed by SWIM information
    - Progress using SWIM information in operations
  - SWIM Producer Programs
    - New capabilities/information services
  - Special Topics
    - Topics of interest related to Information Exchange: e.g., SWIM cloud, international SWIM harmonization, etc..

SWIFT Updates

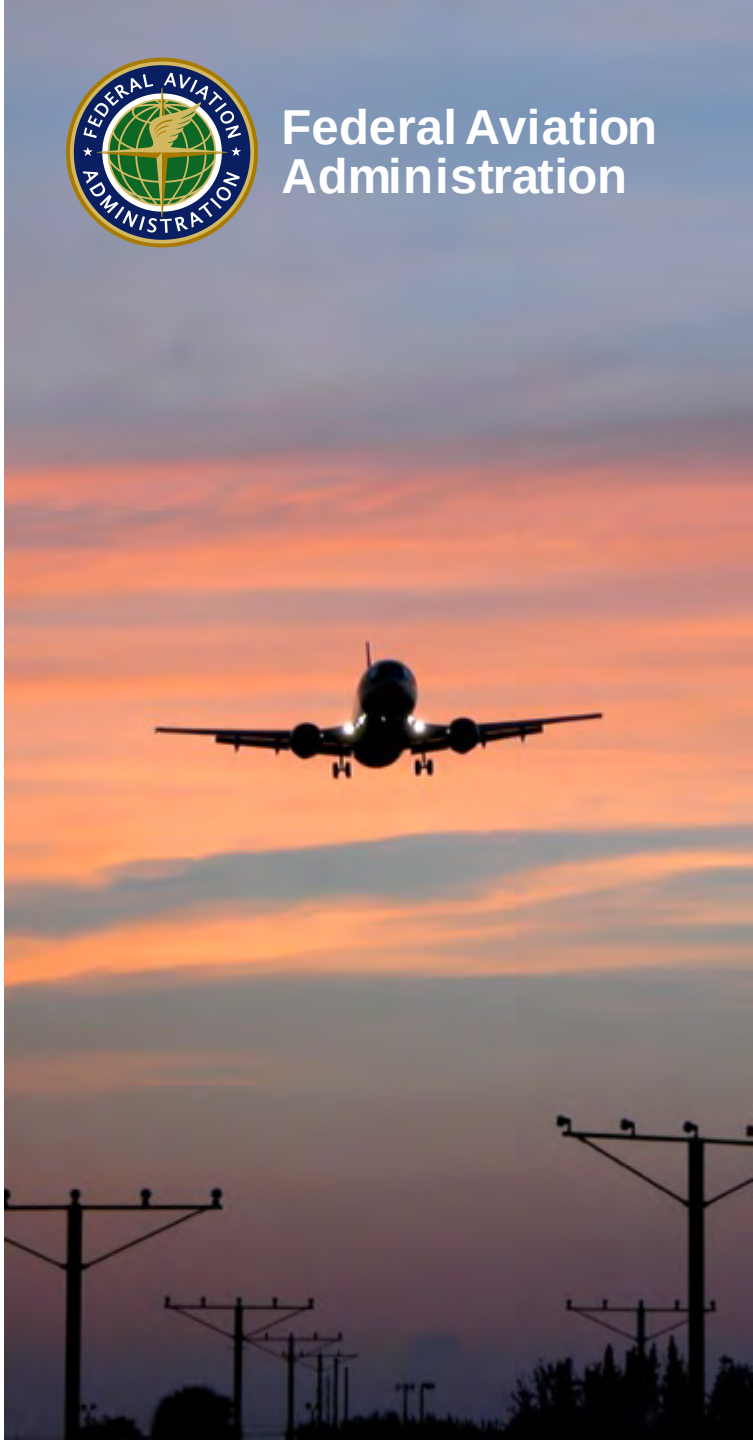
Program Updates

David Almeida

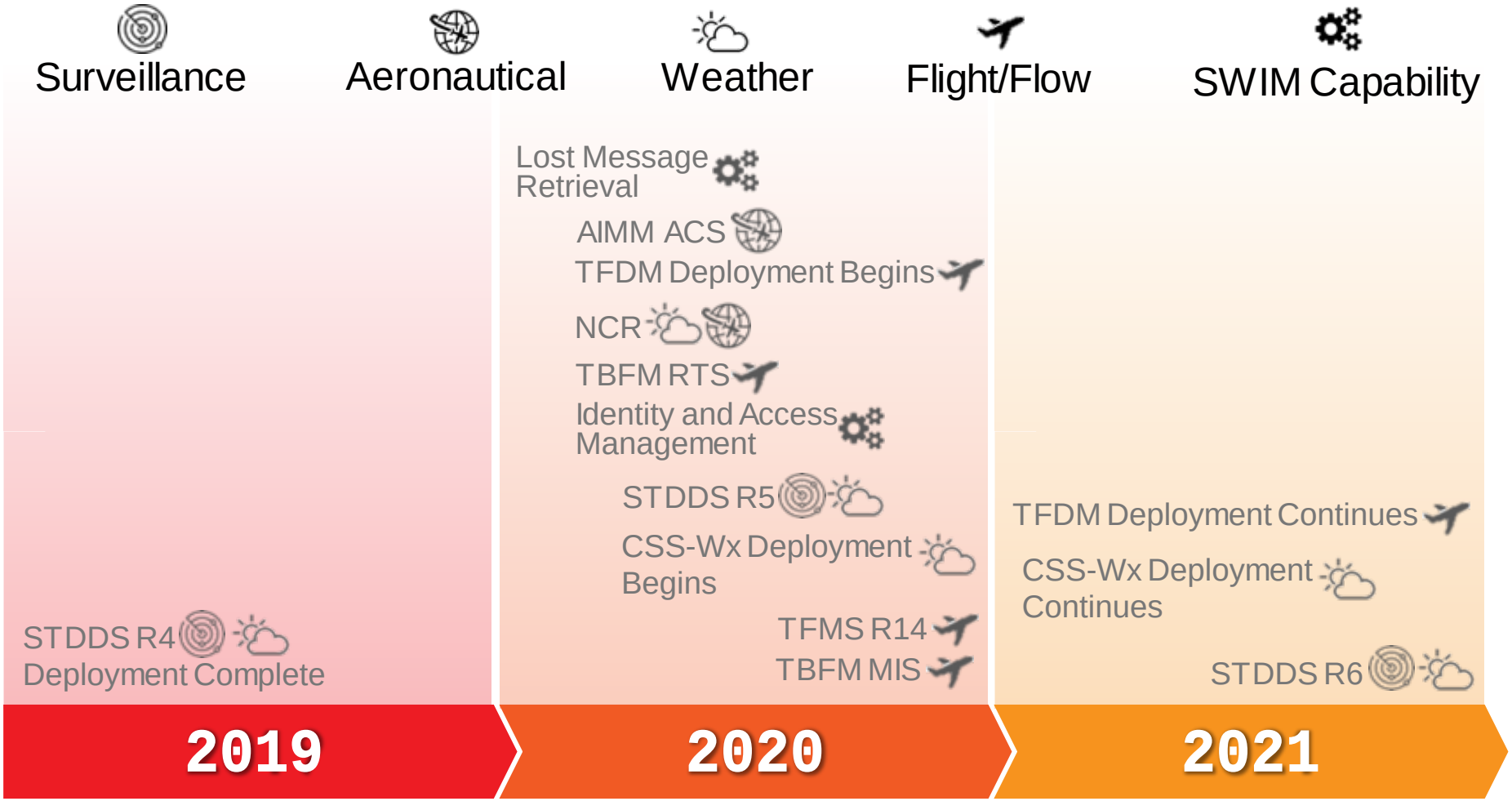
SWIFT Community Moderator

August 8, 2019

Federal Aviation Administration



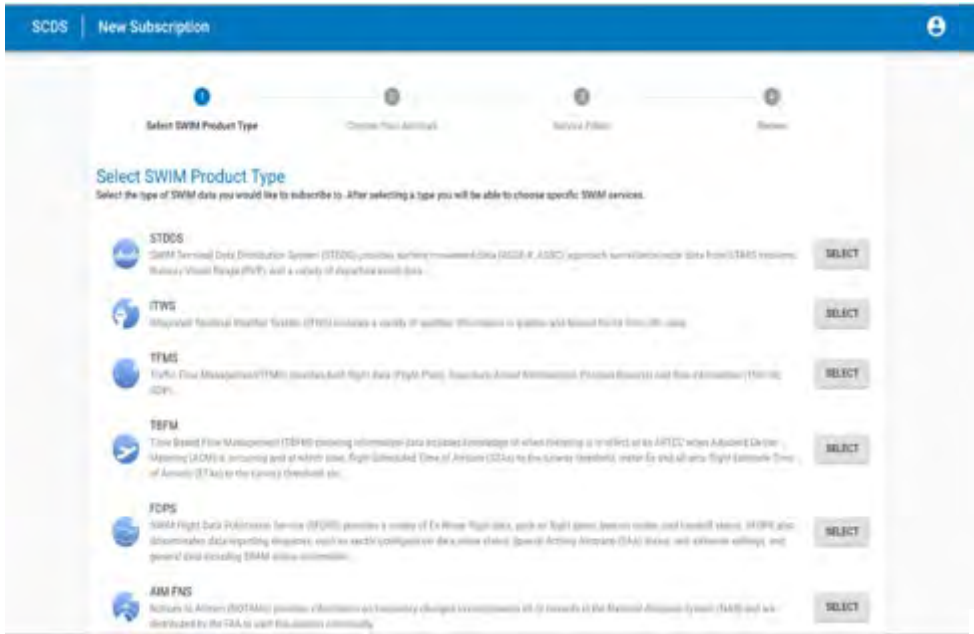
SWIM Planned Deployment Roadmap

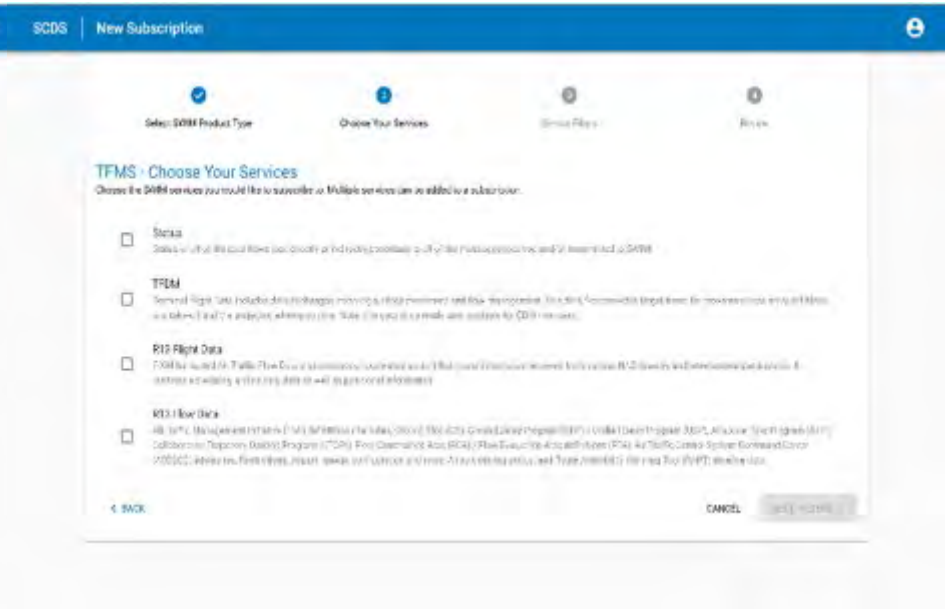


*Calendar year dates, subject to change

SWIM Cloud Distribution Service (SCDS)

SCDS is a publicly accessible cloud-based infrastructure dedicated to providing real-time SWIM data to the public via Solace JMS messaging. This service will include access to the same publicly available data that is currently offered via the NAS Enterprise Service Gateway (NESG) SWIM implementation.





Why SCDS?

1. Primary SWIM Access Mechanism

SCDS is the new SWIM Service for external consumers that provides access to the same publicly available data on the NESG

2. Improved User Experience

SCDS provides an enhanced user experience offering self-registration, self-provisioning and advanced filtering capabilities

3. Additional Benefits

SCDS provides benefits such as newly available metrics/statistics and provides security through standard encryption (and therefore does not require a VPN connection) or service acceptance testing

SCDS Experience

Self-service Provisioning: Ability to create connections in real time

Help Desk Support: Dedicated Help Desk

Service Management: Fine-grained filtering ability

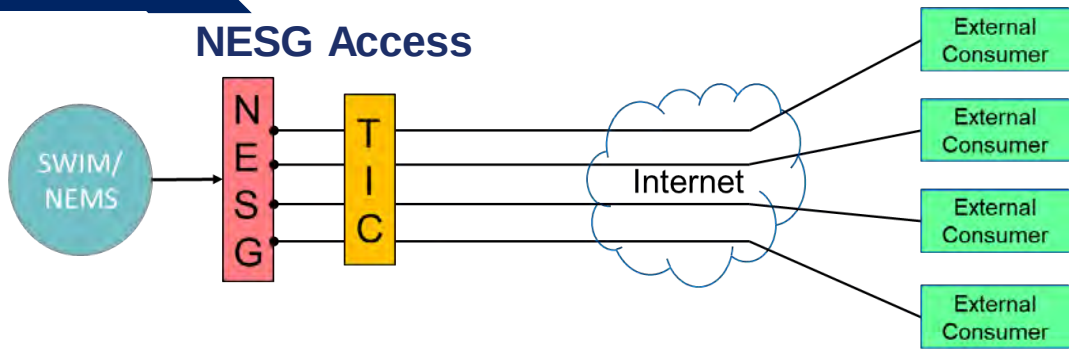
Managed Failover: Redundant connections and cloud technology, to create a reliable environment

Subscription Level Metrics: Detailed view of message rates, bandwidth and other metrics

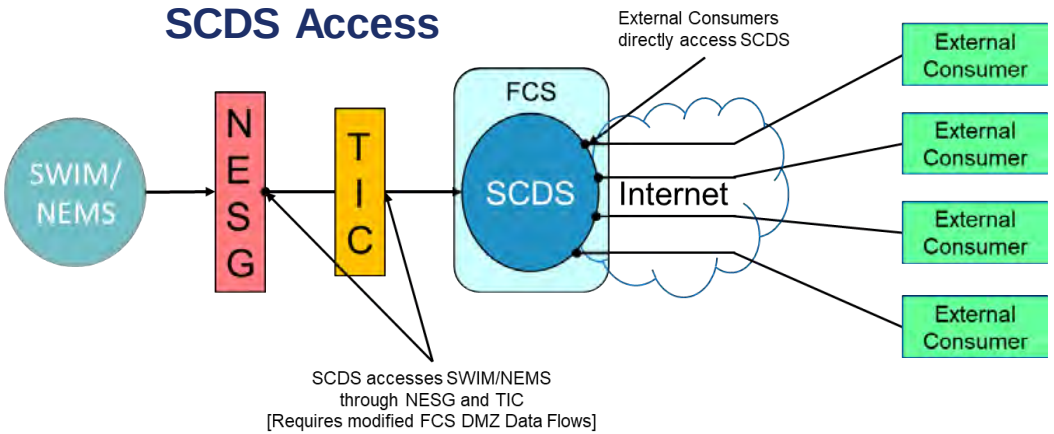
Security Controls: Utilizes TLS connection technology

SCDS Architecture

- Cloud-based infrastructure that provides near real-time SWIM data
- Sustained success of SWIM has led to continued growth of SWIM users
- Increased demand combined with larger data sets leading to costly network and system upgrades
- Over 170 VPN connections to NESG from non-government sources

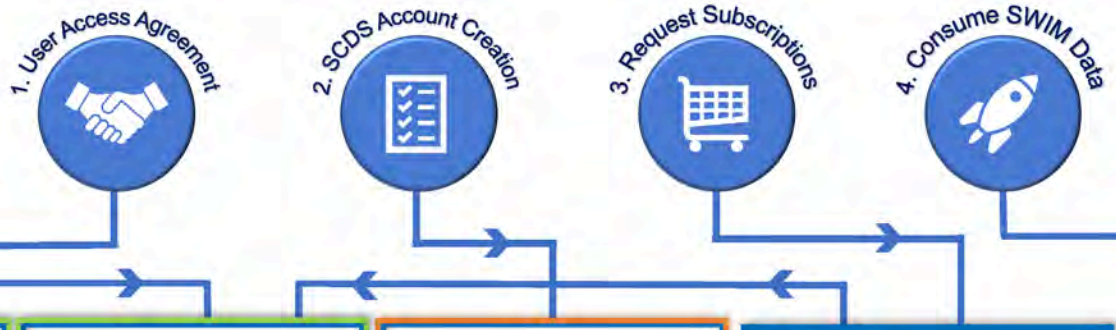


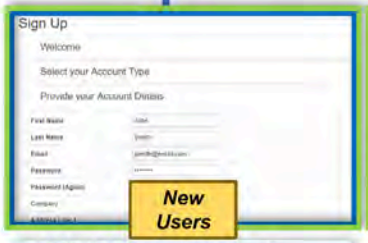
Each external consumer connects directly to SWIM enabled NESG using a VPN connection



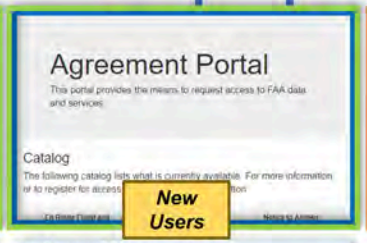
SCDS becomes a single external consumer collapsing many VPN connections into one

On-Boarding Process for SCDS Users

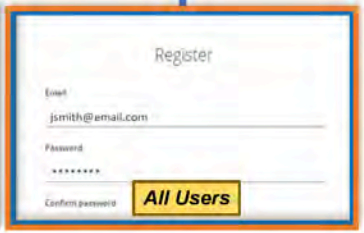




- **FAA Data Access Account** Create an account on the FAA agreement portal https://data.faa.gov/data/register.jsf



- **Access Agreements** Complete the Access Agreements for the SWIM JMS services to be consumed via SCDS https://data.faa.gov/



- **Create an SCDS account** https://scds.swim.faa.gov
- **Registration** Complete the form and click "REGISTER."
- **Update your account information** then click "SUBMIT."
- **Email verification** An email will be sent to the address provided on the previous page. Please validate the email address and click "SIGN IN."
- **Email confirmation** You will be taken to a page notifying you your email has been verified. Click "Back to Application."

- **Subscriptions** Once logged in, you will be taken to the subscriptions page. From here, you can create new subscriptions and view subscription metrics.

Subscriptions will only be approved for those services that have a corresponding signed Access Agreement.

- **Current NESG Users Migrating to SCDS** Create your subscriptions based on the list of your current NESG subscriptions provided to you at the beginning of your on-boarding

- **Filters** Set up your data filters, multiple filters can be applied for one feed
- **Approvals** Subscription requests are reviewed, approved within 72 hours of request and then provisioned automatically
- **Consume SWIM Data** Connect your consumer application to your approved SCDS subscription(s) and consume SWIM data

New Users: 90 Day window for on-boarding

New Users of SWIM data must start at Step 1 "User Access Agreement"

Current Users: 90 Day window to on-board and disconnect from NESG

Current NESG Users migration to SCDS begin on Step 2 "SCDS Account Creation"

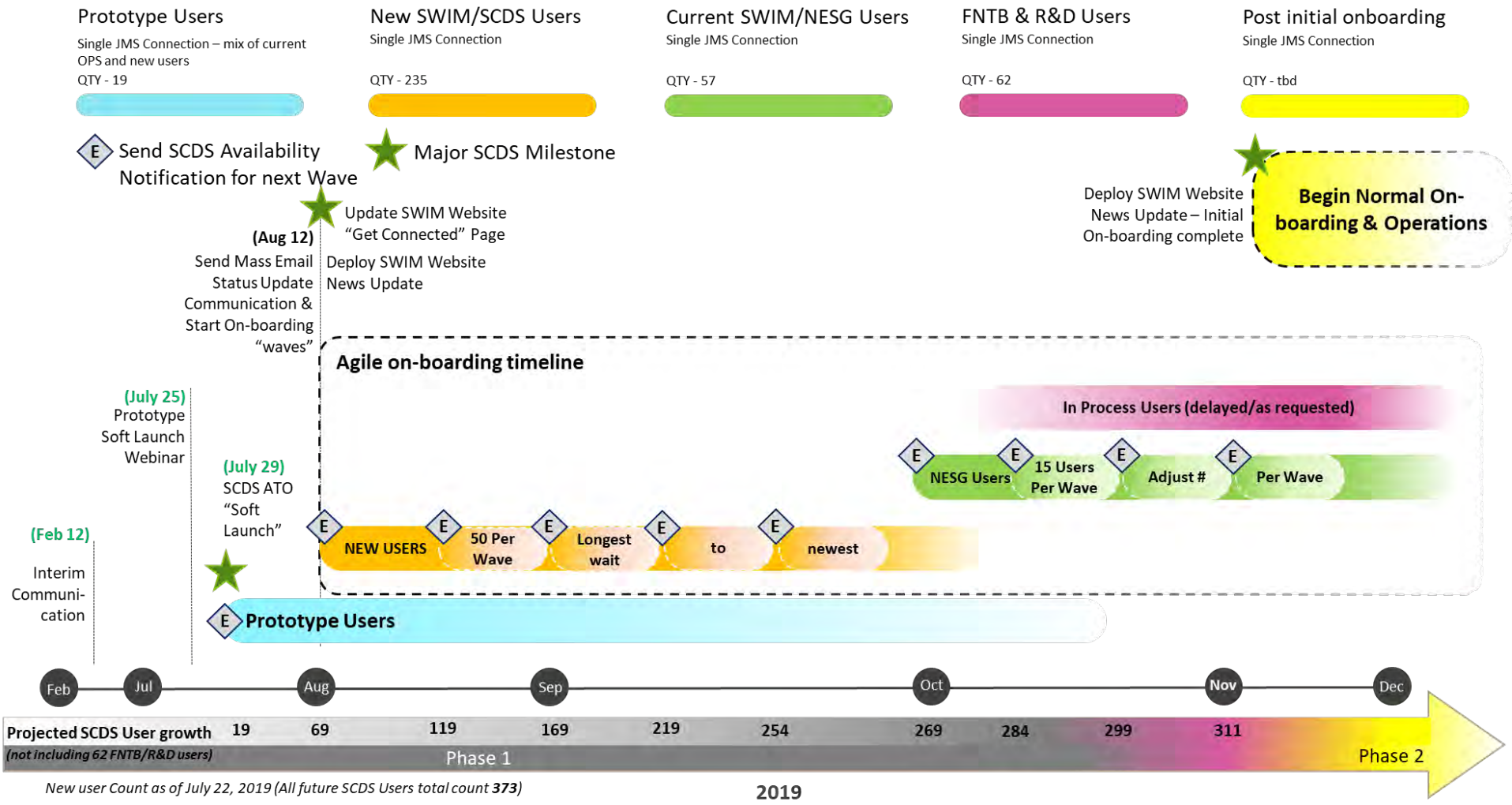
SWIM SCDS Helpdesk Contact Information

- Enterprise Control Center (ECC) Contact Information:
- 855-FAA-NEMC (855-322-6362)
- Use option 3 for Enterprise Services then 1 for SWIM Services (24/7/365)
- 9-ATO-SECC-OPS@faa.gov

Please identify yourself as an SCDS user

Note: The FAA recommends Chrome or Firefox when accessing SCDS

SCDS Agile On-Boarding Plan



Contact Information

For information on SWIM, visit the SWIM website:

https://www.faa.gov/air_traffic/technology/swim/

Register for our next SWIM Users Forum:

https://www.faa.gov/air_traffic/technology/swim/users_forum/

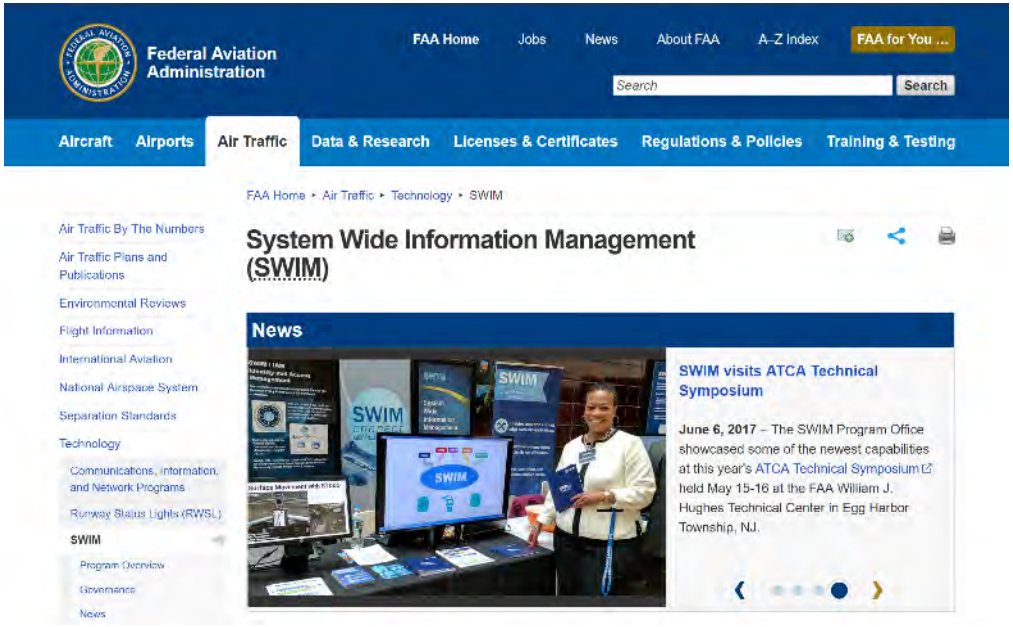
Or contact us via email:

General SWIM Questions

SWIM@faa.gov

SCDS Specific Questions

SCDS@faa.gov



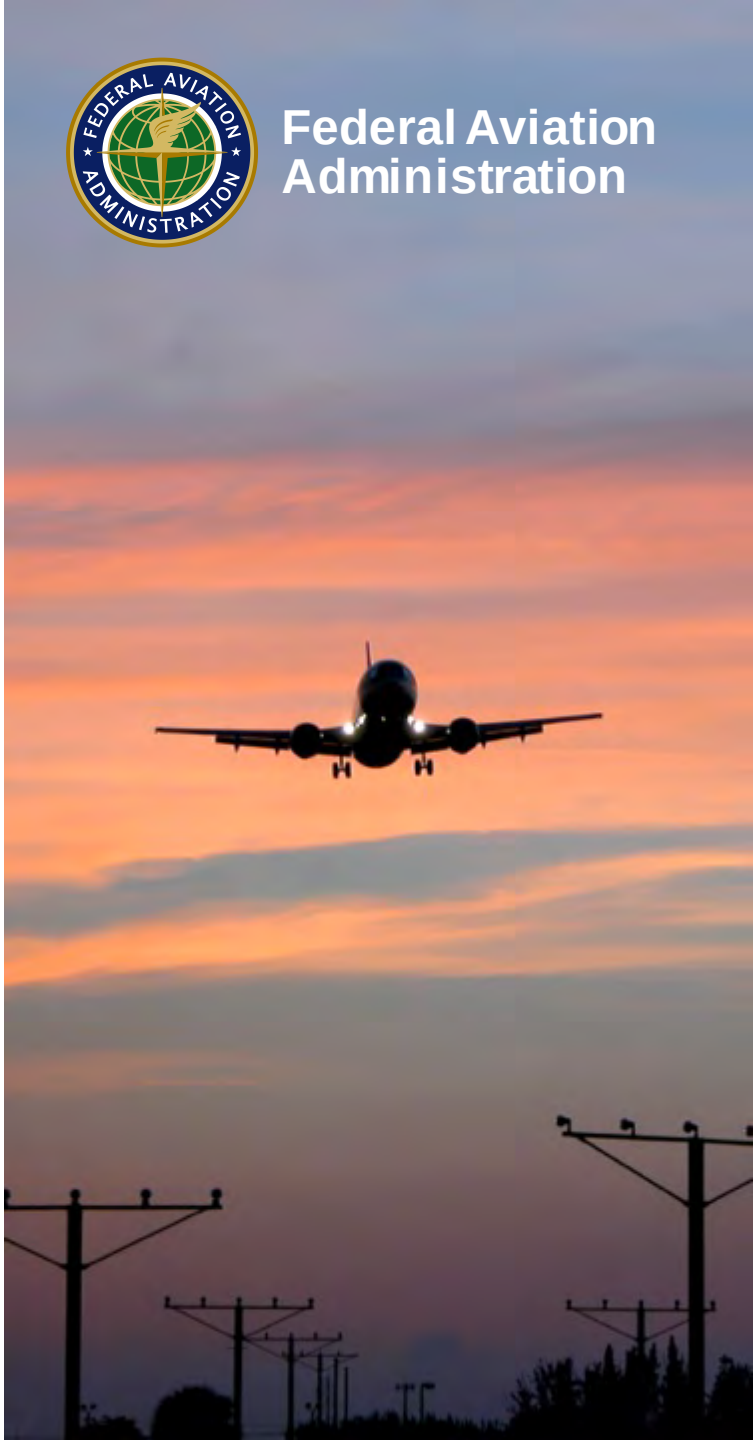
SWIFT Focus Group: Operational Context & Use Case Documents

Update on Focus Group

Jay Zimmer, LS Technologies

August 8, 2019

Federal Aviation Administration



Operational Context Documents

- **Document Progress**
  - STDDS – SMES — DELIVERED — UPDATED
  - TFMS Flow — DELIVERED — UPDATED
  - TFMS Flight — DELIVERED — UPDATE IN PROGRESS
  - TBFM – MIS — DELIVERED
  - SFDPS – Flight — DELIVERED
  - SFDPS – Airspace — DELIVERED
  - STDDS – TAIS — DELIVERED — UPDATED
  - FNS-NDS — DELIVERED
  - ITWS — DELIVERED
  - STDDS – TDES — DELIVERED
  - STDDS – APDS — DELIVERED
  - DCNS – DLD — DELIVERED
  - TFMS Status — DELIVERED
  - SFDPS General — UNDER REVIEW
  - STDDS – ISMC — IN DEVELOPMENT

- **Stable Document Format**
  - Document template/style has been static since SWIFT #4
    - Added references to supporting documentation
    - Added data element descriptions, formatting and restriction information
    - Consistent document naming convention on SWIFT portal
    - Documents have successfully clarified how these systems work and how individual data elements relate to specific real-world activities

Operational Context Document Template

1. Introduction

- Briefly describe purpose of document
- Briefly describe the FAA systems with which the information service interfaces and what type of information it publishes

2. Domain System Description

- In depth discussion of internal FAA systems that create the data ingested and published by the information service
- References to additional information (e.g., ConOps, JMSDD, ICDs)

3. Information Service Overview

- Describe how the FAA system data interfaces with, and is published by, the information service
- Describe each message published by the information service

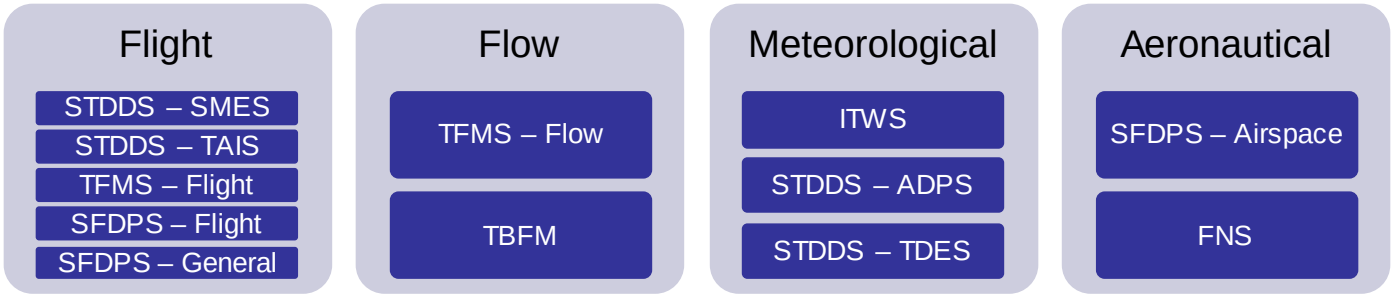
4. Information Service Message Types

- In depth description of XML structure and each data element
- Includes data formats and examples of populated data elements, as needed

Appendix A: Acronyms

Use Case Documents

- **Document Progress**
  - Individual Information Service Documents
    - STDDS – SMES DELIVERED
    - TFMS Flow DELIVERED
    - TFMS Flight DELIVERED
    - TBFM – MIS DELIVERED
    - SFDPS – Flight DELIVERED
  - Domain Information Service Documents
    - Flight Domain DELIVERED
    - Flow Domain DELIVERED
    - Meteorological Domain DELIVERED
    - Aeronautical Domain DELIVERED
- **Updated Document Format**
  - Focus Group decided to group information services by domain and only draft use cases for flight, flow, meteorological and aeronautical domains



Domain Use Case Document Template

1. Introduction

- Purpose of document
- Description of SWIM information services to be addressed
- Discussion of how the data provided by these information services will be used in an operational context and the phase of flight with which the services will apply

2. Current State

- Problem statement describing issues/inefficiencies with current operations
- Perspectives/roles of operational decision-makers
- Current state operational example describing a specific end-to-end flight and how operations would proceed under a given set of constraints

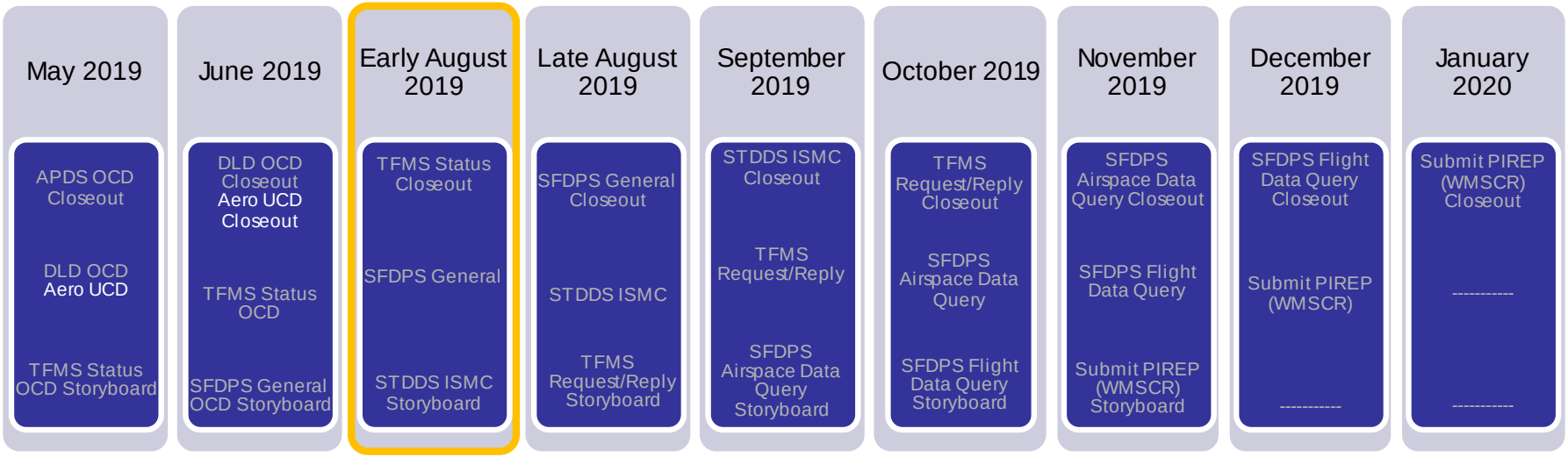
3. Future State

- Future state operational example describing a specific end-to-end flight and how operations would proceed under a given set of constraints with the addition of SWIM information for more informed decision-making
- Benefits describing increased efficiencies gained by SWIM information
- Conclusions

Appendix A: Acronyms

Current Document Schedule

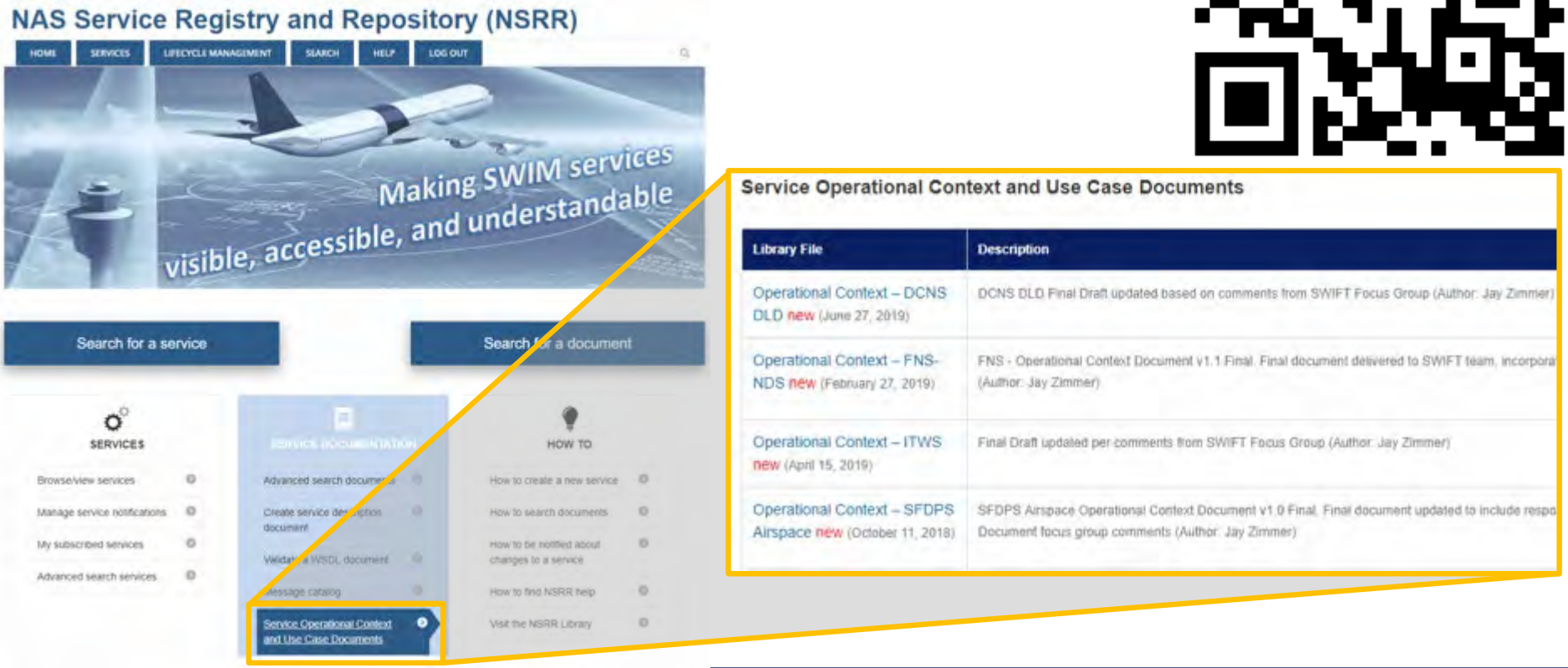
***OCD** – Ops Context Document, **UCD** – Use Case Document



- **In June 2019 delivered final Use Case document, Use Case Focus Group will be suspended unless new services require documentation**
- **Will begin addressing Request/Reply services in late August**
- **Schedule subject to change if service updates are released and existing Operational Context documents need to be updated**

SWIFT on the NSRR

- **NAS Service Registry and Repository (NSRR) is the FAA registry of detailed information about all existing and planned SWIM-enabled services**
- **Link to all SWIFT Operational Context and Use Case documents is now included on the main page of www.nsrr.faa.gov**



SWIFT Documentation

- **In addition to the NSRR, all SWIFT Documentation can also be found at:**
  - https://connect.lstechllc.com/index.cfm/main/swifthome

Next Steps: Operational Context & Use Cases

- **Awaiting feedback on:**
  - SFDPS General Operational Context
- **In development:**
  - STDDS Infrastructure System Monitor and Control (ISMC) Operational Context Document
- **Harmonizing Operational Context Documents**
  - Continue to retroactively update older documents to new template (TFMS Flight)
  - Continue to retroactively update older documents as they are reviewed by producer programs

Interested in the SWIFT Focus Groups?

- **For more information please contact**
- **Jay Zimmer, SWIFT Focus Group Lead**
  - Phone: (703) 963-4979
  - Email: jay.zimmer@lstechllc.com

Leveraging SWIM to Improve Operations

United Operations Analysis

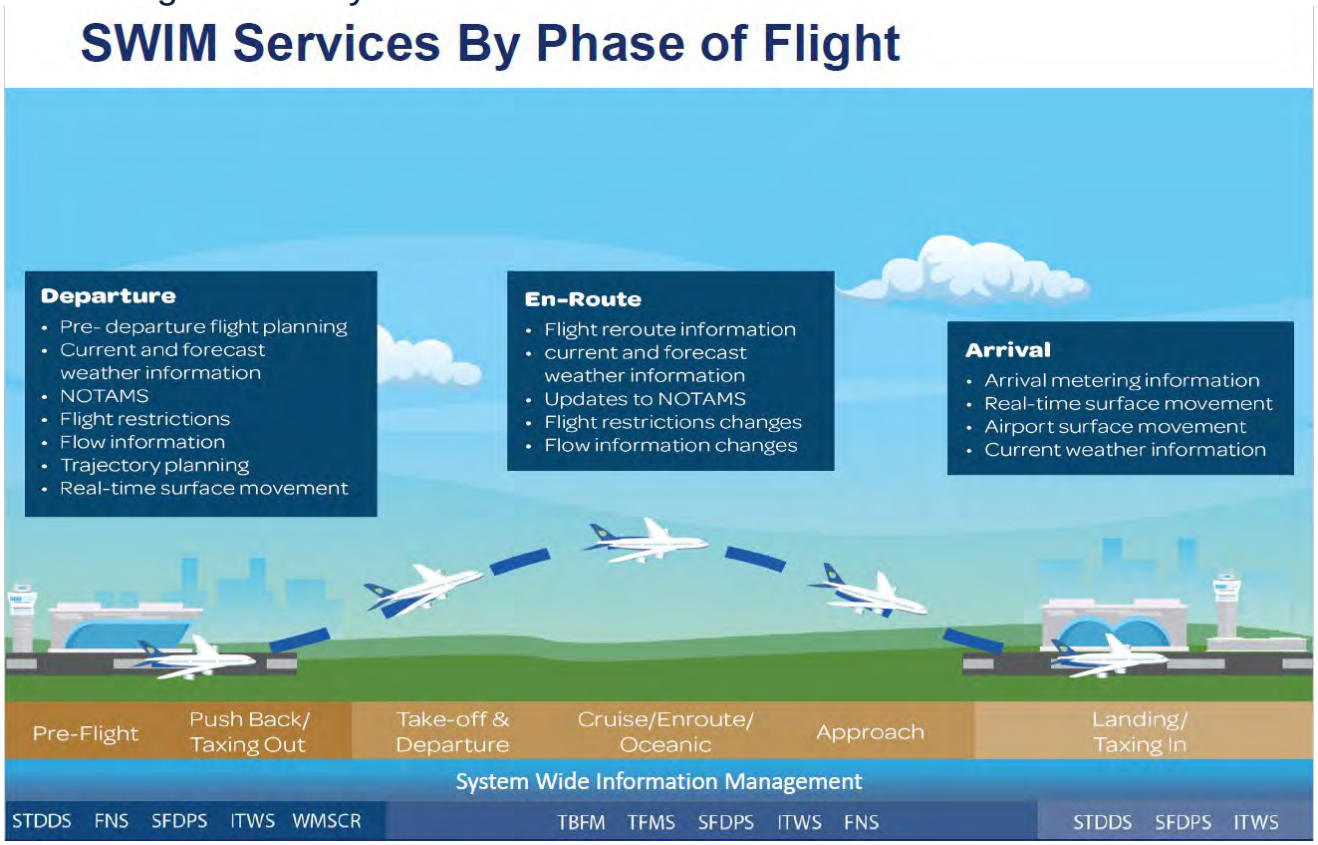
August 2019

A STAR ALLIANCE MEMBER

UNITED

SWIMming with United

- United's SWIM evolution
- Currently swimming in data pools that touch all phases of flight
- SWIM SteerCo – request overload and prioritization effort underway
- Many successes are attributable to connection with the SWIFT – THANK YOU!
- Still much, much to learn – specifically lessons learned from ATD-2/TTP Final TFDM interface documentation, importantly ***substitutions***
- Data – what's missing? – we only know what we know



What's Missing – Vignette

Executive Summary

- **Environment**: ATC programs are initiated by the FAA, managed within an airline AND by FAA, and often influenced or affected by DOT Rules and policy

- **Problem**: We lack access to real-time information on TBFM program settings and parameters that drive a variety of different TBFM applications. Without these data, carriers are unable to:
  - Understand or measure the actions being taken that generate the impact to their flights
  - Assess potential airline-driven solutions
  - Inform potential areas for improvement to program parameters, applicability, or scenarios where playbook or policy modernization is needed to account for the NextGen Deployment

- **Operational/Economic Impact**:
  - Limited visibility into TBFM program parameters, particularly at highly congested airports, results in airlines having little control over their own destiny.
  - Lack of visibility in TBFM in conjunction with scenarios where metering times are regularly above :30 results in flights being delayed frequently enough to make the Chronically Delayed Flight Watch list with no option for substitution.

- **Goal**: Improve access to the program parameters used in TBFM in order to inform airline's ability to work around the restriction, inform refinement of the way the tool is used, and ultimately modernize our National Playbooks to reflect the use and applicability of the new technology, particularly when used in combination with legacy TMIs.

Subbing into a metering delay and the broader implications

Scenario: There are a variety of TMIs in place in the NEC, Wash Mets, and Chicago

Flight UX123 operates from RIC to EWR at 19:45L and is on the CDF watch list for the fourth month. In order to preserve the flight we must protect the three segments prior to UX123 via substitutions in each program throughout the day. Three undesirable subs are necessary on the previous segments to tee up UX123 for success.

While departing RIC, flight UX123 was subbed with UA345, which has 50 more pax on board than UX123. UX123 pushes back for departure on time and is issued a TBFM metering EDTC for 20:30, thereby making it impossible for the flight to meet the Rule.

Without access to TBFM settings there is no way to study or measure know whether the TBFM application in combination with other TMIs is indeed the right thing for the NAS.

This occurs every single day at a handful of highly congested airports.

Prior Months	Next Carrier	Next Flt Num	Next Sch Dprt Time	Origin	Dest	MTD Ops.	Total Sch. Ops.	Current A30	Needs	Req. A30	Last 7 Flights Arrival Minutes (or Cnxl) 1	2	3	4	5	6	7	Best A30	Worst A30
4	C5	4929-7	19:45	SYR	EWR	5	16	20%	7	64%	C/XU	14	C/TA	124	39	C/XA	C/XA	75%	6%
4	C5	4969-7	20:30	DCA	EWR	5	26	0%	13	62%	C/XA	96	68	153	158	C/XA	24	81%	0%
4	C5	4989-7	19:30	SDF	EWR	6	31	33%	14	54%	157	-18	89	29	40	51	C/XA	87%	6%
4	EV	4455-7	18:15	SA										-1	C/XA	177	83	93%	11%
3	EV	3966-7	18:40	CL										148	42	C/XU	120	81%	0%
3	EV	4257-7	21:00	EWR	CLE	5	26	0%	13	62%	C/XU	73	112	114	56	C/XU	111	81%	0%
3	C5	4938-7	18:30	EWR	DCA	5	26	0%	13	62%	C/XA	121	74	179	175	C/XA	130	81%	0%
3	C5	4902-7	17:10	MEM	EWR	6	30	17%	14	58%	C/XA	18	64	90	76	51	C/XU	83%	3%
3	C5	4888-7	21:59	EWR	BUF	5	26	20%	12	57%	0	92	-25	92	91	C/XF	C/XA	85%	4%
3	UA	503-7	20:55	EWR	DFW	5	26	20%	12	57%	130	0	43	93	94	C/XA	584	85%	4%

You can't manage what you can't measure!

SWIM offers new opportunities for post-event operations analysis

- Novel data available via SWIM is empowering our analysts to better understand operational challenges and uncover opportunity
- At IAH, dispatch and ATC staff noticed consistent metering delays on east-bound arrivals
- Leveraging SWIM data, analysts identified and addressed cause of the delays
- Applied takeaways to the system using SWIM

United has developed a SWIM data-lake

Purpose of the data-lake is to ensure fidelity of the data, ease of access and processing speed

SWIM / FAA

- TBFM
- TFMS
- ITWS
- FDPS

Data Processing / Parsing

- Cloud based platform
- Flattening and parsing of SWIM topics

- Analysts access data in the cloud
- Easily shared across the enterprise

IAH inbounds from west experienced increased delays

GUSHR3
RIICE8
SUUNR TTORO3

- United noticed increased inbound delays manifesting in longer flight times and ultimately lower Arrival On-Time 00
- Local FAA confirmed the issues in the northwest corner post
- Increased schedule from our west coast stations drove the issues

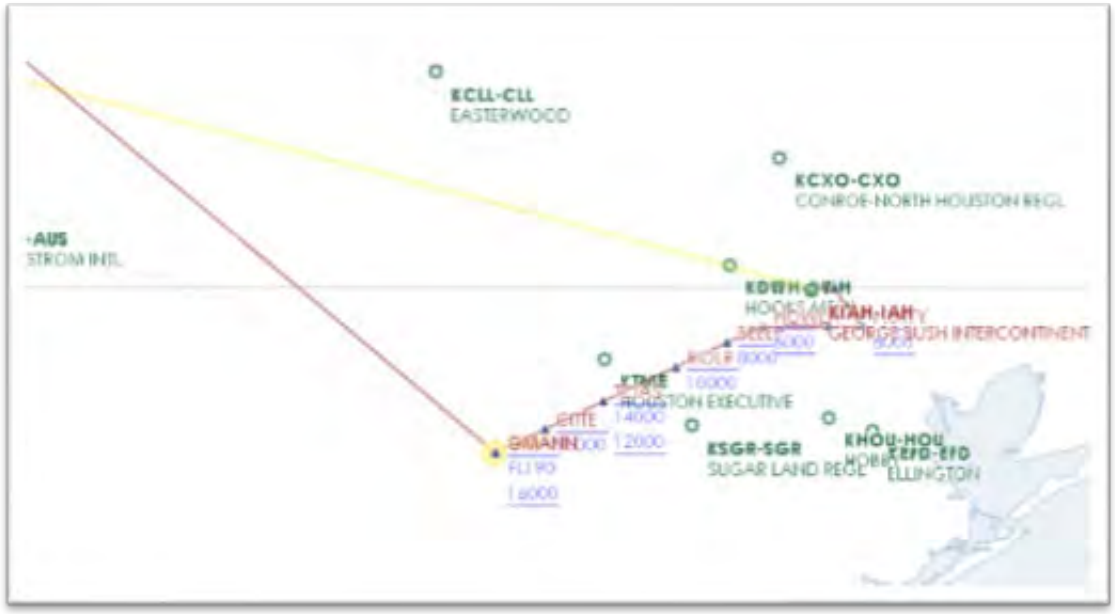
Access to SWIM operational data has enabled new analysis

4/7/2019 Sunday

			NW			NE		SW	SE	
Start	End	Total	MPORT	SUUNR	RIICE	DOOBI	ZEEKK	GMANN	LINKK	WOLDE
12:00	12:15									
12:15	12:30	2				1		1		
12:30	12:45	2	1			1				
12:45	13:00	18	3	1		3		1	10	
13:00	13:15	21	5	2		3	3	2	6	
13:15	13:30	14	8			1	2	1	2	
13:30	13:45	8	6			1	1			
13:45	14:00	1	1							
14:00	14:15	3	1	1		1				
14:15	14:30	4		1		2			1	
14:30	14:45	3	1						2	
14:45	15:00	12	1			1	1	3	6	
15:00	15:15	16				5	3	1	7	
15:15	15:30	17	2			9	1	2	3	
15:30	15:45	14	3	2			3	1	5	
15:45	16:00	9	3	2		2			2	
16:00	16:15	1	1							
16:15	16:30	2				2				
16:30	16:45	5	1	1		2			1	
16:45	17:00	5	1	2		1		1		
17:00	17:15	1				1				
12:00	17:15	158	38	12		36	14	13	45	

NW approach

With the data from SWIM we are able to optimize the arrival peaks



- Fix balance west coast departures across SW corner
- Increases a flight time but reduces the overall delay we observe

Access to SWIM data enabled incremental operational improvement at IAH; potential to apply same analysis and strategy to other hubs using SWIM

A STAR ALLIANCE MEMBER

UNITED

BREAK

DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.

NBAA

NBAA Case Study: Refining Airspace Restrictions with SWIM

August 8, 2019 | Denver, Colorado

Ernie Stellings

Executive Summary

Environment:

- Many NBAA operators are caught in Airspace Flow Programs (AFP) when they are overflying areas with no plans to descend, so they receive unnecessary restrictions
  - –Common in ZJX on southbound flights to Caribbean, ZOB/ZNY on eastbound flights to New England
- ZJX ATC is aware of the situation but unable to issue waivers to only high-altitude overflights due to airspace design (only 1 altitude block in higher en route sectors)
- ZNY has both low and high-altitude en route sectors
- NBAA members vary in size and lack access to pertinent NAS data (OIS, etc.) in a mobile delivery mechanism

Problem statement:

- No clear tools available to help traffic managers determine if overflights should be captured in AFP initiatives when landing in more distant areas than the constrained area

Executive Summary (Cont'd)

Impact:

- If it can be proved that delayed overflights are a common problem across user groups, it may be beneficial to amend AFP procedures in ZNY, potentially other airspaces with similar issues
- Depending on top of altitude where flight are exempt, for example, an AFPs at FL120-FL380 would also benefit some of the air carriers who operate above that on overflights.
  - In essence, by removing NBAA flights/higher air carrier flights, the AFP delays are less for all operators due to less demand

Goal:

- Use SWIM data to resolve how common it is for overflights to be caught in AFPs and unnecessarily delayed
- Use CDM processes to make ZNY aware of the issue and see if it can be ameliorated

Problem Description

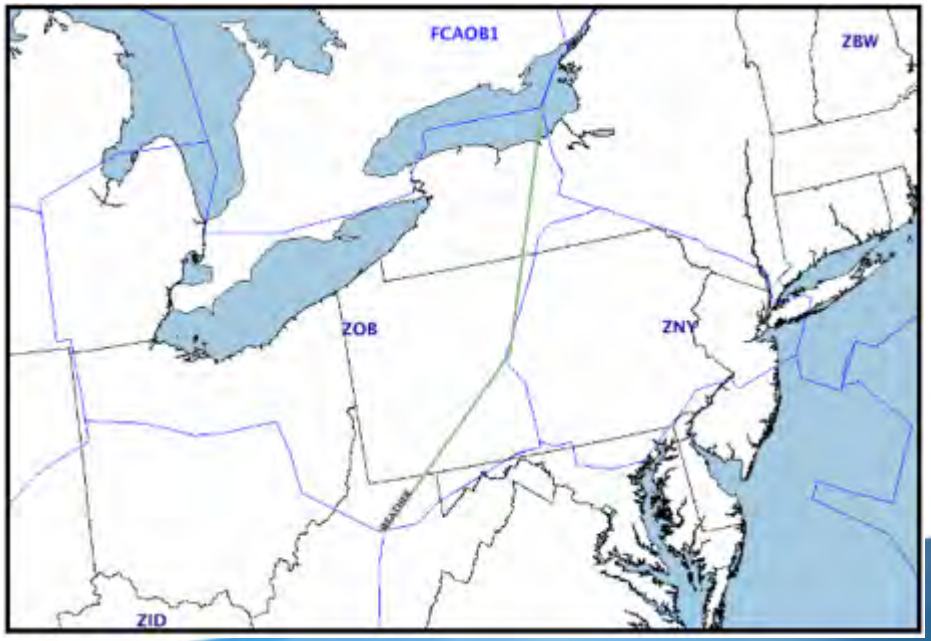
- ZOB/ZNY AFPs include traffic restrictions for overflights at higher altitudes that are landing outside of ZOB/ZNY
- Can we use SWIM data to show restrictions can be refined to lower altitudes to avoid overflights that are adversely impacted?
- Metrics: Minutes saved per program, time savings for members (loss of efficiency), arrival airport resources (i.e., logistical problems, like Limo Services; potentially qualitatively)

ATCSCC Advisory

ATCSCC ADVZY 029 FCAOB1 06/06/2010 CDM AIRSPACE FLOW PROGRAM

MESSAGE:
CTL ELEMENT: FCAOB1
ELEMENT TYPE: FCA
ALTITUDES INCLUDED: FL120 TO FL600
ADL TIME: 1425Z
DELAY ASSIGNMENT MODE: DAS
ENTRY ESTIMATED FOR: 06/1700Z - 07/0259Z
CUMULATIVE PROGRAM PERIOD: 06/1700Z - 07/0259Z
PROGRAM RATE: 90/90/95/95/100/100/100/100/100/100
POPUP FACTOR: 6/6/6/6/6/6/6/6/0/0
FLT INCL: ALL FLIGHTS IN FCAOB1 DYNAMIC FLIGHT LIST
DEP SCOPE: (ALL) ZAB ZSE ZFW ZKC ZME ZTL ZOA ZLC ZLA ZAU ZMP ZDV ZID ZMA ZHU ZJX ZBW ZOB ZDC ZNY
CANADIAN DEP ARPTS INCLUDED: NONE
MAXIMUM DELAY: 104
AVERAGE DELAY: 43
IMPACTING CONDITION: WEATHER / THUNDERSTORMS
COMMENTS:

EFFECTIVE TIME: 061429 - 070359
SIGNATURE: 10/06/06 14:30



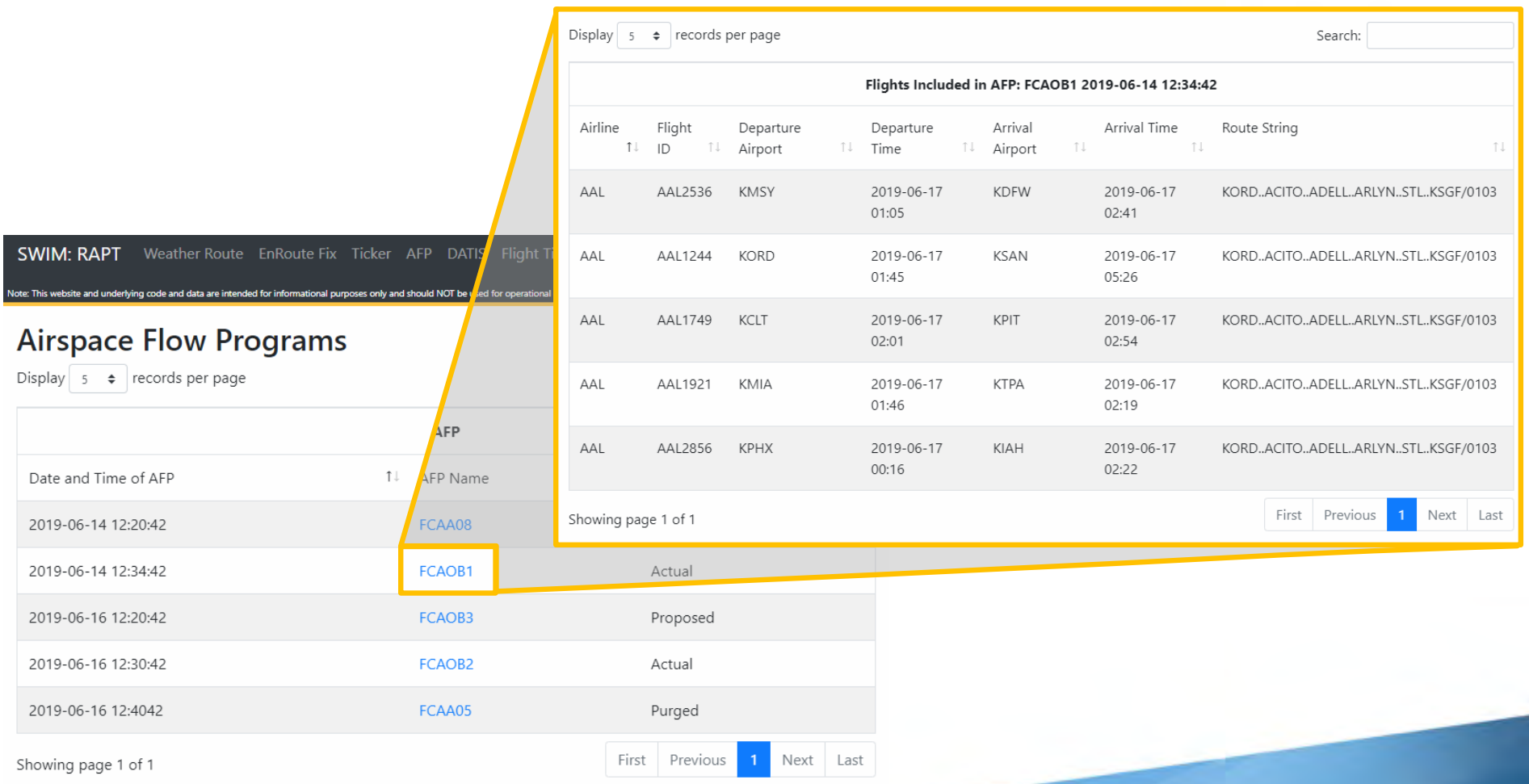
Study Methodology

- Record flight data for days with ZOB/ZNY AFPs
- Identify flights that do not descend in ZOB/ZNY
- Analyze route strings/altitudes to identify the where ‘non-descending’ flights operate
  - “Are there common routes where this situation commonly occurs?”
- Identify flight stratums/locations where majority of flights are overflights that receive unnecessary restrictions
  - “If my flight is at X altitude above Y fix it always gets hit with this delay unnecessary so what can I do about it?”

Widget Development to Support Study

- Ingest AFP data from Traffic Flow Management System (TFMS)
- Include TMI Flight List, which lists all flights affected by an AFP
- TMI Flight list includes flight ID, departure/arrival airports, but not the filed route of flight
- Cross reference TMI Flight List with SWIM Flight Data Publication Service (SFDPS) flight plans/track data to identify filed routes of each flight
  - –SFDPS and TFMS both include the ERAM GUFI, so flights can be linked across services
- Database can also be queried directly to identify additional patterns

Widget Development to Identify Affected Flights



Post-Study Solutions

- If study can prove unnecessarily delayed overflights are a systemic problem, conclusions can be used improve CDM options
  - Direct negotiation with ZNY/ZOB for specific flights/altitudes for tactical flight management
  - Reduce ceiling of AFPs so high altitude flights are not restricted/throughput restricted
  - Exempt flights landing outside of ZOB/ZNY or ARTCCs that do not require descent in ZOB/ZNY (e.g., eastbound to New England)
  - Modify shapes of AFPs to allow a track for overflights

NBAA

DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.

National Business Aviation Association 1200 G Street NW, Suite 1100 Washington, DC 20005 (202) 783-9000 www.nbaa.org

General Aviation Departure Readiness Time Submission Using Mobile Technology

Presented by Ernie Stellings, NBAA Air Traffic Services

NBAA
NATIONAL BUSINESS AVIATION ASSOCIATION

08/08/2019

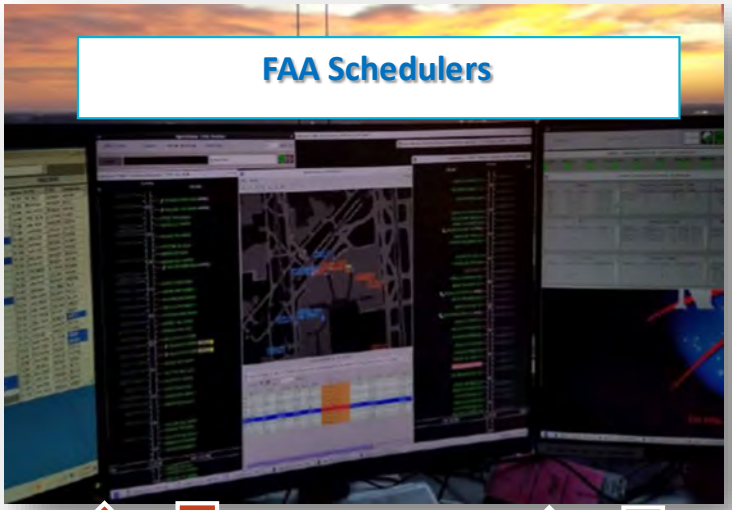
Briefing prepared by MITRE for presentation to SWIFT

MITRE

The Challenge

Many airlines have automation to generate departure readiness data and automatically submit it to the FAA via SWIM.

How will general aviation operators exchange departure readiness information? Sometimes only the pilot has that information.



MITRE has been investigating the use of mobile technology to provide this capability in collaboration with the FAA, NBAA, and NASA.

Approved for public release. Distribution unlimited 18-3327-11.

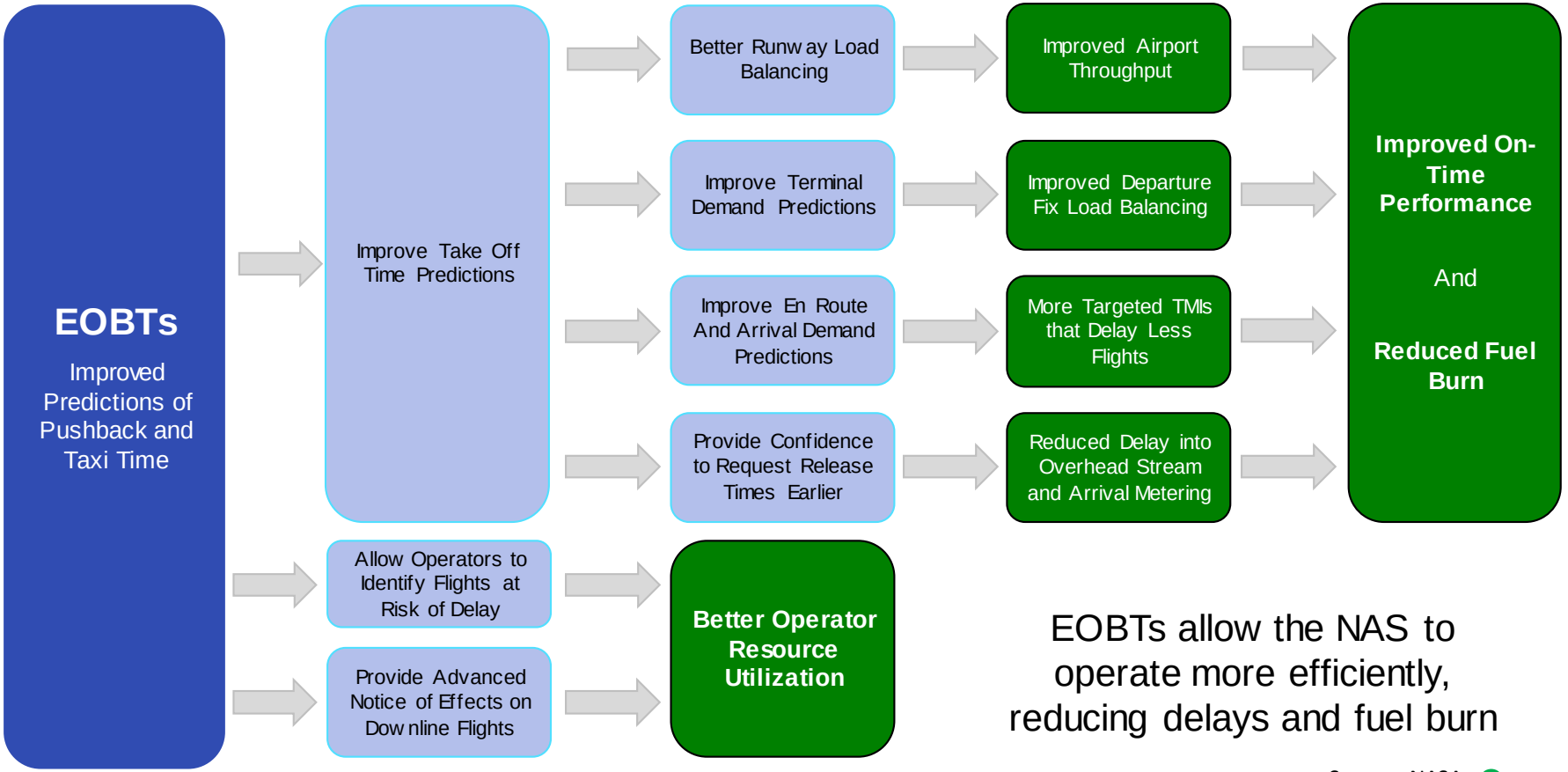
MITRE

Which surface data element represents departure readiness…

Earliest Off Block Time (EOBT)

A time submitted by GA/BA flight operators or pilot via the mobile app, to indicate when they will be ready to start taxiing. This means, engines running, at appropriate spot on the ramp, ready to contact Ground Control for taxi.

Benefits of Estimated Off Block Times for ATC and Operators



EOBTs allow the NAS to operate more efficiently, reducing delays and fuel burn

Source: NASA

MITRE

Current Research

- **MITRE is using mobile technology to enable the submission of departure readiness information, specifically EOBTs, by General Aviation (GA) and Business Aviation (BA) pilots at three airports:**
  - Charlotte Douglas International Airport (CLT)*
  - Dallas Love Field Airport (DAL)*
  - McCarran International Airport (LAS)

**In collaboration with NASA as part of ATD-2*

CLT Results and Lessons Learned

- **Exploring methods for collecting readiness data from GA pilots and the impact of it on the surface scheduler**
  - Pilots use SMS texting to submit EOBTs
- **Pilots receive data, such as estimated takeoff time and expected runway, after readiness submission**
  - Feedback from participants: returned data helps with planning, can program expected runway in FMS before taxi, and passengers can coordinate pickup times at destination using estimated takeoff time
- **Applying lessons learned in CLT at DAL and LAS**
- **Using a new interface (Pacer*) to collect the same data at DAL**
  - Allows for better situational awareness of departure demand and easier enrollment

*More detail on following slides

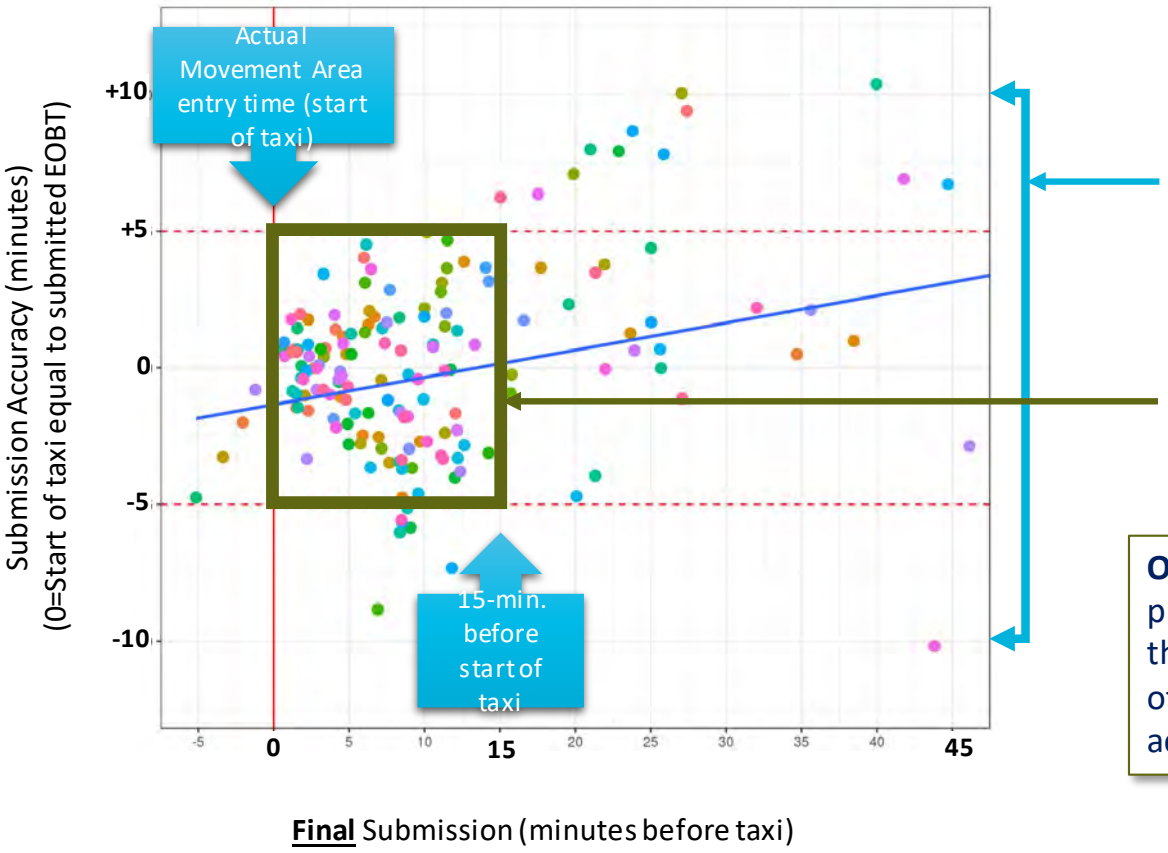
GA Flight Deck

Approved for public release. Distribution unlimited 18-3327-11.

MITRE

Departure Readiness Submission Accuracy

CLT Business Aviation (BA) Pilots



- When pilots submitted their EOBT estimate within 45 minutes of their actual Movement Area entry time, the accuracy of their estimate was within ± 10 min.
- When pilots submitted their EOBT estimate within 15 minutes of their actual Movement Area entry time, the accuracy of their estimate was within ± 5 min.

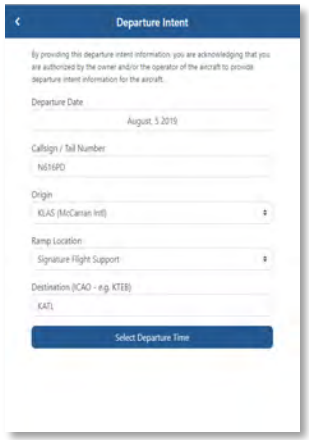
Observation: GA/BA pilots can provide departure readiness times that are consistent with the accuracy of airline provided data and deemed acceptable for departure scheduling.

LAS Overview

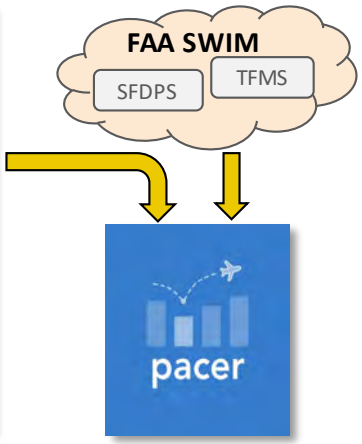
- **Surges in GA demand due to special events can cause congestion and delays**
  - Leveraging work by McCarran Airport, MITRE developed progressive web app, Pacer, to improve GA pilots awareness

- **Key Pacer Features:**

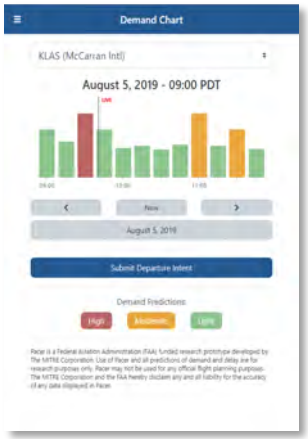
1. GA pilots submit intended departure times



2. Develops demand picture from mobile inputs and SWIM data



3. GA pilots see departure demand



- **Expected Benefit:**
  - GA pilots communicate delays to customers and potentially avoid delays by changing departure times
- **Next Steps:**
  - Begin using pacer in Vegas in September
  - Official pacer launch at NBAA-BACE in October
  - FY20 research to determine how pacer data gets back to FAA via SWIM

MITRE

MITRE

MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our federally funded R&D centers and public-private partnerships, we work across government to tackle challenges to the safety, stability, and well-being of our nation.

Learn more www.mitre.org

Approved for public release. Distribution unlimited 18-3327-11.

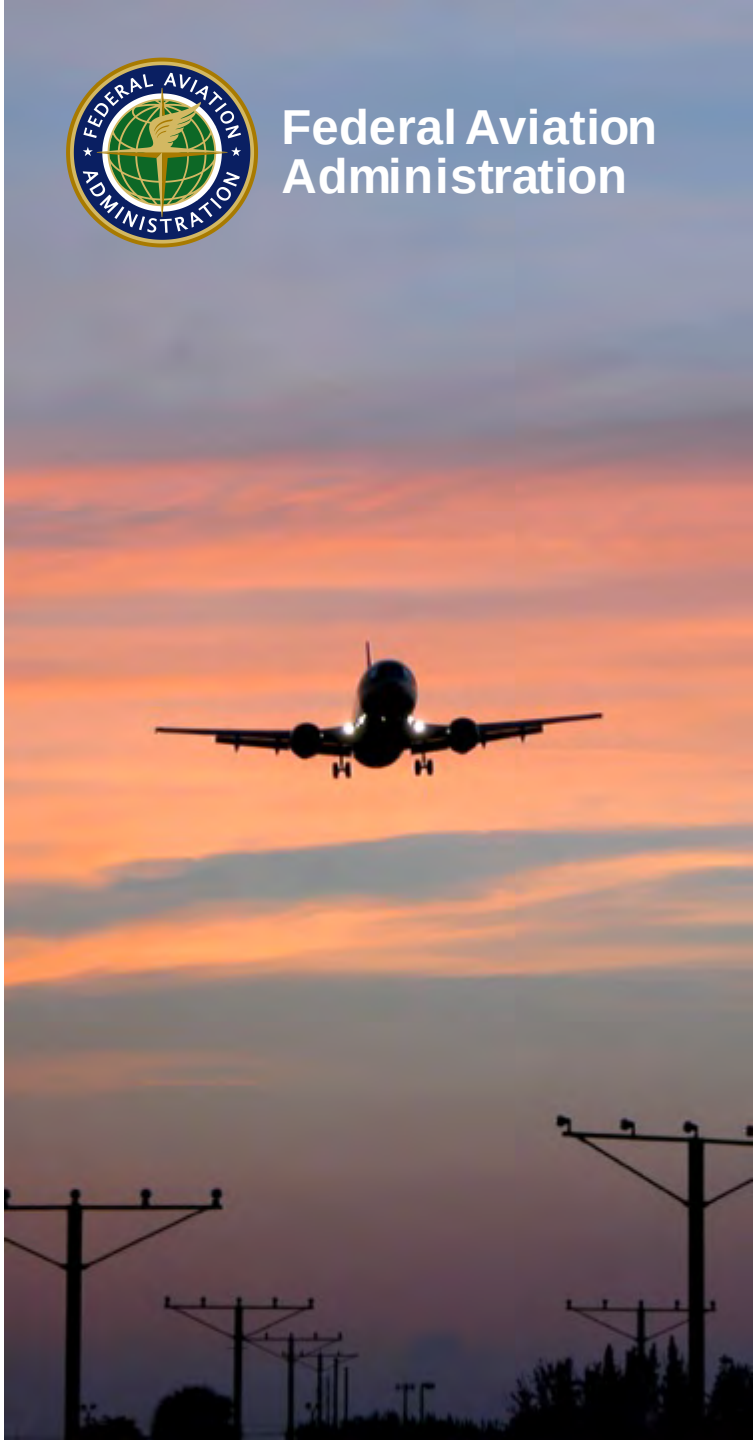
Approved for public release. Distribution unlimited 18-3327-11.

MITRE

SWIM Terminal Data Distribution System (STDDS)

SWIFT Conference

Presented to: SWIFT
By: Brian Love, SWIM Engineering Support
Date: August 8, 2019



Agenda

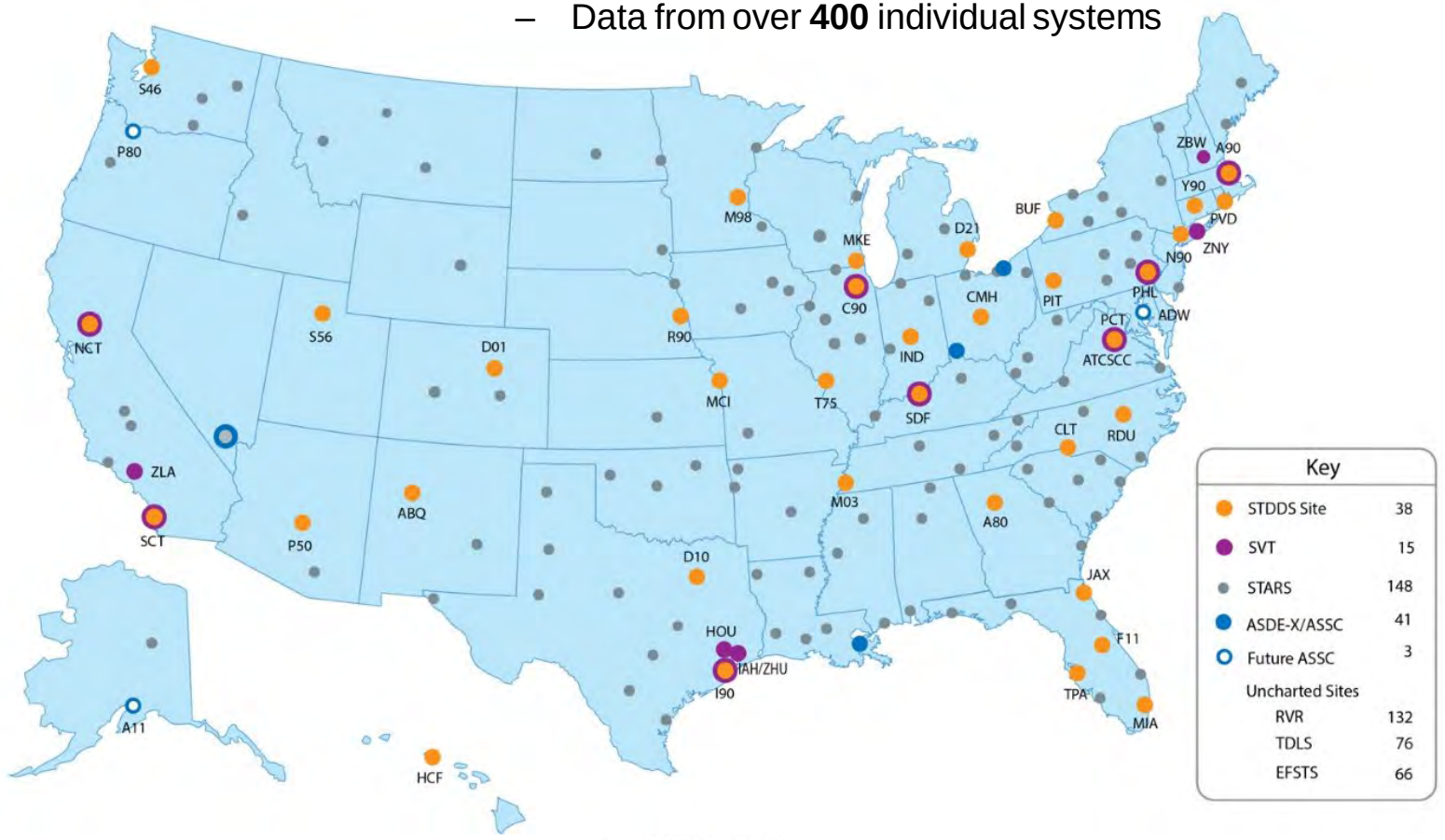
- **Background**
  - Locations
  - Architecture
  - Services
- **Roadmap**
  - Timeline
  - R5 Tech Refresh
  - R6 Enhancements
- **Deep Dive**
  - Services
    - APDS (RVR website)
    - ISMC (Site Monitor)
    - SMES (SVT)
    - TAIS
    - TDES
  - R4 Enhanced Data
- **Resources**

STDDS Background

- **SWIM Terminal Data Distribution System (STDDS) converts legacy terminal data collected from airport towers and Terminal Radar Approach Control (TRACON) facilities into easily accessible information, which is published via the National Airspace System (NAS) Enterprise Messaging Service (NEMS).**
- **STDDS publishes data from selected FAA airport and terminal systems:**
  - ASDE-X - Airport Surface Detection Equipment – Model X
  - ASSC - Airport Surface Surveillance Capability
  - STARS - Standard Terminal Automation Replacement System
  - RVR - Runway Visual Range
  - EFSTS - Electronic Flight Strip Transfer System
  - TDLS - Tower Data Link Services
- **STDDS publishes data to NAS and non-NAS subscribers, via NEMS in accordance with SWIM standards**

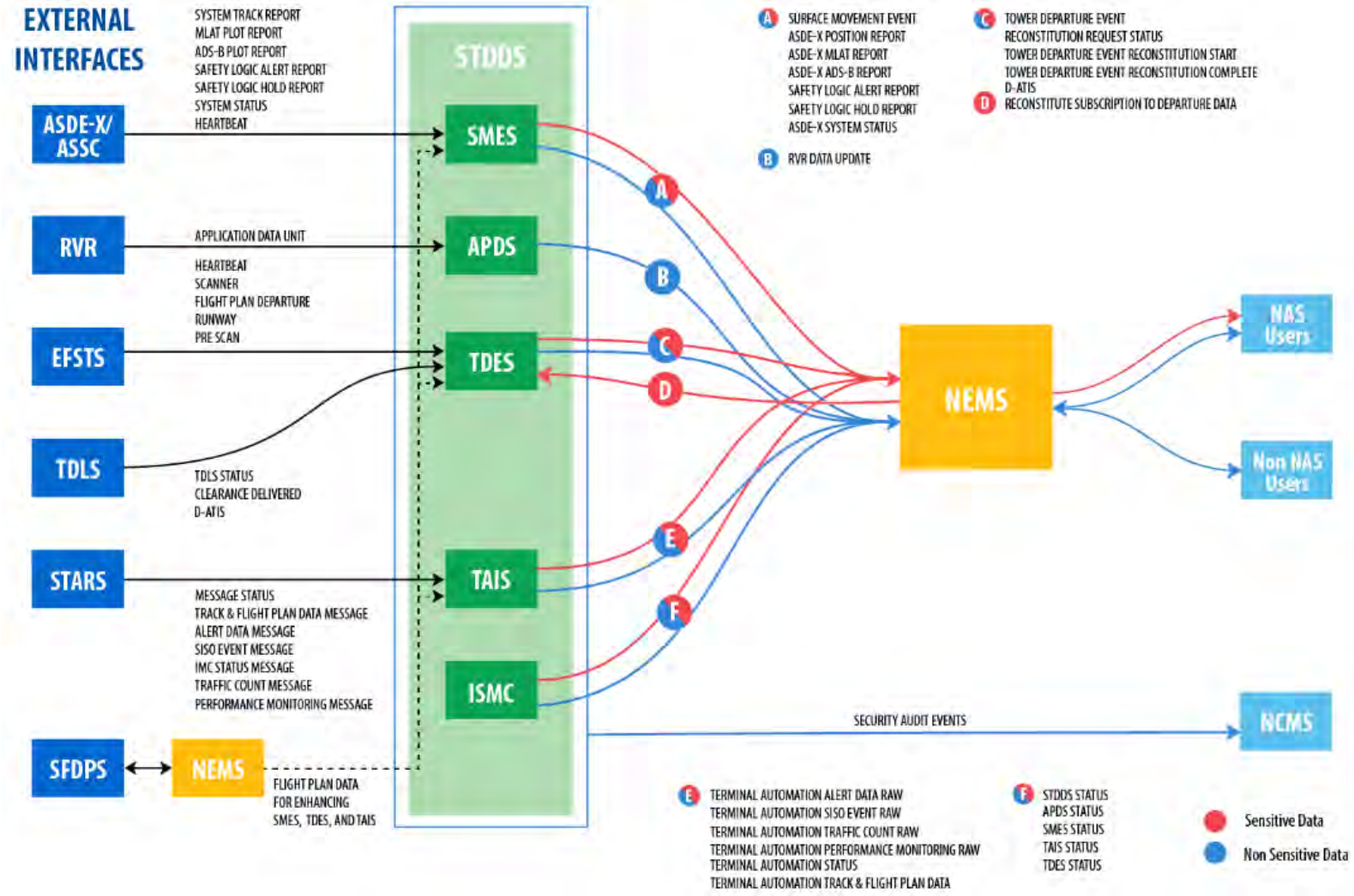
STDDS Locations

- **Installed at 38 TRACONS**
  - Access to data from over **200** airports
  - Data from over **400** individual systems



Valid as of June 2019

STDDS System Architecture



STDDS Services

STDDS Service	Description
APDS - Airport Data Service	RVR data including visual runway range, trend information and runway edge lighting
ISMC - Infrastructure, Monitor, and Control Service	Provides periodic status information for all STDDS sites and services
SMES* - Surface Movement Event Service	ASDE-X/ASSC data including Cat11/Cat10 position reports, safety alerts and OOOI events (Spot Out, Off, On, Spot In)
TAIS* - Terminal Automation Information Service	STARS data including status, track and flight plan, alert, SISO event, IMC status, traffic count, and performance monitoring
TDES* - Tower Departure Event Service	TDLS/EFSTS data including D-ATIS, clearance delivery time, taxi start time, takeoff time and departure runway

***SMES, TAIS, and TDES services are enhanced with SFDPS flight plan information where applicable**

STDDS Timeline

Release	Deployment	Description
R3.0	June 2013	• Baseline
R3.1	May 2014	• ASSC Interface • Data Compression
R3.2	September 2015	• STARS/TAMR Interface
R3.3	July 2017	• ASDE-X/ASSC CAT10 Data in NMA • SMES Safety Alerts • Lat/Long added to TAIS track points
R4	March 2019	• Enhance STDDS TAIS, TDES, and SMES data with SFDPS GUFI/flight plan data • TDES filtered feed • TDES D-ATIS messages
R5	April 2020	• Hardware Tech Refresh at 38 STDDS sites
R6	Spring 2021	• TAIS message enhancements • Publish additional TDLS messages • SMES runway event and CAT10 enhancements

STDDS R5

- **Description**
  - Technical Refresh: replacement of hardware at STDDS TRACONS
    - Addition of 2 ASSC sites—ANC and PDX
    - Change to TAIS data ceiling—adapted by TRACON to include all tracks associated with flight plans
    - **No changes to the schema or functionality**

- **Timeline**
  - Key Sites Summer/Fall 2019, Deployment early 2020

STDDS R6 SMES Enhancements

- **Enhance SMES with 2 additional airport movement events:**
  - Runway in—target has entered the geographical boundaries (lat/lon) of a runway
  - Runway out—target has exited the geographical boundaries (lat/lon) of a runway
- **Add *_COVAR and DF type fields to the MLAT and ADSB CAT10 messages to improve track precision measure**
  - Covariance matrix values for calculating the geometric dilution of precision (GDOP) of the track:
    - XX_COVAR
    - YY_COVAR
    - ZZ_COVAR
    - XY_COVAR
- **Extend SFDPS data enhancement to the ASDE-X/ASSC CAT10 data (MLAT and ADSB messages)**

STDDS R6 TAIS Enhancements

- **TAIS**
  - Reduce flight plan repetition
  - Add rawFlightRules field to TerminalAutomationFlightPlan message
    - rawFlightRules can contain more than ‘V’ for VFR, ‘P’ for VFR on Top, and ‘E’ for Enroute IFR (site adapted)

STDDS R6 TDES Enhancements

- **TDES**
  - Publish additional TDLS data in TDES messages
    - Adds beacon code, ECID and aircraft type from TDLS to all TDES messages except the D-ATIS message.
  - Parse and publish entire dataHeader in DATISMessage
    - Includes the Data Type, ATIS code, and Data Generation Timestamp found in the DATIS message header
      - R6 will continue publishing the dataHeader field containing raw D-ATIS data, for backwards compatibility.
- **Enhance TDES with additional TDLS messages, including:**

Name	Description	Definition
PDC, PDA	PDC Clearances	Pre-departure clearance information delivered by TDLS
CCI, CCR, CCA, CCP	DCL Clearances	Information exchanged between AOCs and controllers to coordinate initial clearances, revised clearances, and pilot responses.
GRM, GIR	Gate ID Request	Information exchanged between Airline Operations Center (AOC) to coordinate planned gate usage.

STDDS R6 ISMC Enhancements

- **Publish link status and site heartbeat in MMIXM format**
  - Changes in the link status of STDDS input data will be published in Maintenance Management Information eXchange Model (MMIXM) format
    - The existing ISMC service status messages in XML native format will continue to be published
  - Each STDDS site will publish a heartbeat message once a minute in MMIXM format to determine connection availability
  - MMIXM format data will be available for subscription by all consumers

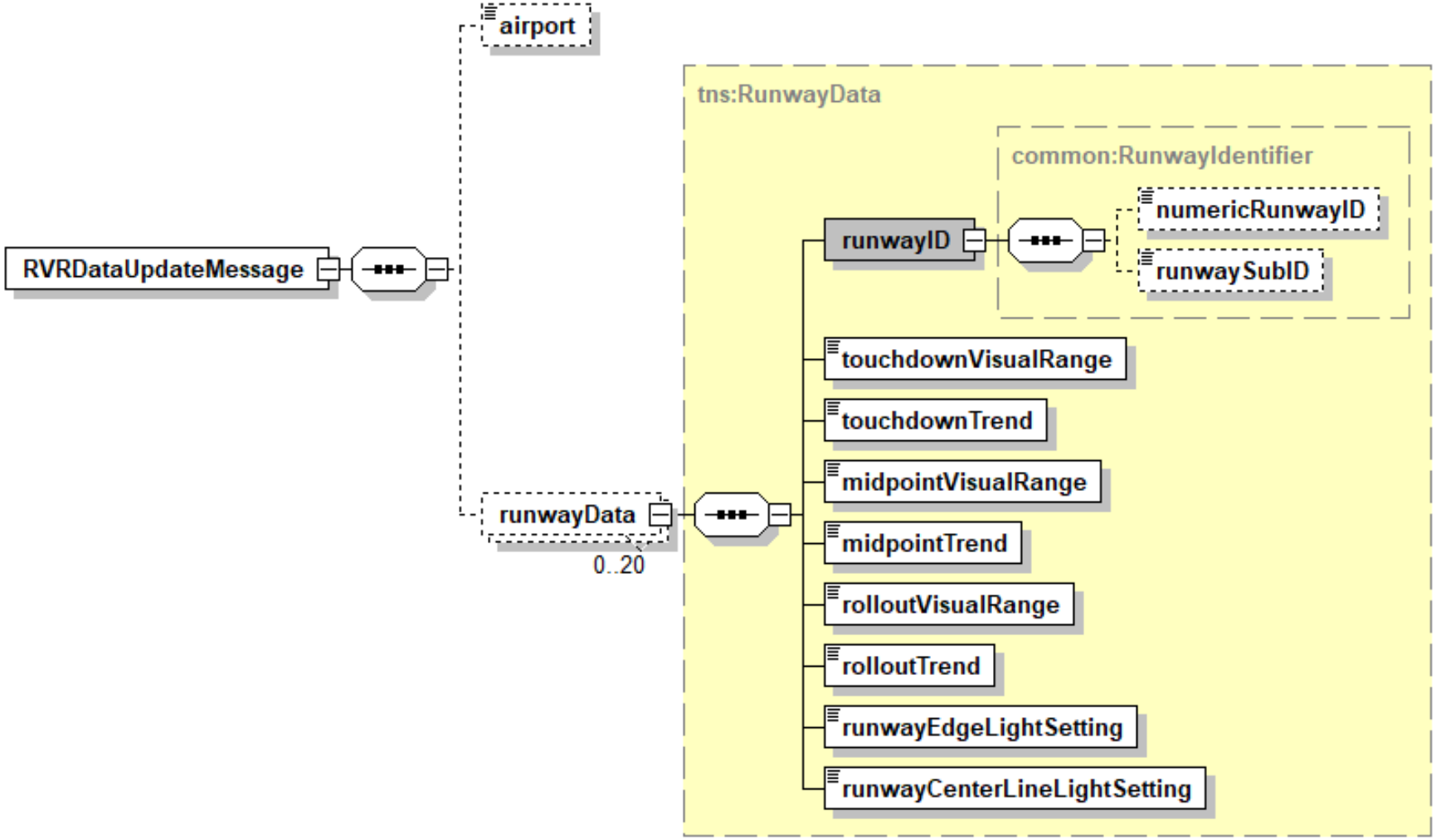
Current STDDS Services

- **APDS -** Airport Data Service
- **ISMC -** Infrastructure, Monitor, and Control Service
- **SMES -** Surface Movement Event Service
- **TAIS -** Terminal Automation Information Service
- **TDES -** Tower Departure Event Service

Airport Data Service (APDS)

- **RVRDataUpdateMessage (msgType=RR)**
  - Delivers runway visual range information for airports equipped with RVR systems
  - Used to detect reduced lateral visibility at the runway surface
  - Measurement is in hundreds of feet, at three different points on the runway
  - Trend information for each point is provided
  - On/Off status and intensity of runway edge and centerline lights is also provided
  - Messages are delivered every 2s for each airport, with each message containing all RVR runways at that airport
    - Exceptions are ORD, DFW, DEN and SEA which have dual RVR systems. These sites deliver 2 messages every 2s, each containing different sets of runways for those airports.

RVRDataUpdateMessage



RVR Website Demo

https://rvr.data.faa.gov

RVR Status Monitor

02:38:05z 03-13-2019

Airport Name Lookup | RVR Custom View | Help

RVR Airports									
ABQ >6000	ACK 00	ACY >6000	ADW 5500	AGC >6000	ALB >6000	ALW >6000	AMA 2000	ANC >6000	ATL 5500
AUS 6000	AVP >6000	BAF 00	BDL >6000	BFI >6000	BHM >6000	BIL >6000	BIS >6000	BNA >6000	BOI >6000
BOS >6000	BTR >6000	BTV >6000	BUF >6000	BUR >6000	BWI 6000	CAE >6000	CGI 00	CHS >6000	CLE 4500
CLT >6000	CMH >6000	COS >6000	CRP >6000	CRW >6000	CSG 00	CVG 5500	DAB >6000	DAL >6000	DAY >6000
DCA >6000	DEN 4500	DFW >6000	DPA 6000	DSM 2800	DTW 6000	ELP >6000	EUG >6000	EVV >6000	EWR 4500
FAR >6000	FAT >6000	FLL >6000	FNT >6000	FSD 2200	FSM >6000	FWA >6000	GEG >6000	GFK >6000	GJT >6000
GPT >6000	GRB >6000	GSO >6000	HOU >6000	HPN >6000	HSV >6000	HUF >6000	IAD >6000	IAH >6000	ICT >6000
ILG >6000	IND 5500	ISP >6000	JAX 5500	JFK 4500	LAX >6000	LGA >6000	LGB 5500	LIT >6000	LMT >6000
LNK 2400	MAF >6000	MCI >6000	MCN 00	MCO >6000	MDW >6000	MEM >6000	MFR >6000	MGM 4500	MIA >6000
MKE 6000	MRY >6000	MSP 4500	MSY >6000	MWH >6000	OAK >6000	OKC 6000	OMA 1200	ONT >6000	ORD 4500#
ORH >6000	PAE >6000	PBI >6000	PDX >6000	PHL 6000	PHX >6000	PIT >6000	PSC 4000	PVD >6000	RDU 6000
RIC 5500	RNO >6000	SAN >6000	SAT 5500	SAV >6000	SDF >6000	SEA >6000	SFO 4000	SJC >6000	SLC >6000
SMF >6000	SNA >6000	SPI >6000	STL >6000	SUS >6000	SYR >6000	TEB >6000	TPA >6000	TUL >6000	TYS >6000
VNY >6000	YIP >6000								

KEY:

Values shown are lowest visibility (in feet) over last 10 minutes.
If ≠ symbol appears after visibility value then not all runways reporting.
Select an airport to view its current RVR values.

>6000	2500-6000	1300-2400	800-1200	0-700	No Data

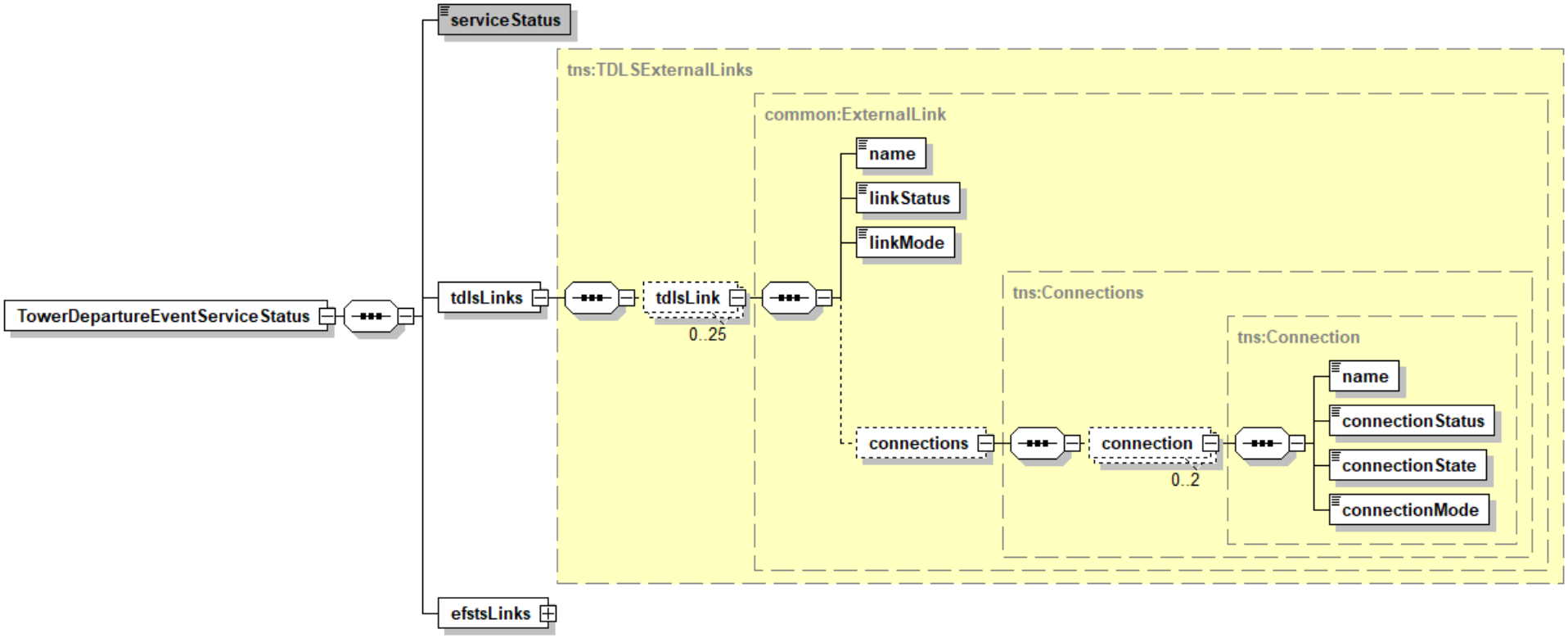
Infrastructure, System Monitor and Control Service (ISMC)

- **Message Types:**
  - AirportDataServiceStatus (msgType=AS)
  - SurfaceMovementEventServiceStatus (msgType=SS)
  - TerminalAutomationServiceStatus (msgType=lS)
  - TowerDepartureEventServiceStatus (msgType=TS)
- **Provides status of STDDS service by TRACON, and list/status of external links (RVR, ASDE-X systems, etc.)**

STDDS Site Monitor

- **Provides 30-day status history of connections between producer systems (ASDE-X/ASSC, STARS, RVR, TDLS, EFSTS) and STDDS sites**
- **Drill between STDDS TRACON → Service → Interface Connections**
- **STDDS Site Availability file published in the NSRR and the STDDS web site is helpful in determining site mappings**

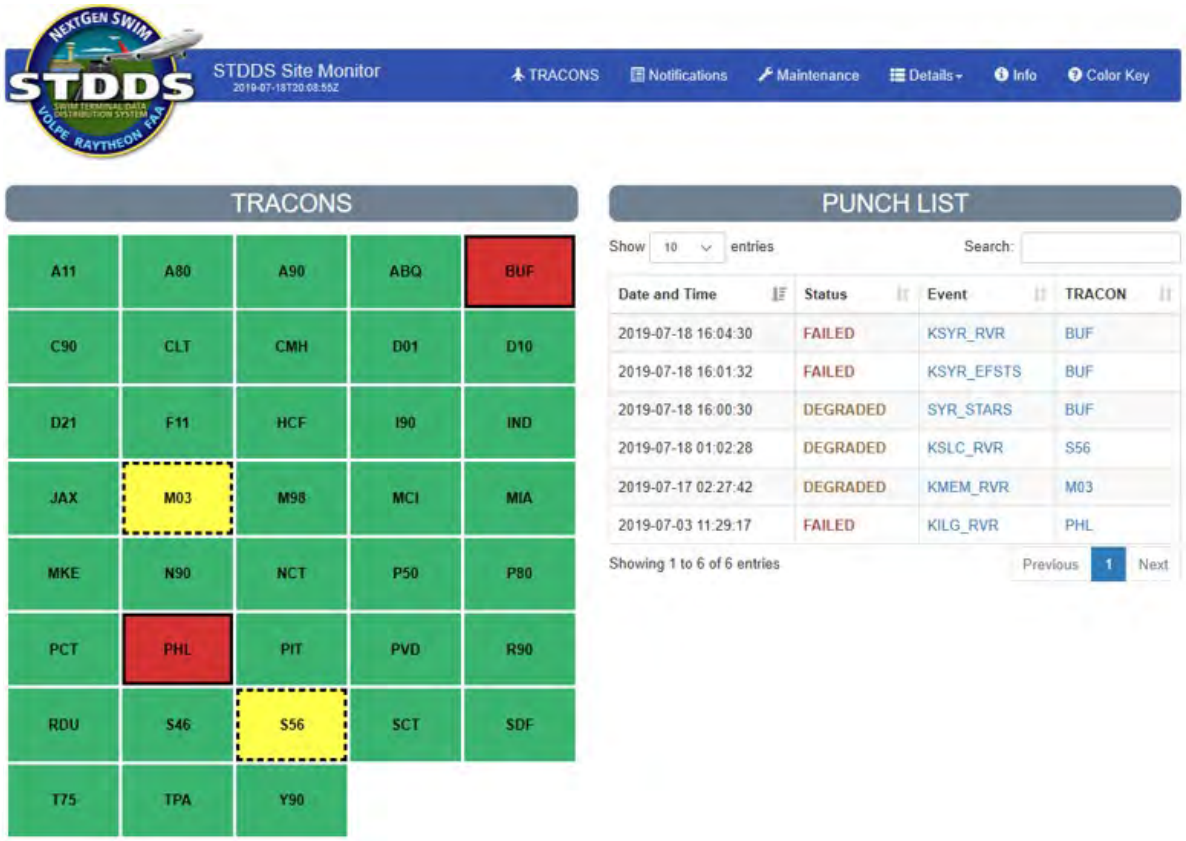
xxxServiceStatus



xxx = AirportData, SurfaceMovementEvent, TerminalAutomationInformation, TowerDepartureEvent

Site Monitor Demo

https://swim.volpe.dot.gov/stdds/



Surface Movement Event Service (SMES)

- **ASDEXMessage.positionReport (msgType=AT)**
  - Delivers Cat11 messages from ASDE-X and ASSC systems
  - Fused from 4 data sources: ASR, SMR, MLAT, ADS-B
  - Messages output once per second per flight track
  - Contains aircraft identification, position, and limited flight plan information
  - Enhanced with SFDPS flight plan data where available

- **CAT10 ASDEXMessage.positionReport (msgType=AD, ML)**
  - Delivers Cat10 messages from ASDE-X and ASSC systems
  - AD Messages are ADS-B; ML messages are MLAT
  - Contains beacon code and position information
  - Only available in the non-movement area, providing limited coverage of ramp area, coverage varies by airport

Surface Movement Event Service (SMES)

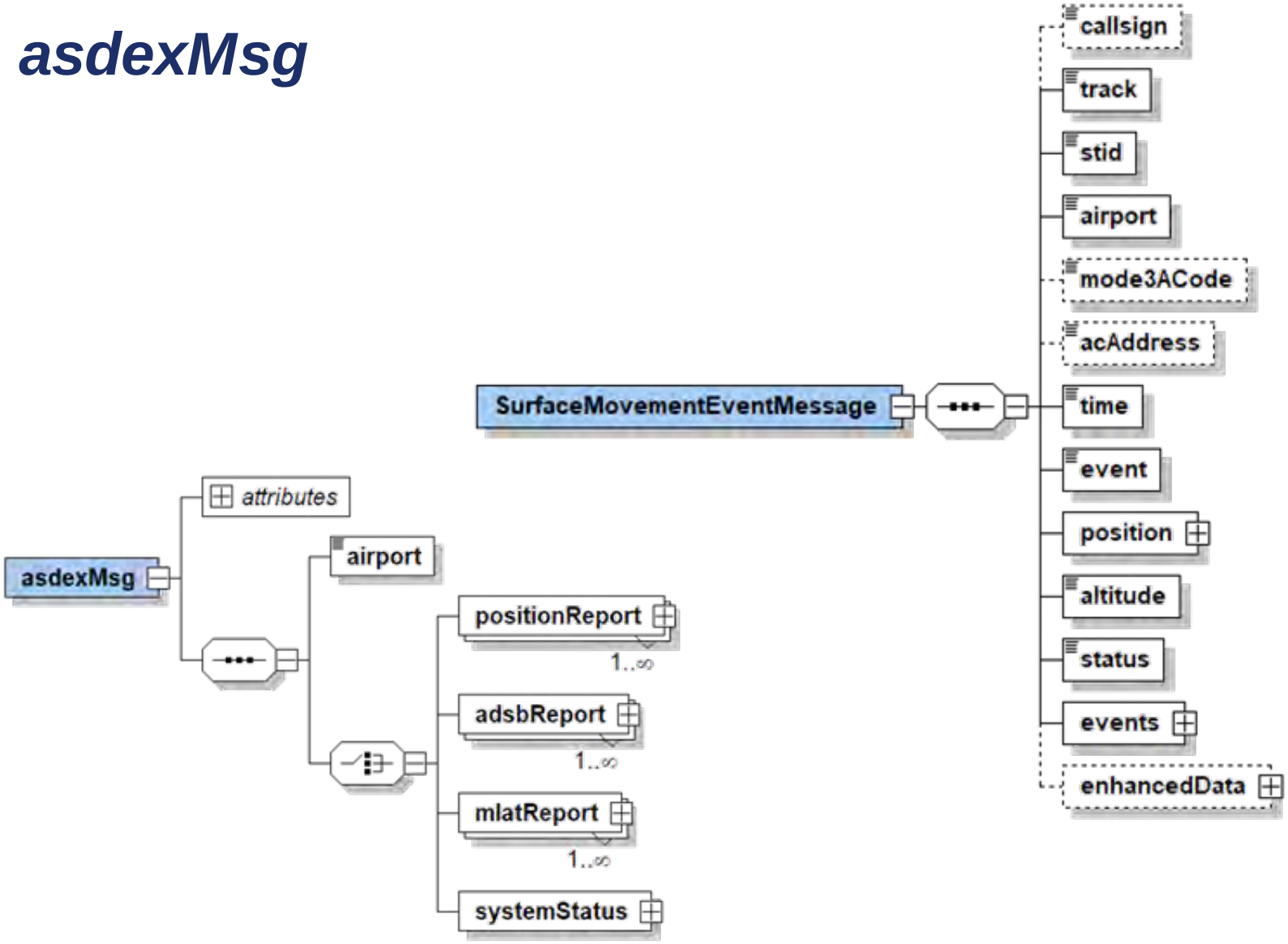
- **SurfaceMovementEventMessage (msgType=SE)**
  - Derived from Cat11 messages and airport ramp boundary information
  - Identifies the following flight transitions, and the time they occurred:
    - SPOTOUT: aircraft transitioned from ramp area to movement area
    - OFF: aircraft has taken off
    - ON: aircraft has touched down
    - SPOTIN: aircraft entered a ramp area
  - Useful for managing airport traffic and congestion

- **SafetyLogicHoldBarMessage (msgType=SH)**
  - Identifies whether hold bars are enabled/disabled
  - For enabled hold bars, identifies whether they are visible or not
  - However, need "decoder ring" from FAA to interpret *control* location

SMES Delta Encoding (Position Report Messages)

- **Position reports are delta encoded and batched when they are published**
- **The first time a track is seen, or every minute, all data fields are filled out in the published messages. (full=true)**
- **Subsequent messages contain only fields whose values have changes from the previous published message. (full=false)**
- **If a field has been removed from the previous track report, the field is marked with a removed attribute (r="1") and contains the previous value received if required.**

asdexMsg

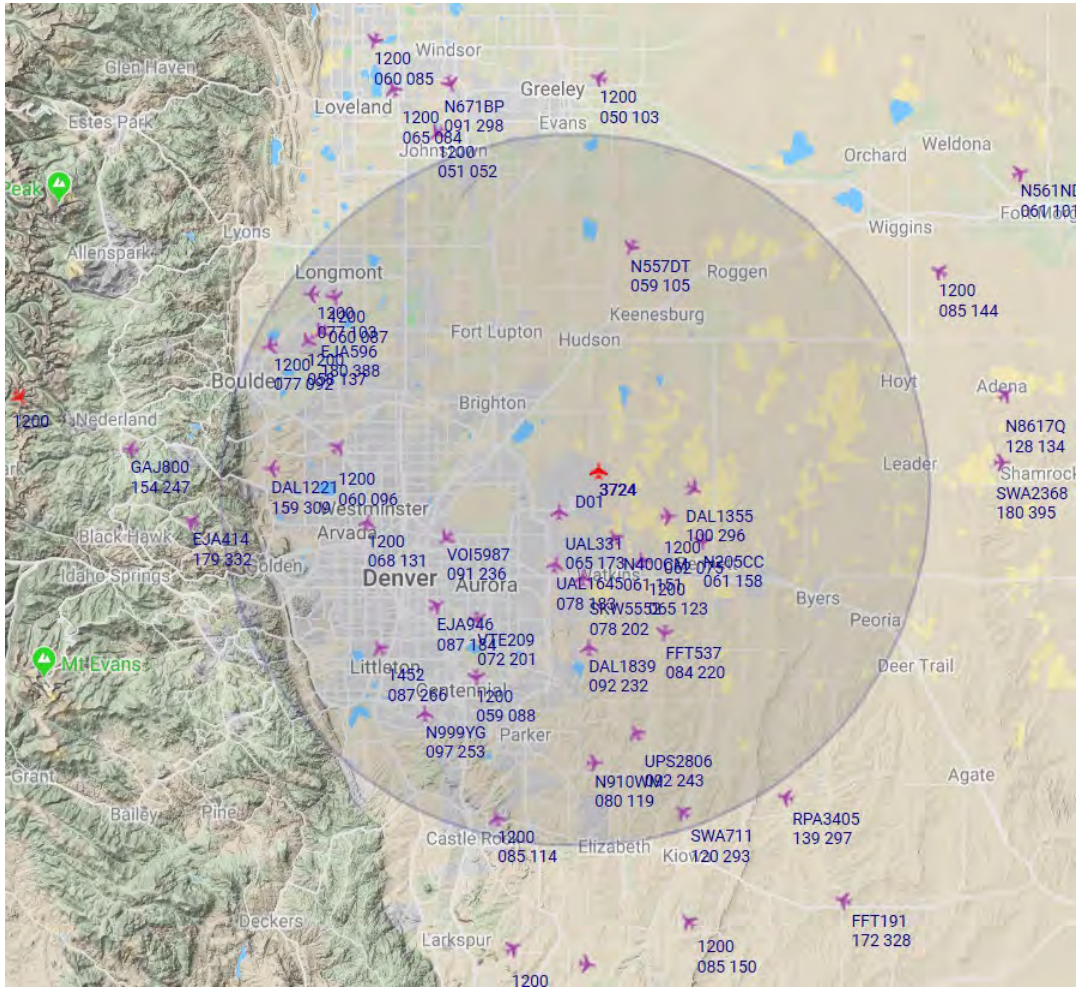

callsign
track
stid
airport
mode3ACode
acAddress
SurfaceMovementEventMessage
time
event
position
altitude
status
events
enhancedData
attributes
asdexMsg
airport
positionReport
1..∞
adsbReport
1..∞
mlatReport
1..∞
systemStatus

Public SMES Demo/Tool

http://www.airportviewer.com/

Another Public SMES Demo/Tool

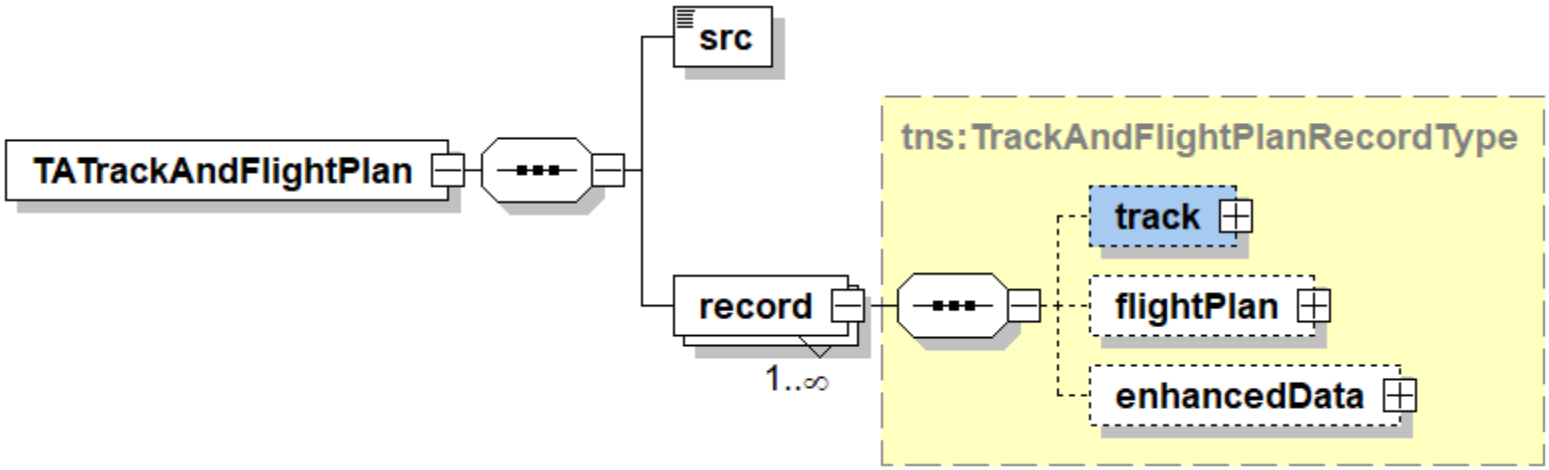
http://donovansys.com



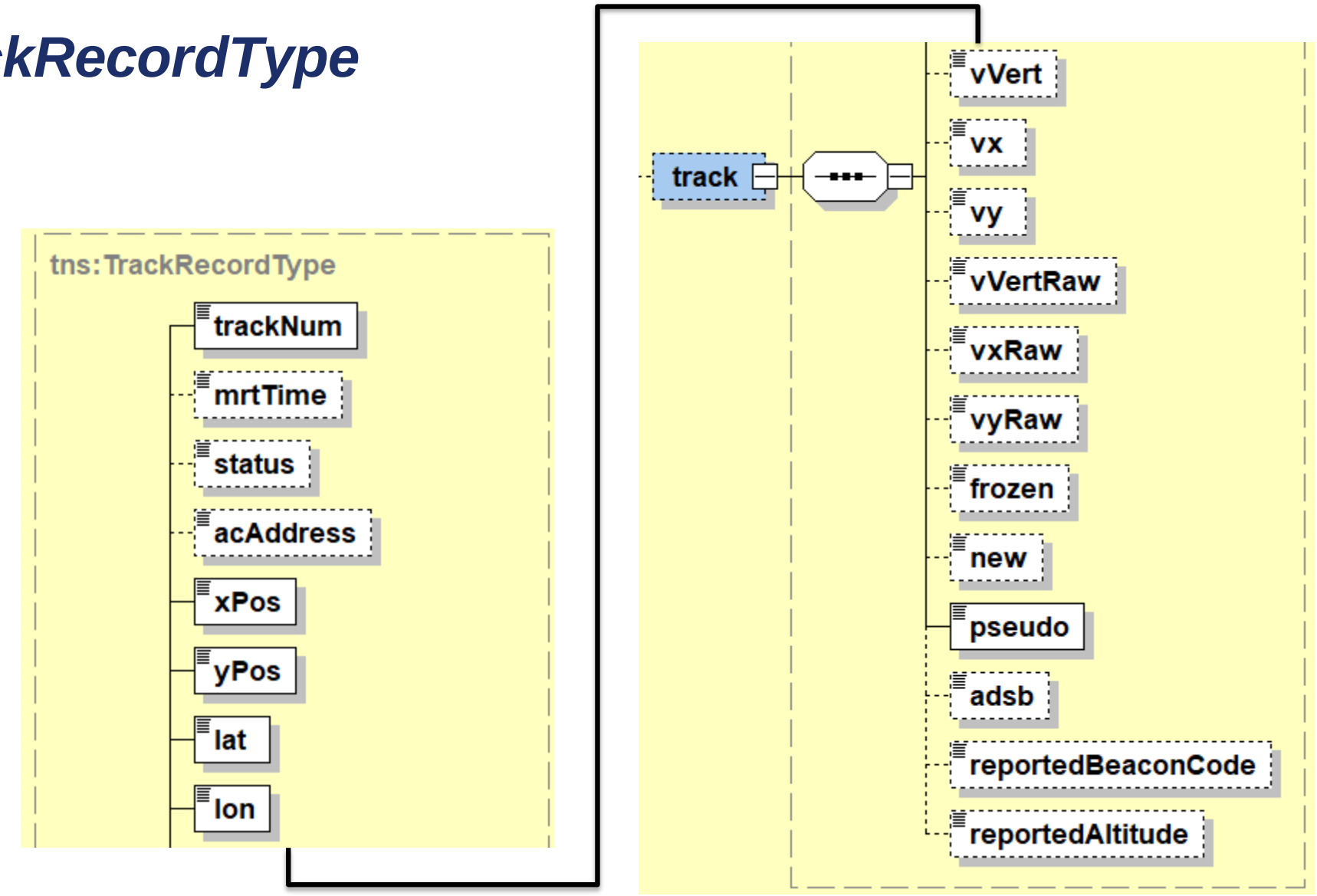
Terminal Automation Information Service (TAIS)

- **TerminalAutomationStatus message (msgType=ST)**
  - Derived from STARS AIG100
  - STARS system status
- **TerminalAutomationTrackAndFlightPlanData message (msgType=FP)**
  - Derived from STARS AIG200
  - Includes one or more Flight Plans and Track point data records
  - Reports track points using calculated lat/lon
  - Enhanced with SFDPS flight plan data where available
  - Supports strategic and tactical decision making, as well as monitoring and statistical analysis

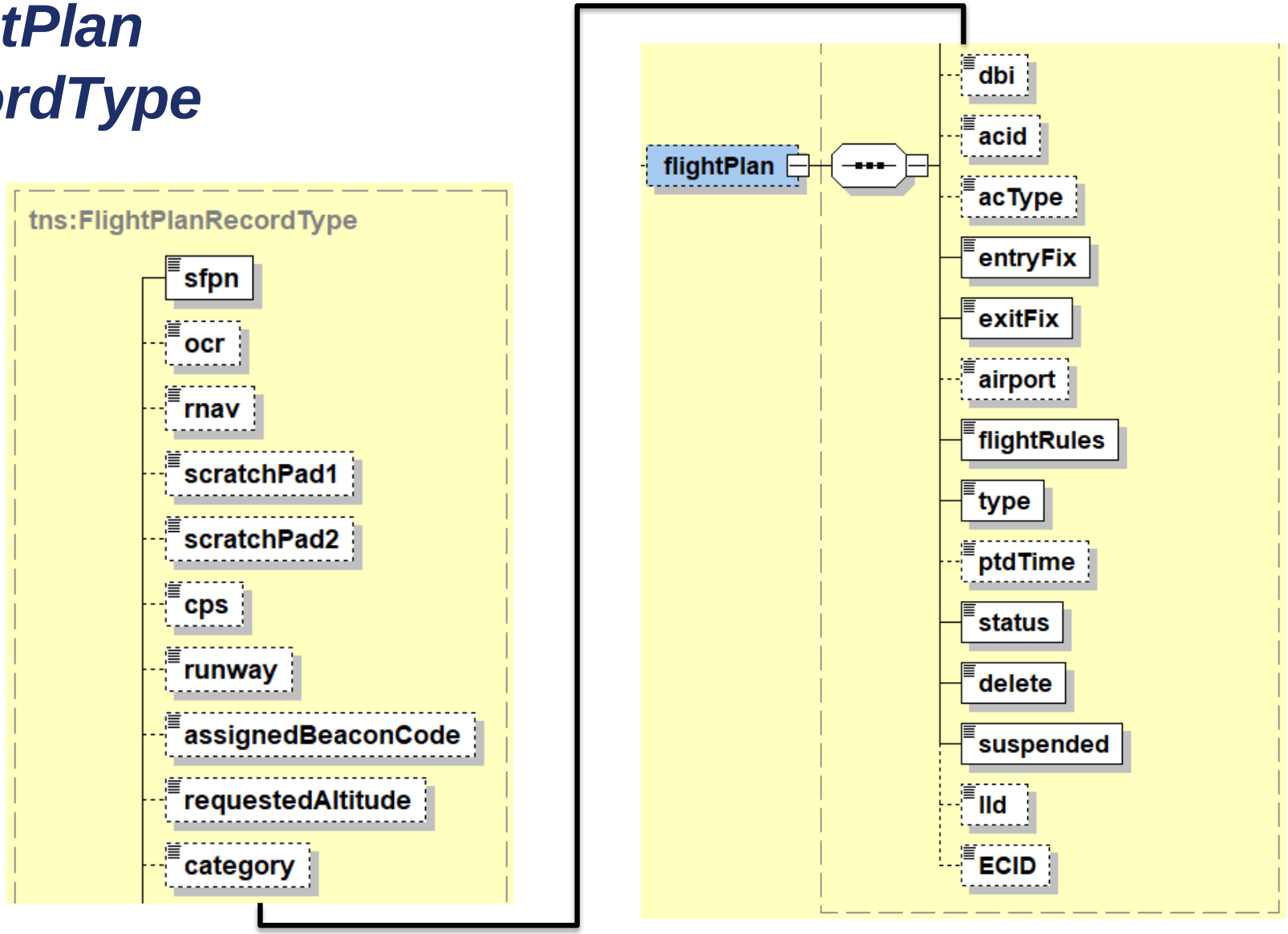
TATrackAndFlightPlan



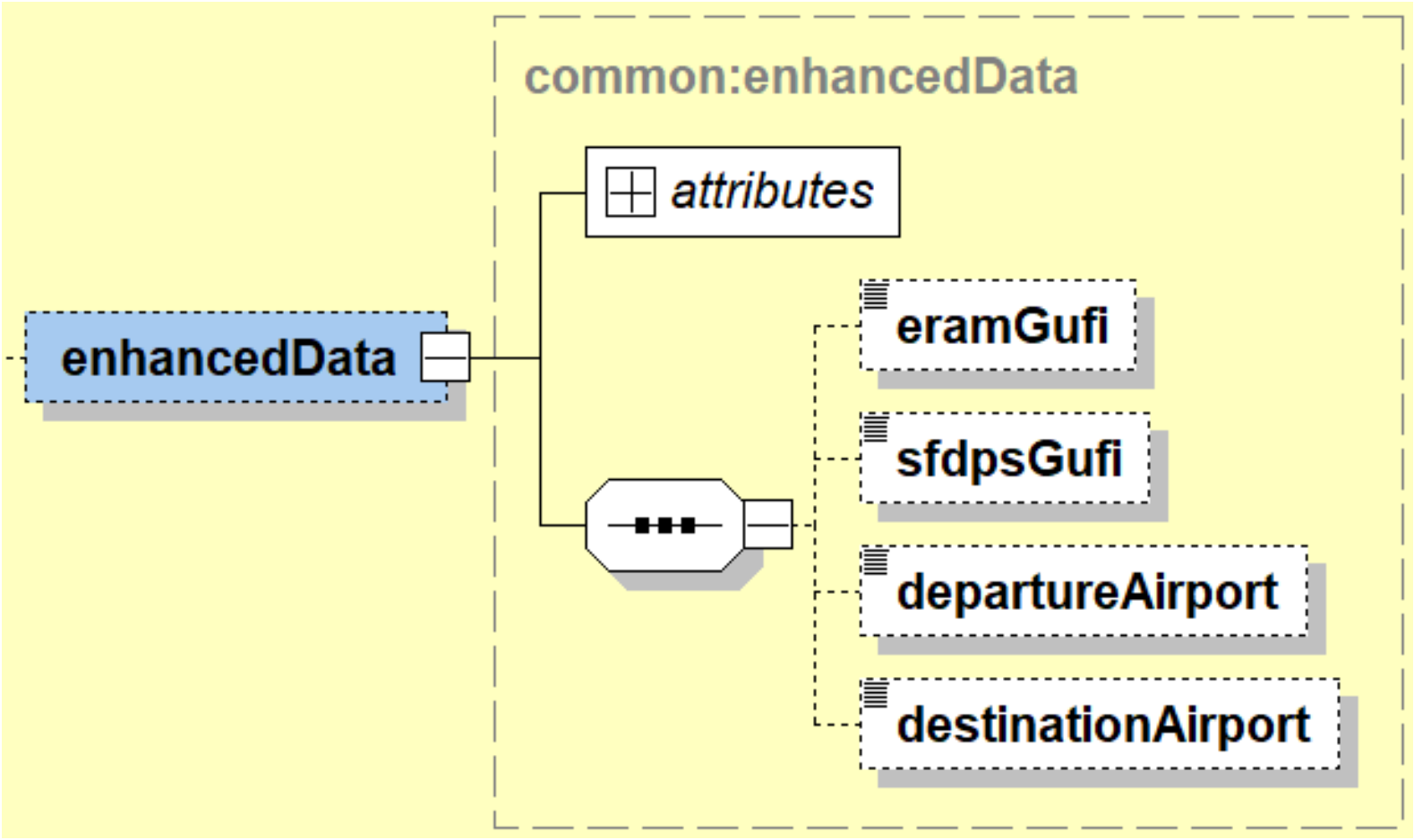
TrackRecordType



FlightPlan RecordType



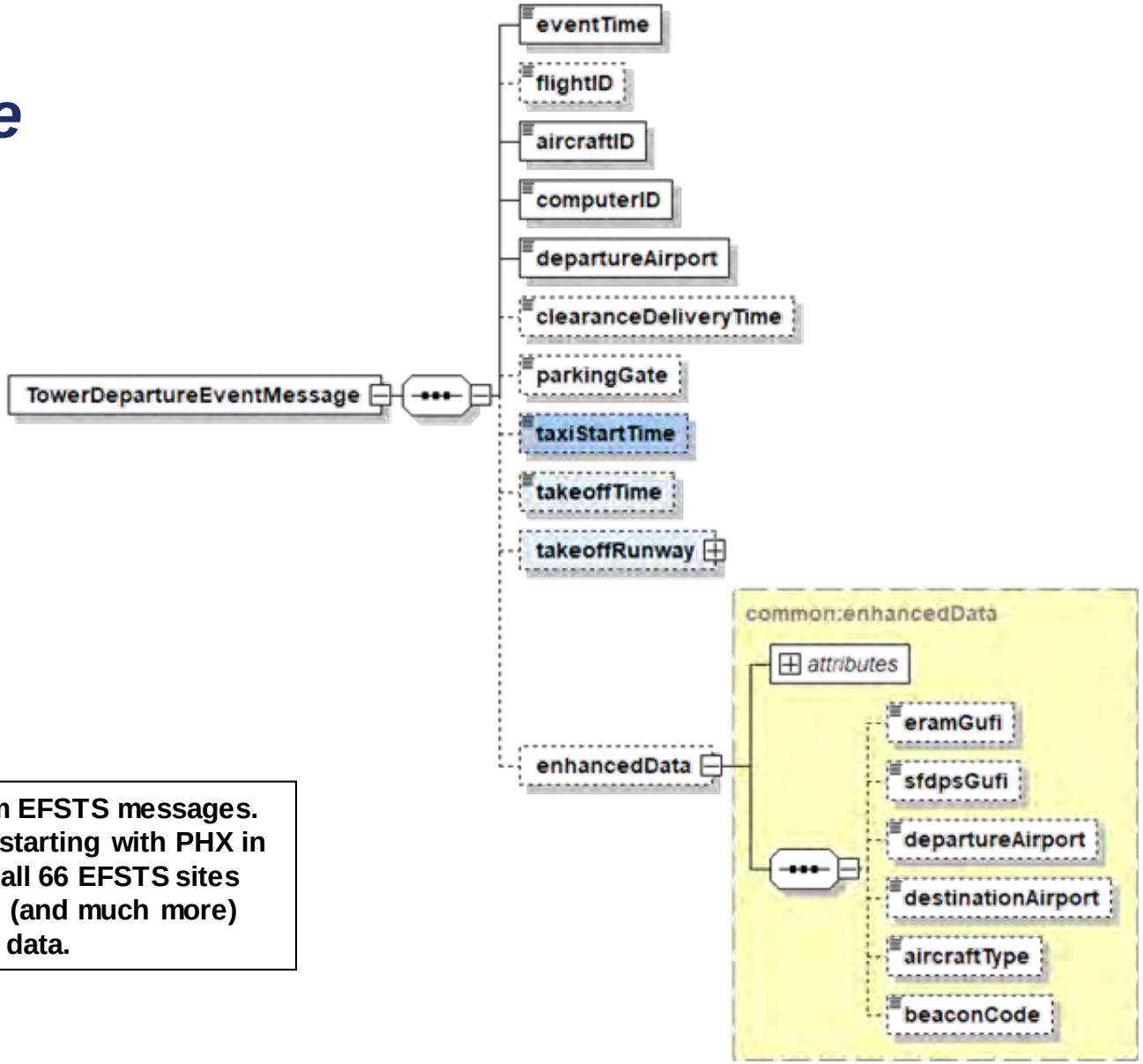
enhancedData



Tower Departure Event Service (TDES)

- **TowerDepartureEvent message (msgType=DE)**
  - Sent upon the receipt of a corresponding departure event from EFSTS and/or TDLS.
  - Enhanced with SFDPS flight plan data where available
- **DATISData (msgType=DD)**
  - Provides airport conditions, such as current weather information, active runways, and Notice to Airmen (NOTAMs)

TowerDeparture EventMessage



Blue highlighted fields come from EFSTS messages. EFSTS is being retired by TFDM, starting with PHX in 2020. TFDM will ultimately retire all 66 EFSTS sites by 2030. This EFSTS information (and much more) will be available in the TTP SWIM data.

SFDPS Enhanced Flight Data

- **STDDS R4 correlates flight records in the SMES, TAIS, and TDES services with SFDPS flight plan data, where available.**
- **Enhanced flight data may include the following fields:**
  - En Route Automation Modernization (ERAM) Globally Unique Flight Identifier (GUFI)
  - SFDPS GUFI
  - Departure Airport
  - Destination Airport
- **Enhanced flight data matching serves two purposes**:
  - Adds departure airport to arrival records and arrival airport to departure records
  - Allows correlation among STDDS and SWIM services.

Correlating GUFIs

STDDS	SFDPS	TFMS	TFDM
eramGUFI	flightPlan identifier	“eramGUFI” (when known)	“eramGUFI”
sfdpsGUFI	additionalFlightInformation Name=“FDPS_GUFI”		
	gufi (**deprecated**)		
		flightRef (TFM)	

Message header properties for STDDS messages

- timestamp=2014-01-13T10:55:52.878Z
  UTC date and time of message generation
- msgType=AT, SE, RR, ST, FP, IR
  Flavor of STDDS message (see previous slides)
- airport=KBOS ICAO code of airport originating the message (for APDS, SMES and TDES messages)
- srcTracon=PCT FAA location id of the STARS site (for TAIS messages only)
- tracon=A90 FAA location id of STDDS site that produced the message
- sendTo=authorized
  Indicates message sensitivity, restricts it to NAS consumers, otherwise “all”
- version=4.0 Header property in R4.0, to help identify schema version

STDDS Resources

- **STDDS Website:** https://www.faa.gov/air_traffic/technology/swim/stdds/
  - General STDDS information, news and announcements, FAQ
- **NSRR:** https://nsrr.faa.gov/
  - STDDS technical documentation including schema, JMSDDs, Release Notes, sample data
- **FAA Agreement Portal:** https://data.faa.gov
  - To request STDDS access
- **STDDS Site Monitor:** https://swim.volpe.dot.gov/stdds/
  - Operational status of STDDS TRACONS
- **RVR Website:** https://rvr.data.faa.gov
  - Online source of RVR data—note updated link
- **Program Office Contact:** swim@faa.gov

LUNCH

SWIFT: What's Next?

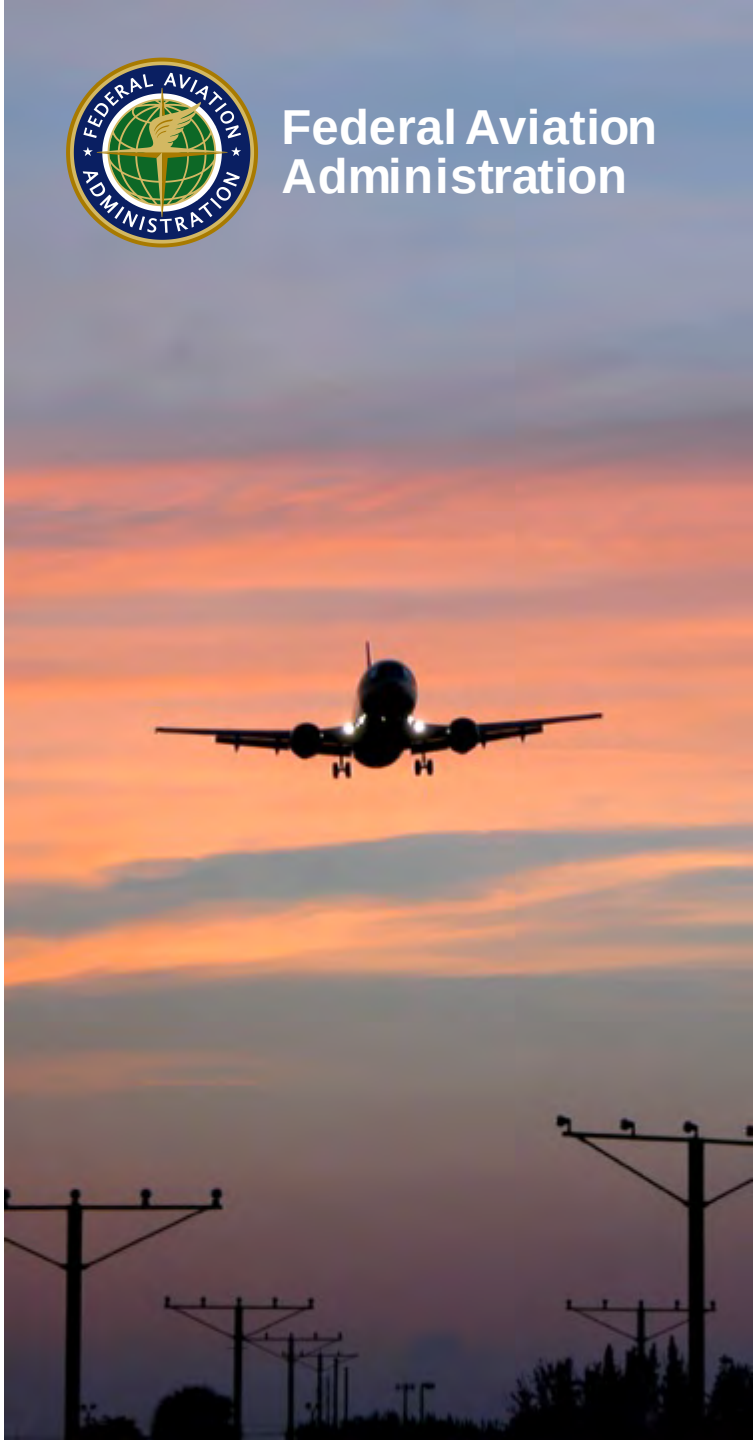
Facilitated Discussion on Industry Priorities

David J. Almeida

SWIFT Community Moderator

August 8, 2019

Federal Aviation Administration



Interactive and Engaged Discussion

- **Purpose:**
  - To have an engaged discussion with the community to identify challenges, interests, obstacles and based on FAA data and information, with impacts to operations, IT and operations research.

- **Question: What topics are important to you and interest to the community?**

Once upon a time…Inputs from past SWIFT

- **Data in Ops → *Focus Group: Ops Context & User Case Studies***
  - Key data elements: EDCTS, Reroutes, TMIs, Flow control
  - Data prognostics: metering data for hubs, optimize congested runways
  - Managing IROPs

- **Data Access → *Information on SWIM Cloud Service (SCDS)***
  - Consistency of products offered from data centers
  - Smarter, more targeted ways to deliver data
  - Centralized source for data internally

Discussion Topics & Areas of Focus

- **Data Governance: Operational Context + System Context**
  - What more context are you looking for in the data?
  - Example: ETA…

- **Trajectory based operation → drive to a TBO NAS**
  - Integration of 3-T's
  - Bi-directional information exchange
  - Enterprise conversation
  - Flight object

Next Step:
Group Work to Discuss Key Questions

Once upon a time…Inputs from past SWIFT

- **Data and Program Insights → *Producer Briefings***
  - Understand TBFM, TFMS, TFDM data
  - Accelerate release of domestic SUA/Real-time versus scheduled SUA data
  - A-CDM/surface management/Gate and apron mgmt.
  - How wide is data set (global vs domestic?)
- **New Capabilities → *Widgets, Focus Group: Ops Dashboard***
  - Data visualization, mobile apps and dashboard
  - Airspace saturation modeling and capacity estimation
  - Automated testing and error response
  - Constraints and modeling (airspace saturation, capacity estimation, etc.)
  - Defining methods and technology enhancements for how to deliver and manage aviation data

Discussion Topics & Areas of Focus

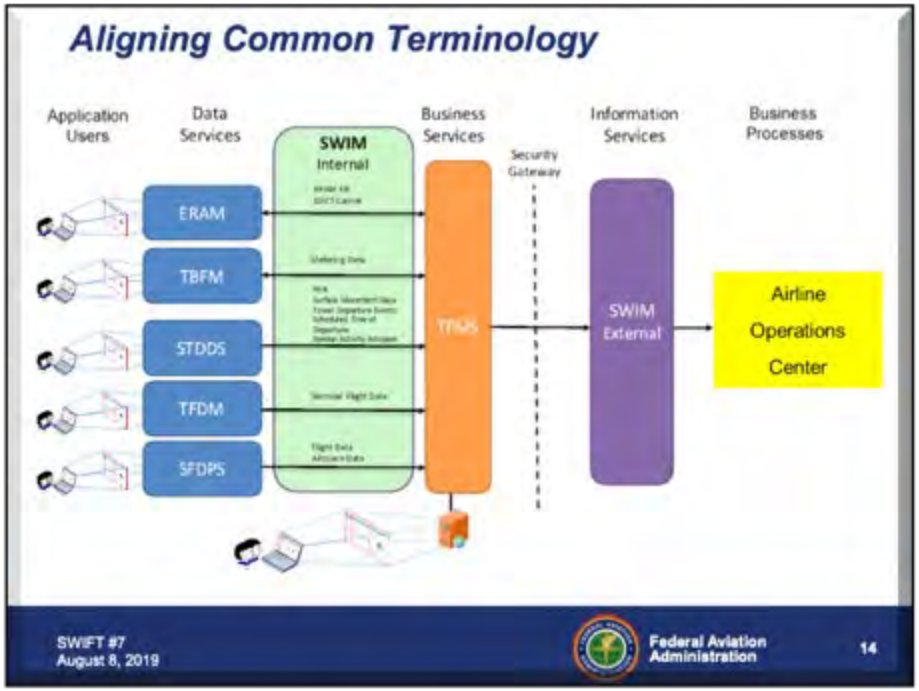
- **Data Driven Operations**
  - "Demand over a fix": average demand over fixes on jet routes
  - "Evolution of a flight plan": Re-routing from filing to off block
- **Uses of Data: Enterprise Strategy vs SWIM Strategy**
  - Data Science: learning from the data itself
  - Data Integration: Tying legacy systems and real time nature of SWIM data
- **Business Process Analysis and SWIM**

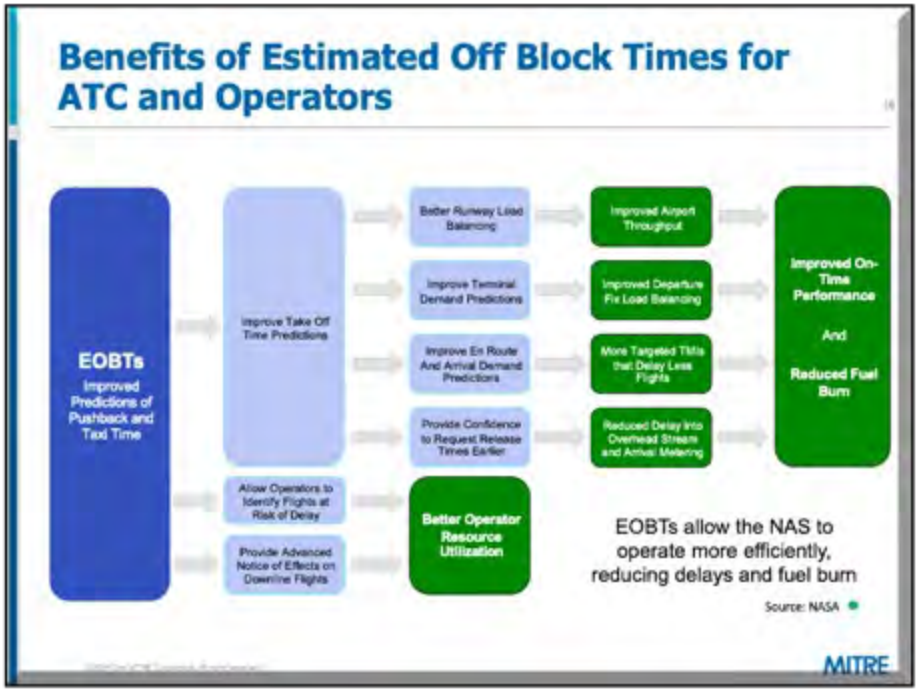
Next Step:
Group Work to Discuss Key Questions

Once upon a time…Inputs from past SWIFT

- **SWIM Business Case → *User Case Studies, Ops Metrics***
  - Sell reason & build business case for connecting SWIM
  - Integrating operations
  - Standardizations across industry
  - Post ops/benefit assessment of PBN

Operational Improvements using SWIM





Integrated Data Foundation
Building One Source–Serving All

SWIFT 7th Meeting

Southwest Airlines

SWIM Process Discussion

August 8, 2019
Denver, Colorado
Rick Dalton, Josh Griffith, and Doug Buckmaster

Agenda

- Process Journey
- Checkpoints
- Kick-off & Post Kick-off Workshop
- Epic Lean Business Case Example
- Prototyping and Progress
- ATD-2 and EOBT Examples
- Q & A

Process Journey

Concept
Idea Generation

- Requests
- Driving Force (Pain)
- Industry Community
- Legislation
- Competitors

Key deliverables
- Products concept description

Research
Assess Ops Needs

- Industry Norms
- Legal issues
- Growth potential
- Customer needs
- Competition
- Operational Integrity

Key deliverables
- Gov't Research Rpt.
- Industry Req. Docs
- Company Strategy Alignment and Agreement

Analysis
Bus. and Tech. Analysis

- Cost/Benefit
- Capacity Planning
- Capital Expenses
- Profitability/Margin
- ROI Estimation

Key deliverables
- Business Cases
- Value Stream Map.
- Hypothesis Outcome Statement
- Product Epics - Features

Development
Product Development

- Technical Specs
- Prototyping
- Trial Production
- Testing & QA
- Health Assessment

Key deliverables
- Prototypes & Trials
- Product Development Schedule
- Product Stories
- Product Testing Report

Launch
Productionize

- Set Launch Dates
- Change Mgmt. Plan
- Rollout Plan
- Training Plan

Key deliverables
- Product Launch Dates Set
- Product Launch Plan
- Product Launch Budget
- Product ROI Measured

Checkpoints

Methodology with Scaled Agile Framework
Collaboration between Business and Technology

Concept
Checkpoint 1

Activities:

- Review product concept description
- Weighted Shortest Job First (WSJF)

Decision:
- Go/No-Go to Research
- Incubate idea or kill

Research
Checkpoint 2

Activities:

- Research approved product concepts
- Weighted Shortest Job First (WSJF)

Decision:
- Go/No-Go to Analysis
- Incubate idea or kill

Analysis
Checkpoint 3

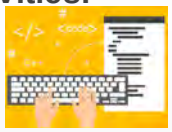
Activities:

- Develop Business Cases
- Identify Value Streams
- Weighted Shortest Job First (WSJF)
- Create Hypotheses, Epics and Features

Decision:
- Go/No-Go to Development
- Incubate idea or kill

Development
Checkpoint 4

Activities:



- Technical Specs
- Prototyping, Trials, and Testing
- Health Assessment

Decision:
- Go/No-Go to Launch

Launch
Checkpoint 5

Activities:

- Set Launch Dates
- Change Mgmt. Plan
- Rollout Plan
- Training Plan

Decision:
- Go/No-Go to Production

Kick-off and Post Kick-off Workshop

Purpose

Kick-off:

- Align enterprise behind reason for SWIM
- Provide awareness & value of SWIM
- Introduce data collection activities
- Gain buy-in
- Appoint POCs

Post Kick-off:

- Refine business cases
- Realign
- Confirm POCs

Outcome

Kick-off:

- Enabled awareness across the enterprise
- Generated interest across the enterprise

Post Kick-off:

- Identified Value Opportunities
- Created initial Business cases
- Refined Working Group
- Approved Funding

Process

Kick-off and Post:

- SAFe methodology
- Identify:
  - Business cases
  - Value stream Mapping
  - Product epics
  - Product features
  - Product stories
- Work collaboratively between Business & Technology
- Develop prototypes
- Continue iteratively

Analysis

Activities

- Cost / Benefit
- Capacity Planning & Expenses
- Profitability Margins
- ROI Estimates

Key deliverables

- Business Cases
- Value Stream Mapping
- Hypothesis Outcome Statement
- Product Epics - Features

Epic Lean Business Case Example

Integrated Data Foundation
Building One Source—Serving All

Lean Business Case

Epic Name: System Wide Information Management (SWIM) – Planning/Post-Ops Modeling	**Funnel Entry Date:** (Date the Epic entered the funnel)	**Epic Owner:**
Epic Description: System Wide Information Management (SWIM) enables the sharing of information between diverse systems enabling the Next Generation Air Transportation System (NextGen) to deliver the right information to the right place at the right time. By storing these new data feeds		
Business Outcome Hypothesis: Enable the optimization and enhanced predictability of SWA's Flight, Crew, and Maintenance schedule.	**Leading Indicators:** Expect an X% increase in OTP and a Y% decrease in CASM.	
In Scope: · Weather Data · NOTAMS/Aeronautical Data · Ground Data · Flight Data · Flow Data	**Out of Scope:** · Building/enhancing applications that utilize the SWIM data · Data for non-commercial aircraft STTDS	**Nonfunctional Requirements:** · API Services · Data store data for modeling

Analysis

Activities

- Cost / Benefit
- Capacity Planning & Expenses
- Profitability Margins
- ROI Estimates

Key deliverables

- Business Cases
- Value Stream Mapping
- Hypothesis Outcome Statement
- Product Epics - Features

Prototyping and Progress - Business and Technology

Integrated Data Foundation
Building One Source—Serving All

Business	Technology	Outcome
▪ Launched ATD-2 trial week of July 15, 2019	▪ Connected to FAA data centers	▪ Receive value early
▪ Produced EOBT	▪ Building prototypes for data storage	▪ Build APIs and data stores for current and future state
▪ Produced taxi-in and taxi-out model	▪ Participating with NASA/FAA	▪ Establish continual partnership between business & technology
▪ Developed partnership with Metron	▪ Establishing API and data store requirements – product epics, features, and stories	▪ Develop prototypes and trials
▪ Prioritized legacy SWIM feeds for retirement	▪ Completing new multi-client TFMS	▪ Continue to develop iteratively
	▪ Publishing CDM data streams	

Product Development

Activities

- Technical Specs
- Prototyping
- Trial Production
- Testing & QA
- Health Assessment

Key deliverables

- Product Stories
- Product Development Schedule
- **Value Delivered Early**
- Product Testing Report

Prototyping with ATD-2 Phase III

Integrated Data Foundation
Building One Source—Serving All

Who

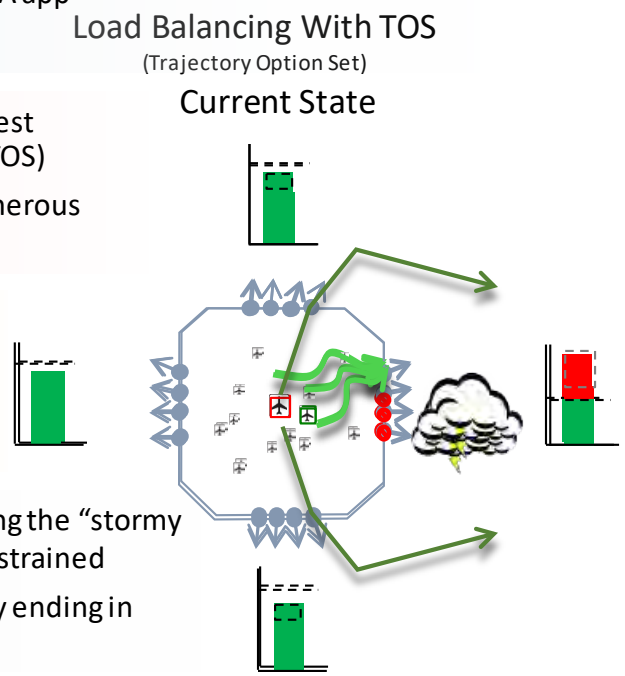
- NASA is running the trial in partnership with the FAA
- Operators participating: American Airlines, Southwest Airlines, and NBAA app

What

- Phase 3 of the Airspace Technology Demonstration – 2 (ATD2) trial will test departure fix load balancing through the use of Trajectory Option Sets (TOS)
- For a busy terminal environment that handles departing traffic from numerous airports

Where

- Dallas terminal airspace, specifically tracking estimated congestion at departure fixes



When

- The trial will began early June 2019 and runs until October 2019, targeting the "stormy season" when departure fixes will have the highest chances of being constrained
- The trial will resume again in the summer of 2020, with the trial officially ending in October 2020

Why

- The FAA has partnered with NASA to demonstrate the practical application and value of several NextGen airspace initiatives
- SWA benefits in the following ways:
  - A real world environment for testing the newly created Earliest Off Block Time (EOBT) model prior to pushing the model to production via SWIM later this year
  - Provides SWA with a new tool for reducing delays at DAL station this summer as daily operations grow to 200/day

EOBT Use Case

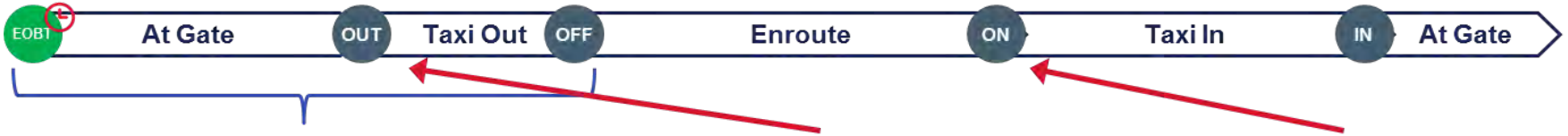
Integrated Data Foundation
Building One Source--Serving All

Current

- SWA communicates departure readiness after push back
- ATC identifies volume issue and delays take-off
- SWA holds on taxiway until cleared or in some cases must return to gate (ex: Crew issue)

- Once take-off occurs, SWA has confidence in flight time estimate

- Enroute ATC delays can occur due to lack of accurate airline demand and airport capacity information



With EOBT

- SWA provides estimate off block prior to push
- ATC sequences SWA flight appropriately; ATC communicates estimated TOBT and TMAT timing if surface metering
- SWA opts to hold at gate with gate services and door open (Clock not started)
- After push, SWA taxi out is unimpeded

- SWA can use ATC-provided 'OUT' estimate to more accurately estimate ON/IN; enables Customer notifications and internal coordination for gate and connecting Customer planning at arrival airport

- Earlier, more accurate airline demand information enables ATC to improve airspace and arrival airport throughput (reduced SWA enroute delay)

EOBT Use Case & Value

Integrated Data Foundation
Building One Source—Serving All

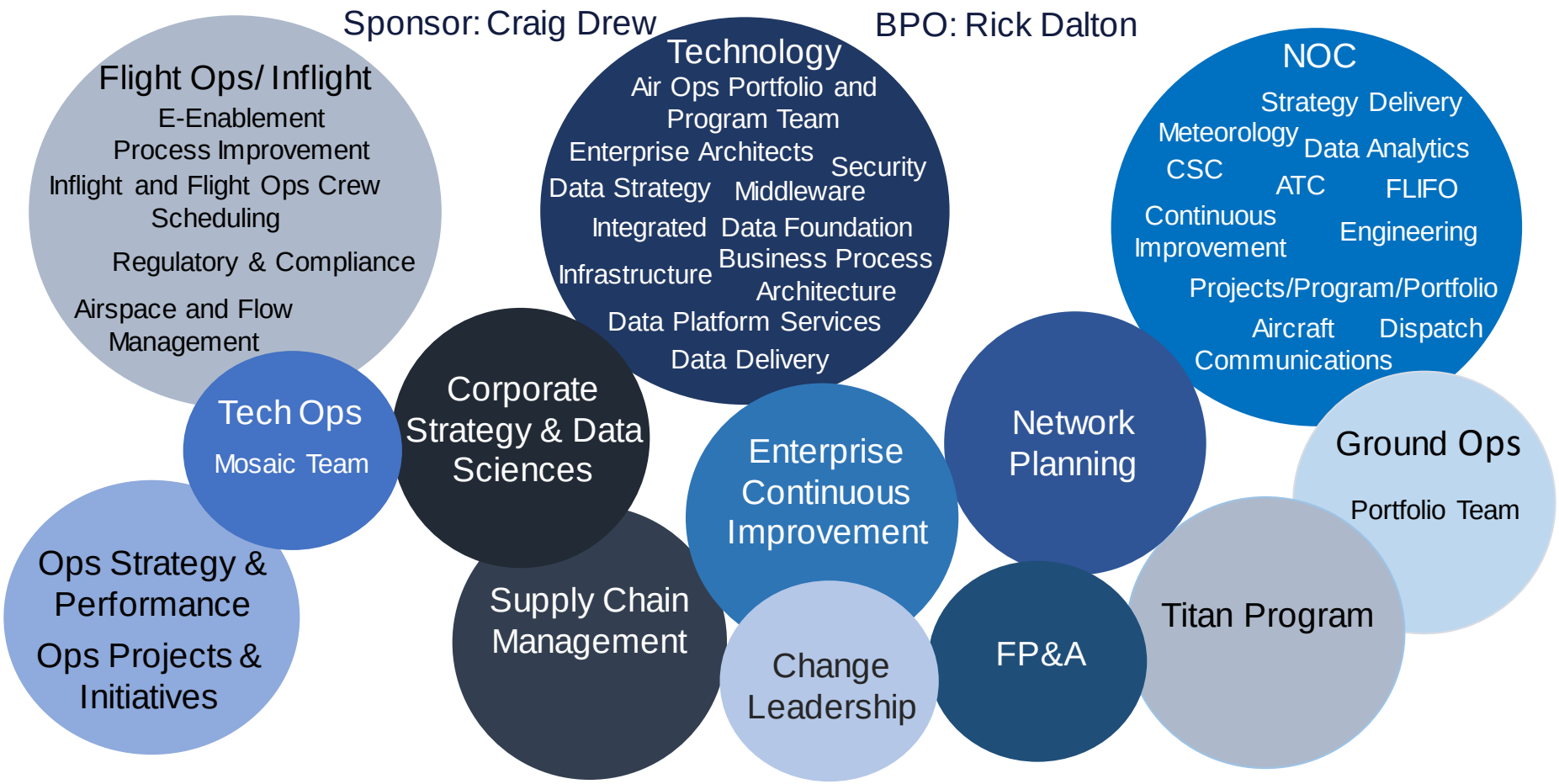
New Metric

EOBT: Earliest Off Block Time

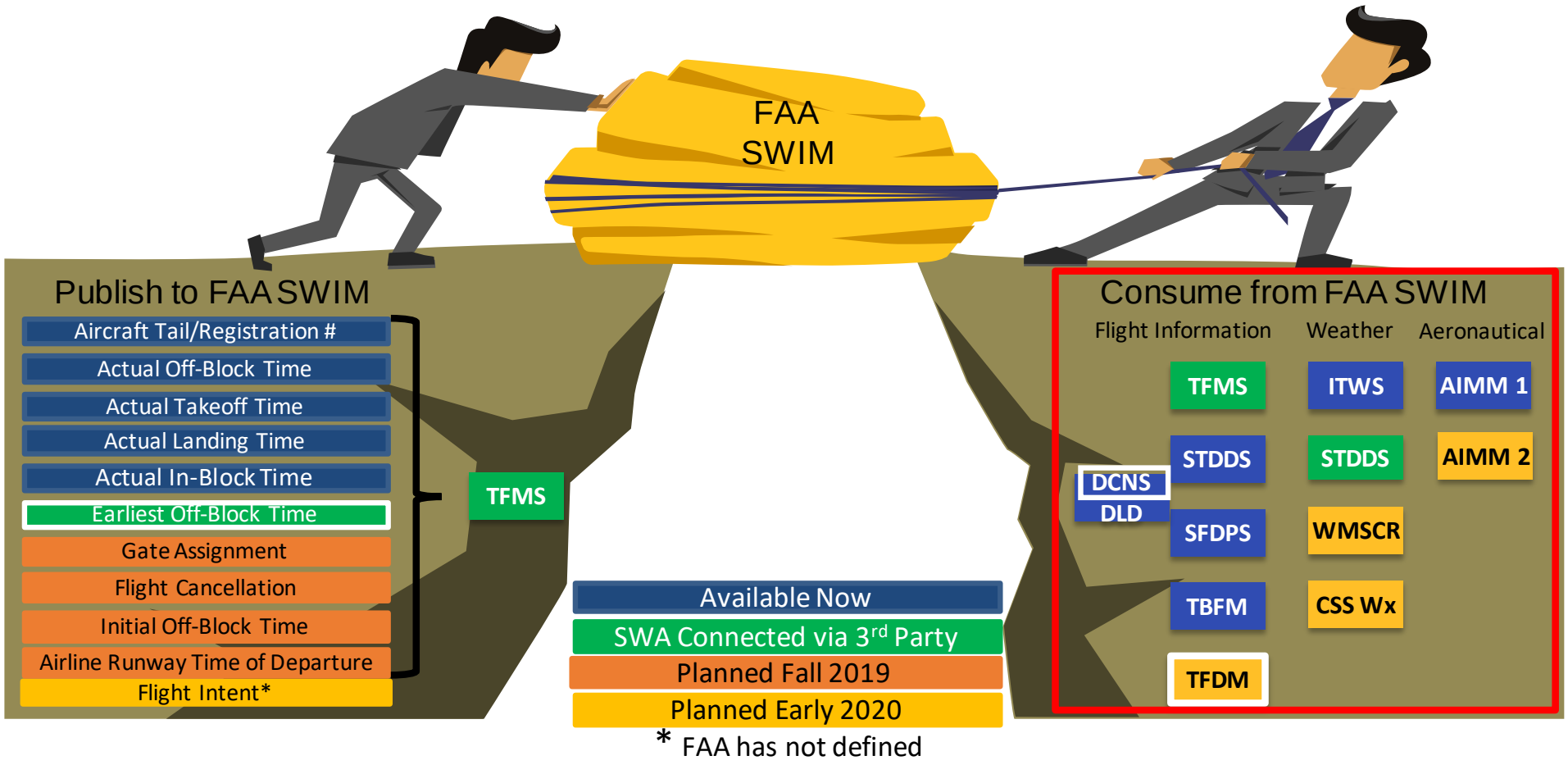
Questions?

Appendix

SWIM Stakeholders?



SWIM at a Glance



Operational Improvements using SWIM

Epic Lean Business Case Example

Lean Business Case

Epic Name:	Funnel Entry Date:	Epic Owner:
System Wide Information Management (SWIM) – Planning/Post-Ops Modeling	(Date the Epic entered the funnel)	

Epic Description:
System Wide Information Management (SWIM) enables the sharing of information between diverse systems enabling the Next Generation Air Transportation System (NextGen) to deliver the right information to the right place at the right time. By storing these new data feeds . . . .

Business Outcome Hypothesis:	Leading Indicators:
Enable the optimization and enhanced predictability of SWA's Flight, Crew, and Maintenance schedule.	Expect an X% increase in OTP and a Y% decrease in CASM.

In Scope:	Out of Scope:	Nonfunctional
· Weather Data · NOTAMS/Aeronautical Data · Ground Data · Flight Data · Flow Data	· Building/enhancing applications that utilize the SWIM data · Data for non-commercial aircraft STTDS	· API Services · Data store da

Analysis

Activities

- Cost / Benefit
- Capacity Planning & Expenses
- Profitability Margins
- ROI Estimates

Key deliverables

- Business Cases
- Value Stream Mapping
- Hypothesis Outcome Statement

EOBT Use Case & Value

- SWA estimates fuel savings of $14.7k - $560k per annum
  - Assumes 10-40% reduction in ATC related taxi out delays
- SWA estimates $3M-$12M in ATC Delay reductions
  - Assumes 10-34% reduction of delays at TFDM configuration A sites
- Estimates are thought to be conservative and do not reflect benefits associated with TOS routing capabilities. Valuation estimates will be refreshed at the conclusion of 2019 ATD-2 Phase III trials

Once upon a time…Inputs from past SWIFT

- **Key Operational Metrics**
  - Operational Performance
    - Output (ramp flow rates) => airline timeframe
    - Accuracy of predicted airport capacity, Surface congestion/taxiway holding
    - Improved safety
    - Impacts: Weather, TMI
    - Routes, Delays (by cause, etc.), Track miles, Block times, Enroute time
  - Business Goals
    - Reduce operating costs
    - Better customer service/support
  - System Level Metrics
    - System reliability, outages, latency, visibility
    - Availability of live/production data on test/tap feeds
    - Test feed outage alerts/workarounds

BREAK

SWIFT Updates:
Aeronautical Information Management Update

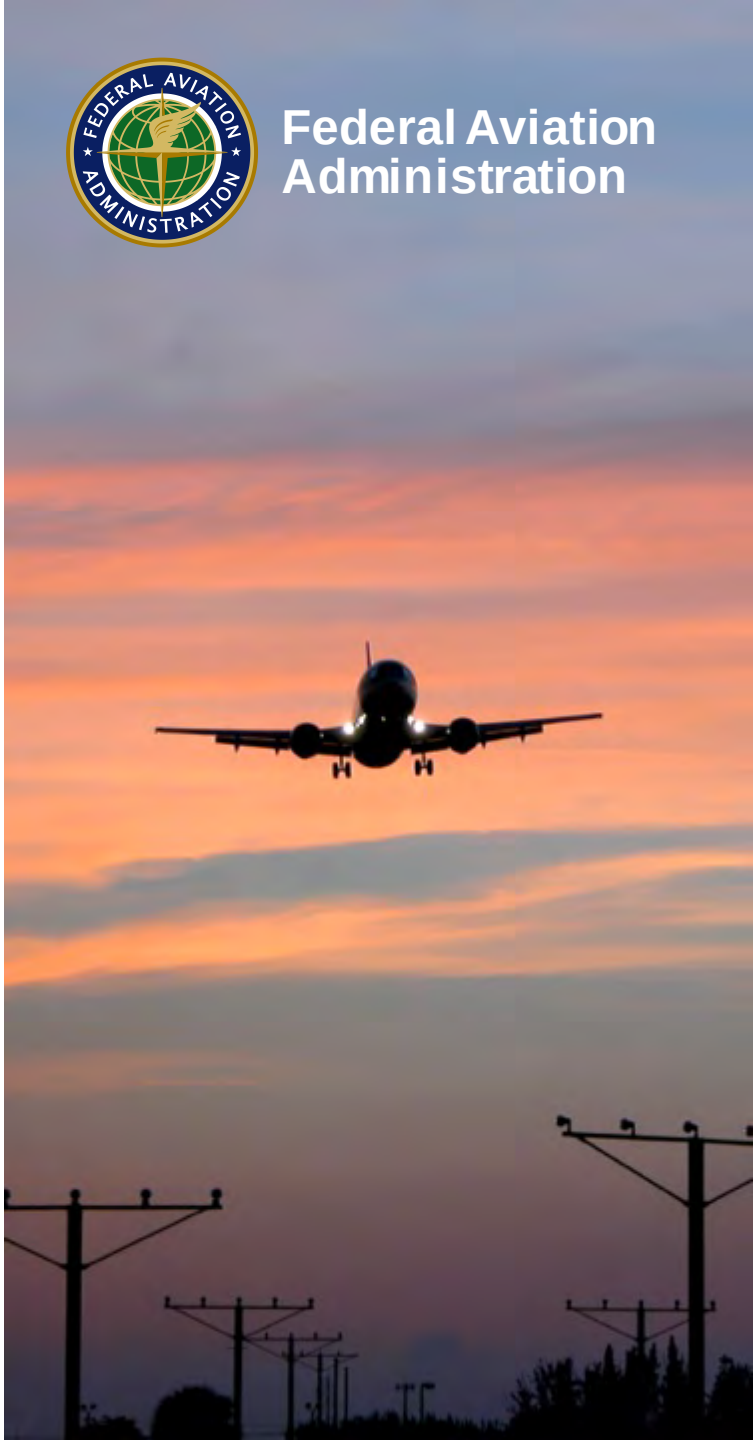
ACS Customer Testbed

David Almeida

SWIFT Community Moderator

August 8, 2019

Federal Aviation Administration



ACS Consumer Testbed (ACT)

- **Created in the R&D domain to provide ACS services**
  - Stakeholders get an early look at available data, service functionality, onboarding processes, consumer design constraints and recommended practices, and a familiarization with the integrated aeronautical data environment introduced by AIMM S2
  - Two instances: canned data (ACT1) and live data (ACT2)

- **ACT will provide users the ability to:**
  - Develop and test their interface with the ACS
  - Develop and test use, functionality, and capability of ACS web-services
  - Interact with, and understand, aeronautical information data set available through the ACS
  - Initial step to on-ramping to ACS

Summary:

- **AIM/ACS program milestones;**
  - ACS/ACT initial load requirement - August 2019
  - ACS Full Operational Capability planned for July 2020
  - FNS NOTAM Database – Would like to have the initial load capability in AWS S3 by the time FNS NDS is available in SCDS for operational use.

Federal Aviation Administration

Federal Notice to Airmen (NOTAM) System (FNS)

Amazon S3

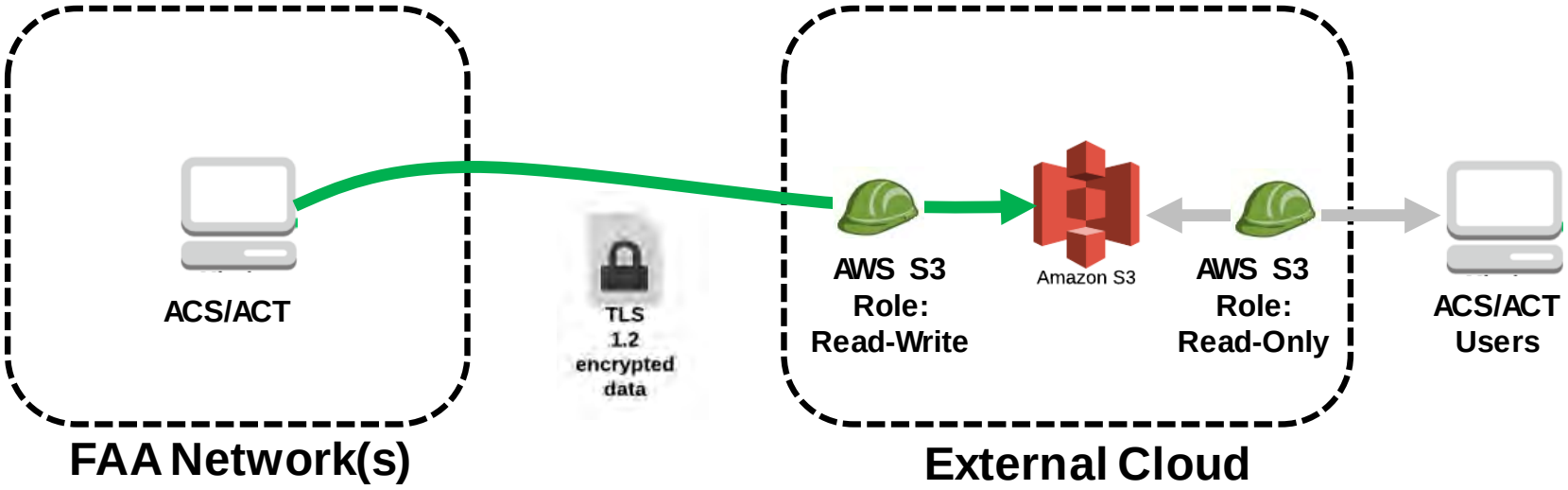
aws

Proposed Solution for ACT Initial Load

- **Implementation on AWS S3 (Simple Storage Service)**
  - ACT services are hosted on FAA Cloud Service (FCS) assets, managed by the FAA's National Cloud Integration Service (NCIS) in AWS public cloud (similar to SWIM Cloud Data Services)
  - Internet-accessible AWS S3 set to PRIVATE with pre-defined access assigned Read-Only (RO) security role
  - Data in S3 is encrypted at rest and uploads encrypted in transit

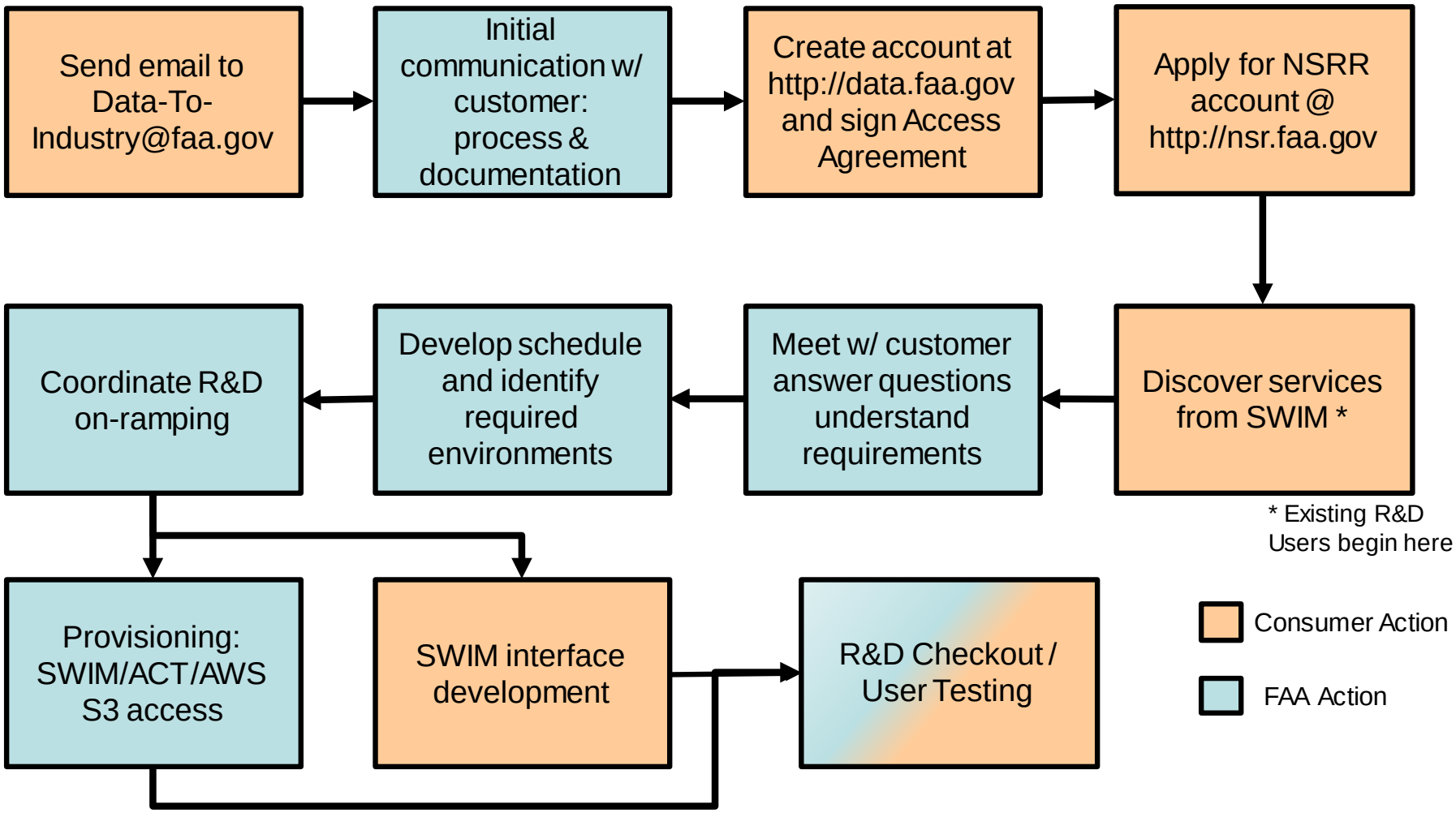
- **Immediate-term (~30 days) solution would make the ACT Aeronautical Information (AI) Database Initial Load and 28/56-day updates available for retrieval from FAA Cloud**

ACS/ACT Approach & Current State



- **AWS S3 buckets setup and ready for use**
- **Aeronautical Services “push tested” load into AWS S3**
- **Initial load of full aeronautical dataset into S3 will occur in late August/ early September**

ACT Consumer On-Boarding to R&D Environment



United Airlines SWIM-Enabled Web Application

SWIFT 7

United Flight Training Center
Denver, CO

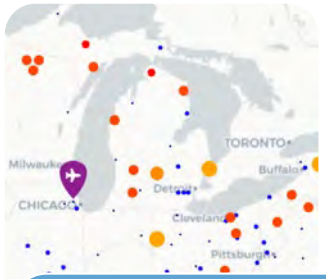
8/8/2019

A STAR ALLIANCE MEMBER

Goals/Problem Statement

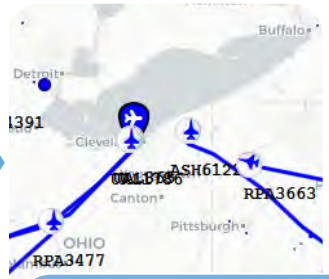
- Began development because of the opportunity these new data feeds opened up
- Initial goal was to demonstrate how data feeds can be visualized for easier interpretation
- Once initial build was developed, began adding enhancements to the viewer

Development Process



Initial Development

- Legacy Data Feeds
- Textual Field Condition NOTAMS and Runway Visual Range
- Plot on map of CONUS



Data Source Enhancements

- Added SWIM Data Feeds
- TFMS flight tracks
- TFMS Ground Stops and Ground Delay Programs
- SFDPS filed alternate airports

Visual Enhancements

- Mobile view optimized for operations personnel

Future Enhancements

- Transition legacy feeds to SWIM
- Additional products: Digital Automatic Terminal Information Service (D-ATIS), Restrictions, etc..

UNITED

Initial Development

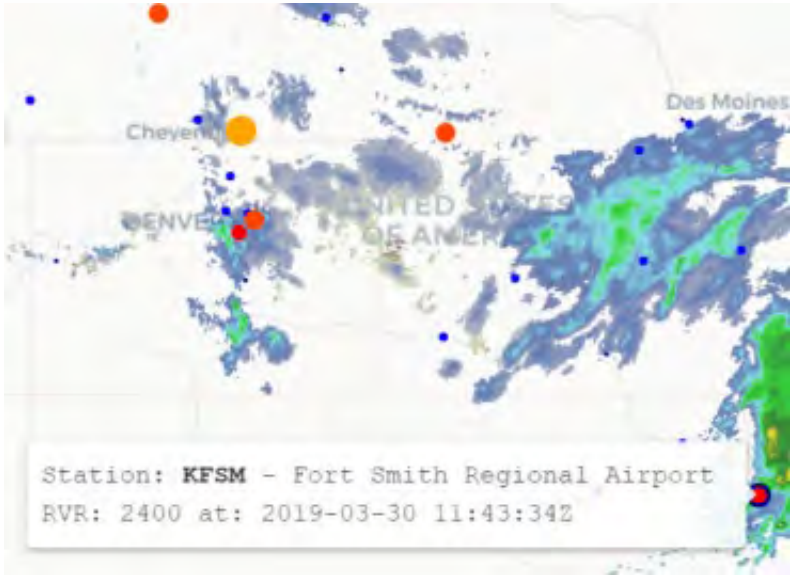
- Development began pre-SCDS so initial builds used legacy feeds that were easily accessible through the Aeronautical Information Data Access Portal (AIDAP)
  - Field Condition (FICON) Notice to Airmen (NOTAM)
  - Runway Visual Range (RVR)
  - Terminal Area Forecast (TAF)
  - Weather Radar/Satellite
- Build visual plotting NOTAMS with weather layers on a map
- Enhanced situational awareness versus looking up the NOTAM for a possible alternate
- NOTAMs for an alternate destination only show that airport, but a visual can alert you that all nearby airports have degraded conditions and it may be worth a phone call to verify conditions
  - Enhanced information leading to proactive, rather than reactive operations

Legacy Data Visualizations

Domestic TAF's

Domestic TAF's | International TAF's

Sig Wx	ID	Report	Amended	Updated
TS	KATL	KATL 311545Z 3116/0118 27004KT P6SM VCSH SCT040 BKN100 FM311800 25008KT P6SM VCSH SCT060 SCT120 TEMPO 3120/3124 4SM TSRA SCT040CB BKN080 FM010300 30003KT P6SM SCT040 BKN100 FM011400 26005KT P6SM SCT040 SCT150	0	2019-07-31 16:48:00Z
TS	KBDL	KBDL 311446Z 3115/0118 22007KT P6SM SCT250 FM312000 23006KT P6SM VCTS BKN060CB FM010000 27006KT P6SM BKN060 FM010400 00000KT P6SM BKN100 FM011400 36005KT P6SM SCT250	0	2019-07-31 16:48:00Z
TS	KBIL	KBIL 311120Z 3112/0112 22012KT P6SM FEW150 SCT250 FM311800 12005KT P6SM SCT100 FM312100 12005KT P6SM VCTS SCT120CB BKN200	0	2019-07-31 16:48:00Z
TS	KBOS	KBOS 311445Z 3115/0118 23008KT P6SM SCT250 FM312000 20008KT P6SM VCTS BKN060CB FM010000 23009KT P6SM SCT060 BKN100 FM011100 31005KT P6SM BKN250 FM011500 10008KT P6SM SCT250	0	2019-07-31 16:48:00Z



UNITED

SWIM Data Feed Enhancements

- SCDS Prototype made accessing SWIM feeds easier, added additional SWIM feeds to existing visualizations
- TFMS Flight data to include flight tracks
- TFMS Flow data to add Traffic Management Initiatives (TMIs) including Ground Stops and Ground Delay Programs at airports
- SFDPS data to add filed alternate airport information

SWIM-Enabled Visualizations

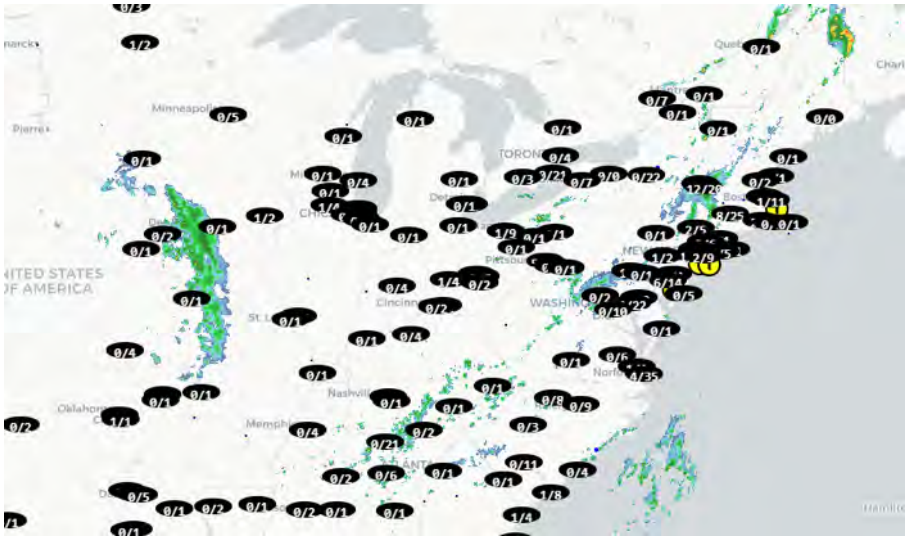
Alternates

Page will refresh every 3 minutes

Destination Station: Alternate Station: Line: All Filter

Copy Excel PDF Column visibility

ROW	CAR	FLT	DEST	ALT	ORI	EON
1	UAL	UAL855	KIAH	KAUS	SPJC	31-16:32Z
2	UAL	UAL1110	KLAX	KONT	PHOG	31-16:33Z
3	UAL	UAL1270	KSAV	KCHS	KORD	31-16:34Z
4	UAL	UAL662	KSFO	KSJC	KSAN	31-16:36Z
5	UAL	UAL1585	KSFO	KSJC	KCMH	31-16:38Z

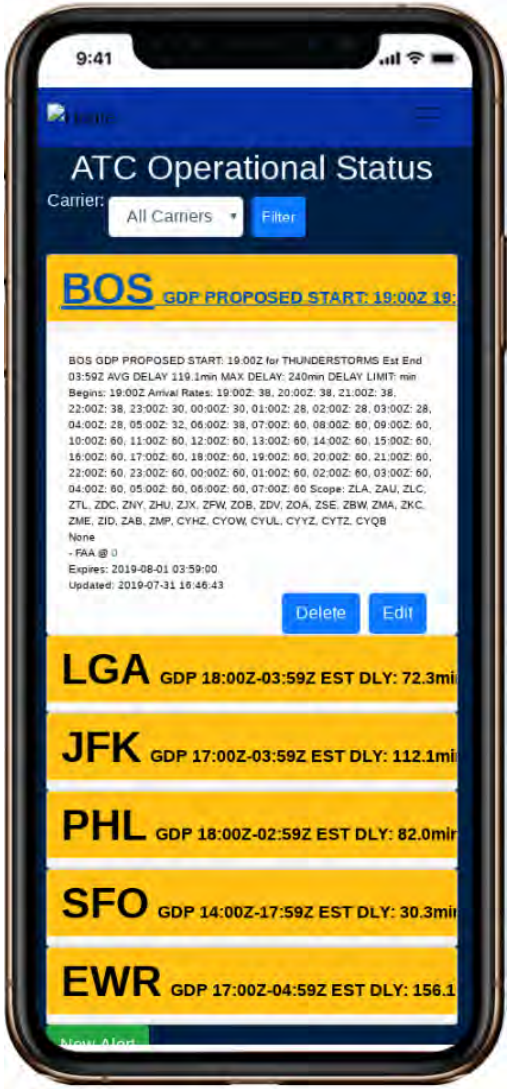


JFK: GDP 17:00Z-03:59Z EST DLY: 112.1mins expires 1st@03:59Z
LGA: GDP 18:00Z-03:59Z EST DLY: 72.3mins expires 1st@03:59Z
BOS: GDP PROPOSED START: 19:00Z 19:00Z-03:59Z EST DLY: 119.1mins expires 1st@03:59Z
EWR: GDP 17:00Z-04:59Z EST DLY: 156.1mins expires 1st@04:59Z
SFO: GDP 14:00Z-17:59Z EST DLY: 30.3mins expires 31st@17:59Z
PHL: GDP 18:00Z-02:59Z EST DLY: 82.0mins expires 1st@02:59Z

UNITED

Visual Enhancements

- United has many personnel that work in the field and are rarely at a desk
- Operations personnel need to be aware of TMIs, but monitoring the OIS page is not feasible
- A mobile optimized page was needed to show them a summary of their operations and all network alerts



UNITED

Planned Future Enhancements

- Transition all legacy data feeds to SWIM once SCDS goes live
- Continue to add products to built out a suite of tools
  - D-ATIS to quickly access terminal information and important NOTAMs
  - TFMS Restrictions to add flow constraints, TMI, route closure information

www.runwayweather.com

UNITED

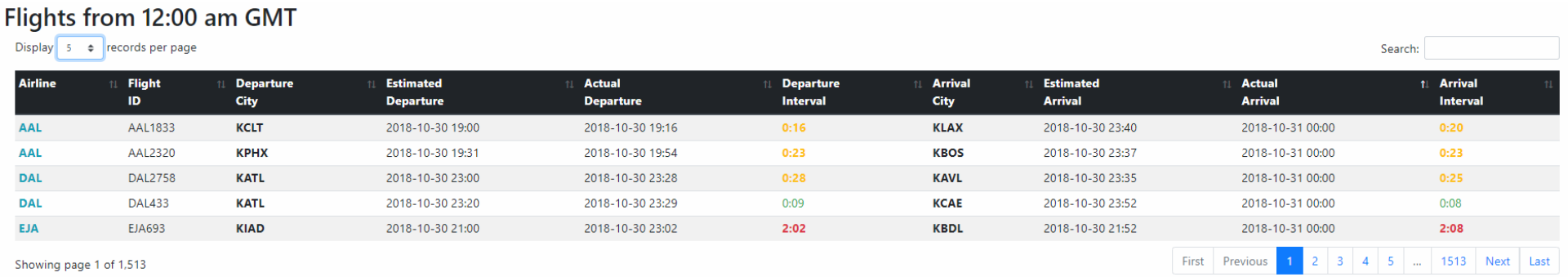
SWIFT WIDGETS

Purpose of SWIM Widgets

- **SWIM data is often visualized in ways that look nice but may not be the most functional based on the operational need**
  - Moving map of aircraft
  - Weather map of CONUS
- **Widgets have been developed to visualize SWIM data in operationally-actionable ways**
  - Enable faster, more accurate decisions based on useful visualizations of data
- **Lightweight web-based applications that can be scaled to desktop or mobile devices**

Flight Arrival/Departure Intervals

- **Sort and filter data to identify how early or late individual flights departed or arrived**
- **Identify which airports/airlines are subject to delays**
- **Visualization of SFDPS live data**



Flights from 12:00 am GMT

Display 5 records per page

Search:

Airline	Flight ID	Departure City	Estimated Departure	Actual Departure	Departure Interval	Arrival City	Estimated Arrival	Actual Arrival	Arrival Interval
AAL	AAL1833	KCLT	2018-10-30 19:00	2018-10-30 19:16	0:16	KLAX	2018-10-30 23:40	2018-10-31 00:00	0:20
AAL	AAL2320	KPHX	2018-10-30 19:31	2018-10-30 19:54	0:23	KBOS	2018-10-30 23:37	2018-10-31 00:00	0:23
DAL	DAL2758	KATL	2018-10-30 23:00	2018-10-30 23:28	0:28	KAVL	2018-10-30 23:35	2018-10-31 00:00	0:25
DAL	DAL433	KATL	2018-10-30 23:20	2018-10-30 23:29	0:09	KCAE	2018-10-30 23:52	2018-10-31 00:00	0:08
EJA	EJA693	KIAD	2018-10-30 21:00	2018-10-30 23:02	2:02	KBDL	2018-10-30 21:52	2018-10-31 00:00	2:08

Showing page 1 of 1,513

First Previous 1 2 3 4 5 ... 1513 Next Last

Arrival and Departure Delay Bar Charts

- **Plot overall NAS arrival and departure delays per hour**
- **Identify severity of delays and periods of high demand**
- **Plot arrivals per hour by airline**
- **Visualization of SFDPS live data**

Arrival and Departure Delay Pie Charts

- **Easily recognize overall severity of NAS arrival/departure delays**
- **Visualization of SFDPS live data**

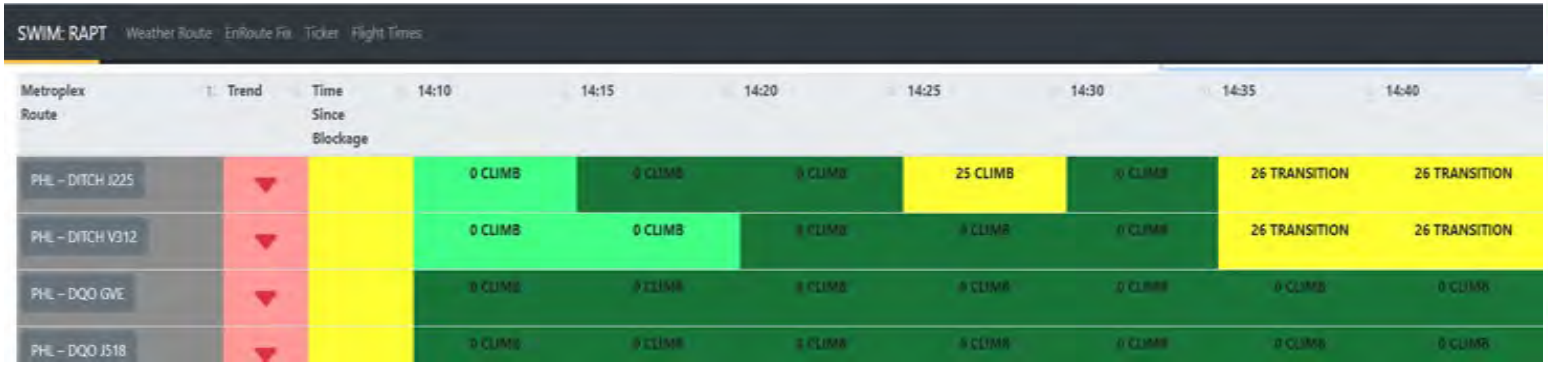
En Route Fix Loading Viewer

- **Developed to support taxi-out use case**
- **Current MIT and MINIT restrictions at specific fixes**
- **Fix loading projections for next hour**
  - Leverages methodology to calculate fix load percent in 15-minute periods
  - Identify specific fixes with limited capacity - this supports informed reroute requests
- **Can be extended to include flight list functionality**
- **Visualization of TFMS, TBFM (currently static data)**

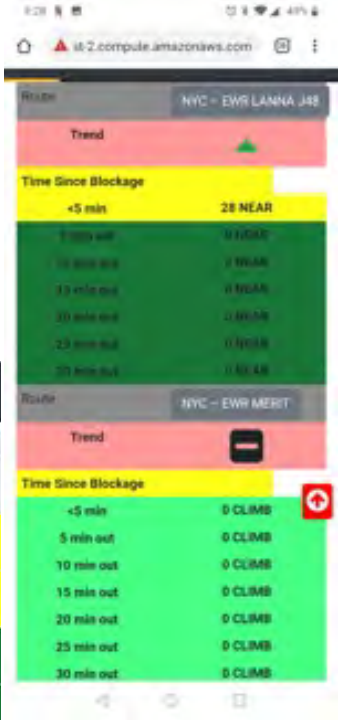
Fix	Miles In Trail	Minutes In Trail	1000 - 1015	1016 - 1030	1031 - 1045	1046 - 1100
WAVEY		10	80	75	60	40
GAYEL	5		60	70	65	60
NEION			60	50	45	40
RBV	15		90	100	95	90
BIGGY	10		75	70	75	80
WHITE			50	40	45	50

Weather Route Availability Tool

- **Developed to support taxi-out use case**
- **Show departure route availability projections for next 30 minutes due to weather constraints**
  - Identify specific departure routes/fixes with limited capacity - this supports informed reroute requests
  - Identify altitude of echo tops, blockage locations
- **Filter routes by metroplex**
- **Visualization of TFMS**
  - Route Availability Planning Tool (RAPT)



Desktop View



Mobile View

Weather Route Availability Tool with Flight List

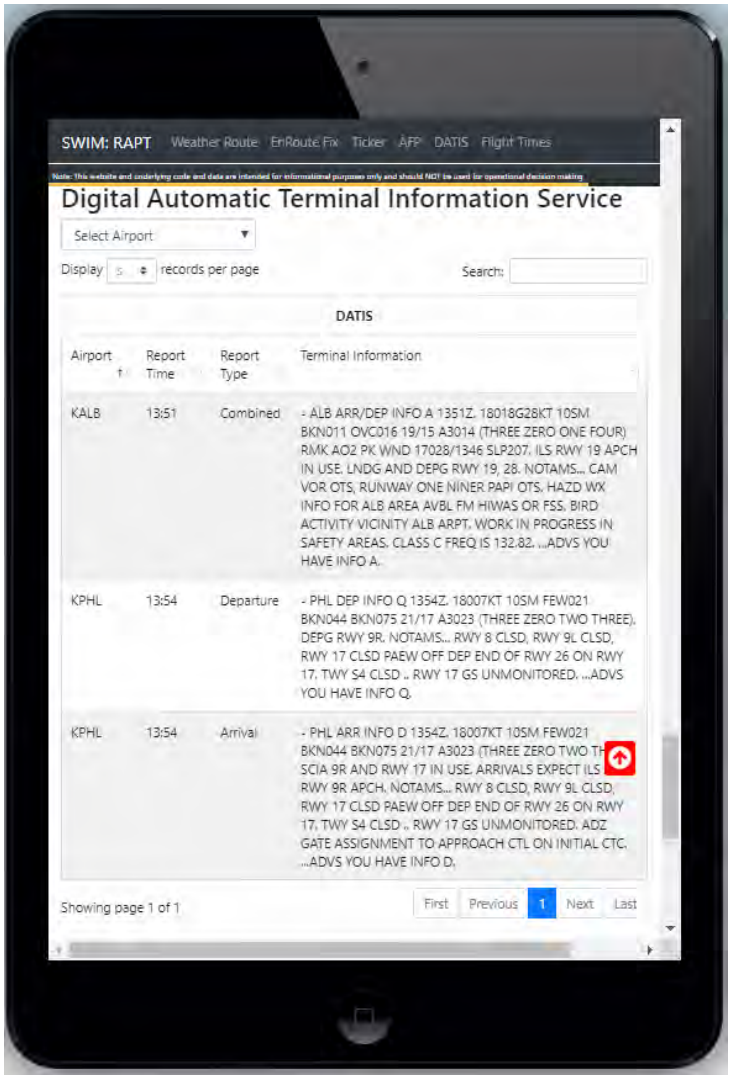
- **Developed to support taxi-out use case**
- **Adds additional capability to Weather Route Availability Tool**
- **Show scheduled flights on each route for next 30 minutes**
  - Upon clicking route, a table pops up with flights scheduled to depart on that route
  - AOC can identify affected flights, as well as capacity concerns
- **Visualization of TFMS and SFDPS**
  - Route Availability Planning Tool (RAPT)
  - SFDPS Flight ACID, Route Strings

Desktop View

Mobile View

Digital Automatic Terminal Information Service

- **Airport Terminal Information required by aircraft operators, such as current weather information, active runways, important NOTAMs, etc..**
- **Ideal for EFB applications**
- **Visualization of STDDS APDS**



Flight Arrival/Departures with OOOI Times

- **Adds additional surface movement times to arrival/departure table**
- **Can infer**
- **Visualization of SFDPS and STDDS SMES**

Flights from 12:00 am GMT

Display 5 records per page

Search:

Airline	Flight ID	Departure City	Estimated Departure	Actual Departure	Departure Interval	Arrival City	Estimated Arrival	Actual Arrival	Arrival Interval	Gate Out Time	Wheels Off Time	Wheels On Time	Gate In Time
AAL	AAL658	KLAX	2019-07-01 18:27	2019-07-01 19:16	0:49	KPHL	2019-07-01 23:17	2019-07-02 00:07	0:50	2019-07-01 18:12	2019-07-01 18:27	2019-07-02 00:07	2019-07-02 00:23
AAL	AAL251	KMIA	2019-07-01 19:20	2019-07-01 21:48	2:28	KJFK	2019-07-01 21:47	2019-07-02 00:25	2:38	2019-07-01 19:05	2019-07-01 19:20	2019-07-02 00:25	2019-07-02 00:40
AAL	AAL2434	KPHX	2019-07-01 19:10	2019-07-01 19:59	0:49	KJFK	2019-07-01 23:44	2019-07-02 00:38	0:54	2019-07-01 19:00	2019-07-01 19:10	2019-07-02 00:38	2019-07-02 00:53
AAL	AAL2368	KBWI	2019-07-01 19:23	2019-07-01 21:09	1:46	KDFW	2019-07-01 22:07	2019-07-02 00:33	2:26	2019-07-01 19:07	2019-07-01 19:23	2019-07-02 00:33	2019-07-02 00:48
AAL	AAL323	KDCA	2019-07-01 19:30	2019-07-01 21:22	1:52	KDFW	2019-07-01 22:09	2019-07-02 00:29	2:20	2019-07-01 21:09	2019-07-01 21:22	2019-07-02 00:29	2019-07-02 00:44

First Previous 1 2 3 4 5 ... 500 Next Last

SWIFT Widget Site

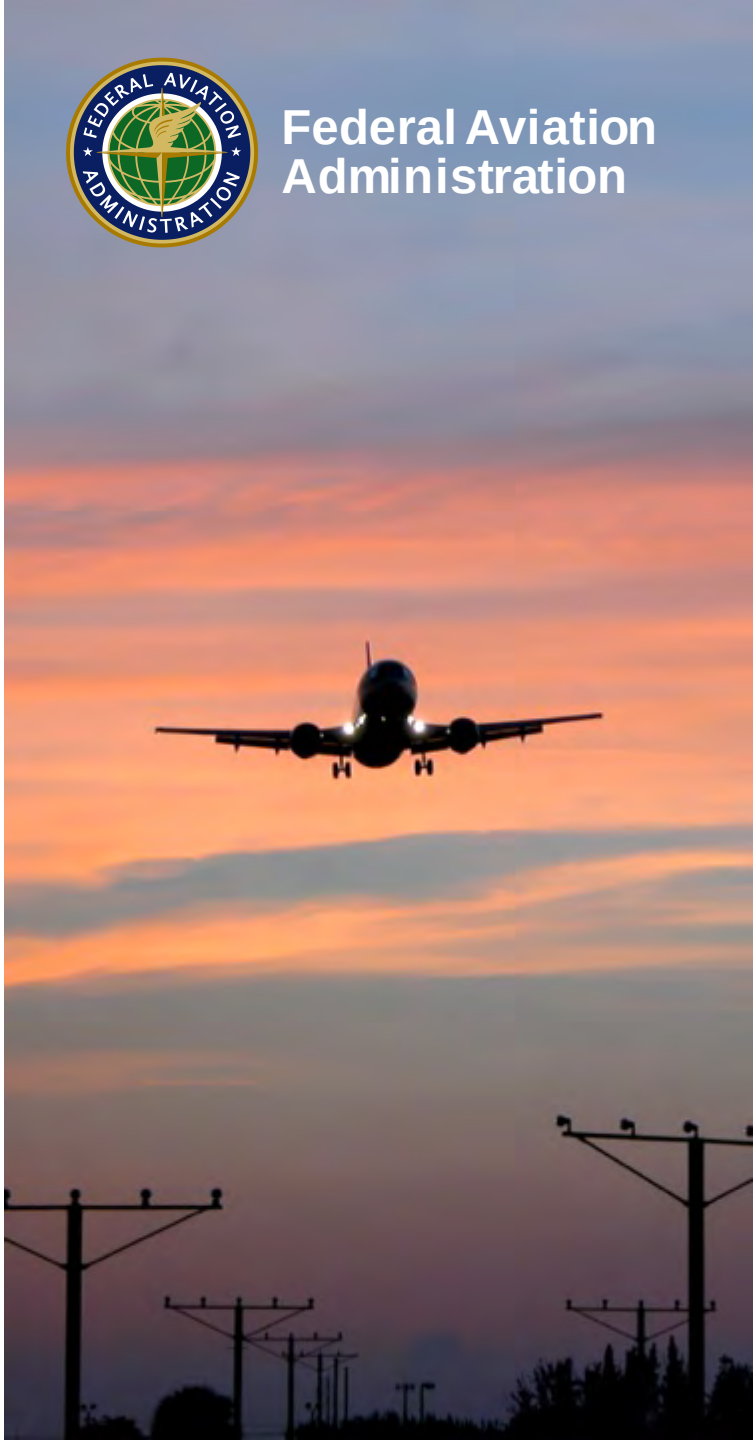
- **Prototype SWIFT widgets can be found at: http://ec2-52-10-209-24.us-west-2.compute.amazonaws.com/content/pages/flight-table.php**
- **Demonstration purposes only, widgets use prototype-non operational data**

SWIM Lost Message Retrieval Capability

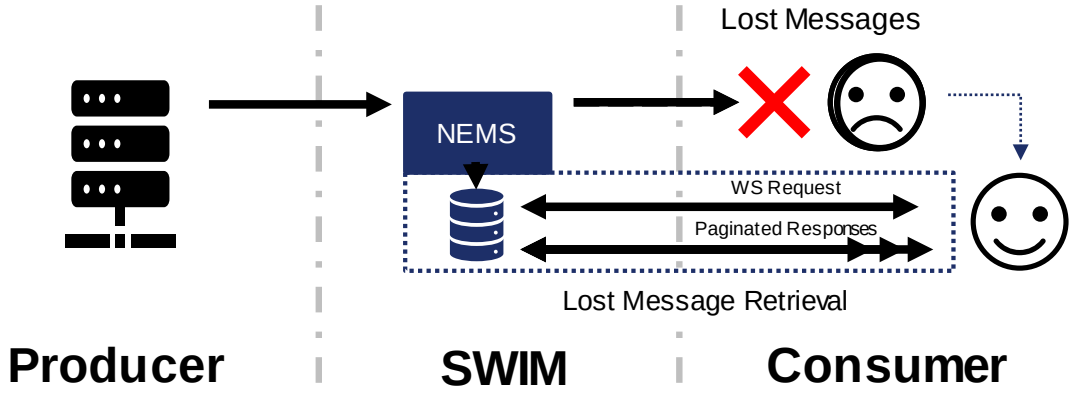
August 2019 SWIFT

Alex Murray
SWIM Engineering

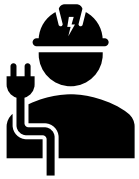
Federal Aviation Administration



Overview

Problem	SWIM consumers have no current means of retrieving messages that were lost due to connection interruptions or other consumer related issues.
Solution	Provide a function that allows consumer to request messages that were not able to be consumed.
Approach	Create a capability to store producer data and allow retrieval of the data by authorized consumers through a RESTful Web Service.
ConOps	

Operational Use Cases



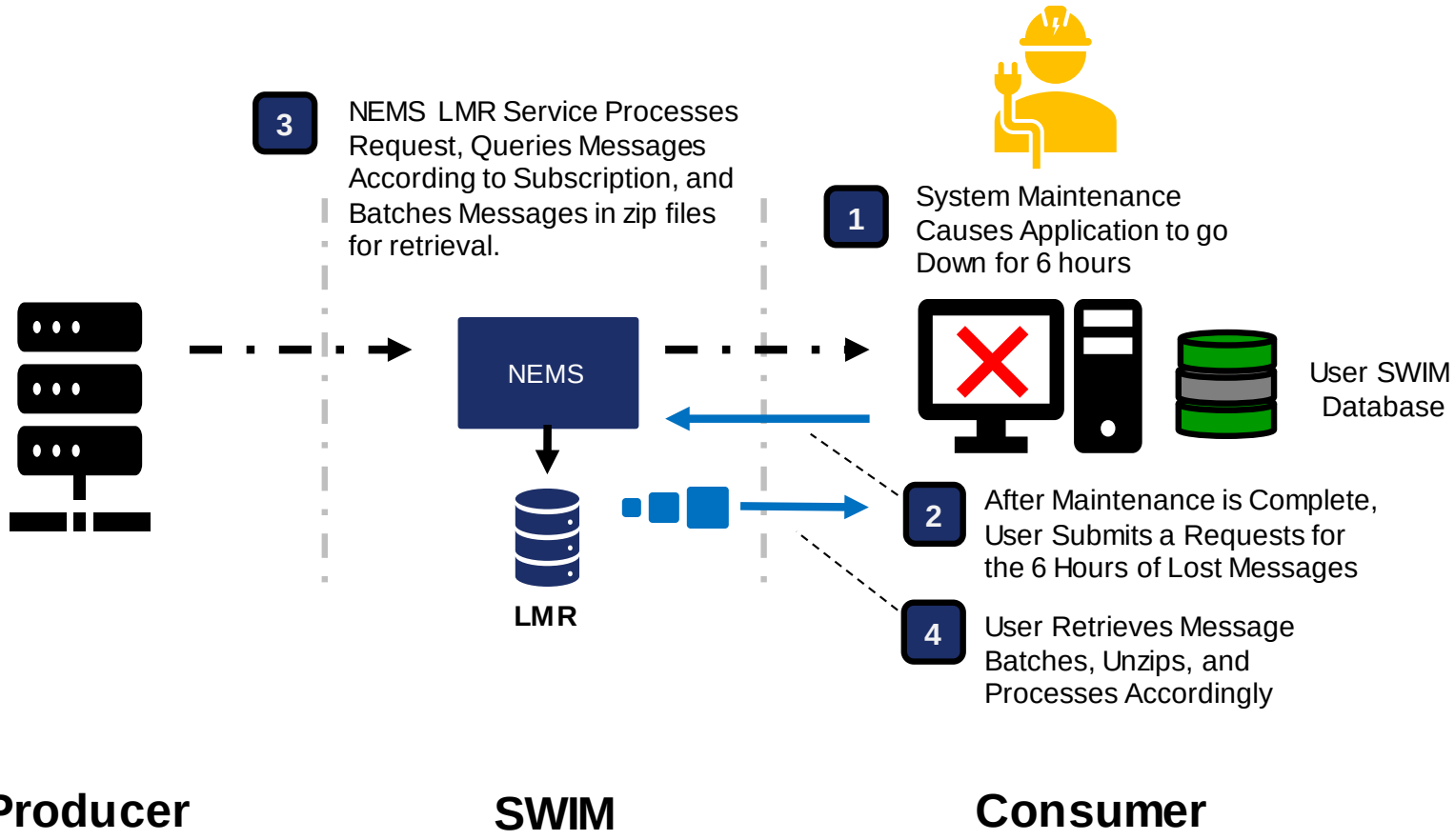
Consumer Maintenance

VPN or Network Issue

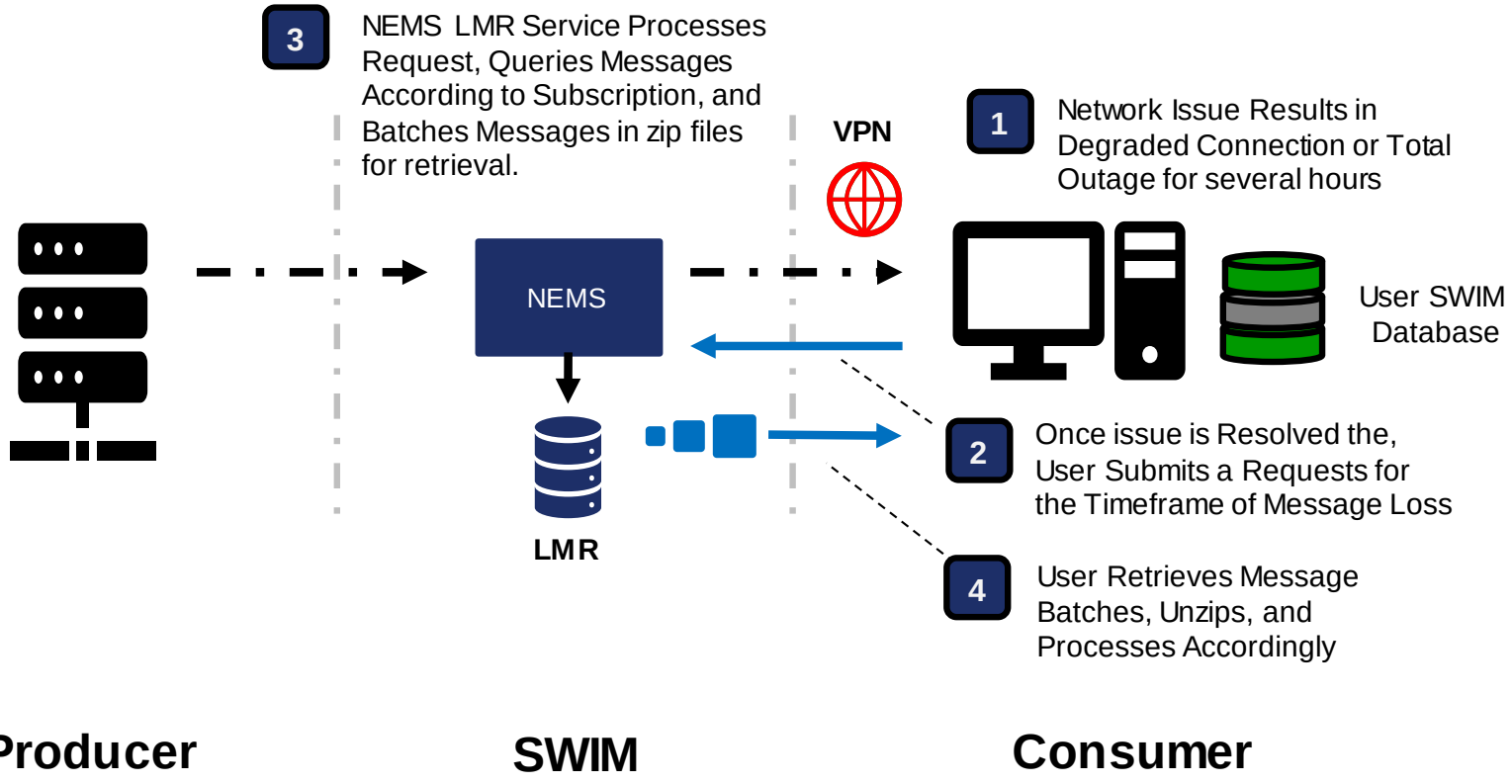
Planned or Un-Planned Events

Enhanced Troubleshooting

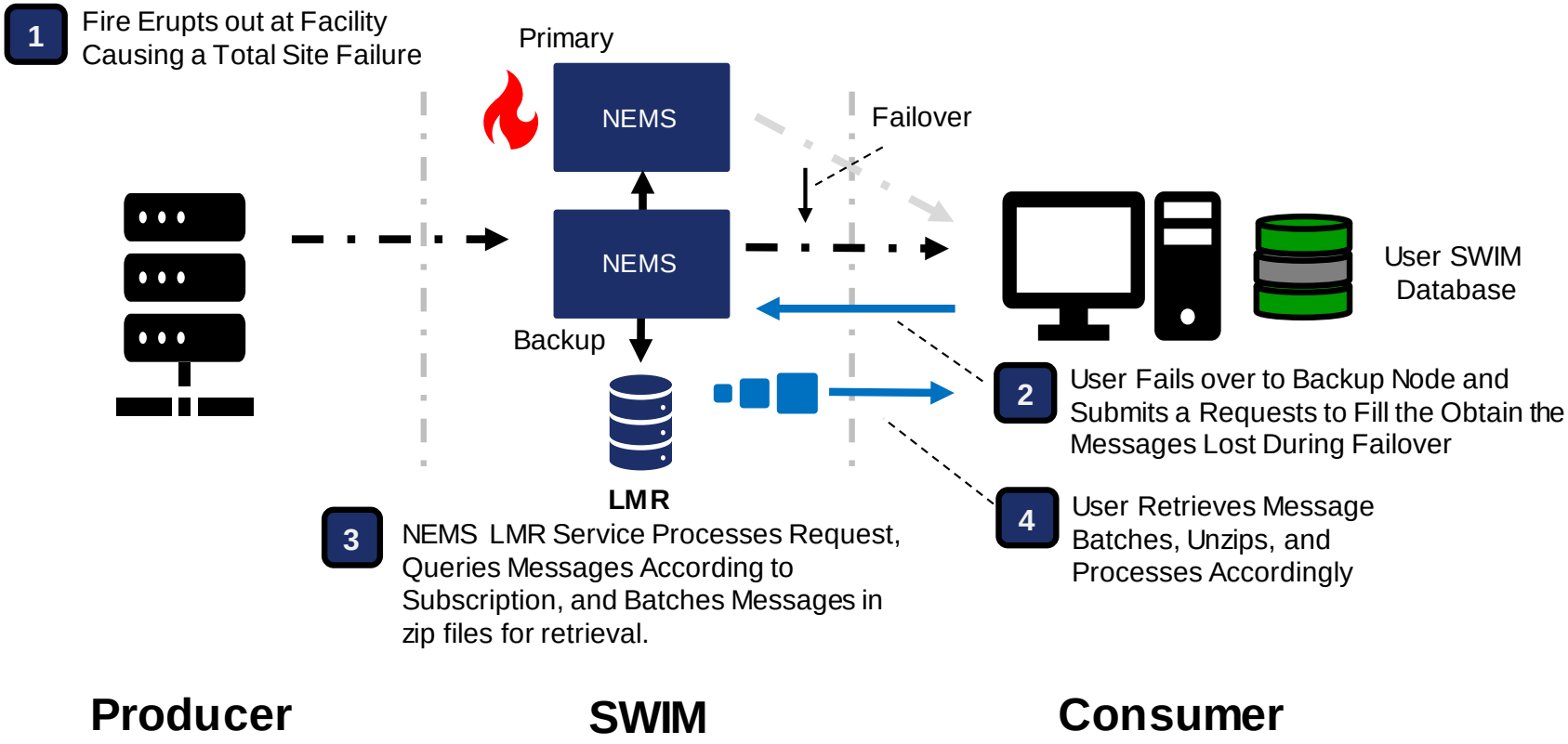
Use Case: Consumer Maintenance



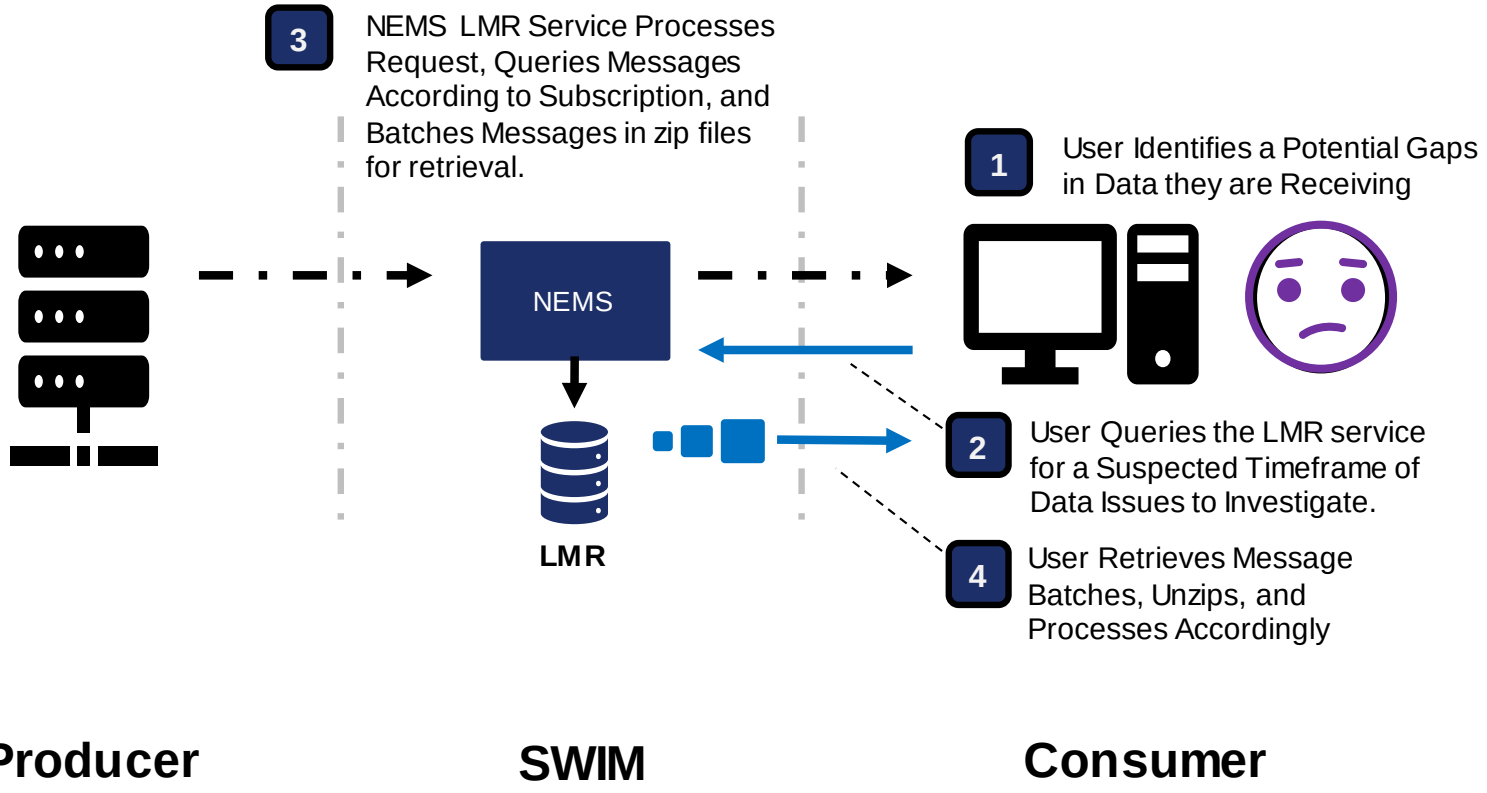
Use Case: VPN or Network Issue



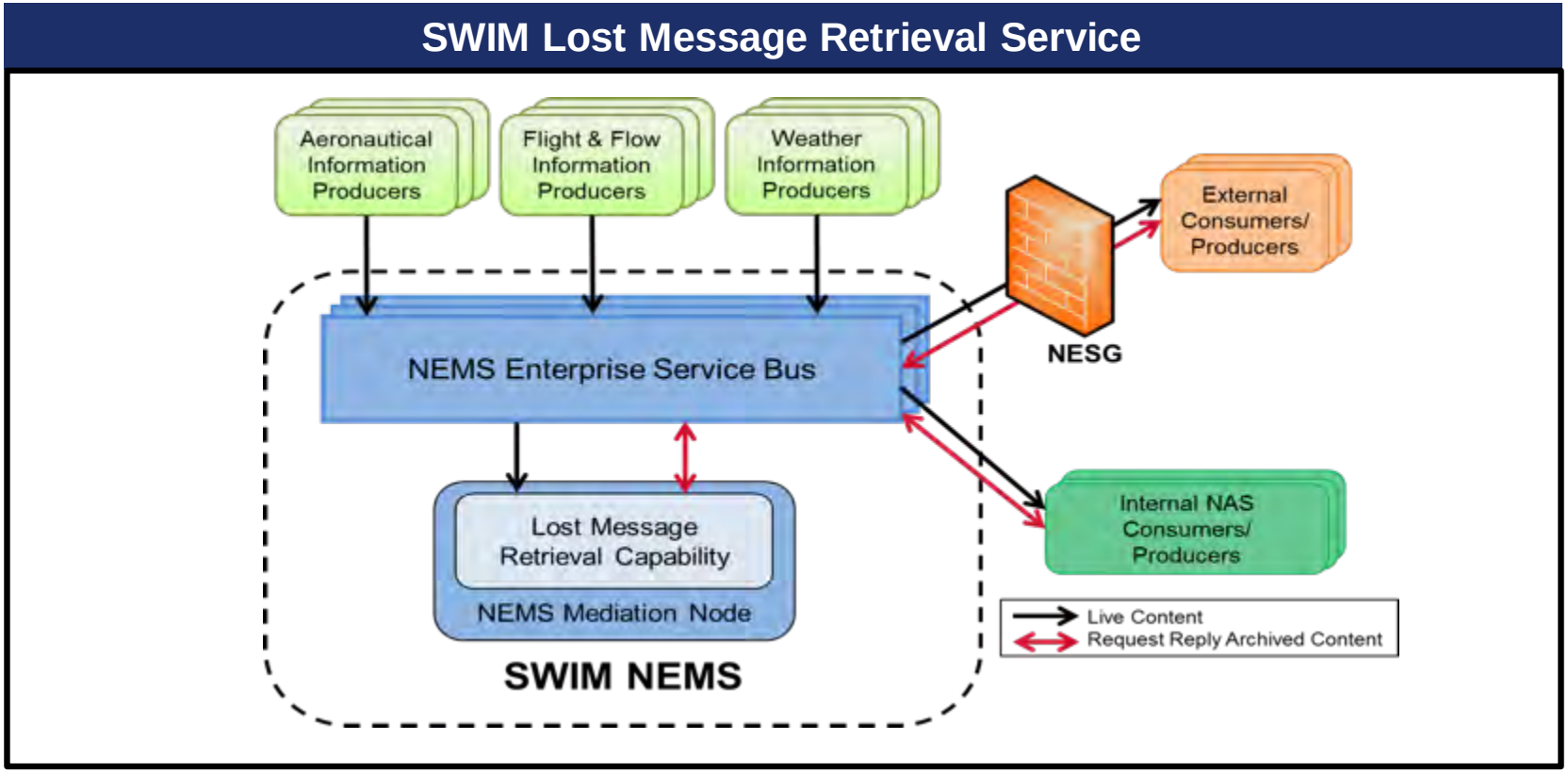
Use Case: Planned/Un-Planned Events



Use Case: Enhanced Troubleshooting

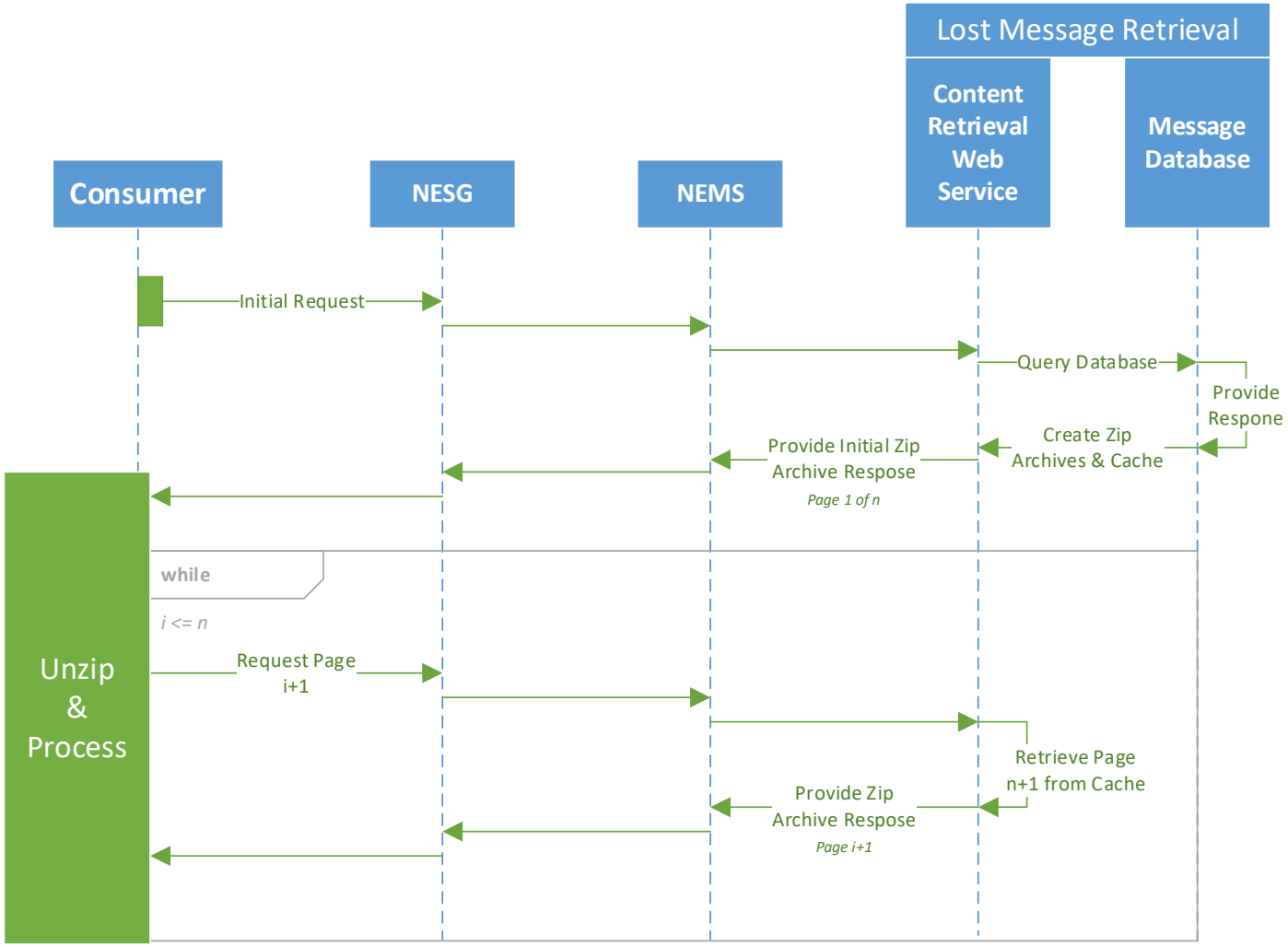


Service Architecture



The Lost Message Retrieval Capability enables the FAA to effectively provide SWIM publish/subscribe (JMS) content from NEMS producers to consumers who were not able to receive the content when it was originally published to NEMS.

Service Sequence



Service Details

Timeframe	15-day moving window
Availability	Within a few minutes of publishing
Metadata	JMS Properties; indexed for retrieval at subscription level resolution
Interface	RESTful Web Service retrieval through message metadata
Delivery	Compressed zip archive containing requested messages as content files
Large Responses	Pagination to retrieve content in smaller chunks via links
JumpstartKit	Sample end user clients provided that automates downloading
Security	Fine grained access control policies control specific access to content
Limits	Number of request per user and concurrent responses

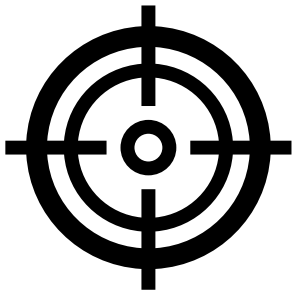
Not Reconstitution

Not a Playback

Not an Archive

A capability to retrieve messages sent over SWIM that where not consumed

Schedule and Availability



Initial Release

- Early 2020
- Available via NAS and NESG
- Published as Service in NSRR

Future Release

- Not currently planned
- Web Application Interface
- Potential hosting in cloud; ESCS

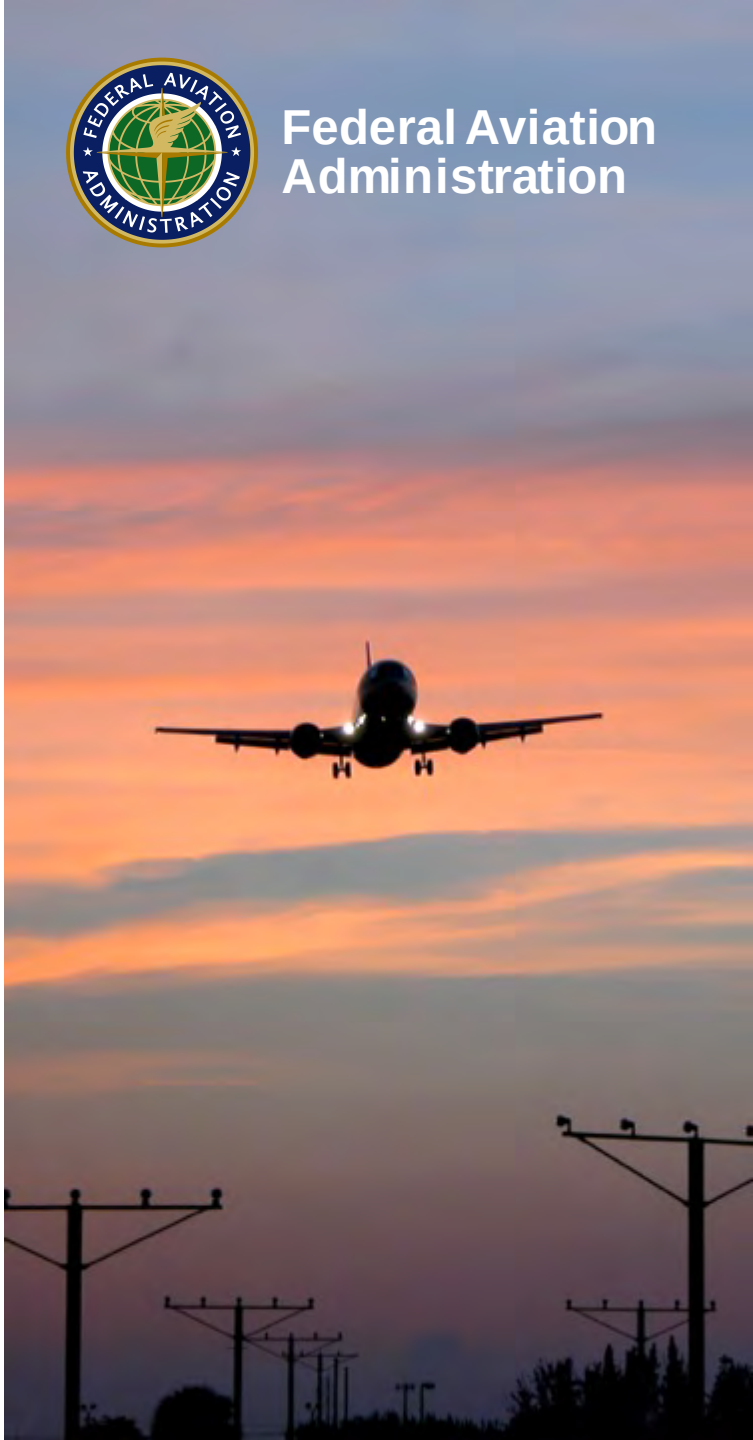
Questions

Update

August 2019 SWIFT

David Almeida
SWIFT Moderator

Federal Aviation Administration



Needs Assessment: External Stakeholders

- **Cloud to Cloud Transfers**
  - More efficient for users: FAA Cloud to Consumer cloud eliminates need to move data through Consumer's data center, then to cloud
- **Bringing New Services Online**
  - Enhanced cloud services would support faster on-ramping of new services, with streamlined testing/accreditation (including expedited qualification/testing phases) and more rapid approval versus NESG
- **Playback vs. Reconstitution vs. Message recovery**
  - Message recovery allowing applications to pick up missed messages when connection recovers.
  - Utilize playback of events for 30-60 minutes of post-ops analysis
  - Longer term data reconstruction/reconstitution can support Consumers re-establishment of their operational status and history

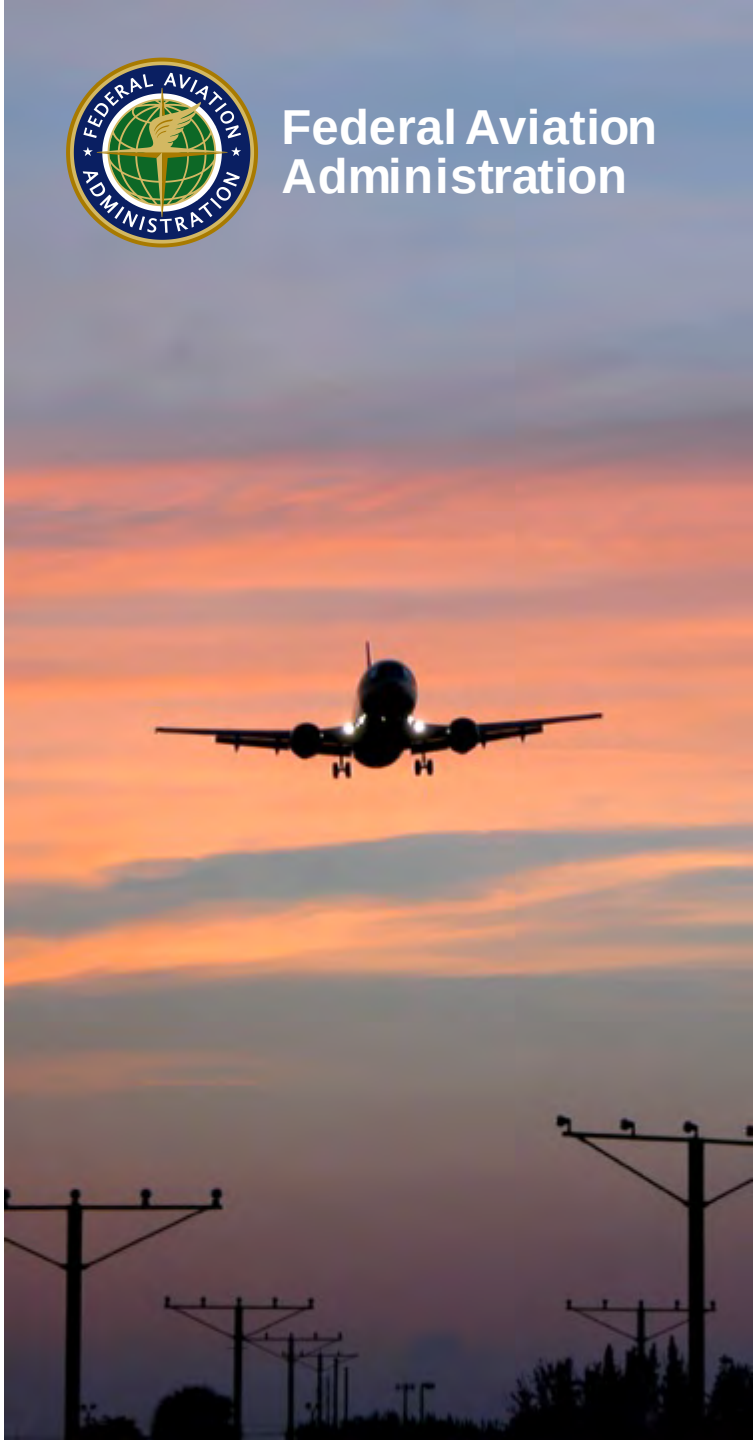
Needs Assessment: External Stakeholders (Cont'd)

- **Enhanced awareness via Dashboard/tools**
- **Single access point to SWIM**
  - Currently there is NSRR, SCDS, SWIFT site, etc.
  - Unified source of data dictionaries, data governance, service documentation
  - Searchable data elements & message composition to identify data provenance
  - Capability to "hover over" data elements in web site and see definitions/more information
  - SWIM help
- **Dashboard that users could configure based on the user profile and which services are subscribed to, service status, IT vs. operational views, etc.**
- **Repository of publicly available SWIM algorithms, "widgets", other community-developed products**

SWIFT:

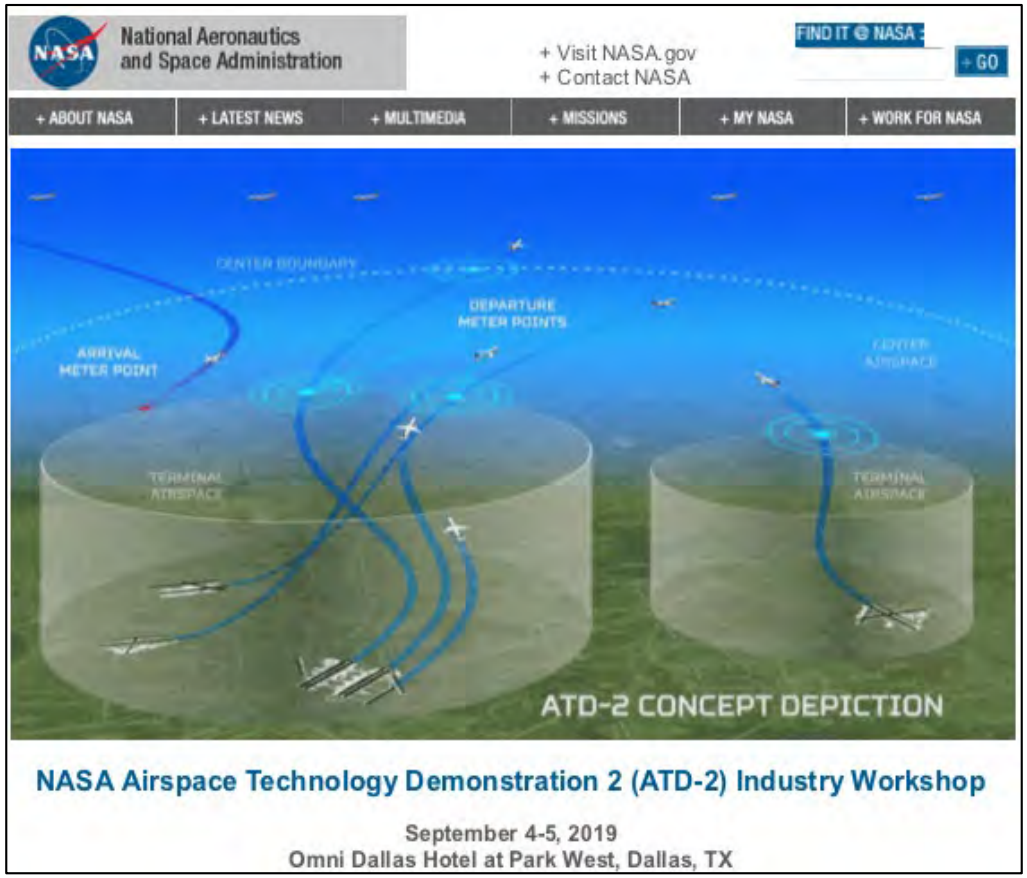
SWIM Industry Collaboration Workshop #7

Federal Aviation Administration



Final Announcements: NASA Industry Day

- **Airspace Technology Demonstration 2 (ATD-2) Workshop**
  - September 4 – 5, 2019



- Transfer to NAS users lessons learned from NASA's ATD-2 project implementation
- Identify emerging needs for tools, services and platforms for the aviation market
- Provide deeper understanding of transformational potential of future surface system
- Enable industry operators to meet upcoming TFDM requirements for their organization while achieving benefits

https://aviationsystems.arc.nasa.gov/atd2-industry-workshop/

Final Announcements: ATIEC Conference

- **Air Transportation Information Exchange Conference**
  - September 23-24, 2019
  - Location: The MITRE Corporation at Tysons Corner, Virginia.

  "ATM Operational excellence through superior information. Handle the expected, Tackle the unknown, Solve the issue."

  - Four Focus Areas:
    1. Information in Operations,
    2. Information Services,
    3. Information Exchanges, and
    4. Information Security

- For more detail and registration information, please visit ATIEC website at:

https://www.faa.gov/air_traffic/flight_info/aeronav/atiec/

Final Announcements: SWIM User Forum

- SWIM User Forum September 12, 2019
- Register at:
  - https://www.faa.gov/air_traffic/technology/swim/users_forum/

Final Announcements

- **SWIFT Workshop #8:**
  - **Date: November 7, 2019**
  - **Location: Delta Airlines @ Atlanta, GA**

SWIFT Contact Information

Joshua Gustin, SWIFT Sponsor & Group Manager

- **Communications, Information & Network Programs**
- **Email: Joshua.Gustin@faa.gov**

Felisa White, SWIFT Chair & FAA Lead

- **Phone: (202) 267-7994**
- **Email: Felisa.White@faa.gov**
- **Email: SWIFT@faa.gov**

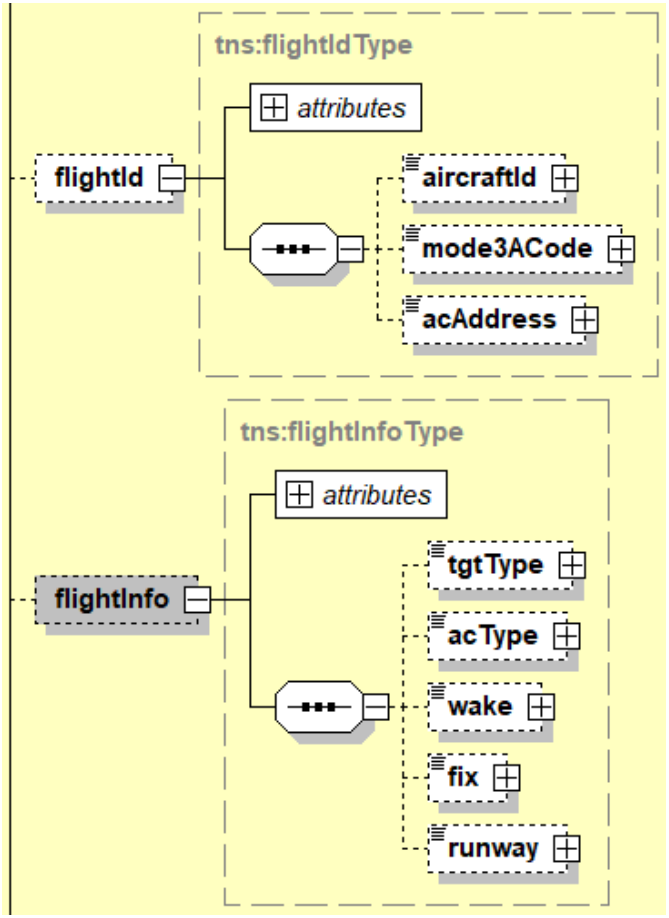
- **David Almeida, SWIFT Community Moderator**
- **Phone: (321) 735-2774**
- **Email: David.Almeida@LSTechLLC.com**

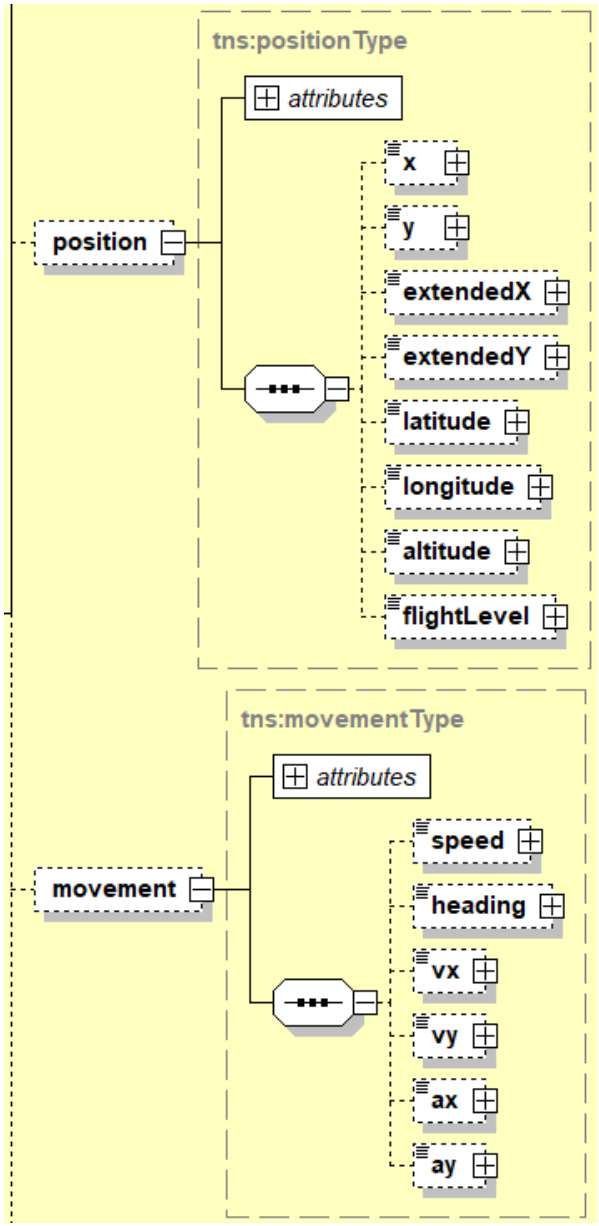
STDDS Back Up Slides

SMES

August 8, 2019
171

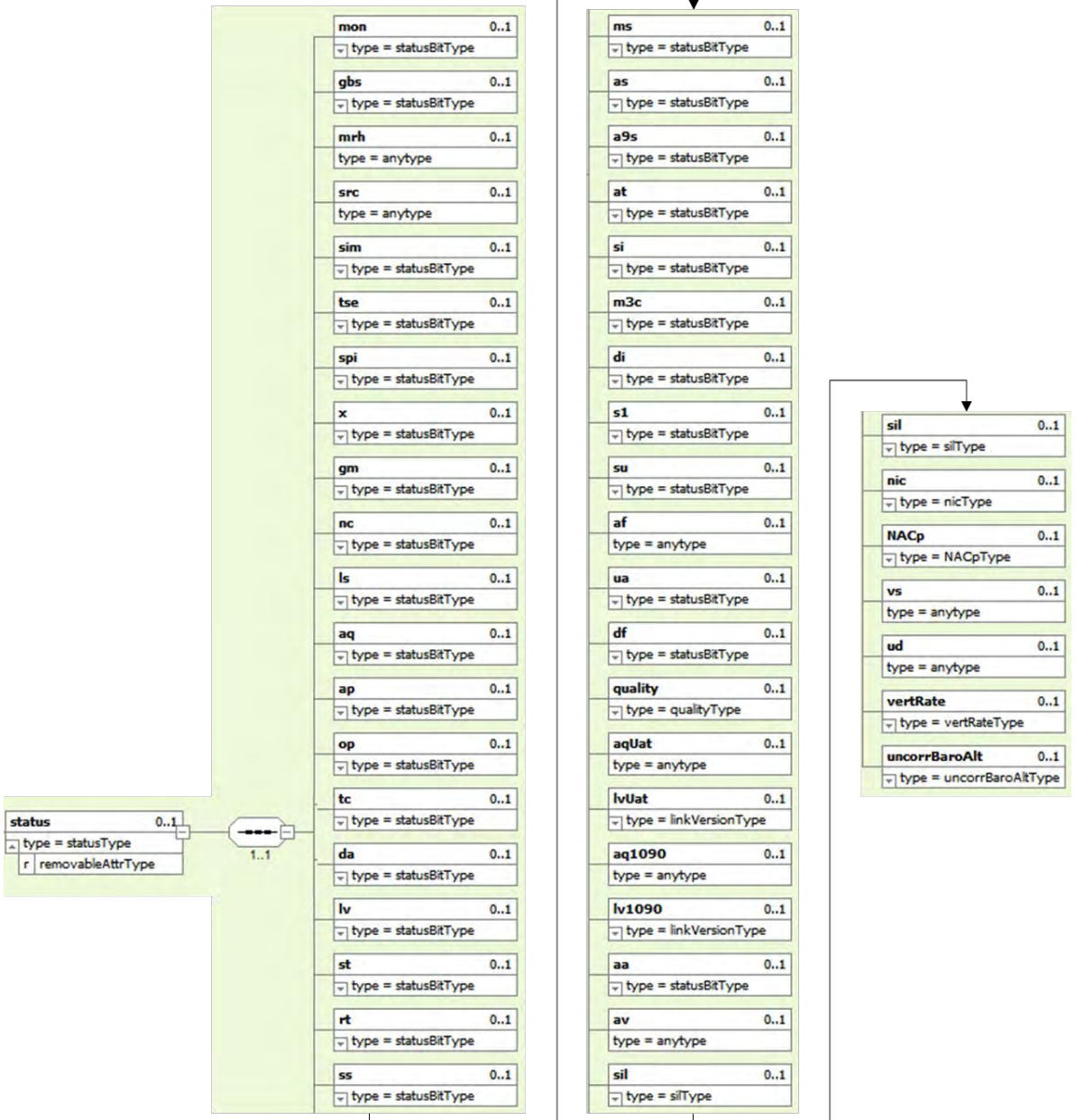
positionReport





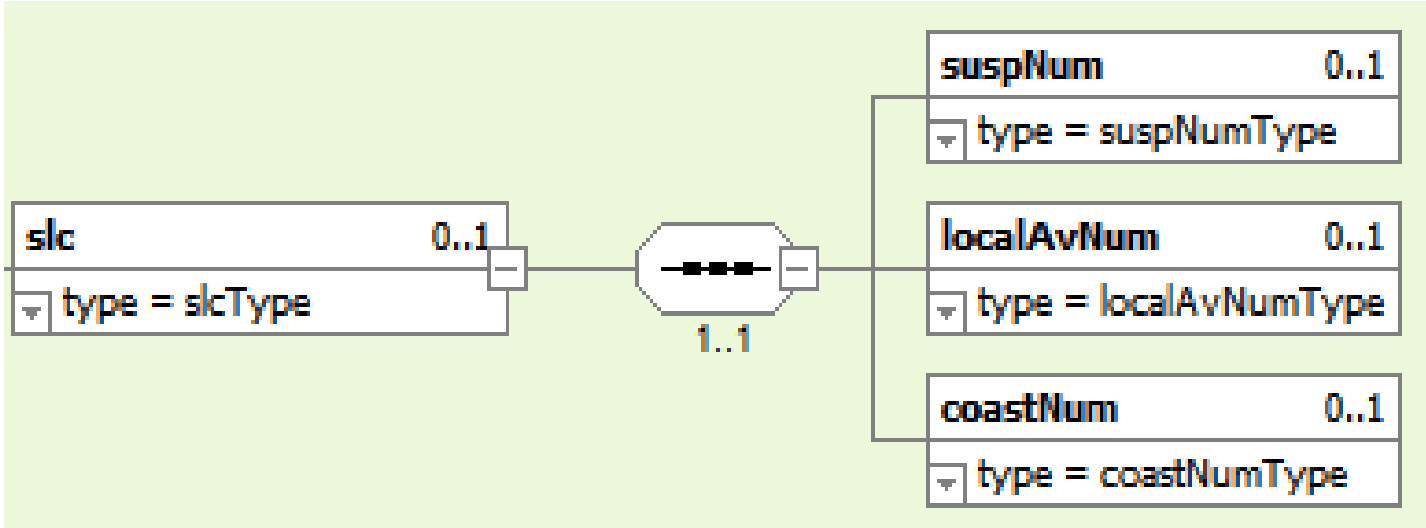
August 8, 2019
172

status

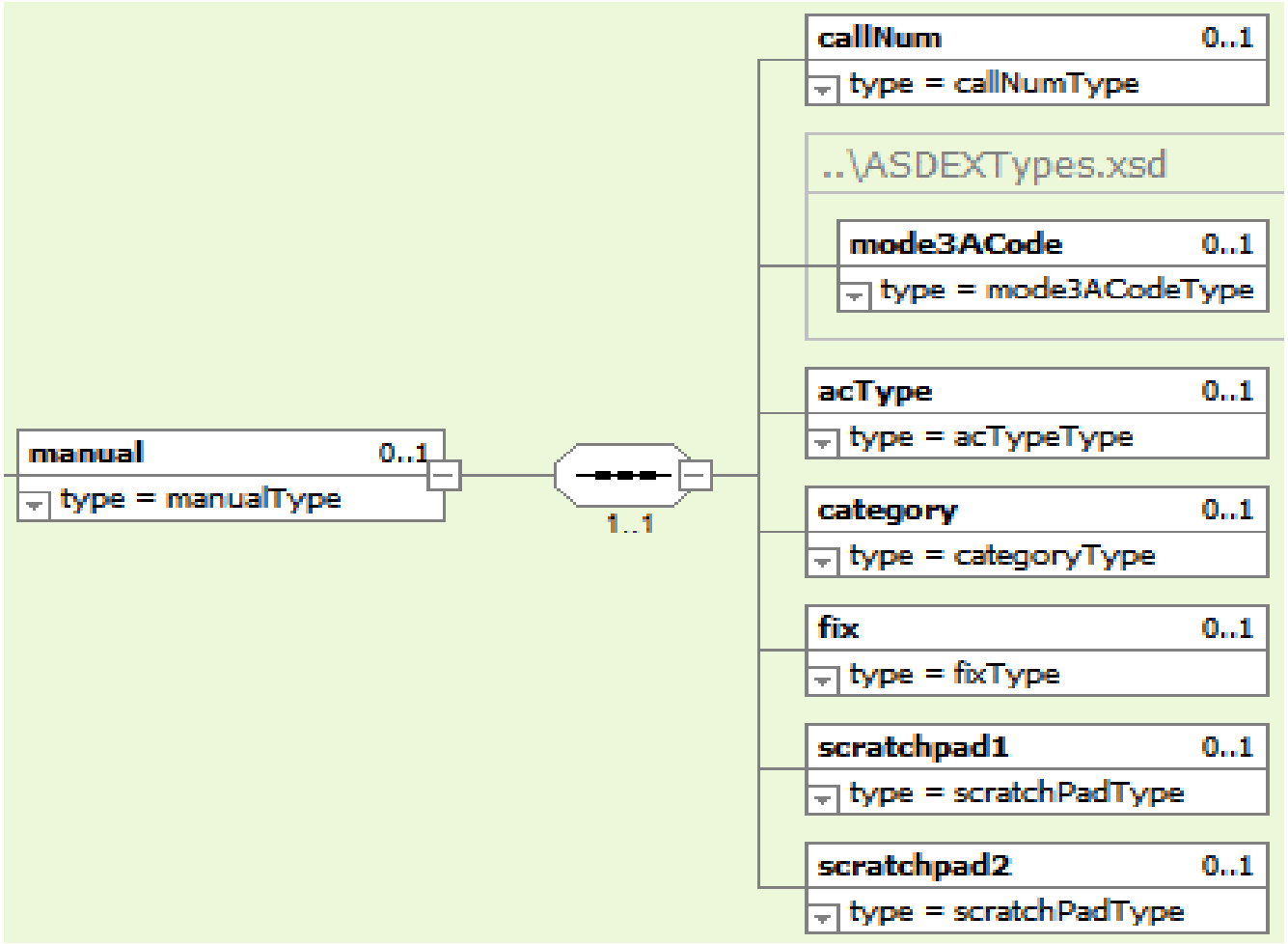


August 8, 2019
173

slc

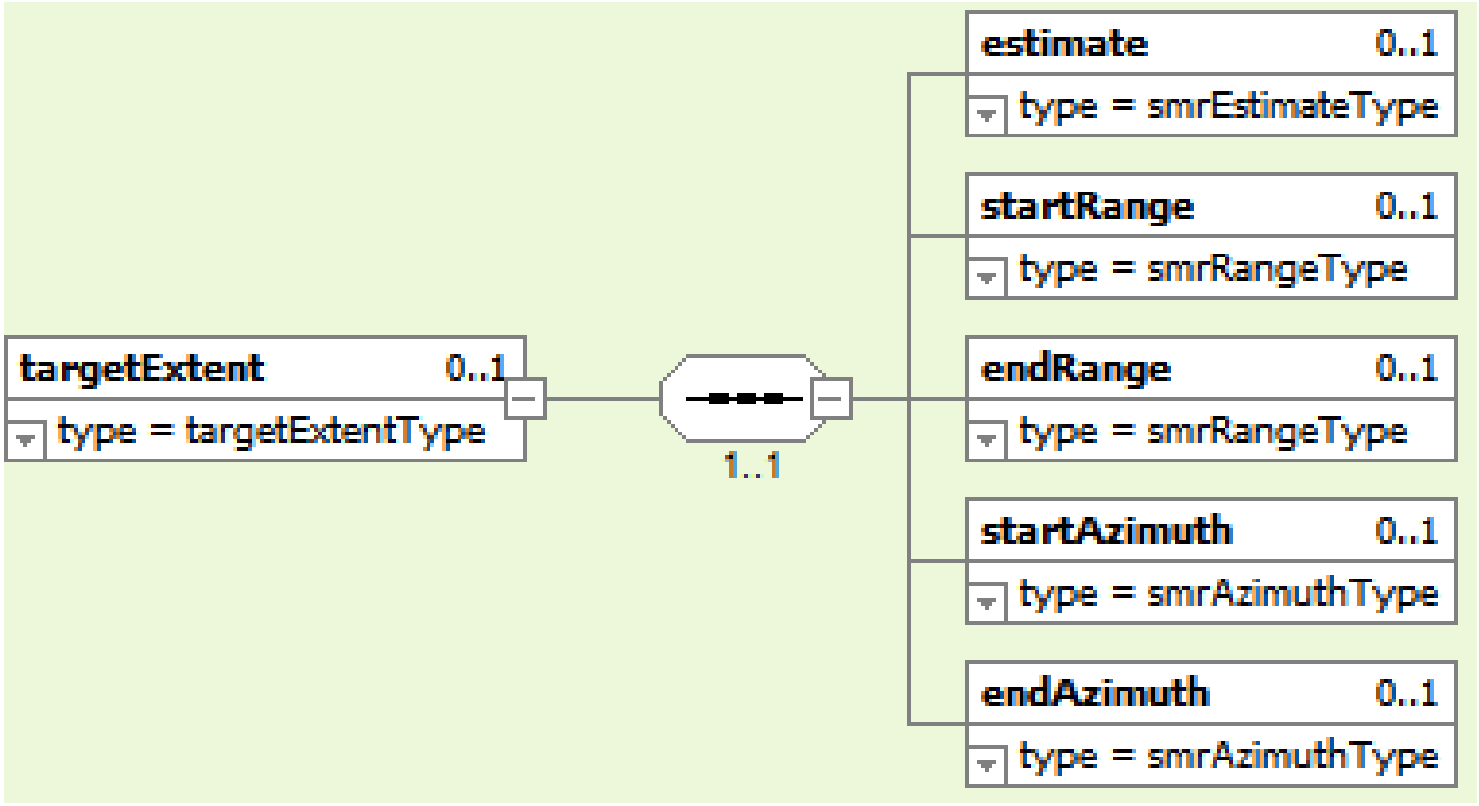

slc
0..1
type = slcType
1..1
suspNum
0..1
type = suspNumType
localAvNum
0..1
type = localAvNumType
coastNum
0..1
type = coastNumType

manual



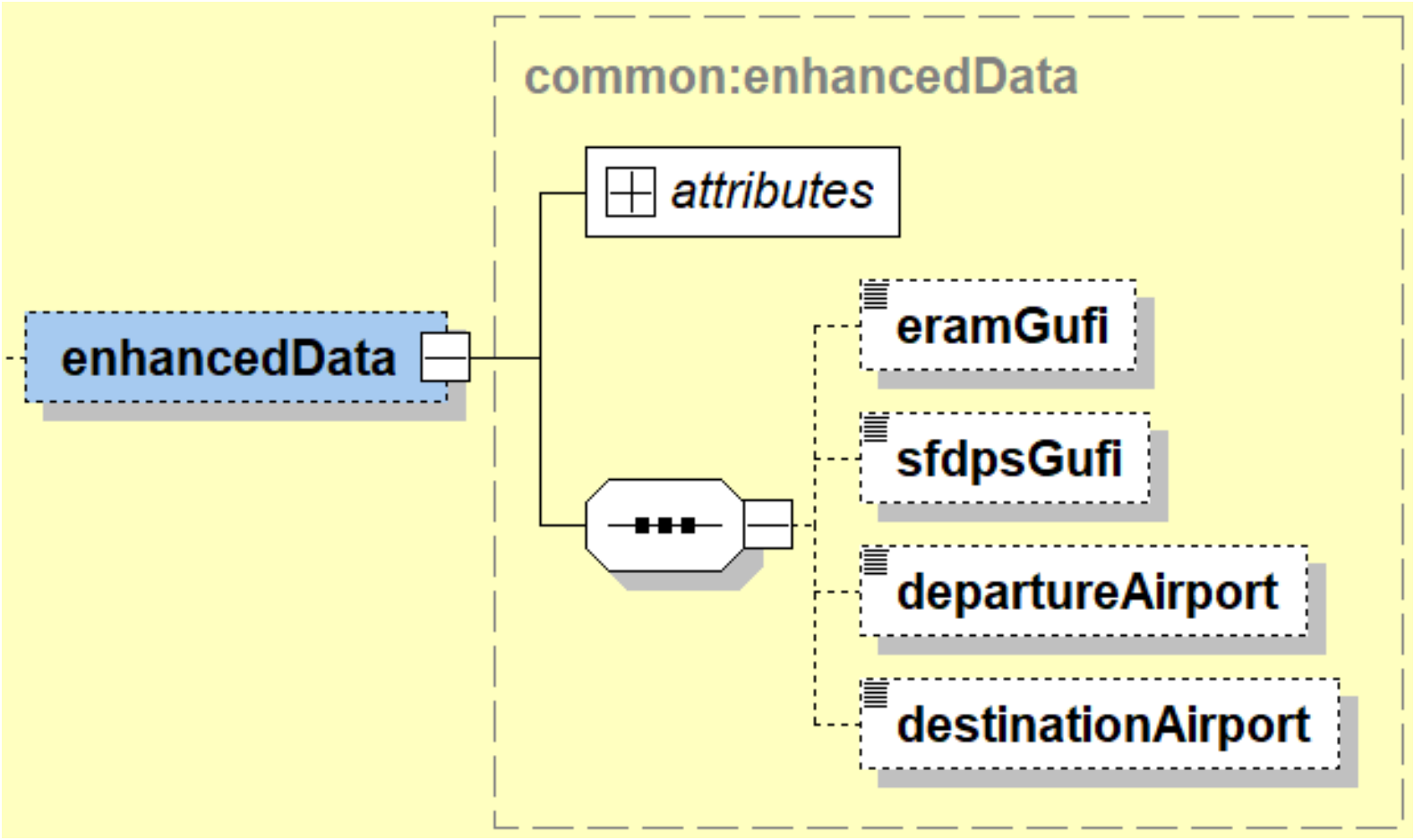
August 8, 2019
175

targetExtent



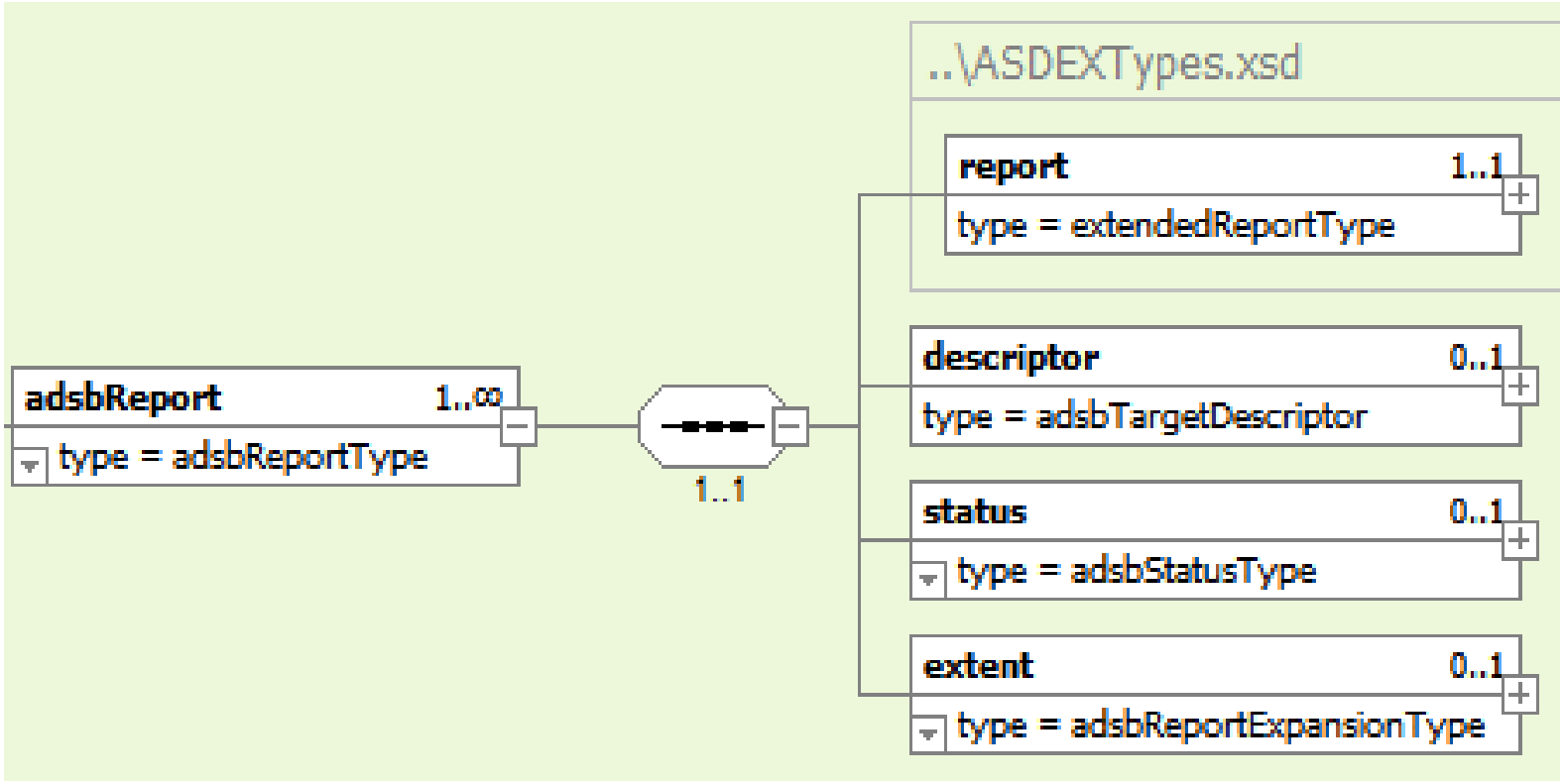
August 8, 2019
176

enhancedData (SMES & TAIS)



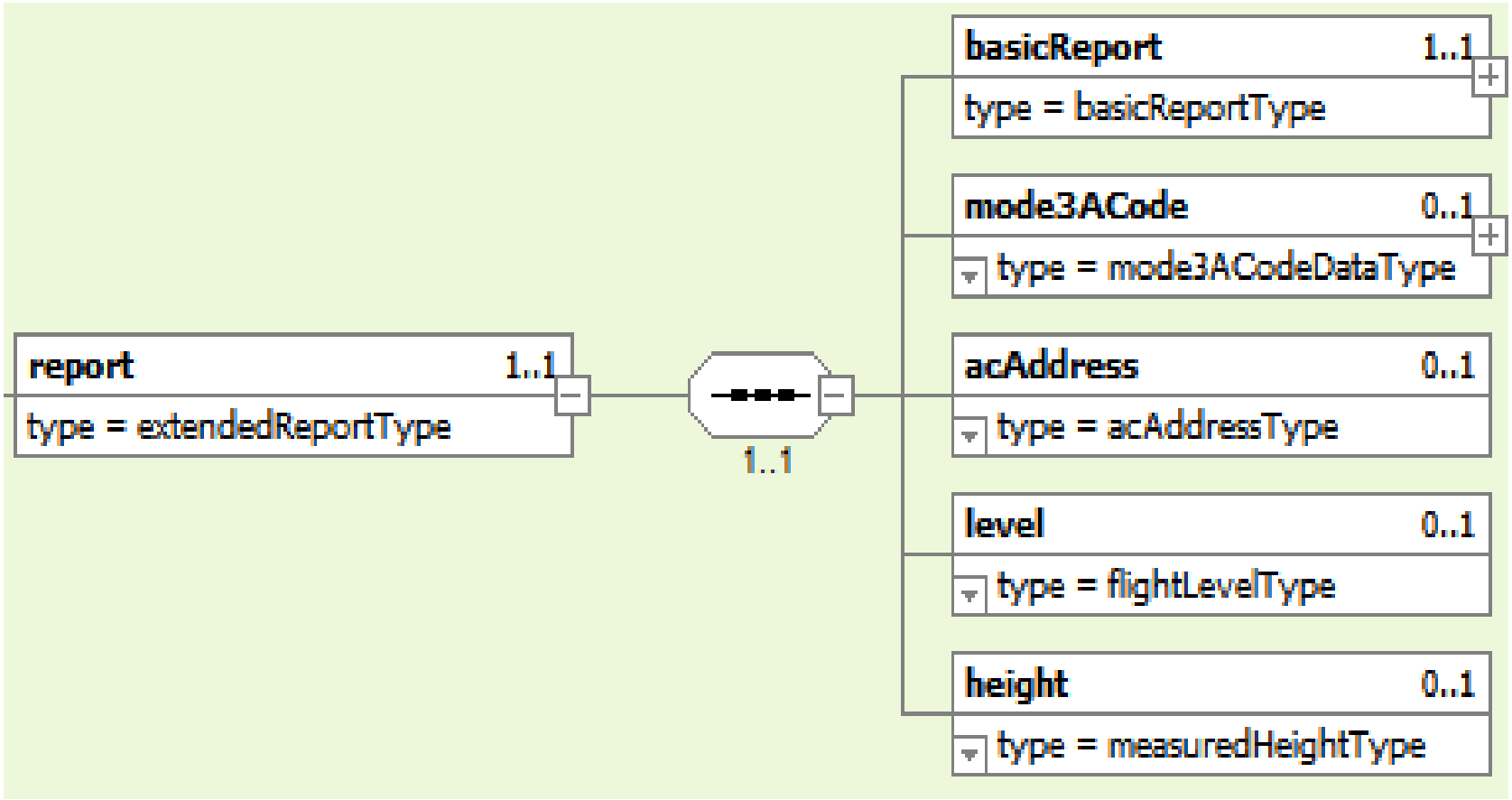
August 8, 2019
177

adsbReport



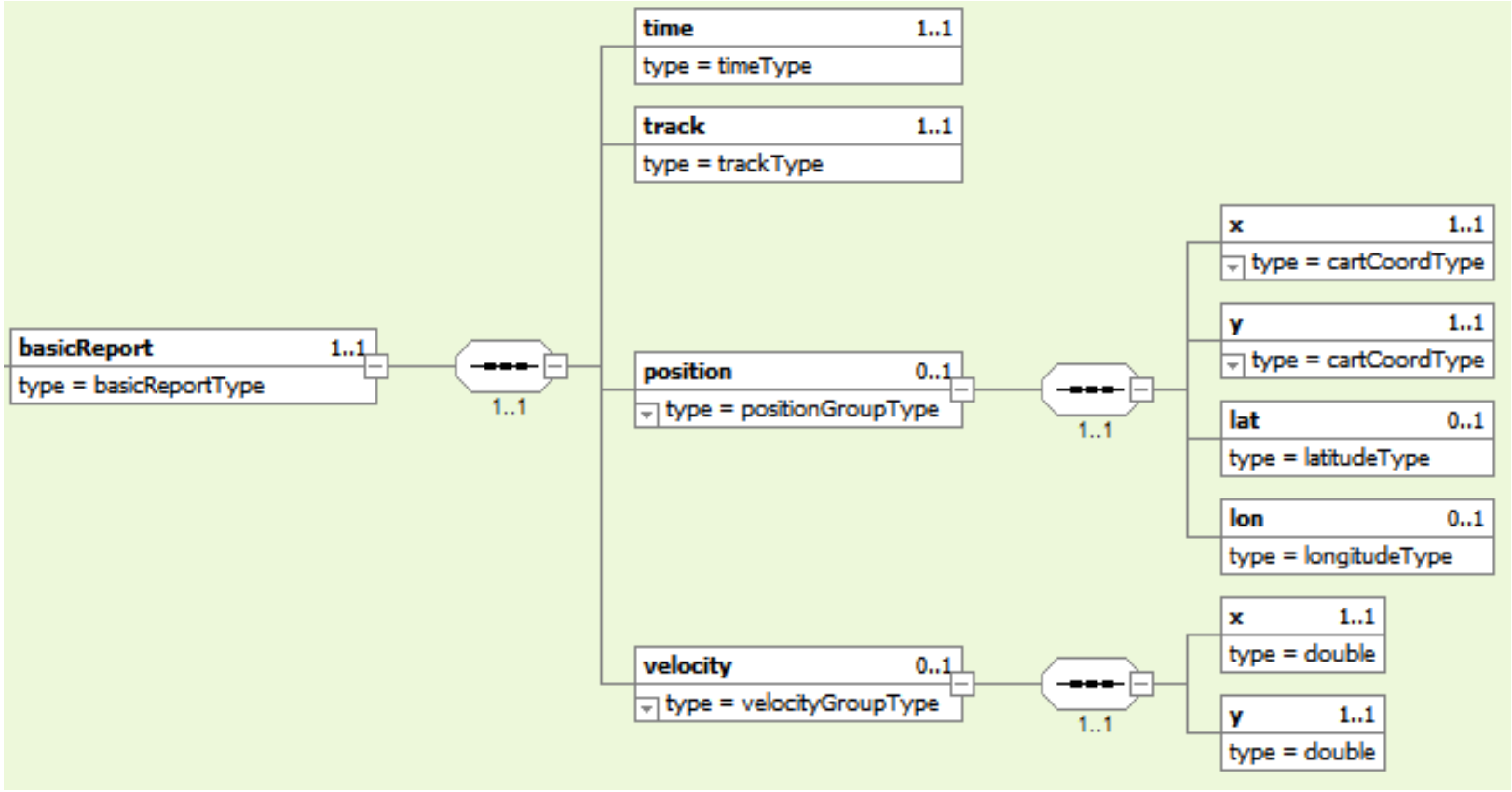
August 8, 2019
178

report



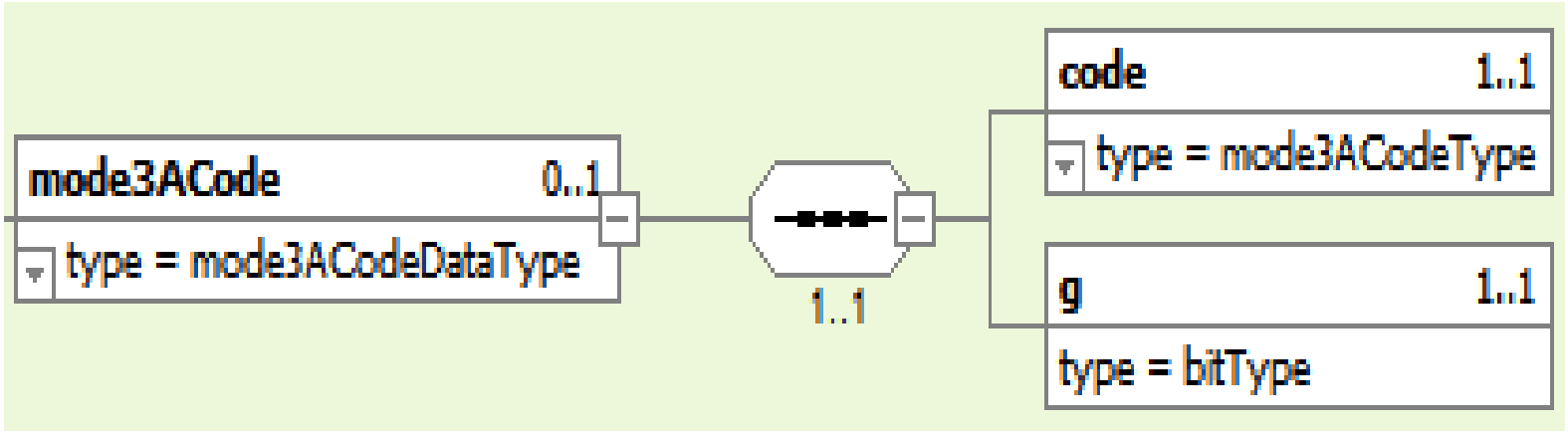
August 8, 2019
179

basicReport

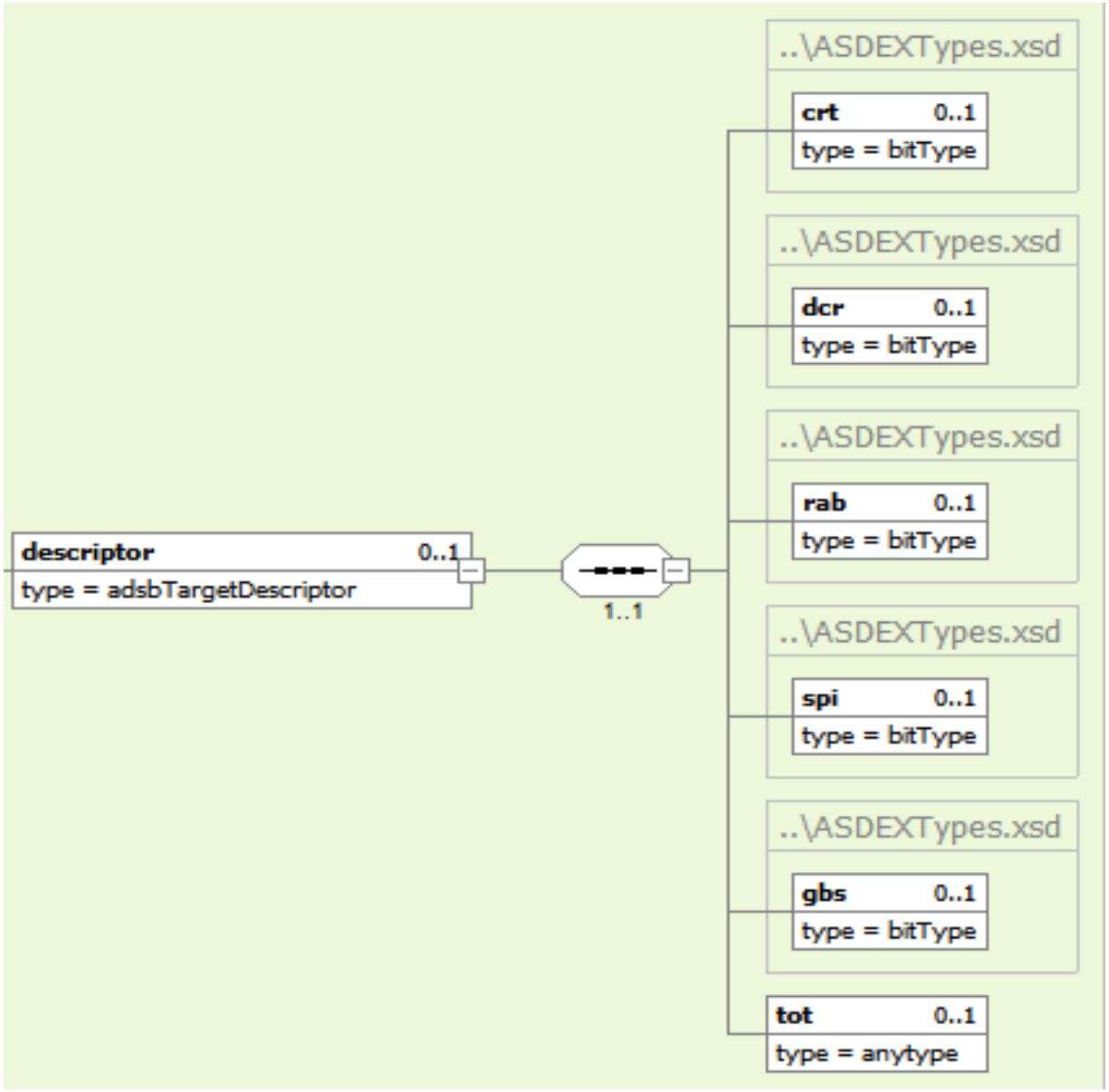


August 8, 2019
180

mode3ACode

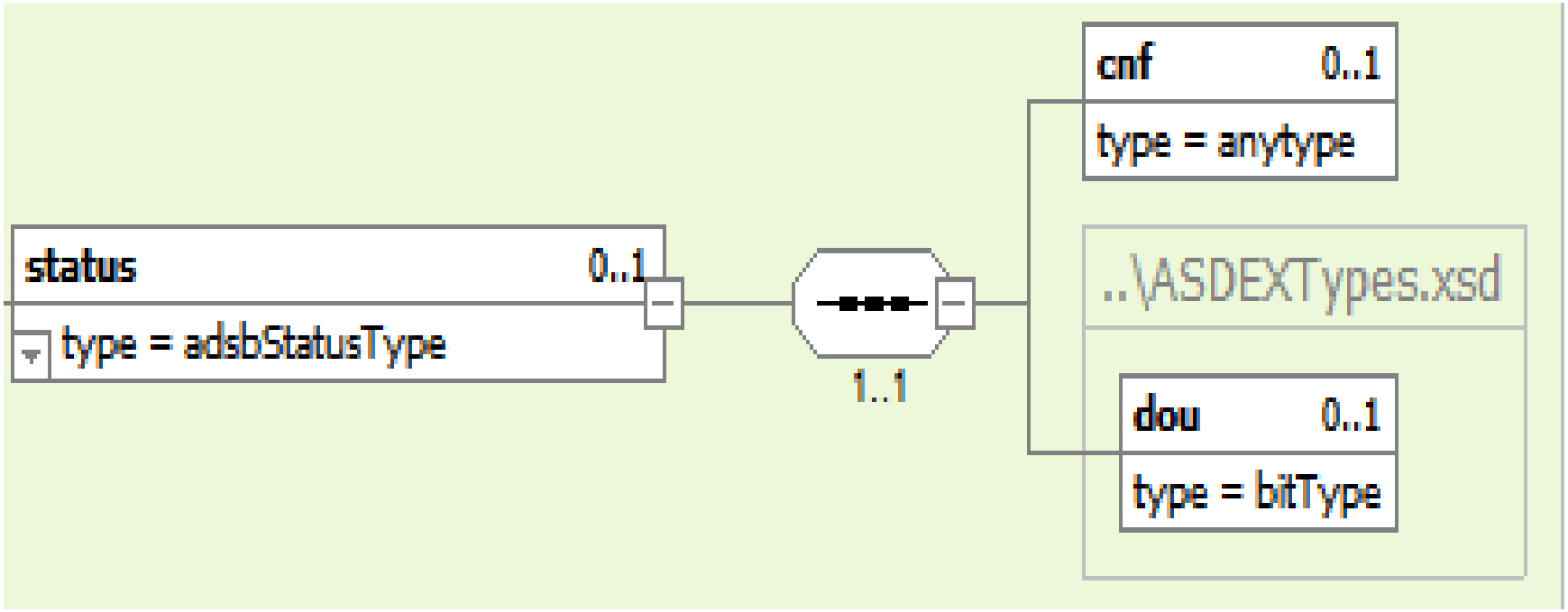

mode3ACode
0..1
type = mode3ACodeDataType
1..1
code
1..1
type = mode3ACodeType
g
1..1
type = bitType

Descriptor (ADSB)



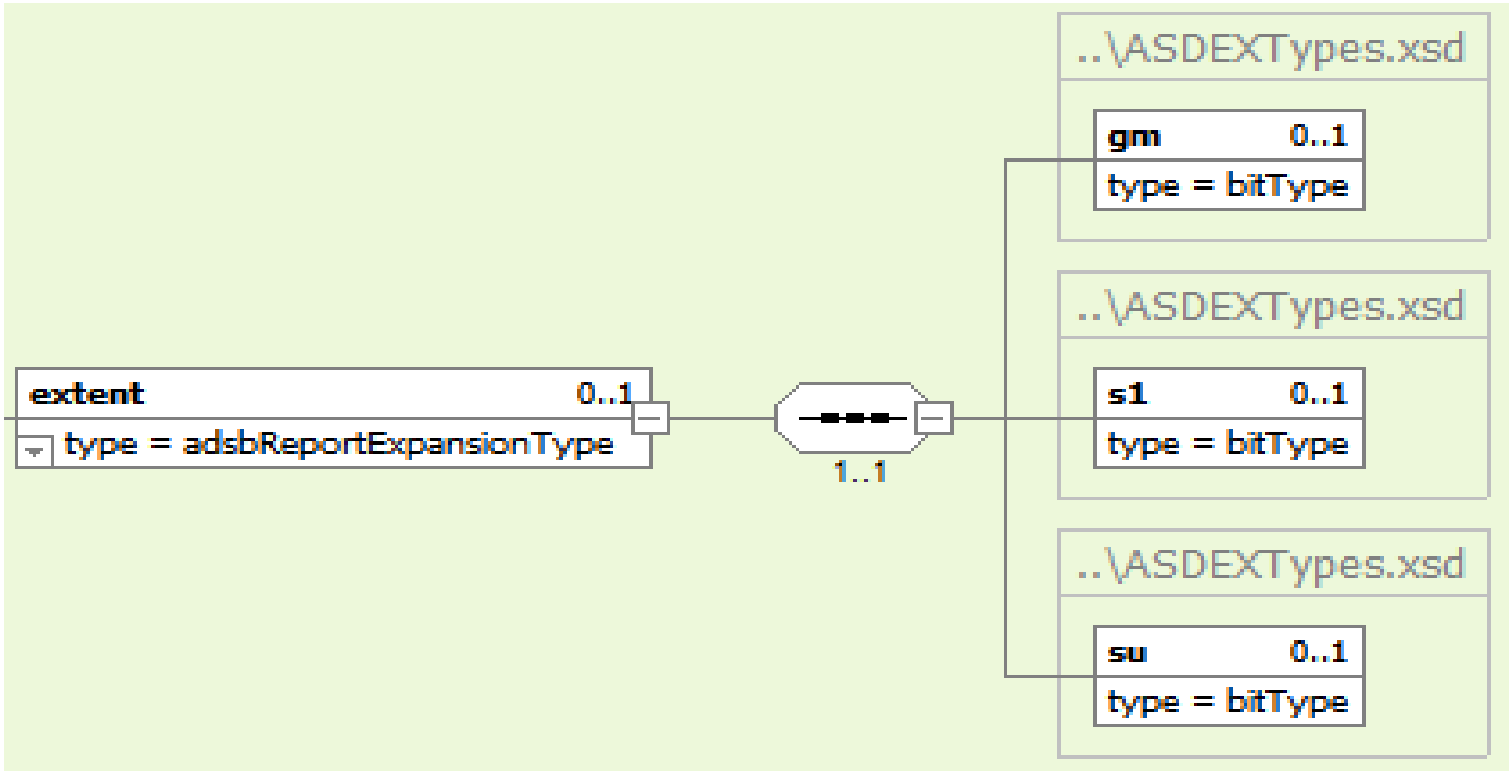
August 8, 2019
182

Status (ADSB)



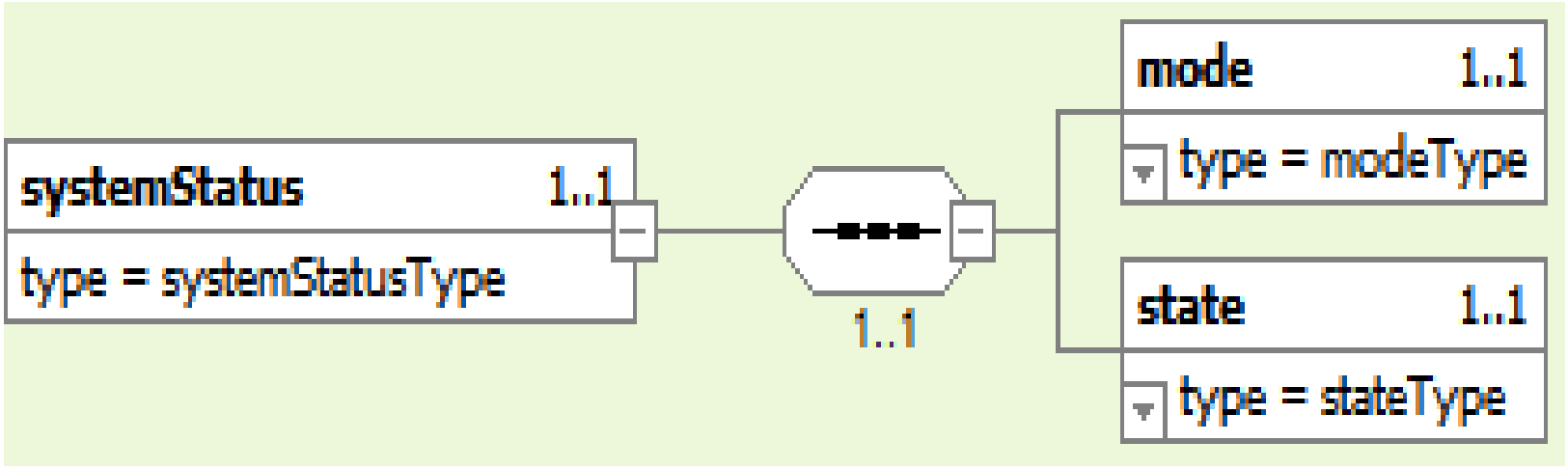
August 8, 2019
183

Extent (ADSB)

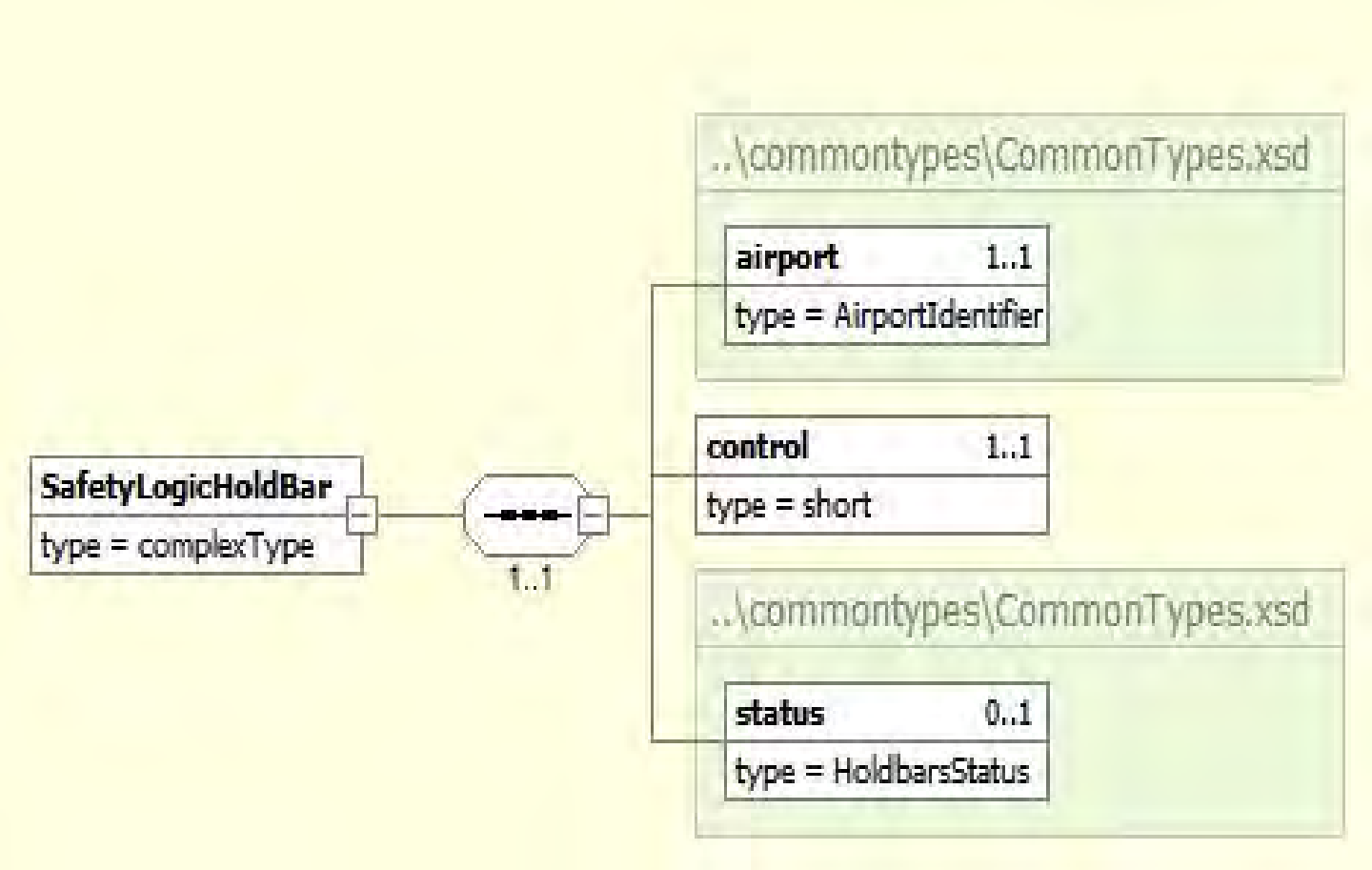


August 8, 2019
184

systemStatus

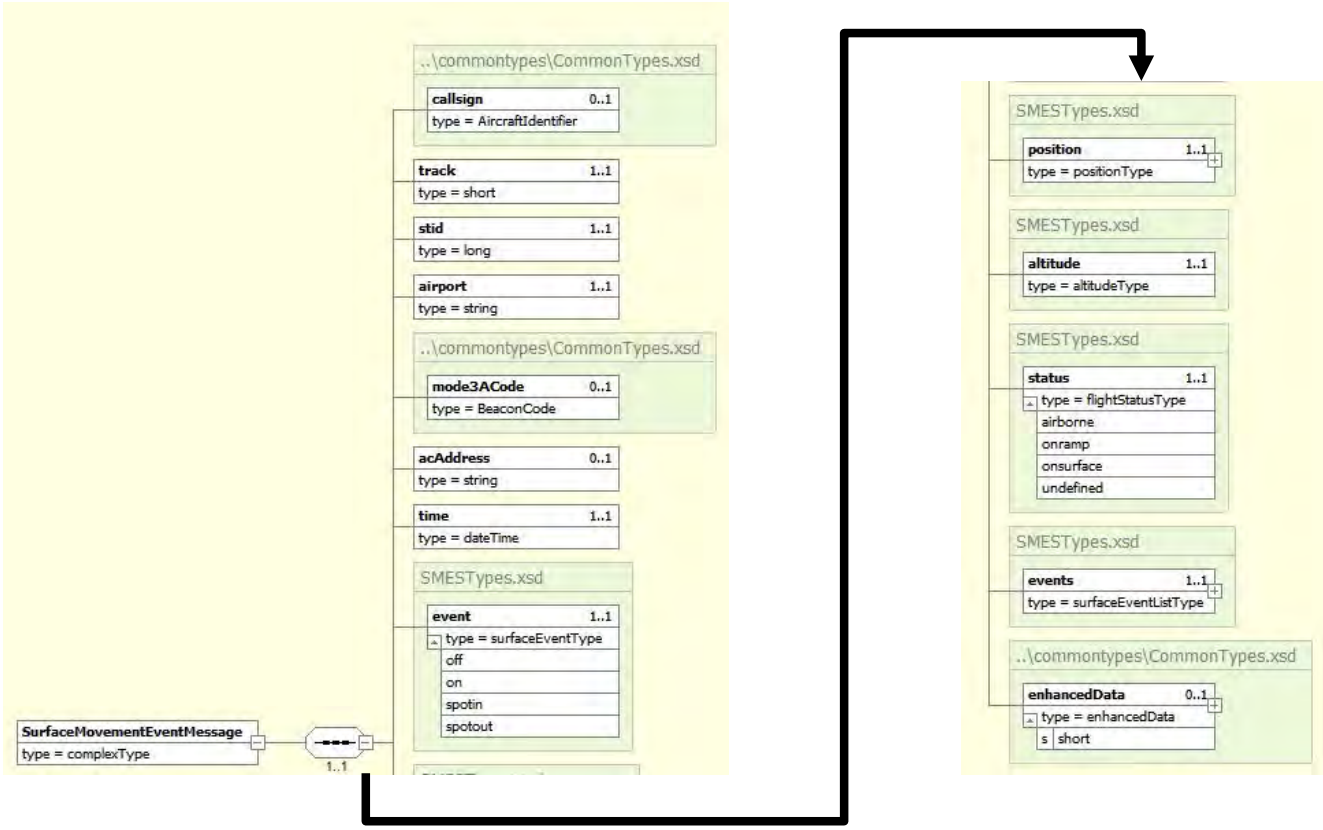


SafetyLogicHoldBar



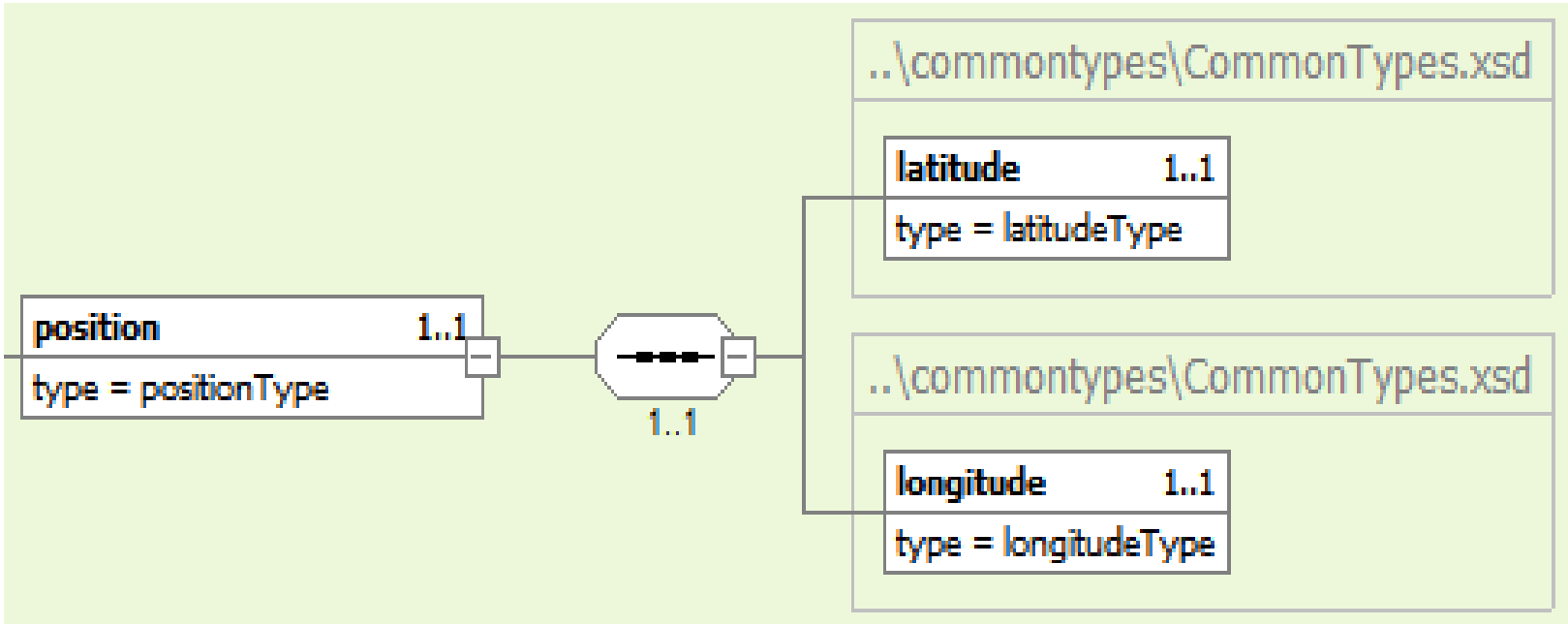
August 8, 2019
186

SurfaceMovement EventMessage



August 8, 2019
187

position

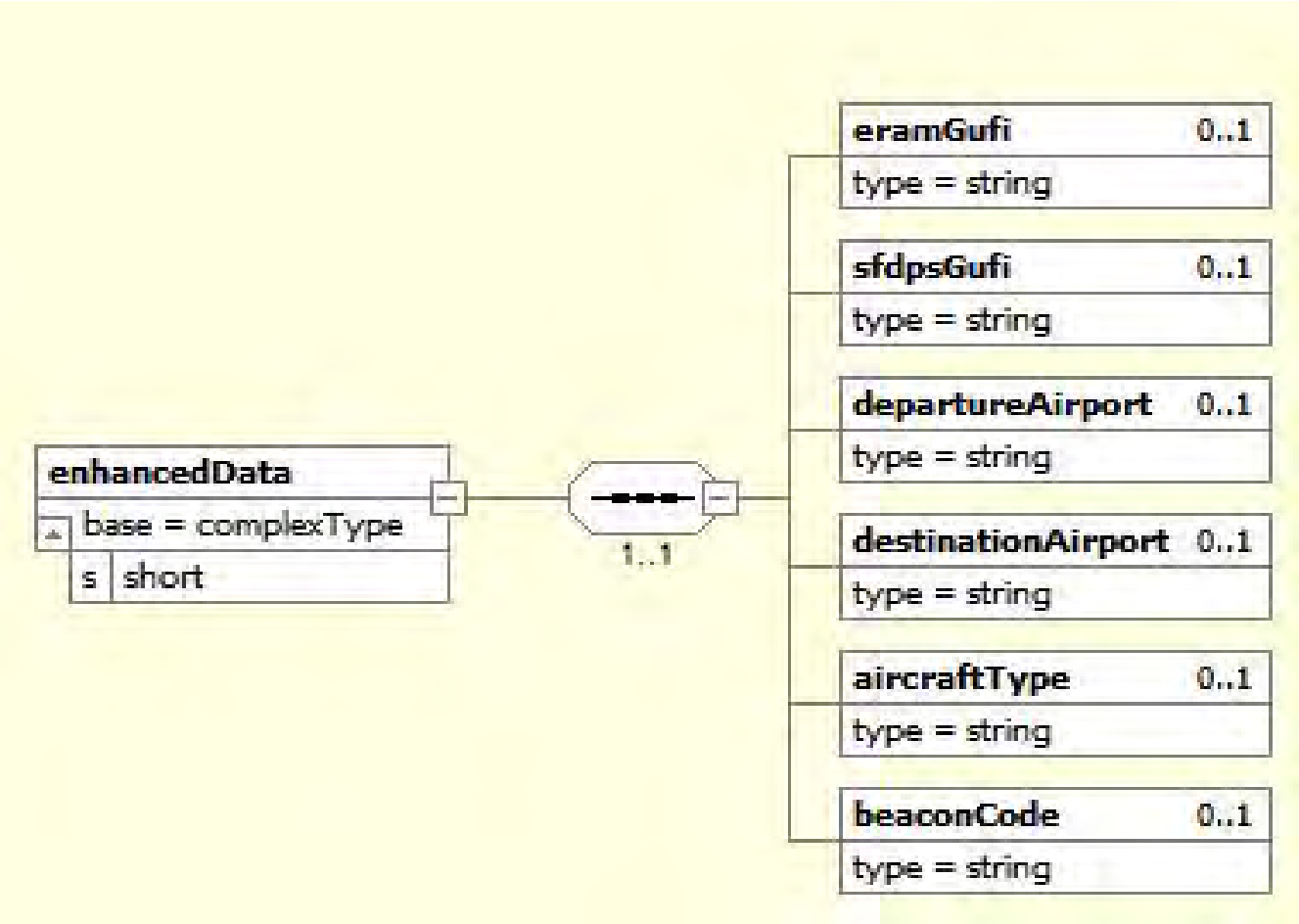


August 8, 2019
188

events

August 8, 2019
189

enhancedData

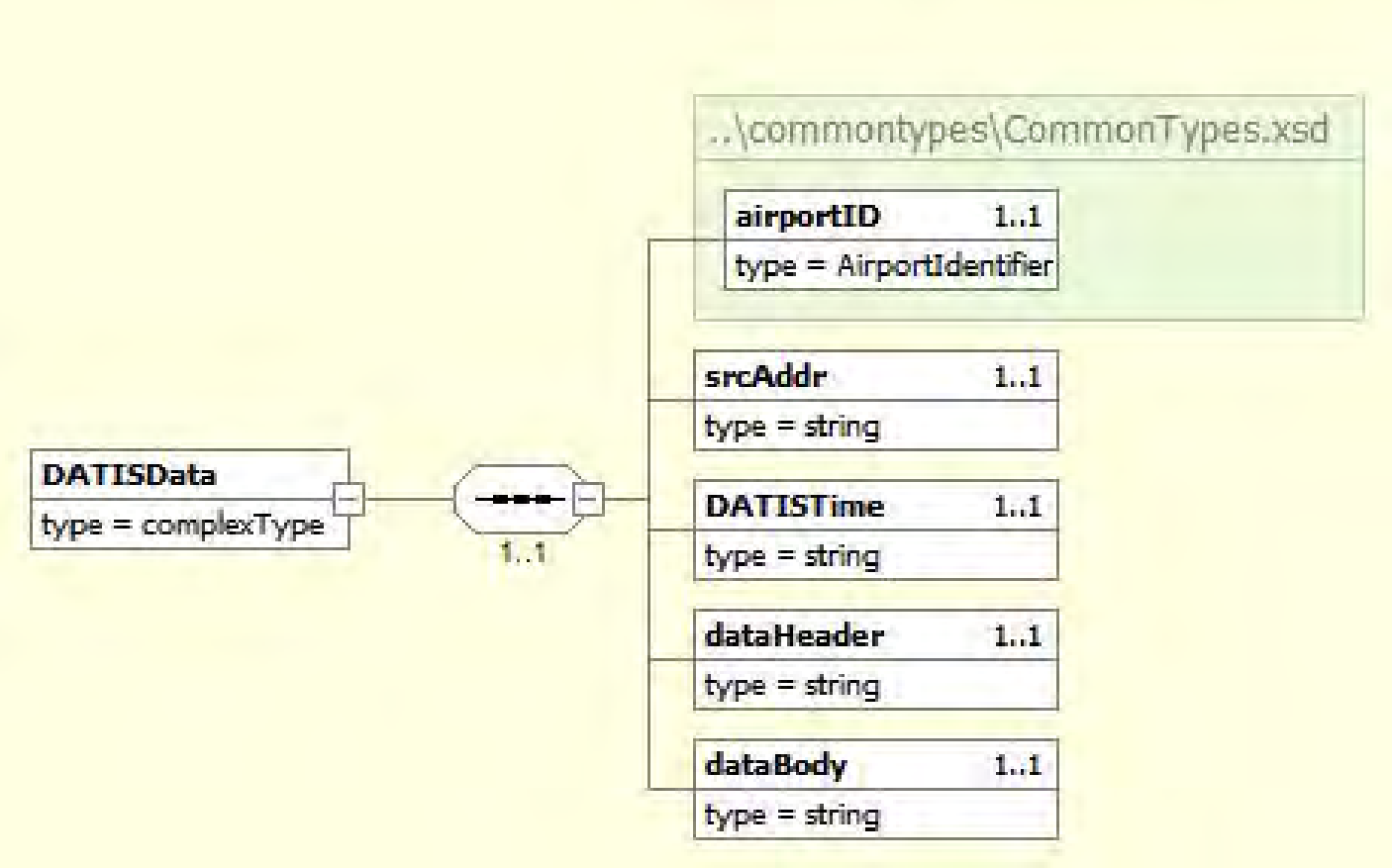


August 8, 2019
190

TDES

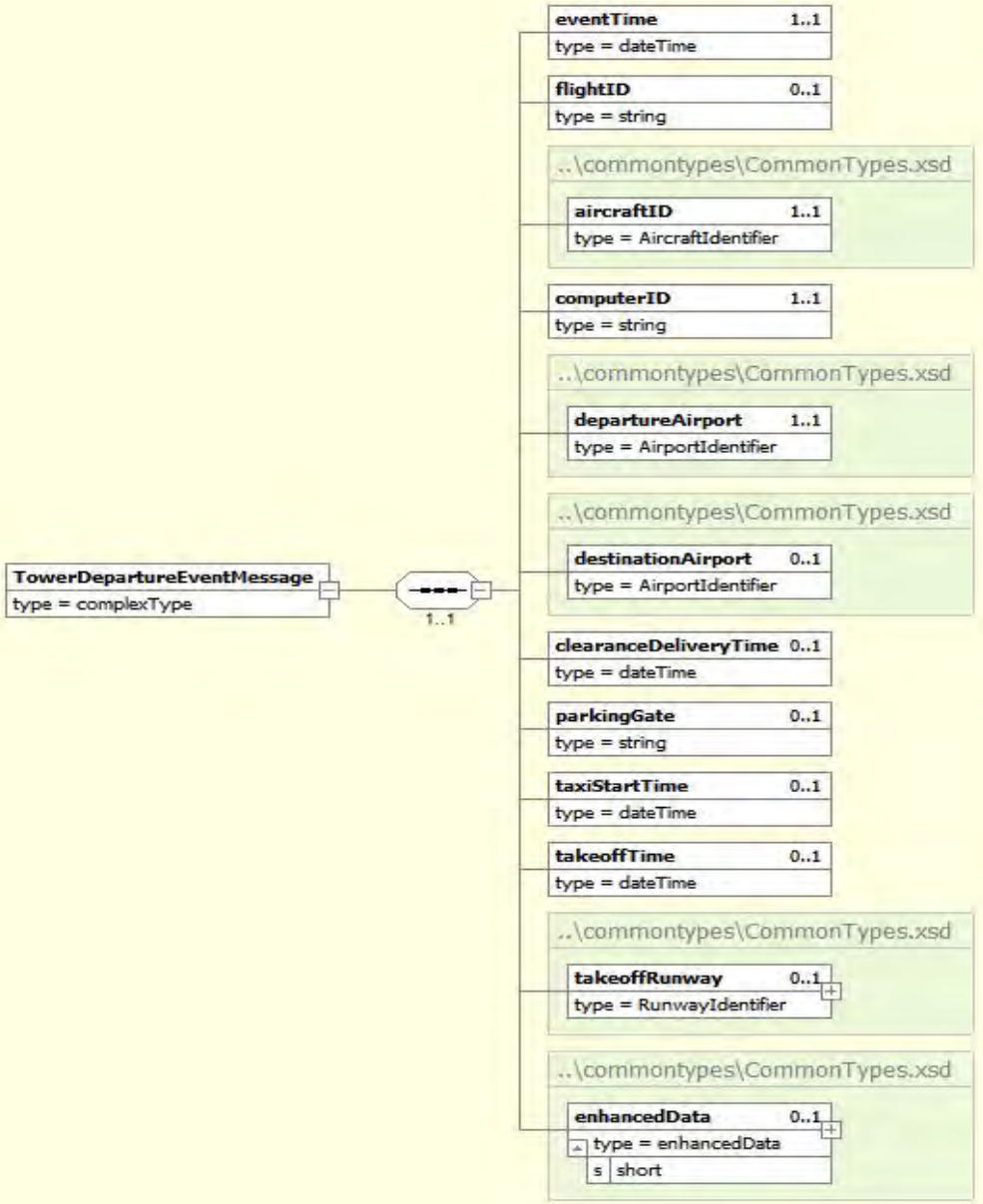
August 8, 2019
191

DATISData



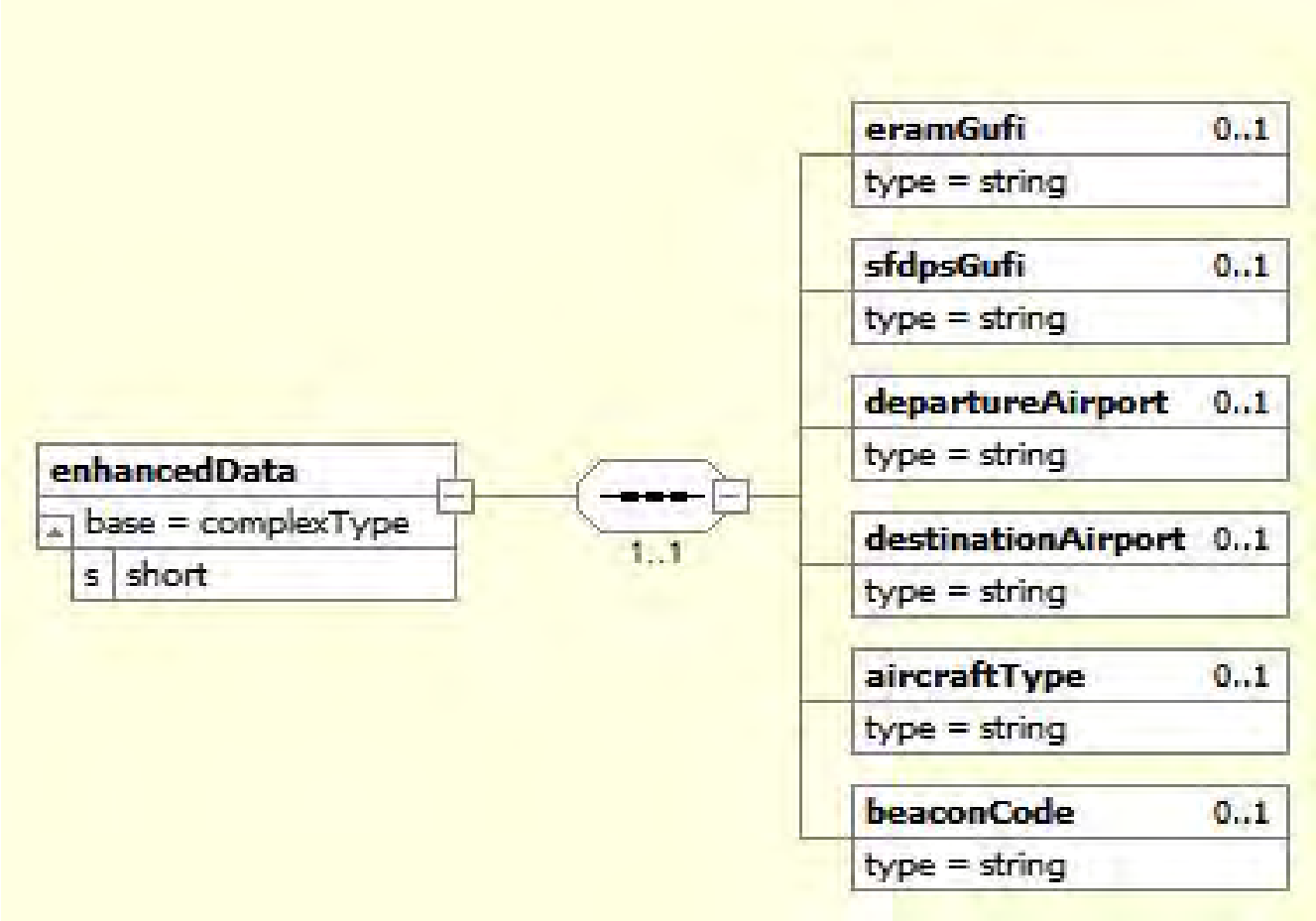
August 8, 2019
192

TowerDeparture EventMessage



August 8, 2019
193

enhancedData (TDES)



August 8, 2019
194