SWIFT:

SWIM Industry

Collaboration

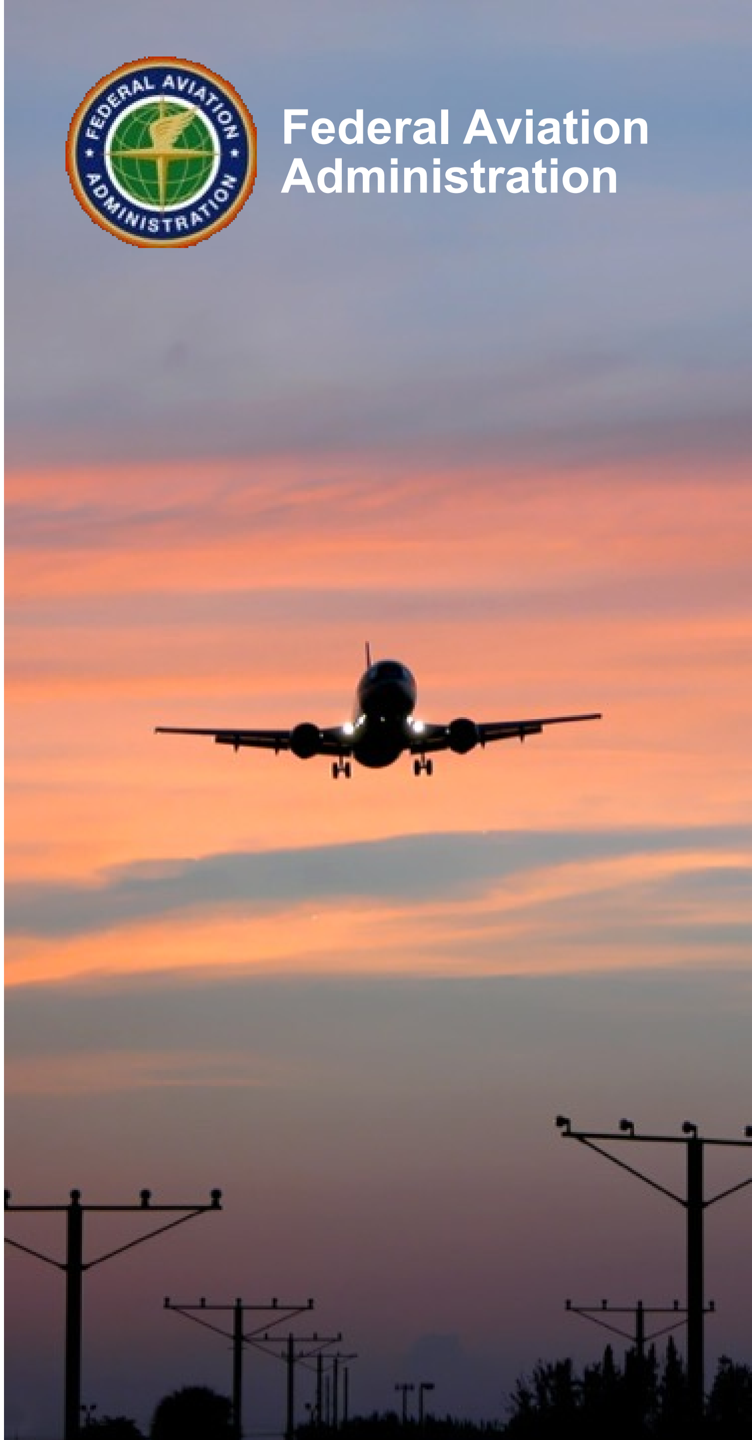
Workshop #5

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

SWIM Stakeholders

FAA SWIM Program

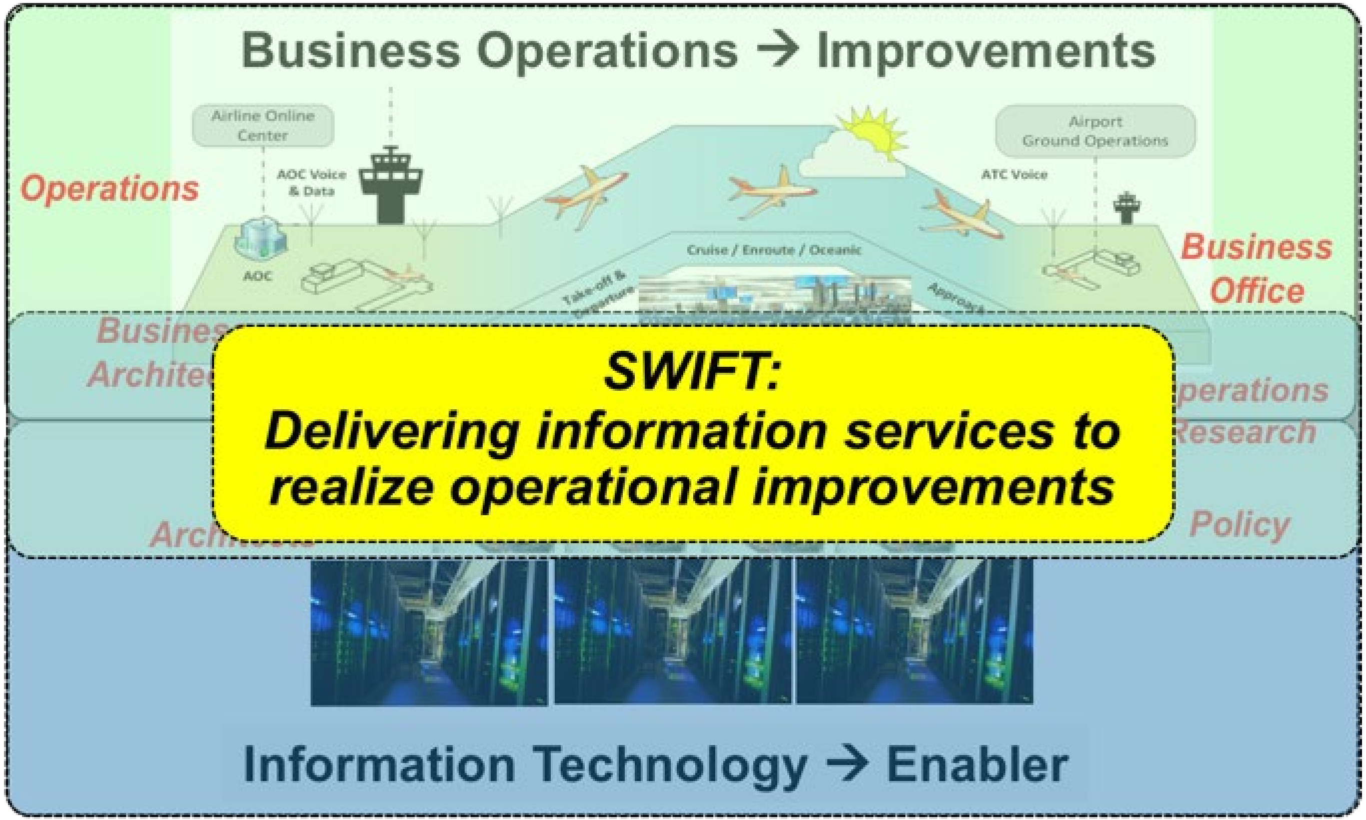
November 15, 2018



SWIFT Collaborative Workshop #5: Agenda

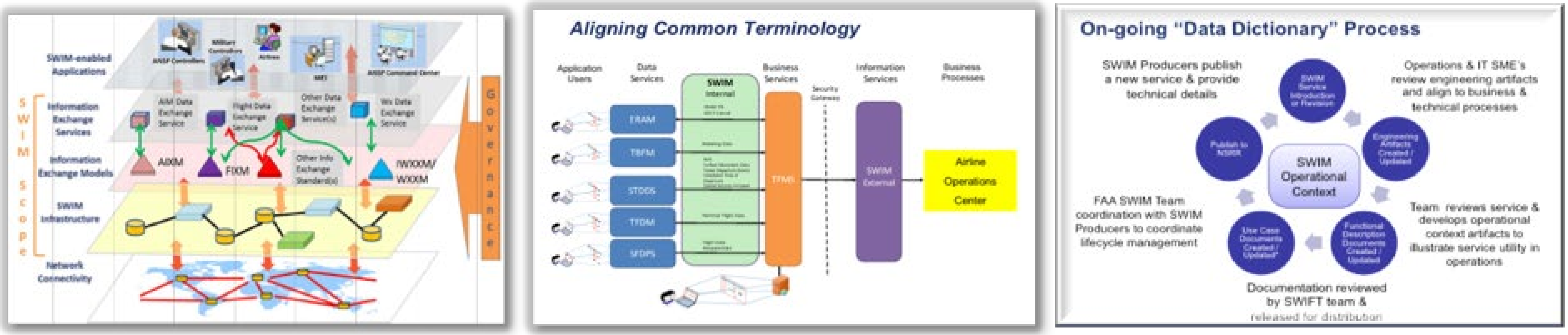
- **Introduction**
  - SWIFT Year in Review
  - Ops Context & Use cases, SWIM Widgets re-visited
- **Case Study 1: *"Operational Integrity"* by Southwest Airlines**
- *Break*
- **Special Topic:**
  - Taxi-Out Case Study follow up: Developing Operational Metrics
- *Lunch*
- **Special Topic: SWIM Data in Motion**
  - Demonstration and discussion of NAS Operational Dashboard (NOD), airport surface predictions and business rules driving applications
- **Special Topic: NASA TTP Business Value Case Study by NASA**
- *Break*
- **Case Study 2: NASA TTP Mediation by NASA**
- **Closeout: SWIFT FY19 and Beyond!**

SWIFT: Different Approach to Realizing Benefits



SWIM = EMPOWERMENT

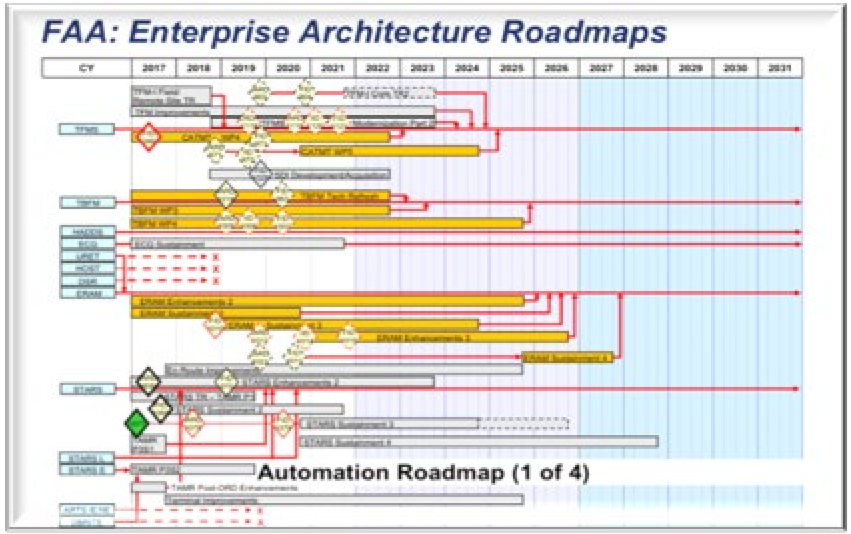
SWIFT: Learning to Speak the Same Language



- **Work collaboratively to translate how SWIM fits in connecting FAA systems and SWIM information**
  - Goal: move beyond demanding information on systems and focus more on business processes
- **Focused on aligned terminology:**
  - Data vs. information services
  - Business services vs. information services
- **Developed Operational Context documents and Use Cases providing operational insights and SWIM "data dictionary"**

SWIFT: Providing Context to SWIM Information

From <u>technology</u>-driven data and information sharing

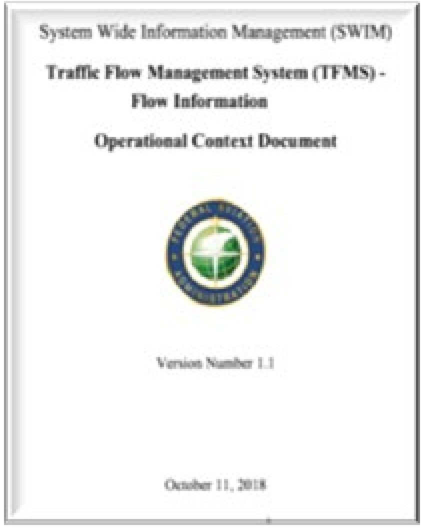


JAVA Messaging Service Description Document

SWIM Terminal Data Distribution System (STDDS)

Surface Movement Event Service (SMES)

To <u>operationally</u>-driven data and information context



System Wide Information Management (SWIM)

Traffic Flow Management System (TFMS) - Flow Information

Operational Context Document

Version Number 1.1

October 11, 2018

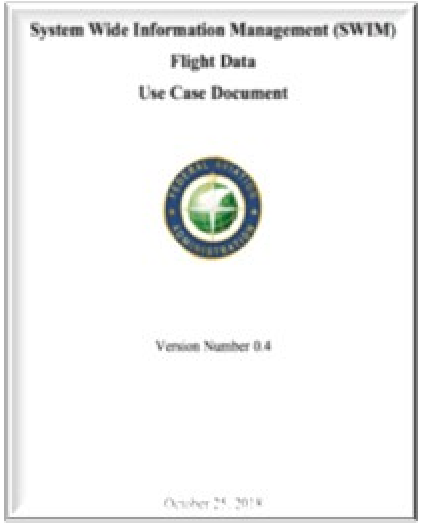
System Wide Information Management (SWIM)

Time Based Flow Management (TBFM) – Metering Information Service (MIS)

Operational Context Document

Version 1.0

September 4, 2018



System Wide Information Management (SWIM)

Flight Data

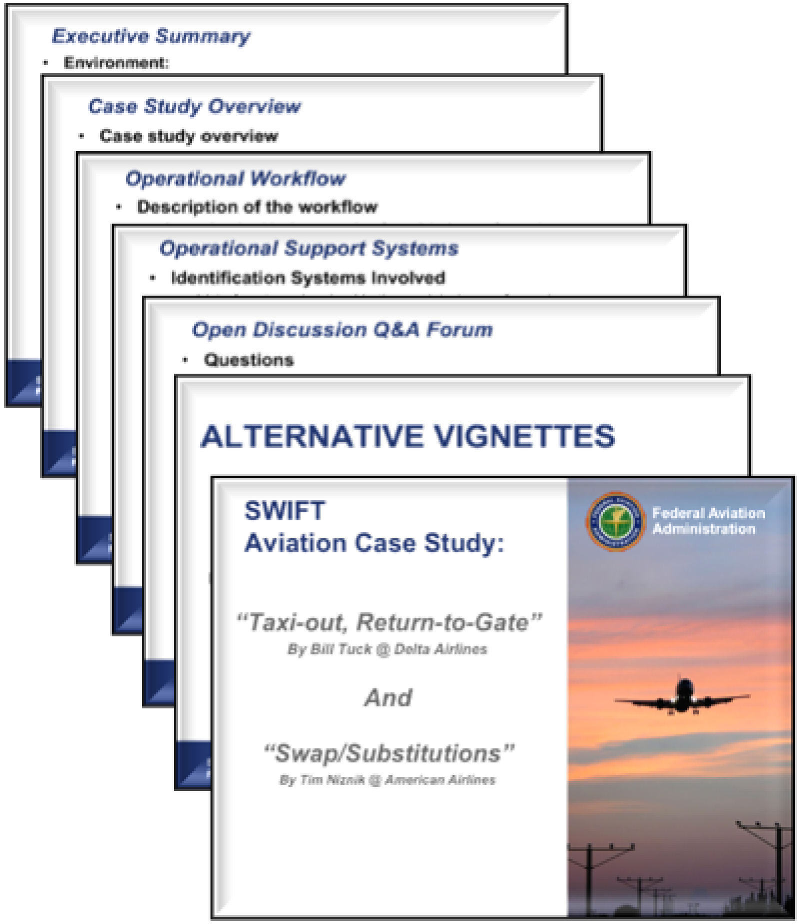
Use Case Document

Version Number 0.4

October 25, 2018

SWIFT: Relating SWIM Information to Operations

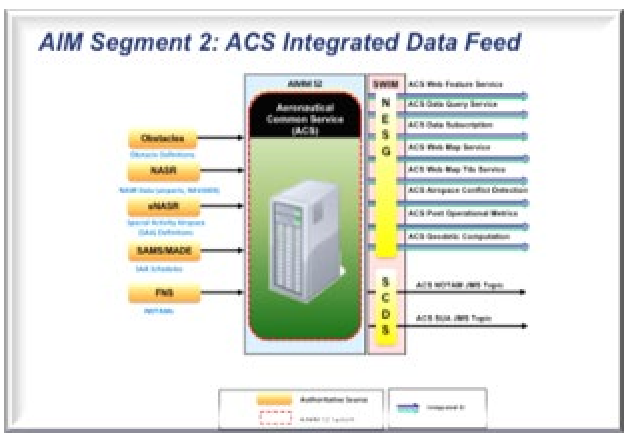
- **Objective:**
  - **"Show and Tell":** Offer a venue to share uses of SWIM Information Services and related lessons learned with the community
  - **"Here is problem I have":** Provide a forum to discuss real-world operational problems and identify underlying NAS systems/related SWIM information services that can contribute operational solutions

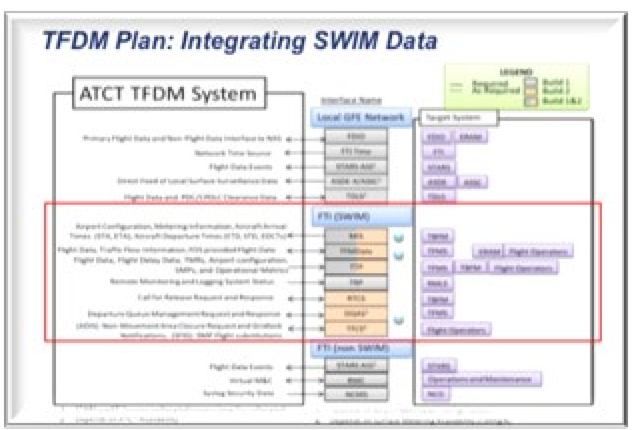


- **Goals:**
  - How can we use SWIM information to better inform operational decisions?
  - How can SWIM data and information help work around operational issues before they materialize?

SWIFT: Platform for Sharing Information

- **Gaining subject matter expert insights in focus areas**
  - Operational Status Dashboard
  - Operational Context and Use Case Documents
- **Engaging SWIM Producers:**
  - Traffic Flow Management System (TFMS), Time Based Flow Management (TBFM), Terminal Flight Data Manager (TFDM), Aeronautical Information Management (AIM)
- **Special Projects and Announcements:**
  - SWIM Cloud Distribution Service and SWIM Portal
  - TFDM Terminal Publication (TTP) Service & ATD-2





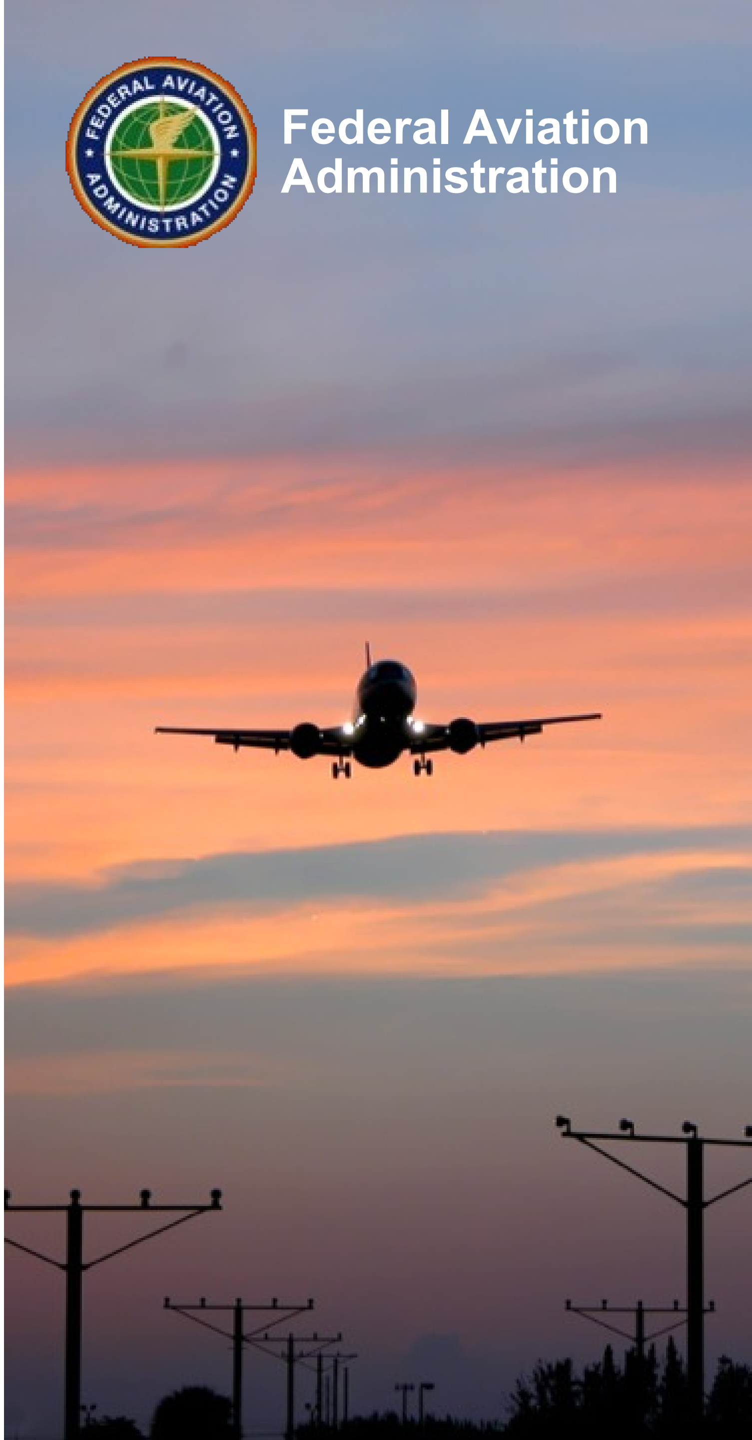
SWIFT Focus Group: Operational Context & Use Case Documents

Ops Context & UC Updates

Kathryn Crispin & Jay Zimmer

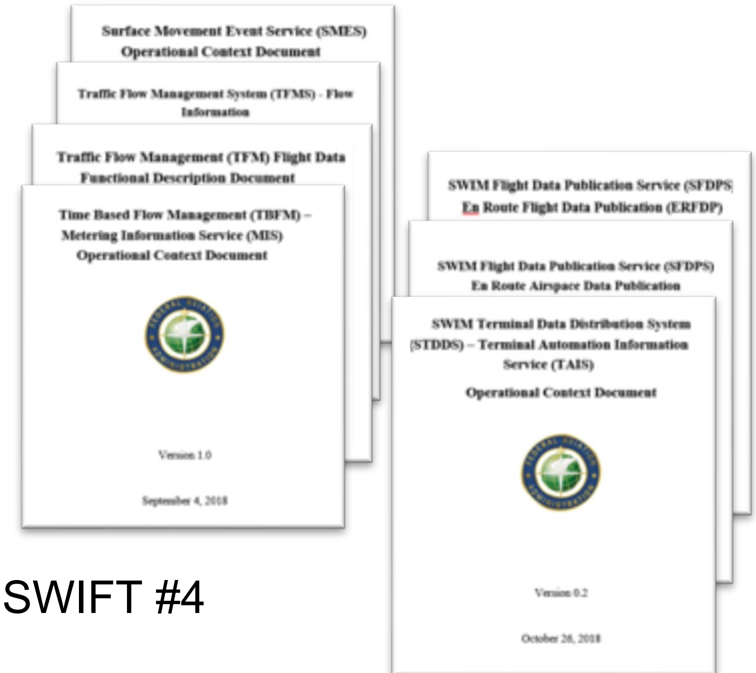
American Airlines & SWIM Program

November 15, 2018



Operational Context Documents

- **Document Progress**
  - STDDS – SMES *delivered, update in progress*
  - TFMS Flow *delivered, update complete*
  - TFMS Flight *delivered, update in progress*
  - TBFM – MIS *delivered*
  - SFDPS – Flight *delivered*
  - SFDPS – Airspace *delivered*
  - STDDS – TAIS: *draft delivered, under review*



- **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
  - Before update to current template, comments commonly concerned editorial issues, confusion around system functionality, misunderstanding of acronyms, confusion about data formats, etc.
  - Since update to current template, comments almost entirely request clarifications about specific data elements and service/message technicalities
    - Documents have successfully clarified how these systems work and how individual data elements relate to specific real-world activities

Operational Context Document Template

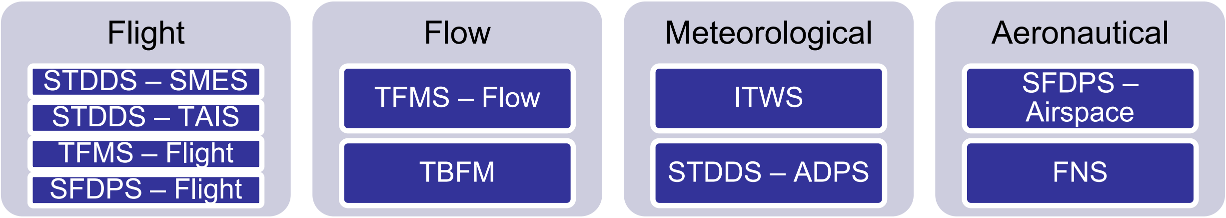
1. **Introduction**
   - Briefly describe purpose of document
   - Briefly describe the FAA systems with which the information service interfaces and what type of information it publishes
2. **Domain System Description**
   - In depth discussion of internal FAA systems that create the data ingested and published by the information service
     - e.g., for STDDS-TAIS, this section explains how terminal radar automation functions
   - 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

Appendix B: Message Headers

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 *draft delivered, under review*
- **Updated Document Format**
  - Monthly delivery of individual information service documents became repetitive (e.g., all flight services had similar benefits)
  - 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

- **Use Case and Ops Context documents will be worked concurrently**
- **Deliver one SWIM service Ops Context Document per month**
- **Deliver one domain Use Case Document every two months**
  - Two months of development time per document will allow for use cases employing multiple information services for each domain
  - Will provide more useful documentation to the user community

	Oct. 2018	Nov. 2019	Dec. 2018	Jan. 2019	Feb. 2019	March 2019	April 2019	May 2019
Closeout	-------	TAIS OCD Closeout Flight UCD Closeout	FNS OCD Closeout	ITWS OCD Closeout Flow UCD Closeout	ADPS OCD Closeout	TFMS Status OCD Closeout MET UCD Closeout	SFDPS General OCD Closeout	ISMC OCD Closeout Aero UCD Closeout
Draft	TAIS OCD Flight UCD	FNS OCD	ITWS OCD Flow UCD	ADPS OCD	TFMS Status OCD MET UCD	SFDPS General OCD	ISMC OCD Aero UCD	-------
Storyboard	FNS OCD Storyboard	ITWS OCD Storyboard Flow UCD Storyboard	ADPS OCD Storyboard	TFMS Status OCD Storyboard MET UCD Storyboard	SFDPS General OCD Storyboard	ISMC OCD Storyboard Aero UCD Storyboard	-------	-------

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

Next Steps: Operational Context & Use Cases

- **Awaiting feedback on:**
  - STDDS-TAIS Operational Context
  - Flight Use Case

- **Continue Harmonizing Operational Context Documents**
  - Retroactively update older documents to new template (SMES, TFMS-Flight)

SWIFT Demonstration:

SWIM 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

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:

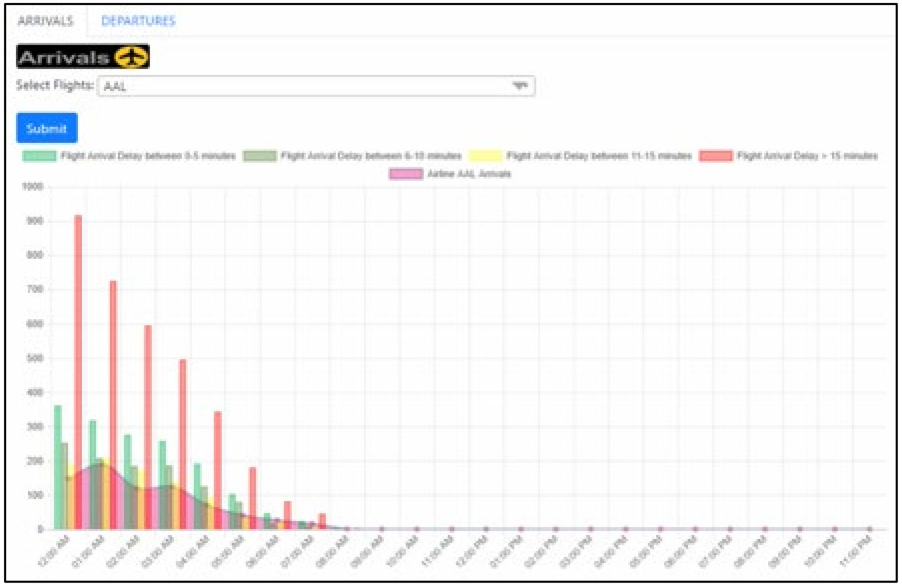
Airline	Flight ID	Departure City	Estimated Departure	Actual Departure	Departure Interval	Arrival City	Estimated Arrival	Actual Arrival	Arrival Interval
AAL	AAL1833	KCLT	2018-10-30 19:00	2018-10-30 19:16	0:16	KLAX	2018-10-30 23:40	2018-10-31 00:00	0:20
AAL	AAL2320	KPHX	2018-10-30 19:31	2018-10-30 19:54	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

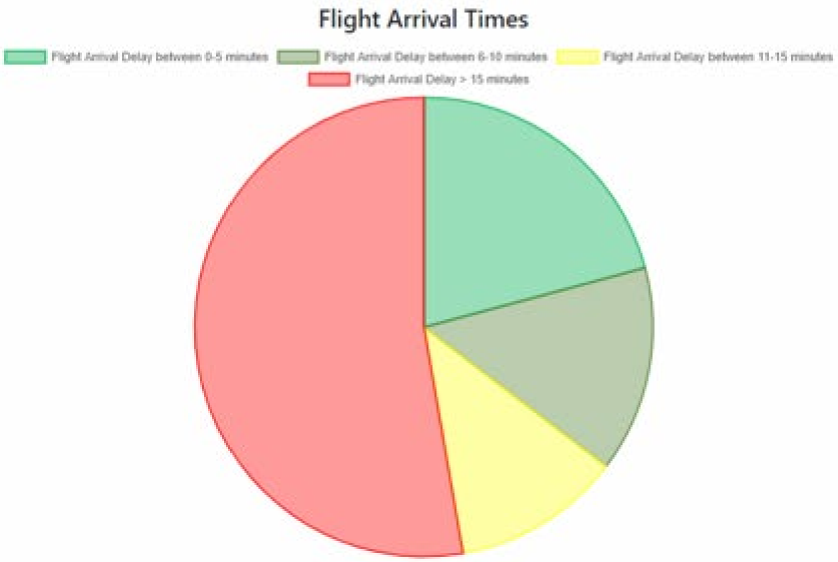
Arrival and Departure Delay Bar Charts

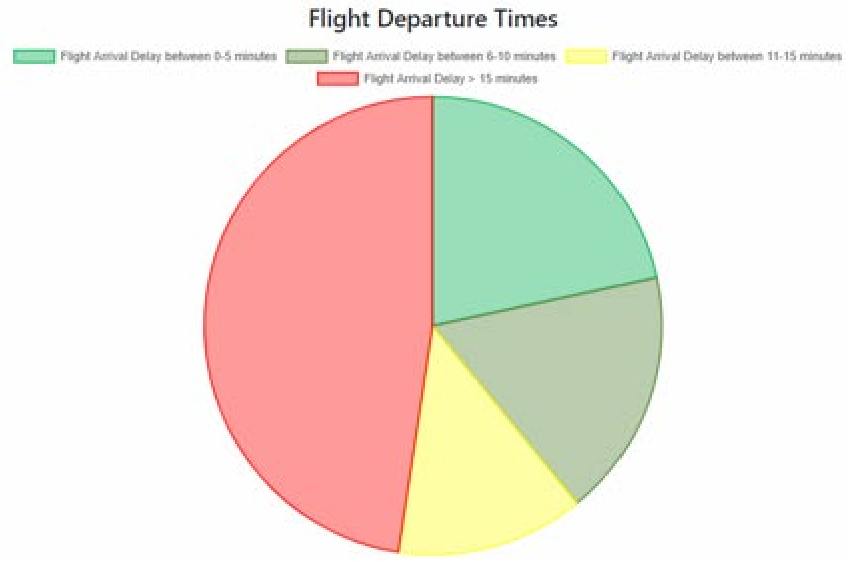
- **Plot overall NAS arrival and departure delays per hour**
- **Identify severity of delays and periods of high demand**
- **Plot arrivals per hour by airline**
- **Visualization of SFDPS live data**



Arrival and Departure Delay Pie Charts

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





SWIFT
Aviation Case Study:

Ops Integrity

Improving the value and timeliness of network decisions

November 15, 2018

Rick Dalton

Environment

- Across a broad spectrum of our decision support platforms we face a lack of sophistication, currency, and resolution of the dataset we use to develop operational solutions. Whether for individual flights or large scale network decisions, the criticality of data fidelity is steadily increasing.
- The execution of operational strategies and tactics involving 100+ airports, 735 aircraft, 8000 Crewmembers and the fluid nature of a complex airspace system requires agile, integrated processes informed by relevant data. This is but one operators level of complexity that must be factored into daily NAS operations.

Problem Statement

- Operational irregularities stress the tolerances of operational networks that depend on scarce resources distributed across a diverse set of complexities.
- One such example can occur during periods of convective weather and peak departure times resulting in compression of demand.
- This can cause a lack of departure gates resulting in lengthy departure delays.
- Airports often share departure fixes exacerbating the problem and resulting in ATC's use of extensive mile-in-trail separation.
- Departure stops and lengthy departure queues are not uncommon.
- The system impact of this is amplified if stale data are provided in the processing of operational solutions.

Impact

- When departure gates are restricted, SWA has limited visibility to the projected wheels up time or length of delay.
- Lengthy taxi out times can have downline impacts to Crew times, passenger connections, aircraft routing requirements, curfews and OTP
- These complicating factors can force mitigation plans.
- If the crew times out, crew scheduling has to coordinate a new crew to meet the aircraft or cancel the flight.
- This results in negatively impacted Customer experience, and costly delays.

Ancillary Risk

- Propagation of low fidelity data through chains of decision support tools further diminishing the value of generated solutions and feeding a cycle of poor decisions.

Goals

- Examine a few operational realities to demonstrate opportunities for improvement.
- Highlight business process and decision support apps that are involved.
- View challenges through the lens of a SWIM enabled process.
- Provide estimated value of increased data fidelity.

Making time for a good operation?

OOOI Times

Scheduled Times

2D

Operational Estimates

Public Actuals

Public Estimates

2P

Public Flight Status

Operational Flight Status

Operational Actuals

Operational Times

Used in the NOC (Network Operations Control) to drive the flight schedule for the current day

SWIFT applications

- Flow
- Monitor
- FliFo

Public Times

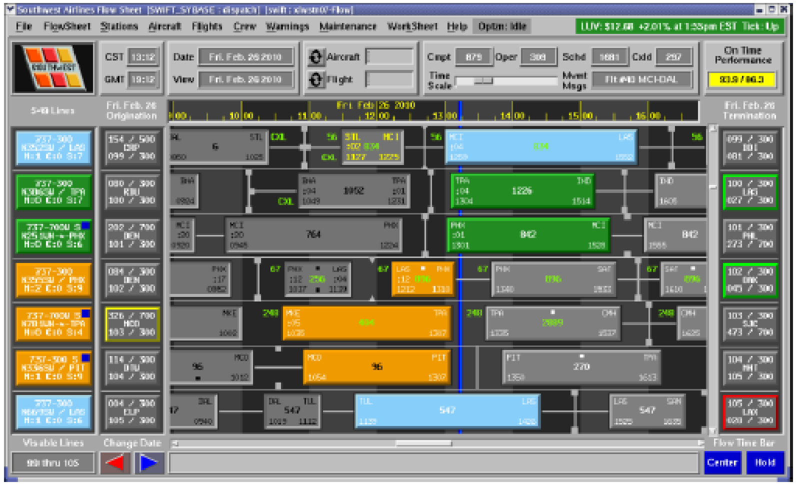
Viewed by the public (SWA Customers)

- FIDS (airport)
- Lone Star/Altea (Res. Agent)
- southwest.com
- CS2 (Cust. Svc. Agent)
- AOM (cell phone)
- FSM (cell phone)
- SWA Smart Phone app

Manual interface exists in this process and the order and supply of supporting data presents significant shortcomings

Flow

Used by SODs to perform Irregular Operations (IROPS) such as Cancel, Divert, add Extra Section



Monitor

Used by Dispatchers to plan flight routes and generate flight releases

Example:

FliFo

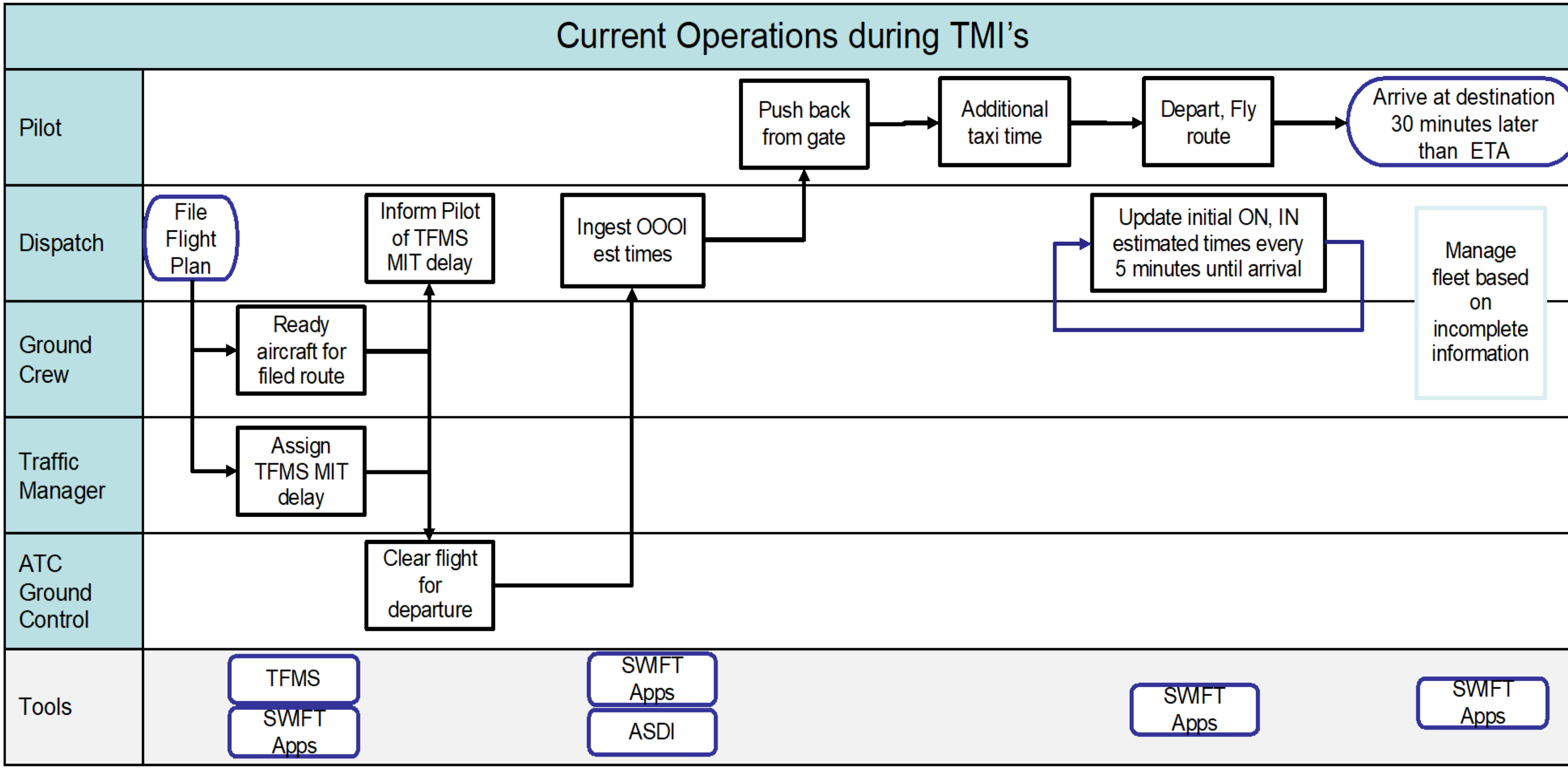
(Flight Following)

Used by FliFo Agents for auditing flight times and posting times to the Public

FliFo is the only SWIFT app that displays Public Times!

Southwest

Operational Business Process: High level view



Chasing real time in 5 min intervals!

FliFo Matrix

If you read the FliFo matrix from left to right, it all makes perfect sense!

FLT	LN	NOSE	TAIL	DEP	ARR	PREV TIME	SCHD OUT	SCHD IN	DIFF SKED	ANCH OUT	SWFT OUT	SWFT OFF	SWFT ON	SWFT IN	CD	DIF POS
2581	N/A	CXLD	CXLD	ONT	OAK	**	0905	1020	:19	0930	0930	0940	1033	1039	14	:0
2581	413	N775	N775SW	PDX	AUS	1229	1300	1655	:08	1300	1303	1316	1642	1647	23	:0
3171	386	N288	N288WN	HOU	SNA	1217	1310	1625	:10	1310					23	
631	228	N950	N950WN	LAS	SFO	1246	1330	1510	8:41	2213	2213	2233	2345	2351	55	5:3
993	39	N628	N628SW	TPA	PIT	1256	1335	1555	1:18	1335	1339	1512	1708	1713	07	
190	478	N450	N450WN	SMF	PHX	1246	1335	1525	:05	1335					23	
1356	439	N964	N964WN	PHX	DTW	1314	1345	1740	:02	1345	1352	1403	1733	1742	53	:0
1686	346	N768	N768SW	MCO	BHM	1309	1350	1525	:14	1350					87	:0
1929	420	N954	N954WN	SAT	BNA	1345	1405	1620	:07	1405	1425	1434	1621	1627	53	:0
2654	1	N507	N507SW	OKC	HOU	1342	1420	1545	:06	1420					23	:0
2903	123	N641	N641SW	TPA	PHL	1420	1430	1710	:28	1430	1449	1520	1731	1738	88	:1
1686	346	N768	N768SW	BHM	MDW	1511	1600	1745	:05	1600						
190	478	N450	N450WN	PHX	MDW	1513	1605	1925	:01	1605	1605	1615	1920	1926		
2654	1	N507	N507SW	HOU	AUS	1512	1615	1700	:13	1628	1628	1638	1708	1713	28	:0
3171	386	N288	N288WN	SNA	SFO	1315	1655	1810	1:07	1751	1751	1811	1911	1917		

Scheduled Times

Operational = Public

Loaded from the PSDS (published schedule) .

SWIFT Schedule Load runs at 2:30 am and loads the schedule for the 11th day out.

Estimated Times

Operational ≠ Public

Updated throughout the day as events occur on the line of flights.

Actual Times

Operational = Public

Updated as the flight progresses from beginning to end.
OOOI times (Out, Off, On, In)

Actual times change the STATUS of the flight.

At the beginning of each day, Operational Estimates are initialized to Scheduled times.

Scheduled Off and On times are not provided in the PSDS, so the Operational Estimated Off and On times are initialized using station Taxi Out and Taxi In times.

SWFT OUT = SCHD OUT
SWFT OFF = SCHD OUT + departure station Taxi Out time
SWFT ON = SCHD IN – arrival station Taxi In time
SWFT IN = SCHD IN

FLT	LN	NOSE	TAIL	DEP	ARR	PREV TIME	SCHD OUT	SCHD IN	DIFF SKED	ANCH OUT	SWFT OUT	SWFT OFF	SWFT ON	SWFT IN
3406	178	N600	N600WN	SLC	LAS		1425	1545		1425				
887	174	N217	N217JC	SEA	SMF		1535	1730		1535				
2055	437	N264	N264LV	OAK	LAX		1545	1700		1545				
3406	178	N600	N600WN	LAS	PHX		1620	1730		1620				
2322	437	N264	N264LV	LAX	SMF		1725	1840		1725				

When Operational Estimated Out and In times equal Scheduled Out and In times, the Operational Estimates are not displayed.

							Scheduled Times (Do not change)				Operational Estimated Times						Public Estimated Times		Actual Times				
FLT	LN	NOSE	TAIL	DEP	ARR	PREV TIME	SCHD OUT	SCHD IN	DIFF SKED	ANCH OUT	SWFT OUT	SWFT OFF	SWFT ON	SWFT IN	CD	DIFF POST	PUBL OUT	PUBL IN	OUT GATE	OFF GRND	IN RNG	ON GRND	IN GATE
2581	N/A	CXLD	CXLD	ONT	OAK	**	0905	1020	:19	0930	0930	0940	1033	1039	14	:04	0930	1035					
2581	413	N775	N775SW	PDX	AUS	1229	1300	1655	:08	1300	1303	1316	1642	1647	23	:02		1645	1303	1316			
3171	386	N288	N288WN	HOU	SNA	1217	1310	1625	:10	1310					23			1615	1309	1315			
631	228	N950	N950WN	LAS	SFO	1246	1330	1510	8:41	2213	2213	2233	2345	2351	55	5:31	2210	1820					
993	39	N628	N628SW	TPA	PIT	1256	1335	1555	1:18	1335	1339	1512	1708	1713	07		1339	1713	1339	1512			
190	478	N450	N450WN	SMF	PHX	1246	1335	1525	:05	1335					23			1520	1333	1343	1501	1513	
1356	439	N964	N964WN	PHX	DTW	1314	1345	1740	:02	1345	1352	1403	1733	1742	53	:03	1355	1745	1352	1403			
1686	346	N768	N768SW	MCO	BHM	1309	1350	1525	:14	1350					87	:04		1515	1350	1356	1456	1506	1511
1929	420	N954	N954WN	SAT	BNA	1345	1405	1620	:07	1405	1425	1434	1621	1627	53	:02	1425	1625	1425	1434			
2654	1	N507	N507SW	OKC	HOU	1342	1420	1545	:06	1420					23	:04		1535	1416	1428	1512		
2903	123	N641	N641SW	TPA	PHL	1420	1430	1710	:28	1430	1449	1520	1731	1738	88	:13	1449	1725	1449				
1686	346	N768	N768SW	BHM	MDW	1511	1600	1745	:05	1600													
190	478	N450	N450WN	PHX	MDW	1513	1605	1925	:01	1605	1605	1615	1920	1926									
2654	1	N507	N507SW	HOU	AUS	1512	1615	1700	:13	1628	1628	1638	1708	1713	28	:03	1625	1710					
3171	386	N288	N288WN	SNA	SFO	1315	1655	1810	1:07	1751	1751	1811	1911	1917									

The most recent Actual time from the previous flight on the line

Diff. between Scheduled In and Operational Estimated In

Anchor Out time (Hold flight)

Most recent Public post code

Diff. between Operational Estimated In and Public Estimated In

Baker App – Optimized solutions

Request a solution

What ifs

- Aircraft out of service
- Reduce station capacity
- Shutdown station
- Specify # to RON
- Target flights
- Evaluate Problem

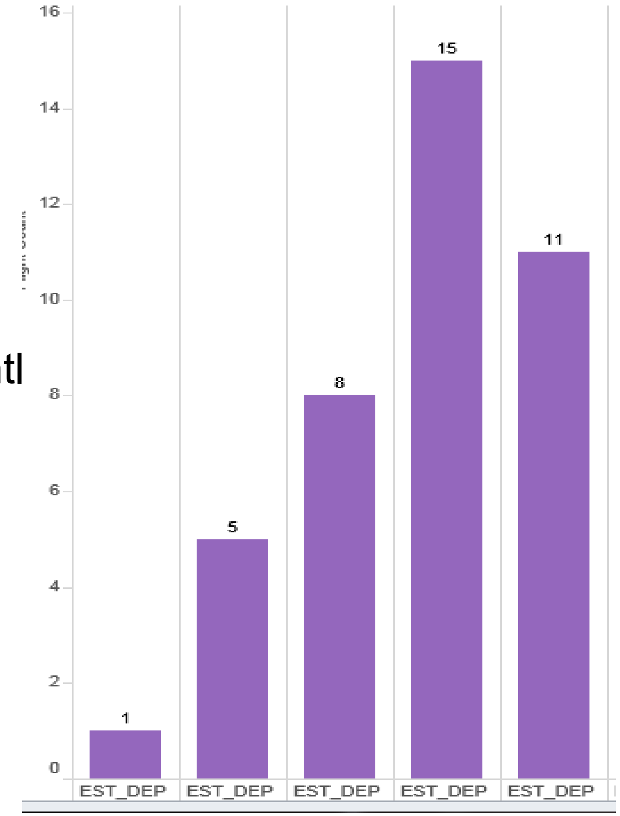
Protections

- Protect Aircraft
- Protect Flight
- Exclude Ferries

Southwest®

Reduce Station Capacity - Arrivals

- The decision to use **Arrivals, Departures**, or **All** can often be based on time of day and how much lead time you have before you begin the reduction.
- Arrivals is generally best if you already have flights in the air, bound for the station you would like to reduce. The airborne flights will count against your rate, possibly even exceeding it, but will allow departures to leave.
- Metering by arrivals early in the day works well, but you departure rate may be higher due to the originators not being accounted for.
- This is a look at a departure chart after a 10 arrival rate was committed.
- Note: If running a reduction with "**Specify # to RON**", then "**Arrivals**" is currentl the only option.

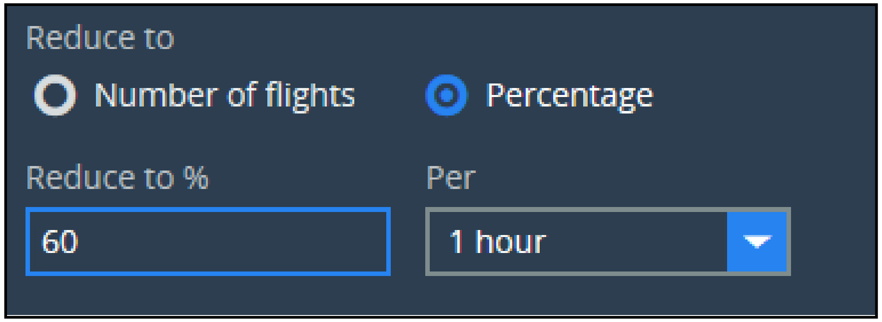


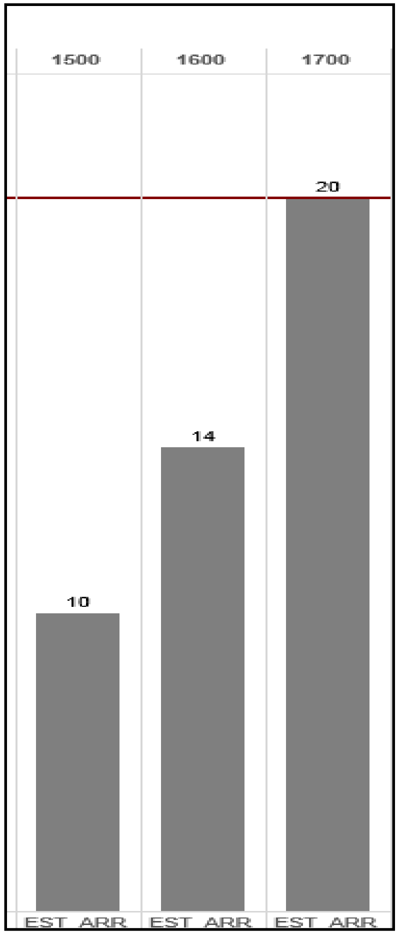
Southwest

Station Capacity Reduction – Percentage

- A reduction to a percentage will take each hour to the percentage selected. As shown in the image on the left, 60% of the scheduled flights each hour will operate and 40% will be cancelled.
- The 1500 hour would be reduced to 6 arrivals, the 1700 hour would have 12 arrivals, as shown in the image to the right.

- **Note:** Model is often forced to round down.

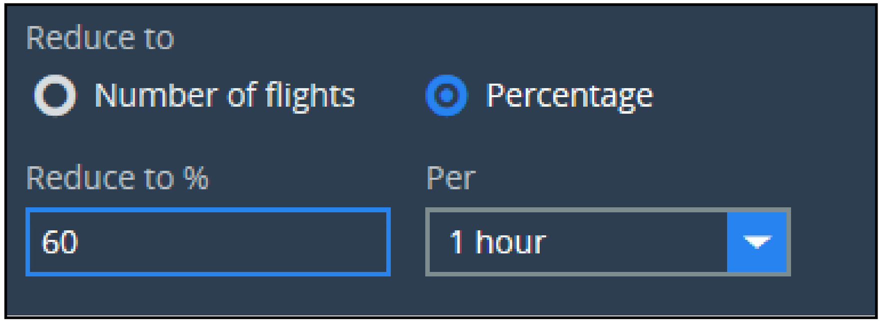


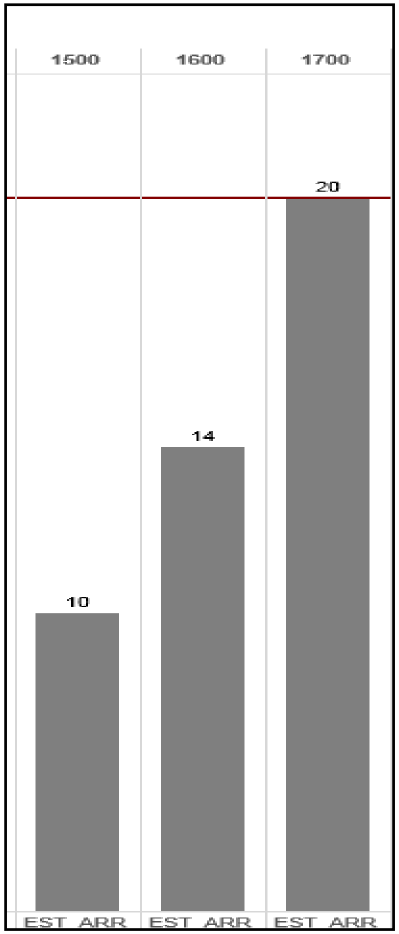


Southwest

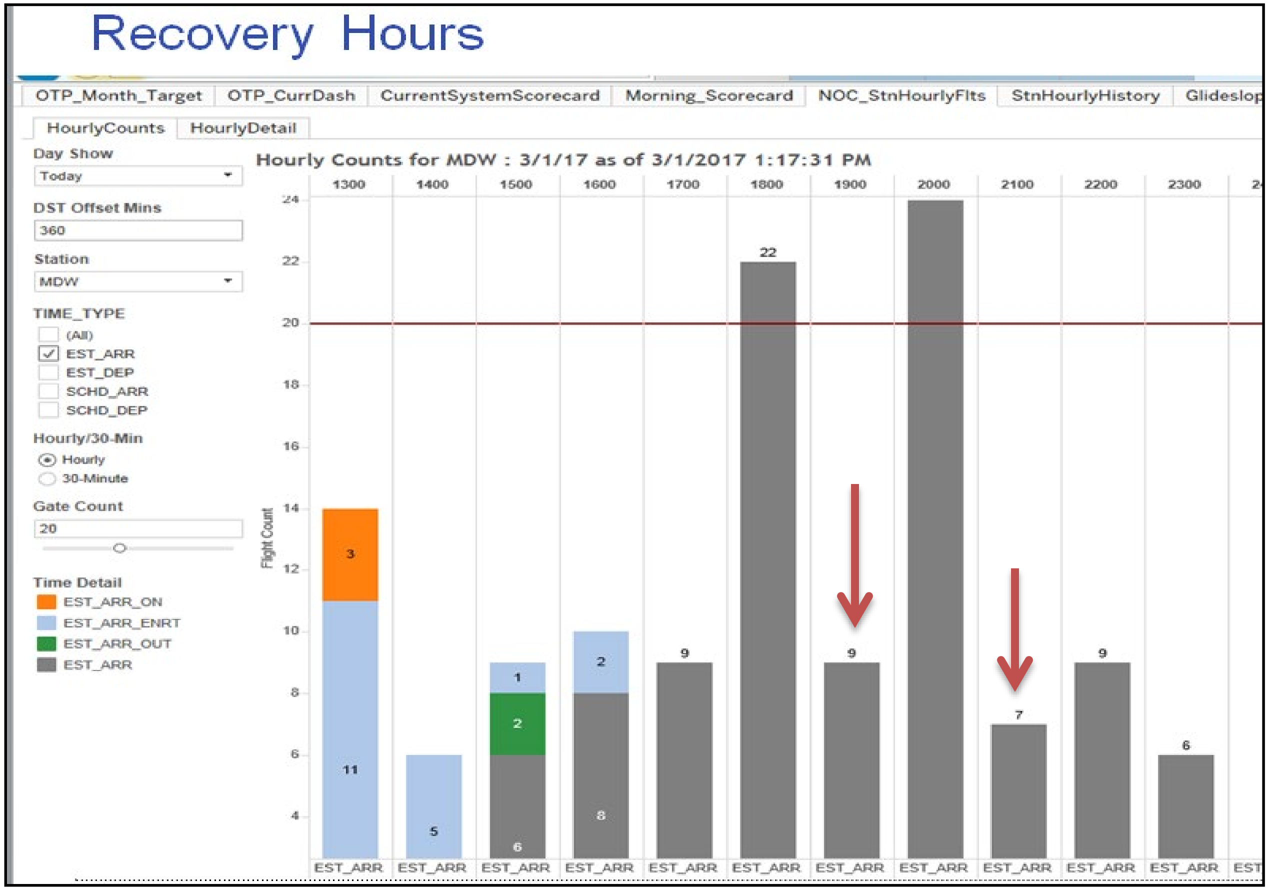
Airspace Capacity Reduction – This needs definition that SWIM can give it

- A reduction to a percentage will take each hour to the percentage selected. As shown in the image on the left, 60% of the scheduled flights each hour will operate and 40% will be cancelled.
- The 1500 hour would be reduced to 6 arrivals, the 1700 hour would have 12 arrivals, as shown in the image to the right.
- **Note:** Model is often forced to round down.





Reduce Station Capacity – Allowing Delay or Metering

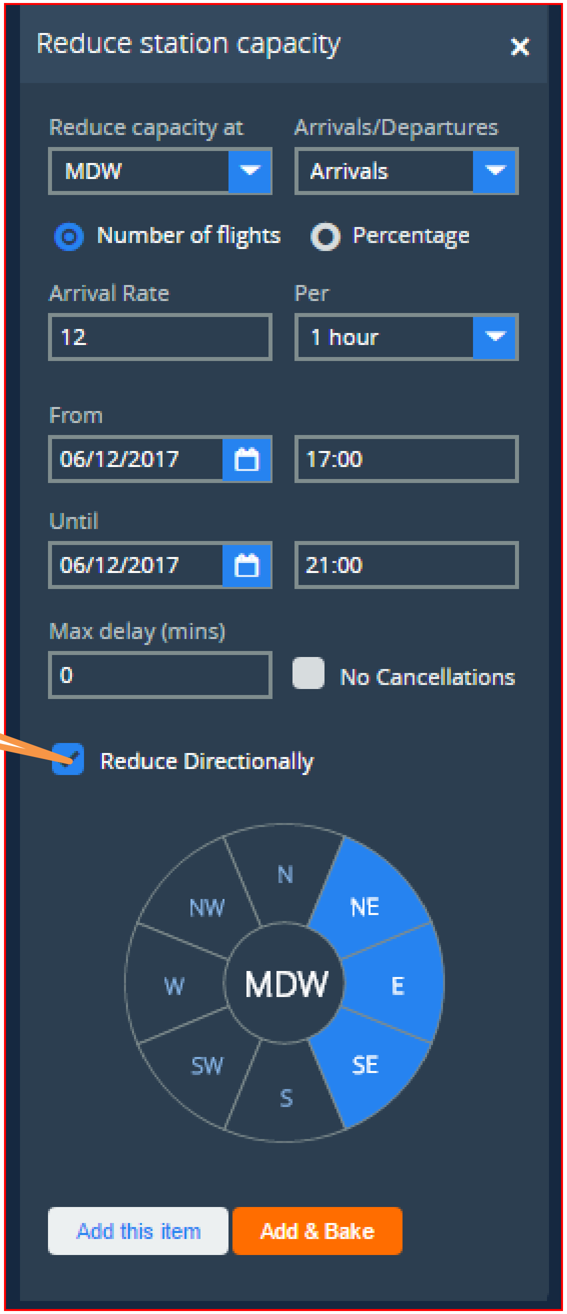


Imagine if we could be evaluating station capacity based on things like anticipated configuration changes or changes from VFR to LIFR conditions.

Southwest

Directional Reduction

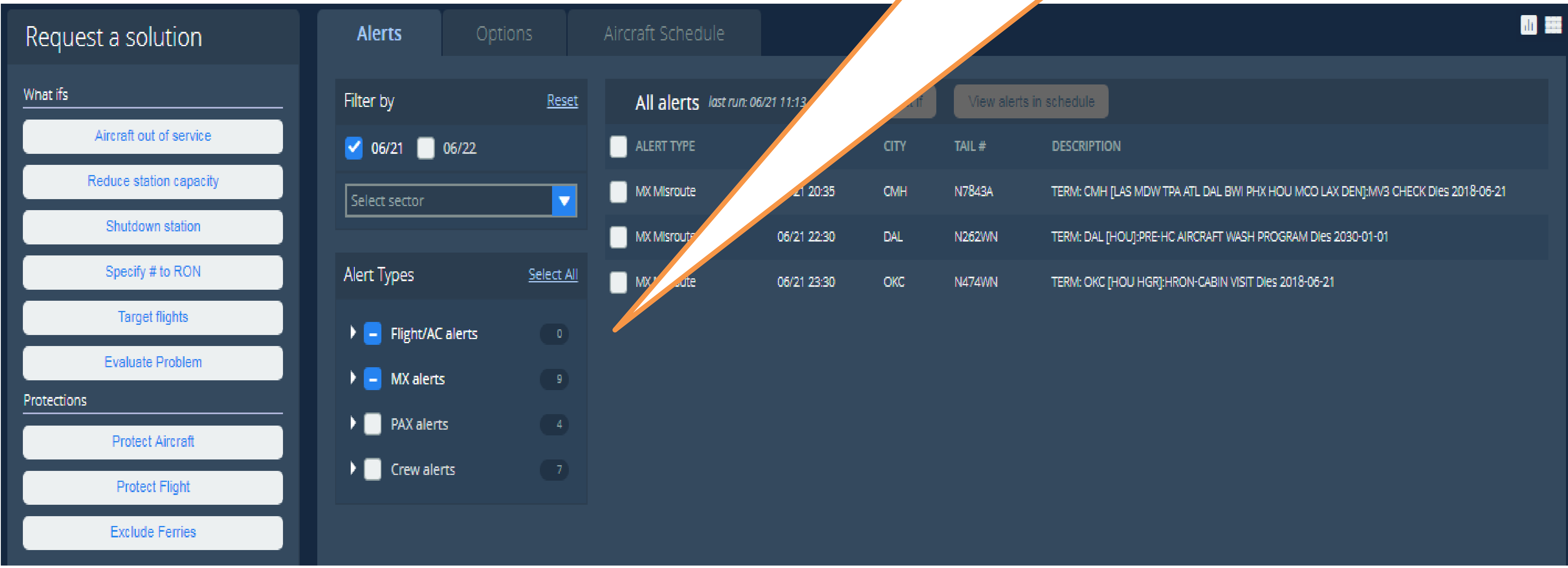
Imagine a radio button to account for enroute constraints (Sector MAP values for instance)



Southwest

Directional Flight Map Tool

Imagine a radio button to account for enroute constraints!
(Sector MAP values for instance)



Southwest

Actual Times and Status – Operational Times

Actual Times and Source

As a flight progresses from start to finish, Actual times are received and flight Status is updated.

Operational Estimates are replaced with Actual times.

The most common source of Actual times is ACARS.

ACARS (Aircraft Communications Addressing and Reporting System) is a digital datalink system for transmission of messages between aircraft and ground stations via radio or satellite.

Actual times can be entered manually in SWIFT or OTIS with time sources such as FliFo, Pilot or Ground Operations.

Actual times are consistently processed and displayed in SWIFT regardless of the time source.

Sources – Operational Estimated Times

So you may be wondering…

What events cause Operational flight times to change from Scheduled to Estimated?

- FliFo Agent – manual time entry in FliFo
- SWIFT automated updates based on Actuals
- ATC Delay Programs
- ASDI Estimates
- Pilot Estimates through ACARS
- Dispatcher – Flight Planning in Monitor
- SOD – IROPS in Flow

But believe it or not…

Actual times on flights generate most of the changes to **Operational Estimated** times!

Operational Times

How Actuals affect Operational Estimated Times

Actual Time	Operational Estimated Out	Operational Estimated Off	Operational Estimated On	Operational Estimated In
OUT GATE	Set to OUT GATE time	Adjusted	Adjusted	Adjusted
OFF GROUND		Set to OFF GROUND time	Adjusted	Adjusted
IN RANGE				
ON GROUND			Set to ON GROUND time	Adjusted
IN GATE				Set to IN GATE time

Southwest

ATC Delay Programs – Operational Times

Traffic Flow Management System (TFMS)
previously Enhanced Traffic Management System (ETMS)

The FAA uses TFMS to manage the flow of air traffic within the National Airspace System (NAS).

Whenever Operational Estimated times change throughout the day, Southwest sends current flight time information to TFMS.

Southwest receives departure time estimates from TFMS when flights are involved in an ATC Delay Program.

Extended Turns & Budgeted Turn Time

Each fleet type has a default budgeted turn time for Extended turns which can be overridden per station.

Budgeted turn time = fleet/station budgeted turn time for extended turns

DLA Admin Tool

Swap Turn Times | IROP Turn Times | EXT Turn Times | Mission Turn

	737-300	737-500	737-700	737-800	717-200
Default	35	35	35	45	35
ATL	25	25	25		
CAK	25	25	25		
DAY	25	25	25		
DCA	25	25	25		
DSM	25	25	25		
EYW	25	25	25		

SWIFT always performs Downline Adjust based on the Budgeted Turn Time!

Southwest

IROPs & Budgeted Turn Time

Each fleet type has a default budgeted turn time for IROPs which can be overridden per station.

When a flight is added or cancelled, SWIFT must create new turns so that Downline Adjust will work properly.

Budgeted turn time = fleet/station budgeted turn time for IROPs

Swap Turn Times | IROP Turn Times | EXT Turn Times | Mission Turn

	737-300	737-500	737-700	737-800	717-200
Default	35	35	35	45	35
ATL	25	25	25		
CAK	25	25	25		
DAY	25	25	25		
DCA	25	25	25		
DSM	25	25	25		
EYW	25	25	25		
SJU	25	25	25		

Southwest

Use Case: SWIM TFDM

Real Time Airport Terminal Information

Problem Statement:

- Inflight Crew Scheduling does not have accurate estimated block in time to help with notification of Crew reschedules. When a Crew reschedule has a short timeframe or is not a 'desirable' reschedule only a phone conversation will require our Crews to work the new flight assignment(s).
- Because a phone call is required we miss notification if a flight blocks in unexpectedly or we waste Crew Scheduling bandwidth as they wait for the SWIFT puck to change color and indicate it is in-gate.

Environment:

- Terminal Flight Data Manager (TFDM) is an FAA Decision Support Tool that accurately reflects the current airport terminal situation.

What's in it for SWA

Current State:

- Crew notifications are a big part of keeping our Crew network flowing. There are times when we have high priority notifications (short notice or to catch the Crew before leaving the aircraft) and we miss notifying the Crew and have to scramble to cover flights.
- Inflight Crew Scheduling relies on SWIFT puck color changes to know when an aircraft is about to, or has, blocked into the gate.
- Inflight Crew Scheduling does not know when an aircraft is having a long taxi-in before reaching the gate.

Future State:

- With a more accurate picture of where an aircraft is on the airport terminal our Crew Schedulers can better manage their Crew notifications and work load priority.
- This will result in fewer missed notifications (that then require short notice Crew reschedules to cover what the missed notification was planned to do).
- This will also allow better Crew Scheduling time management by better predicting when a notification call needed to be initiated.

Southwest

Crew Routing Dynamics - September FDP extension scorecard:

Sep-18		
1	Pilots with unforeseen, reportable actual FDP extensions greater than 30 minutes	26
2	Pilots who were routed away from flying that would have produced a reportable extension-	90
3	Pilots with projected FDP extensions that were routed from flying	156
4	Additional Pilots routed to replace Pilots with potential FDP extensions-	143
5	Total Pilots who were routed to avoid potential FDP extensions (3 + 4)	299
6	Pilots who were routed away from an FDP extension that would not have extended more than 30 minutes in actual ops (3-2)	66
7	Additional Pilots routed to avoid FDP extensions who went fatigued	1
8	Open time trips issued	70

We reported 26 extensions greater than 30 minutes and avoided another 90 extensions that would have been reported. In order to do this, we routed a total of 299 Pilots and issued 70 open time trips.

Southwest

Crew Scheduling scorecard starting from December 4th 2017 thru Sunday, October 7th:

1	Pilots with unforeseen, reportable actual FDP extensions greater than 30 minutes	542
2	Pilots who were routed away from flying that would have produced a reportable extension-	1497
3	Pilots with projected FDP extensions that were routed from flying	2653
4	Additional Pilots routed to replace Pilots with potential FDP extensions-	2374
5	Total Pilots who were routed to avoid potential FDP extensions (3 + 4)	5027
6	Pilots who were routed away from an FDP extension that would not have extended more than 30 minutes in actual ops	542
7	Additional Pilots routed to avoid FDP extensions who went fatigued	14
8	Open time trips issued to avoid potential FDP extensions	1289

Southwest

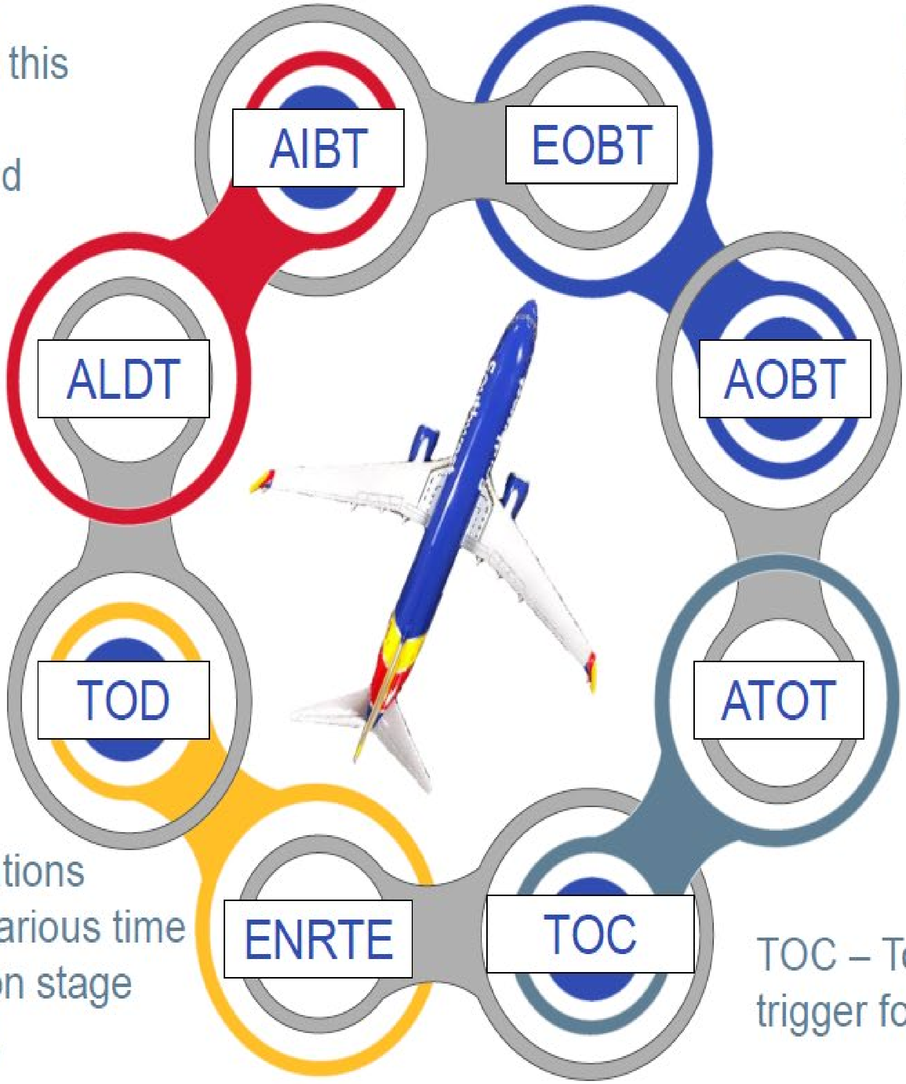
Continuous Optimization – Flight Planning with SWIM elements

AIBT – Actual In Block Time. A recalculation at this point should help inform the next flight and downline systems.

ALDT – Actual Landing Time. A recalculation at this point should help inform the AIBT.

TOD – Top of Descent. A recalculation at this point should help inform the ALDT.

ENROUTE – Recalculations should be triggered at various time increments depending on stage length (25%-50%-75%).



EOBT – Estimated Out Block Time. At a predetermined time during the boarding process this triggers a recalculation.

AOBT – Actual Out Block Time. At Brake Release a recalculation is triggered.

ATOT – Actual Take Off Time. Once Airborne a recalculation is triggered.

TOC – Top of Climb. An Ideal trigger for recalculation.

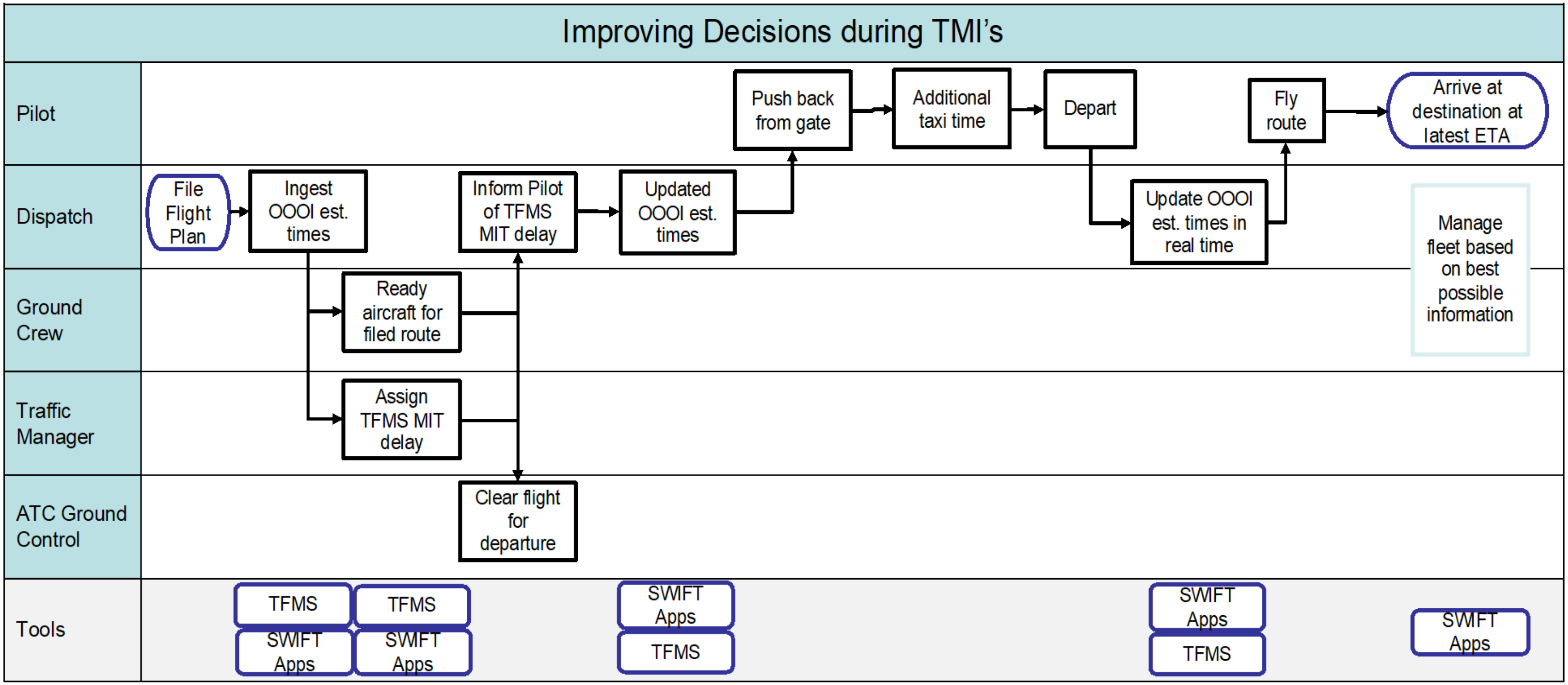
Southwest

Questions for SWIFT Discussion

- How can we get the latest OOOI times, relevant to the operational decision being considered?
- How do we eliminate the ON, IN estimates to be closer to near real time?
- What additional data elements can help manage fleet based on best possible information?

- SWIM Information Services can provide insights:
  - Traffic Flow Management Flight Data

Decision-points with SWIM Information Services



Potential process improvements with SWIM Information

Originally presented
Bill Tuck
May 10, 2018

SWIFT
Aviation Case Study:

"Taxi out, Return to Gate"

Rob Goldman

Delta Airlines

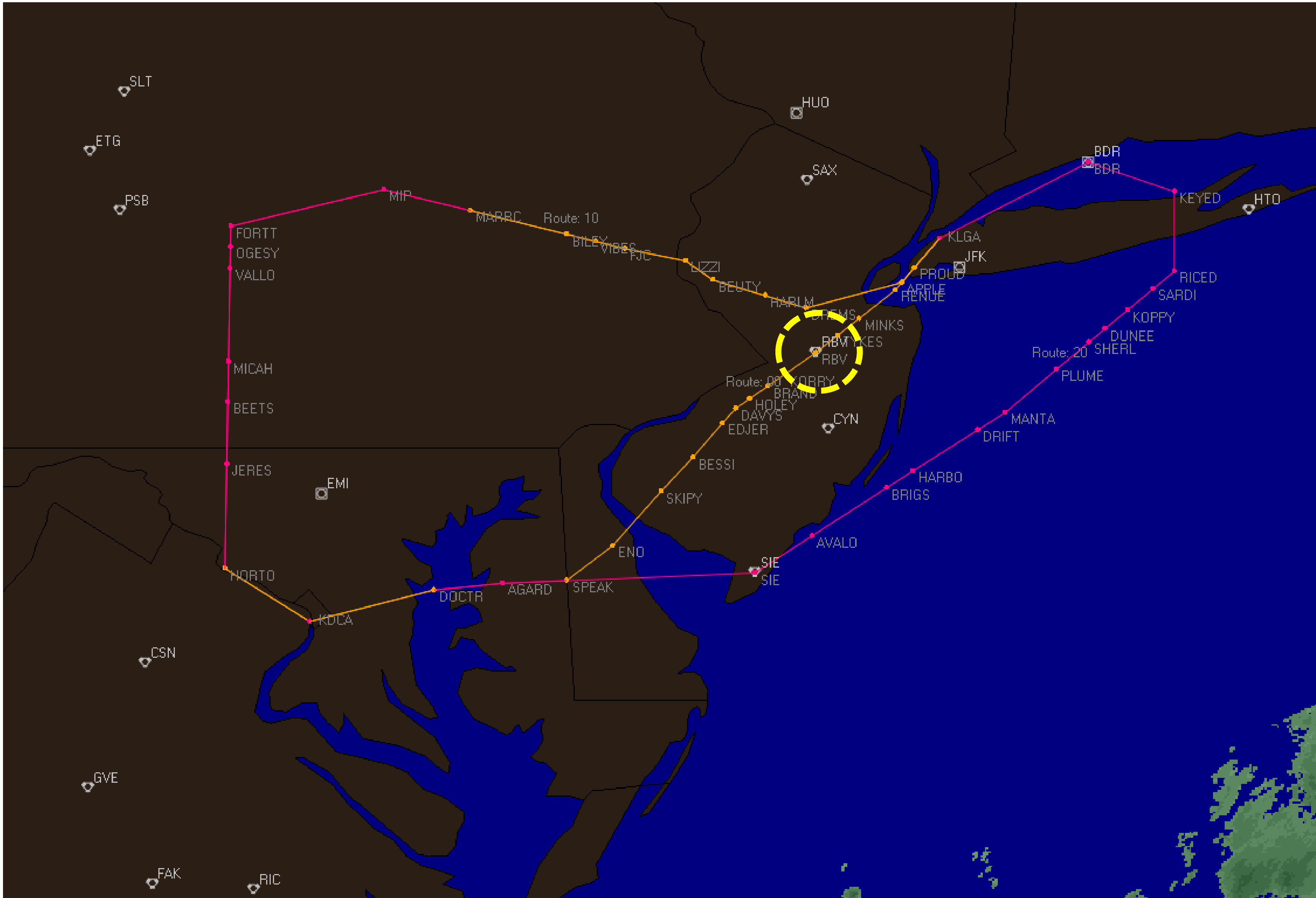
November 15, 2018

DELTA

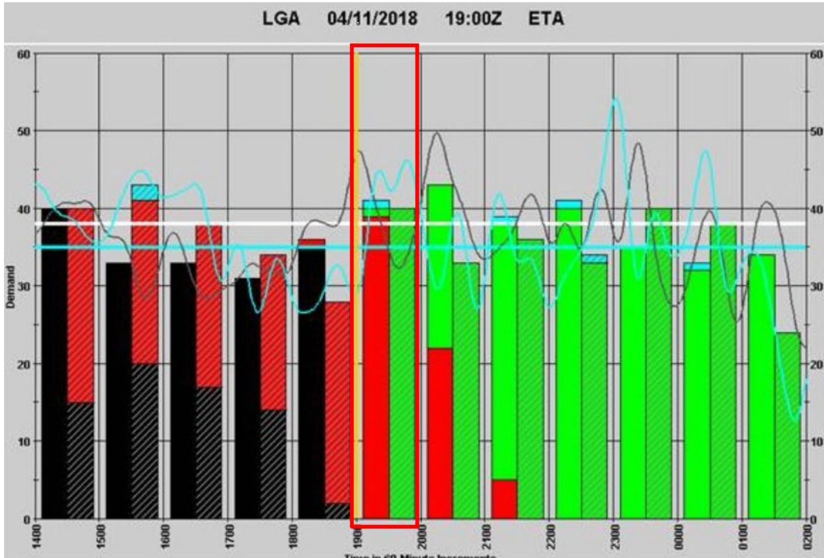
Executive Summary

- **Environment**:
  - Delta has an issue with close in traffic destined to LGA from ZDC
  - Flow through ZDC is heavy during certain times of the day
  - Either MIT (TFMS), or metering (TBFM) can affect availability of overhead stream
- **Problem statement:**
  - During the day, there are periods when more than half LGA demand comes over RBV
- **Impact**:
  - GDP can be planned around, but not typically assigned a delay for MIT/TBFM EDC due to overhead stream, until after push from gate
  - Reduce taxi delay to improve satisfaction of traveling public
  - Reduce customer missed connections due to unpredictable delay
  - Reduce taxi length to avoid additional crew block time and potential for daily duty max
  - Reduced taxi time to result in lower crew block time costs
  - Fewer gate returns due to longer reroutes with insufficient fuel
  - Reduce fuel and time costs of longer reroutes
  - Reduce cascading effects from unpredictable delay (e.g., crew misconnects, a/c swaps, last minute gate changes)
- **Goal:**
  - Improve effects of high fix demand by proactive management and wider distribution of negative effects of mitigating reroutes and metering

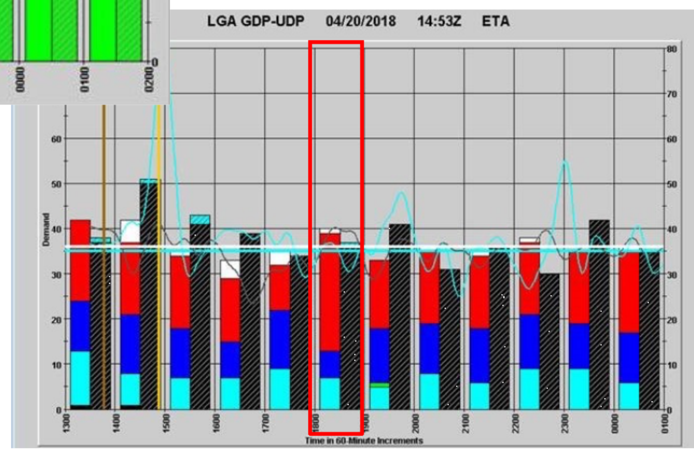
DCA to LGA Route: RBV Congestion



Available tools: Capacity/Demand at Airports



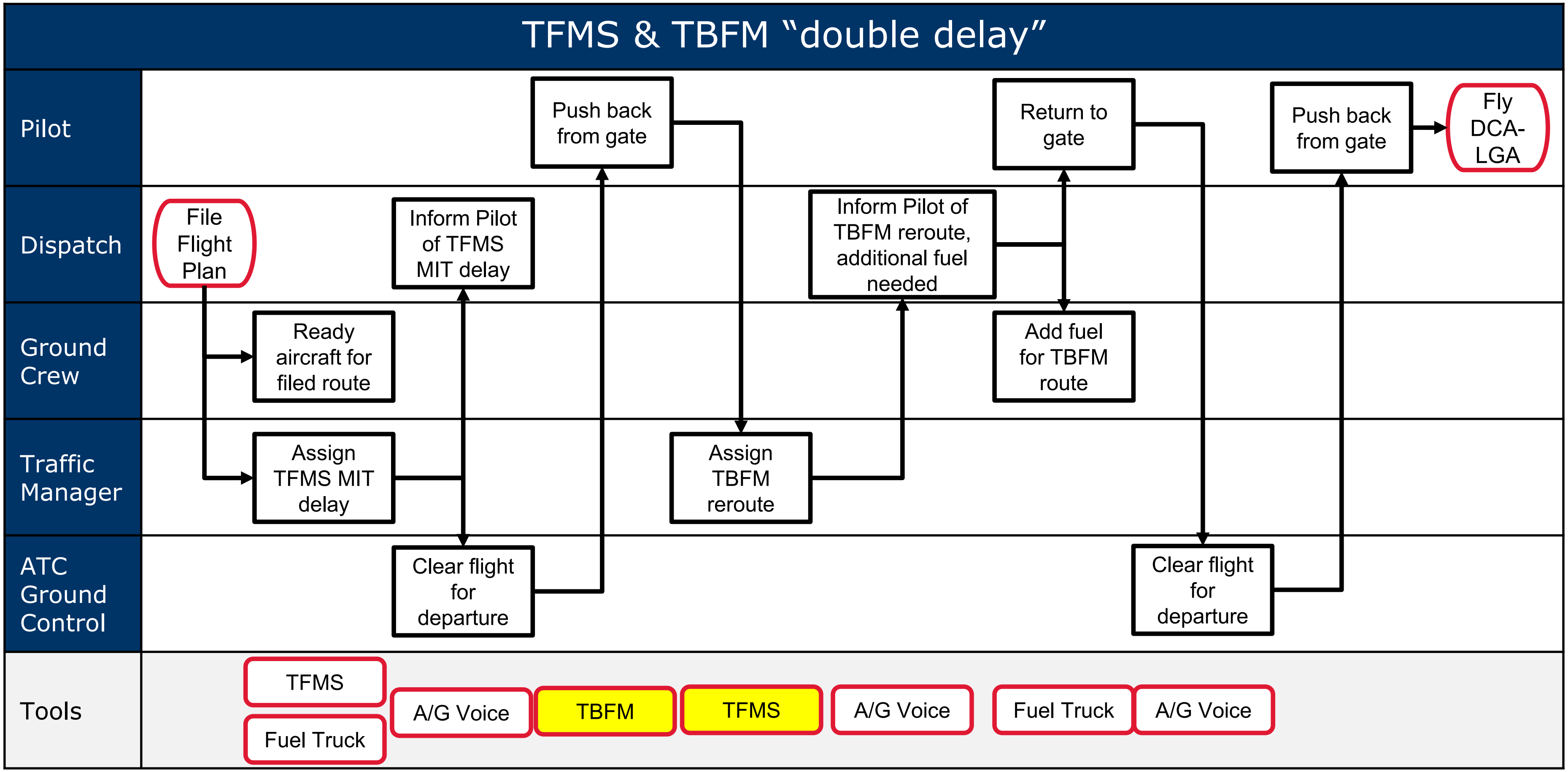
- A few hours later, it appears MIT and/or TMA on the heavier south feed may have contributed to LGA landing under the called airport acceptance rate.



- 18:00z – 26 arrivals over RBV (red bars), 13 arrivals to all other fixes with same inbound restrictions.
- Earlier, inbound demand led to a GS and GDP to support runway 4/31 operations
- If TFMS does not create variable MIT restrictions to favor the heaviest feed, likely to have some double penalty on close-in ZDC flights.

REQUESTING	PROVIDING	RESTRICTION	START TIME	STOP TIME
N90	EWR/LGA	WHITE 5MINIT JETS EXCL: ZDC LTFC 1245-1615 N90:EWR,LGA	04/20/2018 1245	04/20/2018 1615
N90	HPN/TEB	WHITE 7MINIT JETS EXCL: ZDC LTFC 1245-1615 N90:TEB,HPN	04/20/2018 1245	04/20/2018 1615
N90	PHL/ZBW/ZDC/ZNY/ZOB	EWR TBM 4R 1400-0200 N90:ZNY,ZOB,ZDC,ZBW,PHL	04/20/2018 1400	04/21/2018 0200
N90	ZBW	LGA VALRE,NOBBI 15MIT PER ROUTE 1101-0300 N90:ZBW	04/20/2018 1101	04/21/2018 0300
N90	ZDC	LGA RBV 15MIT 1101-0300 N90:ZDC	04/20/2018 1101	04/21/2018 0300
N90	ZNY	LGA LIZZI 15MIT 1101-0300 N90:ZNY	04/20/2018 1101	04/21/2018 0300

Operational Business Process

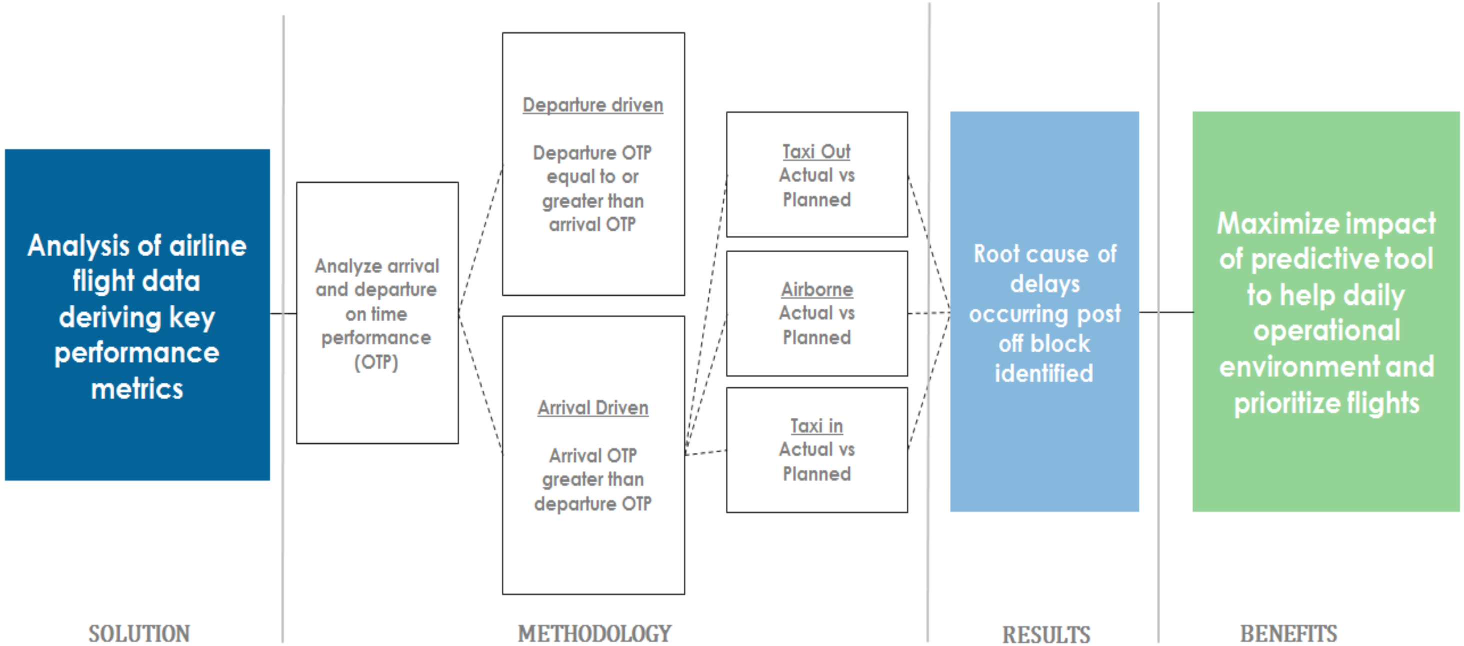


Operational Impacts and Consequences

- After gate push, MIT/TBFM EDC delay
  - Impact: Aircraft held in penalty box, awaiting departure clearance
  - Consequences: cost and schedule delays/connections
- Customer Viewpoint
  - Impact: Taxi length/delay impacts customer satisfaction
  - Consequences: Potential for customer missed connections due to unpredictable delay
- Crew Viewpoint
  - Impact: Taxi length/delay adds crew block time
  - Consequences: Potential for daily duty max
- Fuel and Operations Viewpoint
  - Impact: Taxi to return to gate to refuel for longer reroute
  - Consequences: Fuel and time costs of longer reroute/additional taxing
  - Consequences: Cascading effects from unpredictable delay (e.g., crew misconnects, a/c swaps, last minute gate changes)

Demonstration of predictive tool driven by key metrics with global airline

- **Methodology focused on identifying where operational improvements exist within airline's control and where in the schedule business rules can be enhanced**
- **Analysis derived metrics from SWIM like data to identify flights to target for schedule adjustments to reduce in flight holding:**



SWIFT Goal

Leverage analogous methods to demonstrate how SWIM data can be derived to develop new metrics for optimized business rules in addressing proposed use cases

THALES

Alternative Vignettes:
Enhanced Situational Awareness and CDM Interaction

Enhanced Situational Awareness

- SWIM data can alert FOC to when the traffic situation begins to resemble a "heavy RBV period"
  - TBFM-Metering Information Service (MIS):
    - Provides gate acceptance rates and meter fix acceptance rates (manually set by TMC) to alert FOC of when traffic over RBV becomes constrained
  - TFMData Service:
    - Alerts FOC when a flight is affected by a TMI
    - Alerts FOC when FEA, FCA created to monitor traffic in constrained areas
  - SWIM Flight Data Publication (SFDPS) and SWIM Terminal Data Distribution (STDDS):
    - Provides En-route (SFDPS) and terminal (STDDS) flight tracking allowing for advanced data analytics
    - Vendor tool could monitor traffic counts and alert FOC when gaps are becoming minimized in overhead stream and situation may become progressively worse at RBV in a few hours

30 SWIFT Cas

Enhanced Situational Awareness

- SWIM data can alert FOC to when choosing reroute over taking TBFM delay would result in extra delay or a "sub-optimal route"
  - TBFM-Metering Information Service (MIS)
    - Provides release time
  - FOC flight planning tools
    - Provide preferred route options with associated flying times & fuel requirements
    - If TBFM departure delay less than additional reroute flying time, decline reroute
    - If TBFM departure delay more than additional flying time of reroute, accept reroute ONLY if flight is properly fueled upon initial pushback
      - Requires system logic to identify when conditions signal a "heavy RBV period"
      - Directs aircraft on affected routes to load additional fuel to allow for reroutes without returning to the gate to refuel

INC.

What information is lacking?

- ALT 1: RBV Fix load
- ALT 2: Release Times

→

How can information help?

- ALT 1: Early Notification RBV constraining alert
- ALT 2: Better re-route decision making

→

What is the business operation?

- What business operations are affected?
- What is the operational improvement impact?

Metrics derived from SWIM data to drive business rules & provide new insight

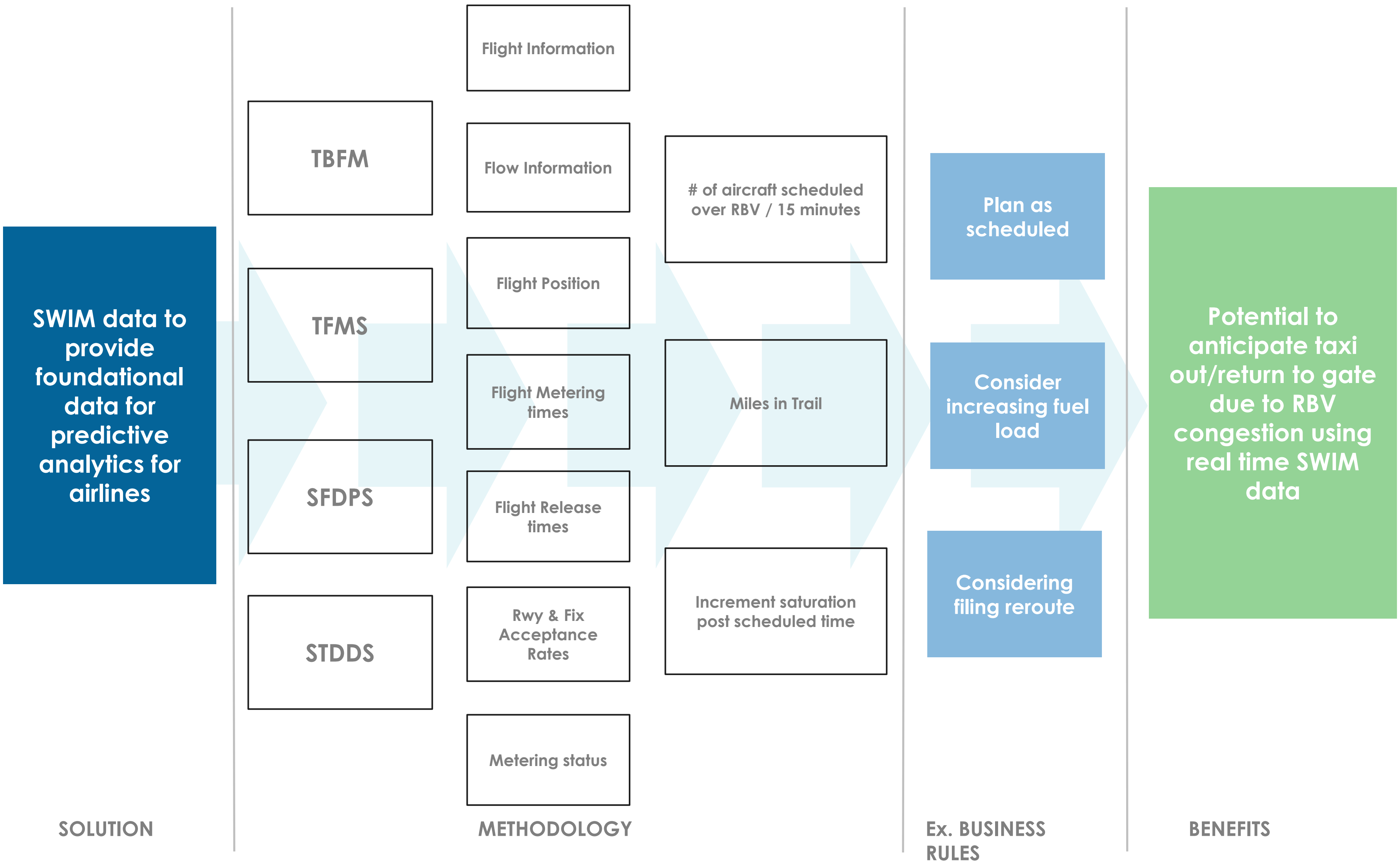
Monitoring traffic flight counts:

X # of RBV scheduled aircraft / 15 minutes	Y Miles in Trail	Z # of 15 min Increments saturated post scheduled time	
< X	No MIT	≤ Z saturated slots	Plan as scheduled
> X	> Y	≥ Z saturated slots	Consider increasing fuel load
> X	> Y	≥ Z saturated slots	Consider filing reroute

Advanced data analytics:

Flying time from the TRACON outer fix to wheels down > X minutes → Begin planning for possible upcoming TMIs

Expanding on SWIM data to anticipate RBV congestion impacts



THALES

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 (currently static data)**
  - Route Availability Planning Tool (RAPT)

Weather Route Availability Tool

			Departure Time						
Route	Trend	PIG	2100	2105	2110	2115	2120	2125	2130
N90 HAPIE	▬	110							
N90 MERIT	▬		33 N90	32 N90	31 N90	31 N90	31 N90	31 N90	31 N90
N90 GREKI CAM	▲		31 N90	31 N90	31 N90	31 N90	31 N90	33 N90	31 N90
N90 GAYEL J95	▼		37 NEAR	37 NEAR	37 NEAR	42 NEAR	42 NEAR	42 NEAR	34 NEAR
N90 COATE J36	▬		31 N90	31 N90	33 N90	27 NEAR	37 N90	34 N90	33 N90
N90 ELIOT J60	▬		38 ENR	38 ENR	38 ENR	38 ENR	39 ENR	39 ENR	40 N90

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 (currently static data)**
  - Route Availability Planning Tool (RAPT)
  - TFMS Flight ACID, Route Strings

Weather Route Availability Tool

			Departure Time						
Route	Trend	PIG	2100	2105	2110	2115	2120	2125	2130
N90 HAPIE		110							
N90 MERIT					1 N90	31 N90	31 N90	31 N90	31 N90
N90 GREKI CAM					1 N90	31 N90	31 N90	33 N90	31 N90
N90 GAYEL J95					NEAR	42 NEAR	42 NEAR	42 NEAR	34 NEAR
N90 BIGGY J75					NEAR	38 N90	41 N90	39 N90	31 N90
N90 WHITE J209					NEAR	41 NEAR	47 NEAR	42 NEAR	43 NEAR
N90 WAVEY J174					NEAR	36 NEAR	35 NEAR	36 NEAR	34 NEAR

N90 BIGGY J75

ACID	Route String	ETD	ETA
RPA4764	KLGA..BIGGY.J75 MXE.CLIPR2.KDCA	11/5/2018 21:01	11/5/2018 21:49
AAL1722	KLGA..BIGGY.J75 .GVE.LYH.CHSLY3.KCLT	11/5/2018 21:09	11/5/2018 22:29
RPA5982	KLGA..BIGGY. J75. CAE.KCHS	11/5/2018 21:15	11/5/2018 22:58
EDV5051	KLGA..BIGGY.J75 .GVE.LYH.CHSLY3.KCLT	11/5/2018 21:22	11/5/2018 22:37
WA8502	KLGA..BIGGY.J75.MXE.NUGGY.TRISH3.KBWI	11/5/2018 21:29	11/5/2018 22:03

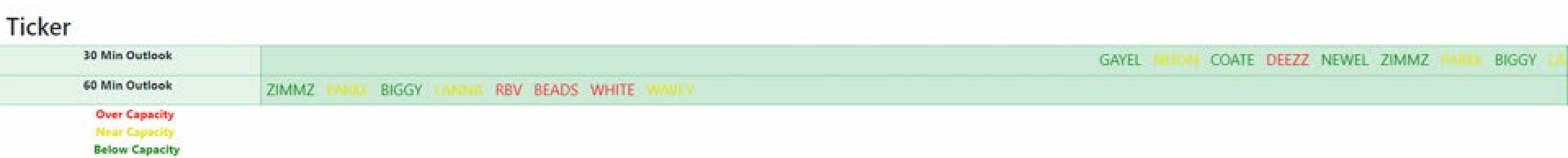
En Route Fix Loading Viewer

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

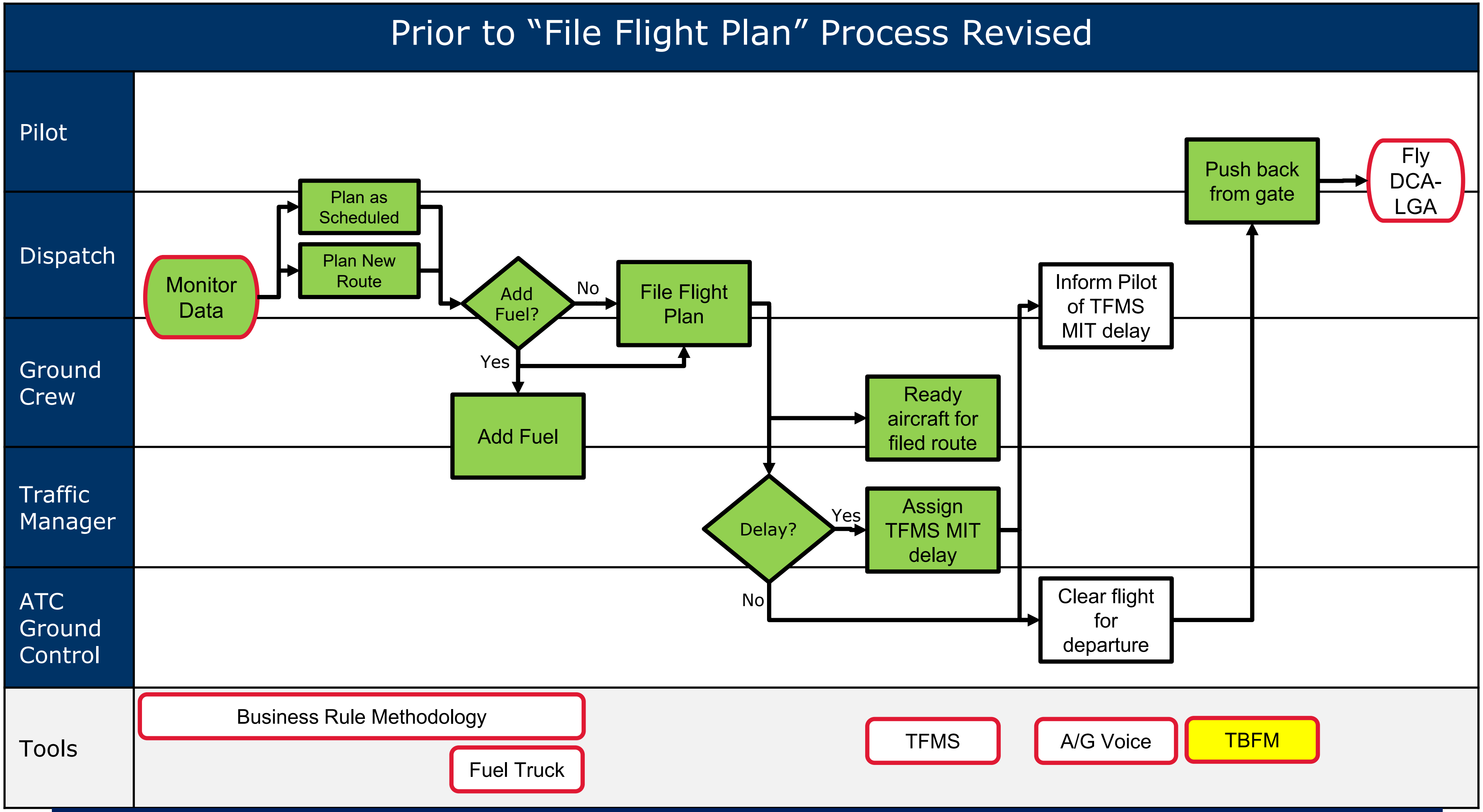
			Fix Crossing Time			
Fix	Miles In Trail	Minutes In Trail	1000 - 1015	1016 - 1030	1031 - 1045	1046 - 1100
WAVEY		10	80	75	60	40
GAYEL	5		60	70	65	60
NEION			60	50	45	40
RBV	15		90	100	95	90
BIGGY	10		75	70	75	80
WHITE			50	40	45	50

Fix Availability Ticker

- **Developed to support taxi-out use case**
- **Show departure fix availability projections**
  - Identify specific fixes with limited capacity, supports informed reroute requests
- **Filter fixes by metroplex**
- **Can presents a subset of Weather Route Availability Tool or En Route Fix Loading Tool in smaller form factor**
  - Both tools present fix/route availability using different source data sets
  - User could tailor ticker based on which data set provides more useful information
  - Operations personnel have limited screen space for additional tools
- **Visualization of TFMS (currently static data)**

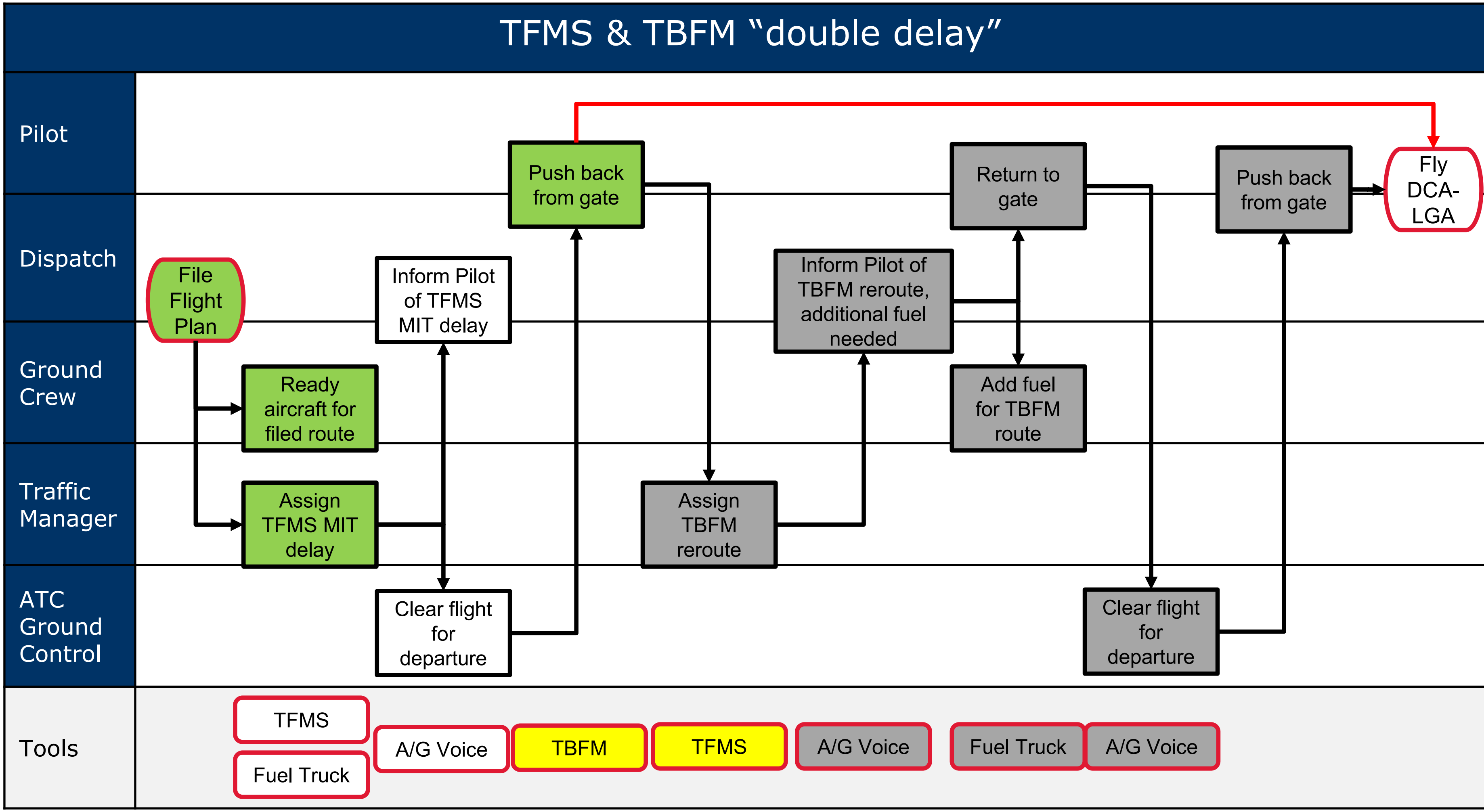


Revised Operational Business Process



Improved Situational Awareness: 45-minute Look Ahead Tool

Revised Operational Business Process



Improved Situational Awareness: 45-minute Look Ahead Tool

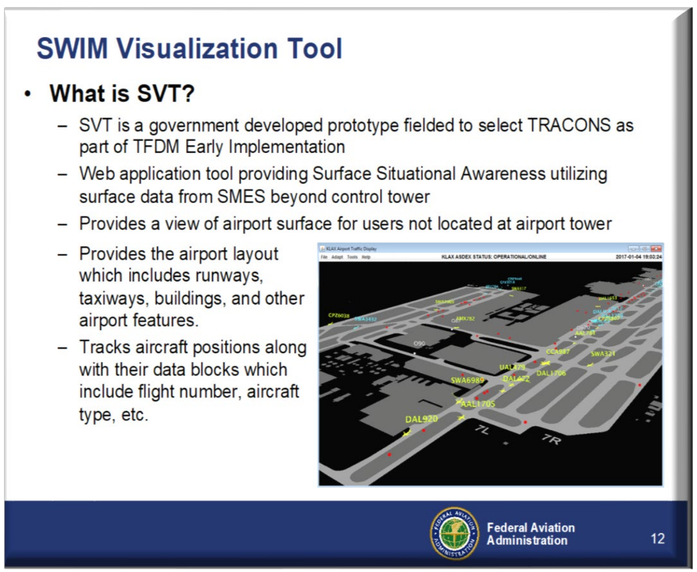
Conclusion

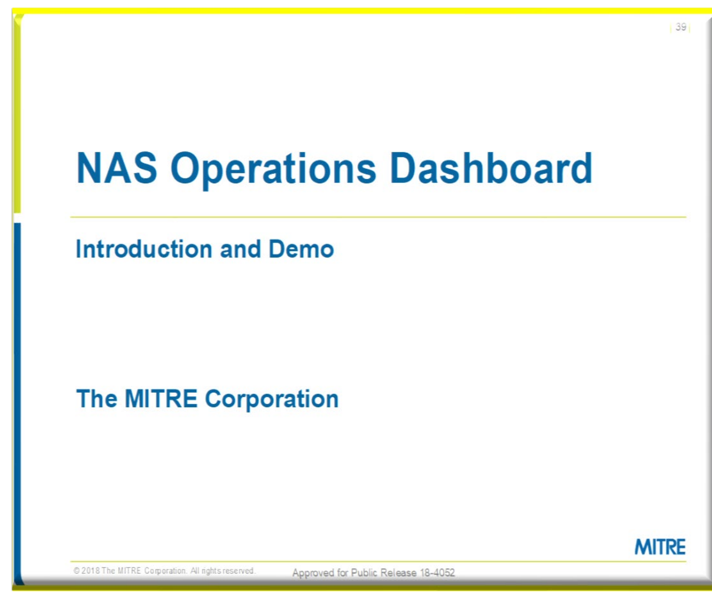
- **Operational Impact: the ‘close-in airport’ problem**
  - The “Taxi-out, return to gate” case study demonstrated an operation that has high impact due to congestion over a key fix
  - Discussed impact of issue and identified alternative business operational improvements based on better situation awareness
- **Identified key metrics driving operational decisions**
  - Collecting metrics are key business case elements, business case
- **Created notional tools as SWIM Widget visualization**
  - Visualization tools to connect the decision-maker to the cognizant information that drives decisions
  - Demonstrated different visualizations of same data
- **Linking SWIM information & business processes**
  - Identified how information services presented to decision-makers impacts business process improvements

SWIFT Lunch

Demonstrating

SWIM Data in Motion





NAS Operations Dashboard

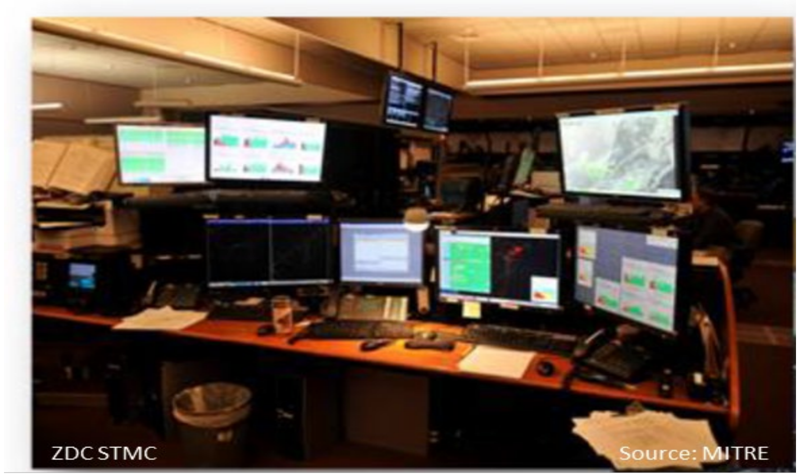
Introduction and Demo

The MITRE Corporation

MITRE

* See notice in Backup

Data Overwhelming or Helpful?

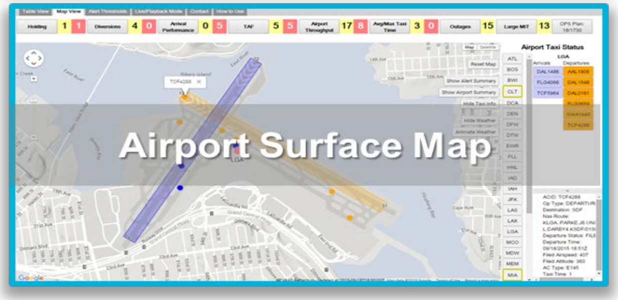


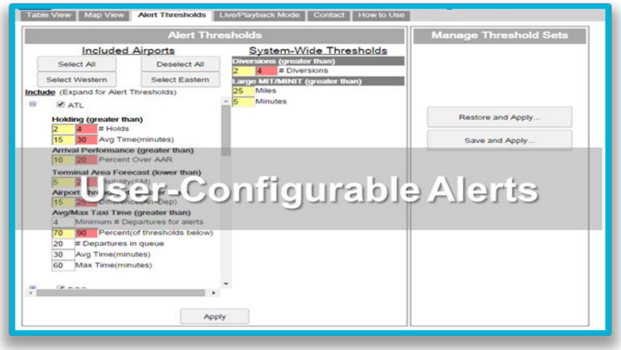
- **Air traffic managers/Industry now have to use a myriad of tools to gain situation awareness of the NAS.**
- **Gathering and processing information is time-consuming and subjective.**
- **Lack of real-time NAS monitoring and alerting capability is a widely recognized shortfall.**

MITRE

NAS Operations Dashboard (NOD)

- **NOD monitors several NAS performance metrics in real time**
  - Initially developed to meet the operational needs of National Operations Managers (NOMs) at ATCSCC
  - Currently being evaluated by ATCSCC, northeast ATC facilities, and selected CDM members
- **NOD's Characteristics:**
  - Native web application (run on any web browser)
  - Enabled by SWIM feeds and other data sources
  - Presents high-level alerts with limited drill-down information
  - One-minute update rate for TFM situational awareness





NOD Metrics and Sources

Performance Areas / Data Category	Metrics / Alerting Events / Usages	Data Sources and Modeling Processes
Airborne Holding	❖ Number of holding flights bound for an airport ❖ Average hold time for these flights	❖ SWIM TFMData live feed ❖ MITRE's holding detection algorithm
Airport Diversions	❖ Number of flights diverted from an airport ❖ Number of flights diverted to an airport	❖ SWIM TFMData live feed ❖ MITRE's diversion detection algorithm
Airport Arrival Performance	❖ Demand as percentage of AAR for current hour ❖ Demand as percentage of AAR for next hour ❖ Current runway configuration (for Map View visualization only)	❖ SWIM TFMData live feed ❖ FAA's internal OIS website (AAR, Runway Configuration) ❖ MITRE's flight trajectory modeler
Airport Weather Event	❖ Forecast low visibility at an airport ❖ Forecast thunderstorm at an airport or vicinity	❖ NOAA Terminal Aerodrome Forecast (TAF) ❖ MITRE's text parsing process
Airport Throughput	❖ Difference in departures and arrivals of previous hour ❖ Difference in departures and arrivals of current hour	❖ SWIM TFMData live feed ❖ MITRE's flight data processing algorithm
Average/Max Taxi Time	❖ Number of departures in queue ❖ Average taxi-out time in the last 15 minutes ❖ Maximum taxi-out time in the last 15 minutes ❖ Average taxi-in time in the last 15 minutes ❖ Maximum taxi-in time in the last 15 minutes ❖ Taxi time of individual flights	❖ SWIM STDDS (SWIM Terminal Data Distribution System) live feed ❖ MITRE's Ground Tracker processes
Outages	❖ Runway outage event ❖ Taxiway outage event	❖ FAA's internal OIS website (System Impact Report) ❖ MITRE's text parsing process
Large In-Trail Restrictions	❖ Mile-in-trail restriction greater than a specified value ❖ Minute-in-trail restriction greater than a specified value	❖ FAA's internal OIS website (In-trail Restrictions) ❖ MITRE's text parsing process
Airborne Metering Status	❖ List of en route centers that show TBFM Status = ON (i.e., metering to an arrival airport is active)	❖ SWIM TBFM live feed ❖ MITRE's TBFM data modeling processes
Weather Images	❖ Color-coded reflectivity level (for Map View visualization only)	❖ NEXRAD Radar Reflectivity from NOAA ❖ Map Tile Server: mesonet.agron.iastate.edu
ATCSCC Operations Plan	❖ Current Operations Plan (information only, no alert)	❖ FAA's internal OIS website (Operations Plan)

Data in Supporting Airport Surface Information

- **Airport Throughput – Difference in arrivals and departures by hour**
  - Data Sources:
    - SWIM TFM Data live feed
    - MITRE's flight data algorithm
- **Average/Max Taxi time – Number of departures in queue and taxi in and out times**
  - Data Sources:
    - SWIM STDDS live feed
    - MITRE's Ground Tracker processes
- **Outages – Runway and taxiway outages**
  - Data Sources
    - FAA OIS Website
    - MITRE's text processing algorithm
- **Airport Arrival Performance – Demand for current and next hour; airport configuration**
  - Data Sources
    - SWIM TFMData live feed
    - FAAs OIS website
    - MITRE's flight trajectory modeler

MITRE

Business Rules

- **Designed to be a high-level alerting system**
- **Information should be intuitive**
  - "Normal" color coded system (green, yellow, red)
- **The "what" that is alerting just be customizable by element**
  - Not all metrics are the same at different airports
- **There should be some drill-down capability**
  - But not meant to replace other tools
- **Update rate should support light-weight application**
  - Not intended for 1 or 5 second updates to information
  - TFM situation awareness

Approved for Public Release 18-4052

NOD for Timely Decision-Making

Right Information to the Right People at the Right Time

Command Center

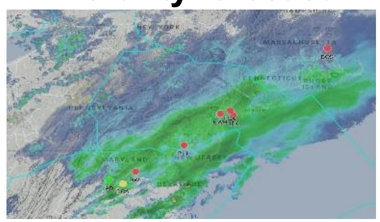
- Alerted of low visibility forecast
- Proactively manage the arrival
- Issue GDPs if needed
- Inform stakeholders
- Coordinate other facilities

En route Center

- Alerted of taxi-out time increasing
- Slow down arrivals, space them out from other centers
- Ready for the holding event because it was in the plan

NAS Operations Dashboard

Alerts of low visibility forecast



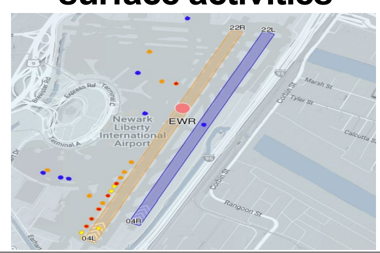
Alerts of next hour demand over capacity

Airport	Next Hour Arrival Demand/ Capacity
EWR	34/36
JFK	44/28
LGA	41/32

Alerts of Taxi-out time increasing

Airport	Avg Taxi-Out Time (Minute)
EWR	00:40 ↗
LGA	00:28 ↗
JFK	00:41 ↗

Viewing airport surface activities



NAS Users

- Alerted of next hour demand over capacity
- Plan for potential holding with extra fuel
- See the situation and make tactical adjustments
- Cancel some flights and inform customers

Terminal Approach

- Know of the potential overload situation in advance
- Work with the tower for throughput options
- Coordinates in advance with centers to ensure the right number of airplanes are delivered

Demo

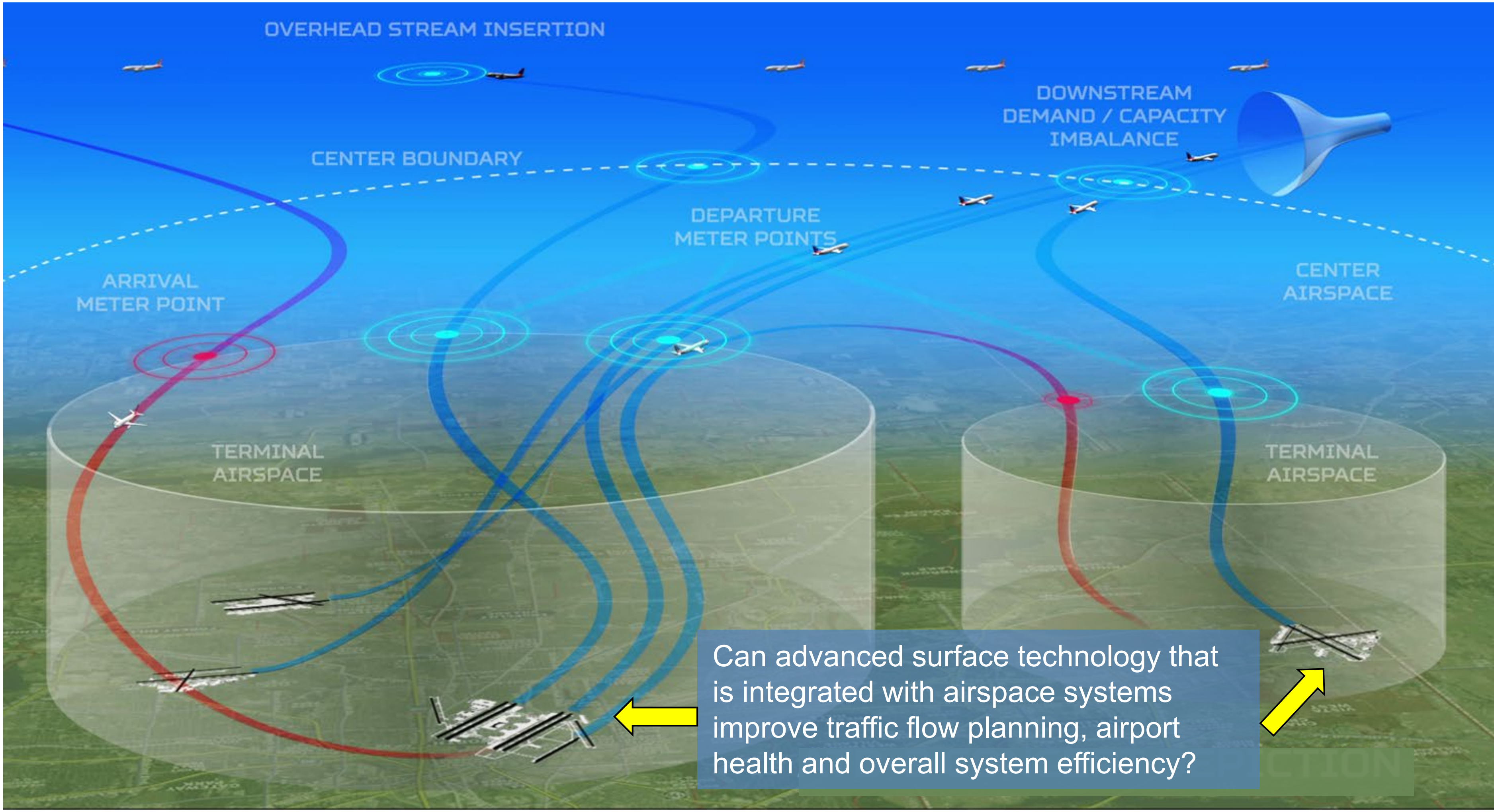
NASA Airspace Technology Demonstration 2 (ATD-2)

"Powered By SWIM"

Briefing to SWIM Industry-FAA Team (SWIFT) Workshop

Nov. 15, 2018

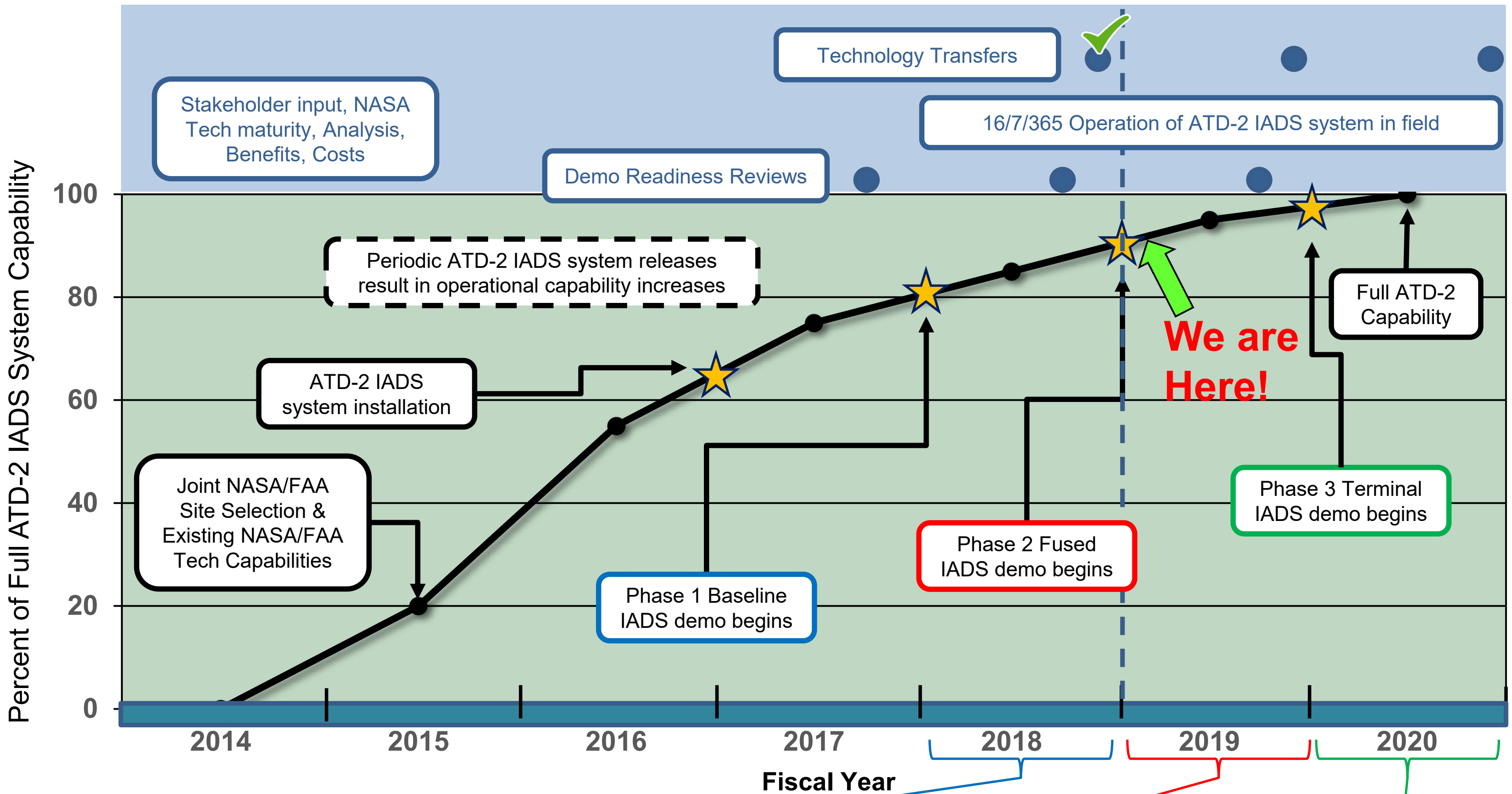
Integrated Arrival/Departure/Surface (IADS)



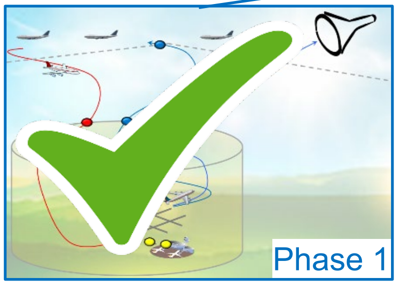
ATD-2 is the name of the collaborative multi-agency, multi-group project that is developing the IADS system

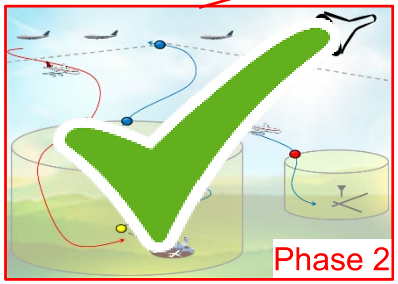
Concept video online at: http://aviationsystemsdivision.arc.nasa.gov/research/tactical/atd2.shtml

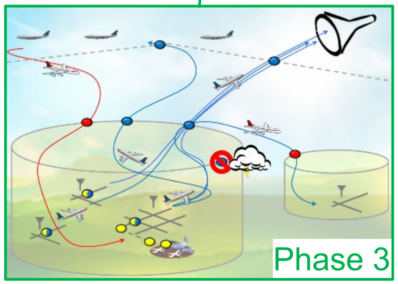
ATD-2: Progress Indicator Chart



Field Demo structured in 3 year-long phases with increasing IADS system capabilities.







ATD-2 is a Prosumer of SWIM Data

- ATD-2 has greatly benefited from existing System Wide Information Management (SWIM) feeds
  - The project is powered by real-time SWIM data
  - Look for the icon to the right in this presentation

- ATD-2 consumes and utilizes the following SWIM feeds in real-time
  - Traffic Flow Management System (TFMS) - Flight & Flow data
  - SWIM Terminal Data Distribution System (STDDS)
  - SWIM Flight Data Publication Service (SFDPS)
  - Time Based Flow Management (TBFM)
  - Terminal Flight Data Management (TFDM)
  - Terminal Automation Information Service (TAIS)

- ATD-2 produces the following real-time SWIM feed on SWIM R&D
  - TFDM Terminal Publication (TTP)
  - This is in close coordination with the TFDM Program Office, using same JMSDD
  - The desire is to foster early industry ***innovation*** in preparation for TFDM

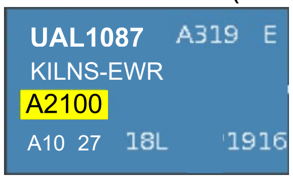
ATD2 Data Exchange and Integration- Operator View

ATC to Operator

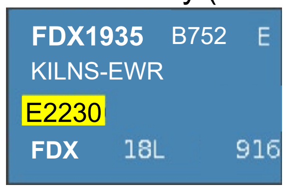
- Real-time traffic management initiatives
- Airport configuration coordination
- Runway intent information

SWIM

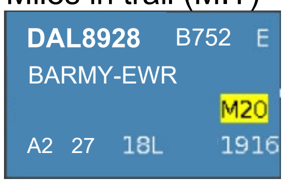
Call for release (APREQ)



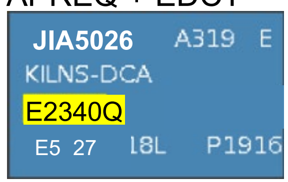
Ground delay (EDCT)



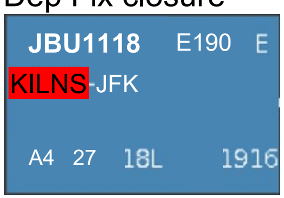
Miles in trail (MIT)



APREQ + EDCT

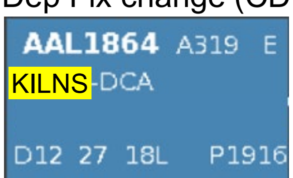


Dep Fix closure

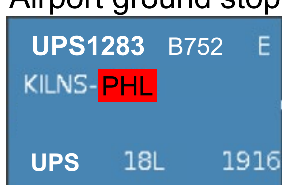


ATC runway change

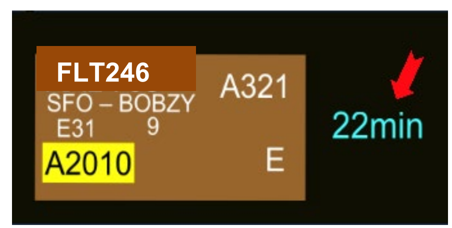
Dep Fix change (CDR)



Airport ground stop

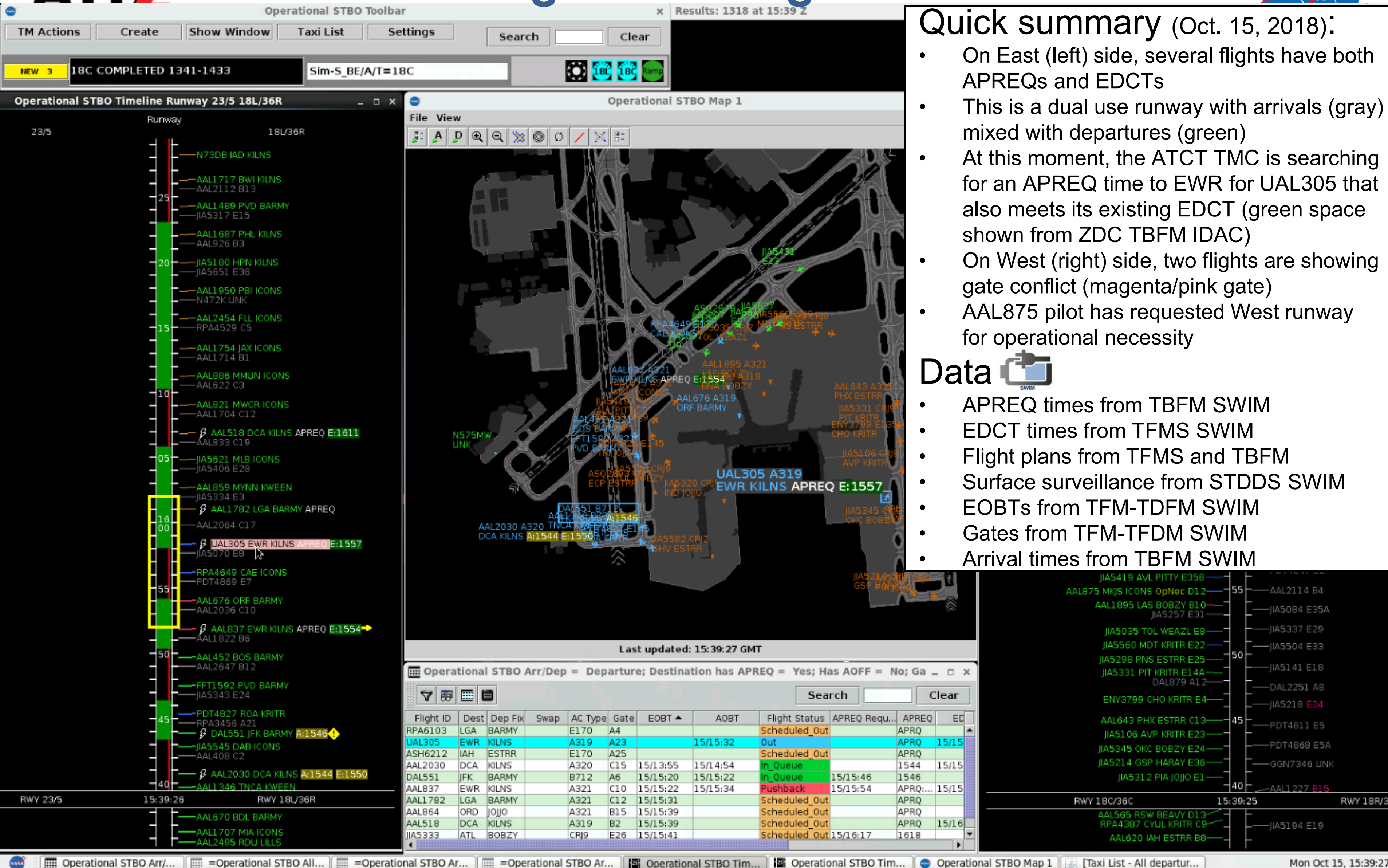


Ramp Tool Colors and Symbology



- How long can I ***hold at the gate*** and still make my APREQ or EDCT time?

Data Exchange and Integration- TMC View



Quick summary (Oct. 15, 2018):

- On East (left) side, several flights have both APREQs and EDCTs
- This is a dual use runway with arrivals (gray) mixed with departures (green)
- At this moment, the ATCT TMC is searching for an APREQ time to EWR for UAL305 that also meets its existing EDCT (green space shown from ZDC TBFM IDAC)
- On West (right) side, two flights are showing gate conflict (magenta/pink gate)
- AAL875 pilot has requested West runway for operational necessity

Data

- APREQ times from TBFM SWIM
- EDCT times from TFMS SWIM
- Flight plans from TFMS and TBFM
- Surface surveillance from STDDS SWIM
- EOBTs from TFM-TDFM SWIM
- Gates from TFM-TFDM SWIM
- Arrival times from TBFM SWIM

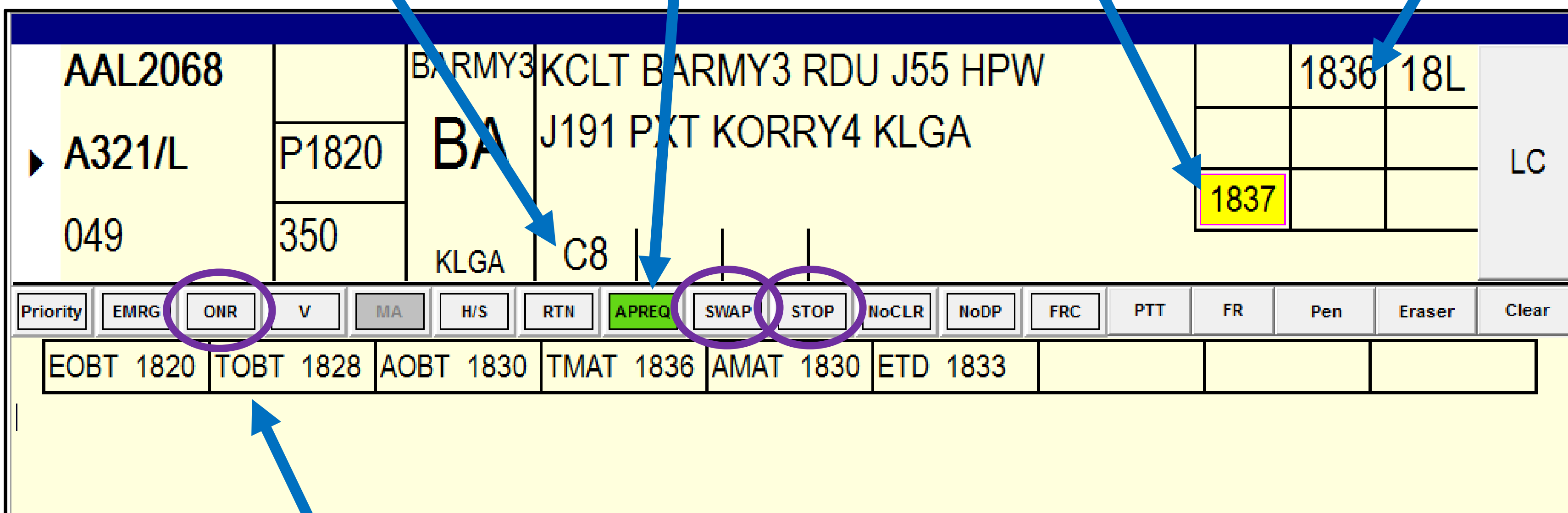
East Runway

West Runway

ATD2 Data Exchange and Integration- Controller View

- ATD-2 and Advanced Electronic Flight Strips (AEFS) began two-way real-time data sharing at CLT on Sept. 20, 2018. This is going well!
- AEFS sends information from controllers back to ATD-2, which shares this on the TTP SWIM feed

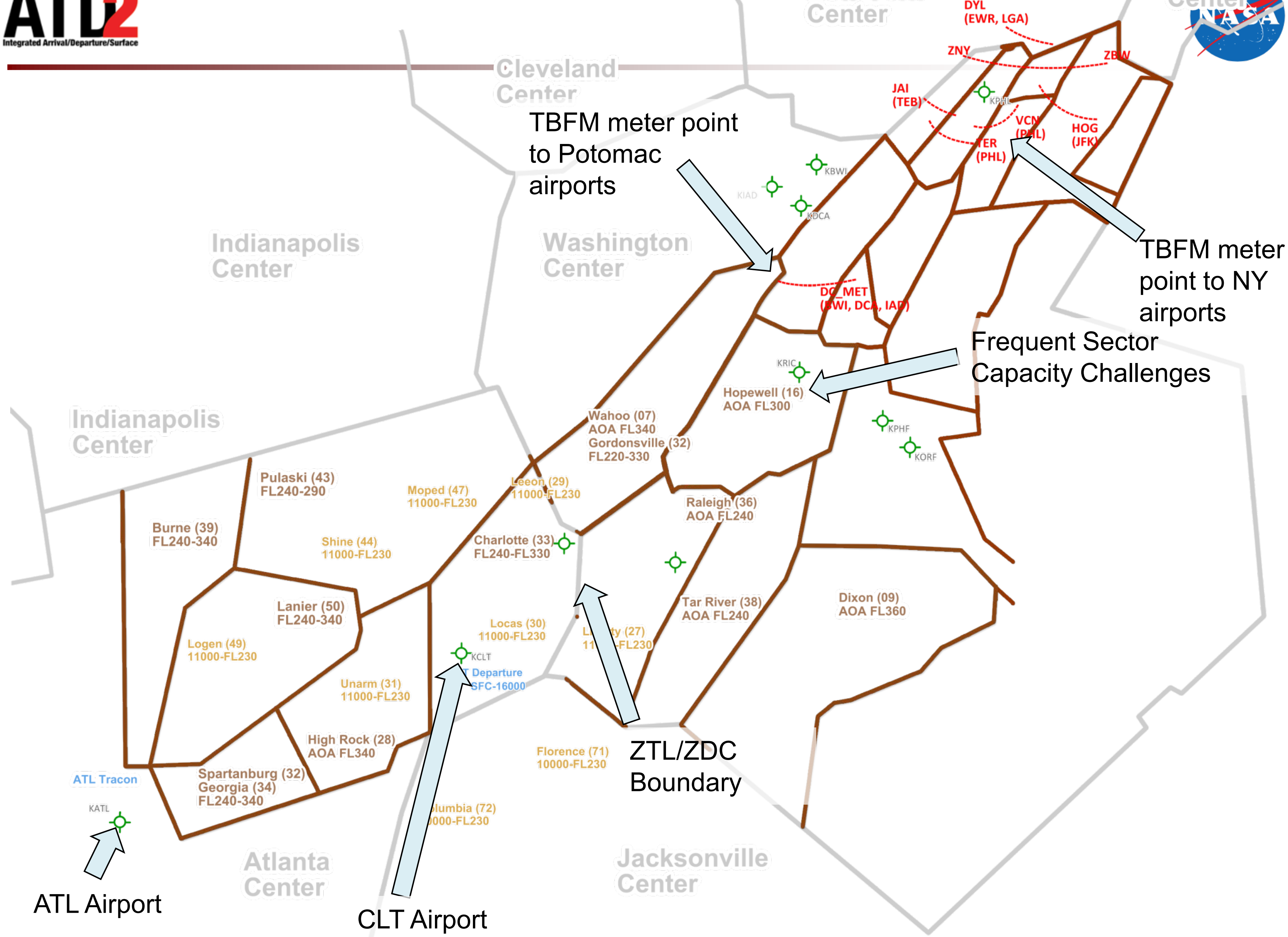
Parking Gate | APREQ indicator | APREQ release time in block 16 | TMAT in block 11



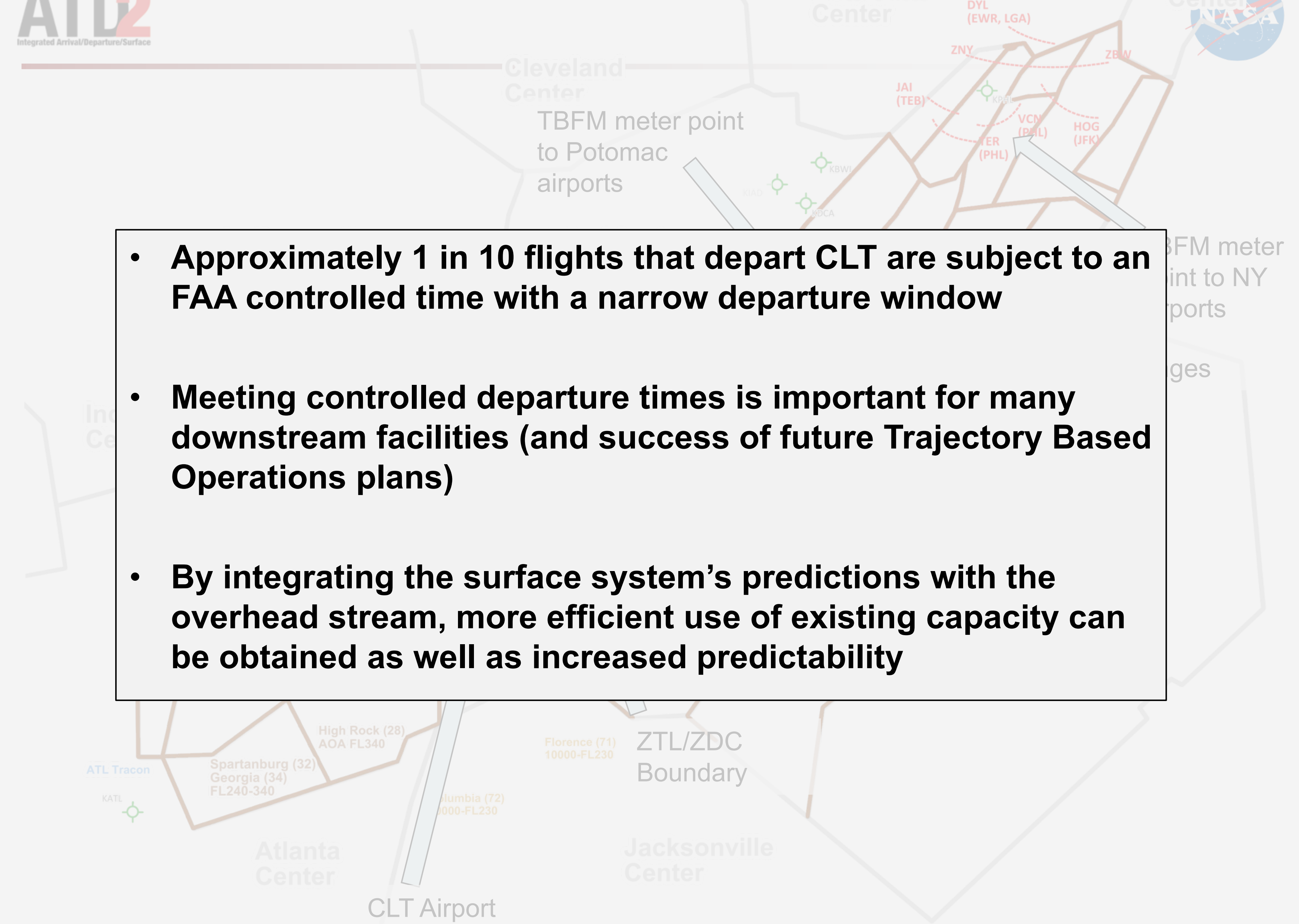
ATD-2 Times: EOBT, TOBT, AOBT, TMAT, AMAT, ETD (TTOT)

- As controllers make updates, you get them on TTP SWIM!

Overhead Stream Overview



Overhead Stream Overview



- **Approximately 1 in 10 flights that depart CLT are subject to an FAA controlled time with a narrow departure window**
- **Meeting controlled departure times is important for many downstream facilities (and success of future Trajectory Based Operations plans)**
- **By integrating the surface system's predictions with the overhead stream, more efficient use of existing capacity can be obtained as well as increased predictability**

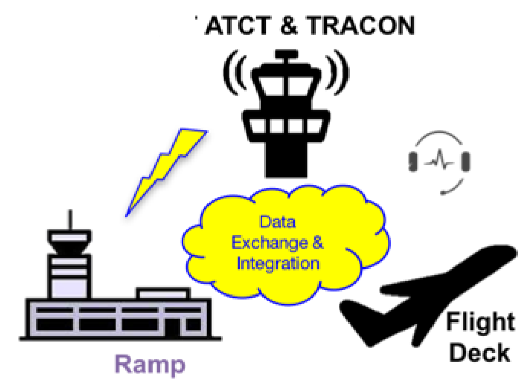
ATD2 Integrated Arrival/Departure/Surface

Pre-Scheduling with EOBTs

1. At an adaptable time prior to departure (e.g. 15 min) the ATD-2 system uses the EOBT, taxi time estimate and a buffer to electronically submit a release time request to TBFM

- ***Important Note***: Providing an EOBT gives you an advantage!

SWIM



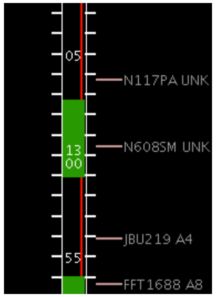
2. Center TMC approves or adjusts the time based on center constraints

3. ATCT and Ramp utilize the now visible APREQ time on their strips and pushback advisories

The data is made available on the TTP SWIM feed so that Operators can get it to their pilots

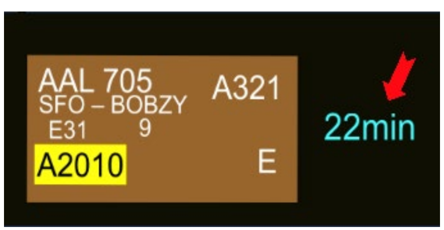
SWIM

4. IDAC-style scheduling between TBFM and ATD-2 is used to re-schedule as necessary



Honor Restrictions with Greater Fuel Efficiency

- Target Movement Area Entry Times (TMATs) are important both for surface metering and to make overhead stream slot reservation



- How long can I ***hold at the gate*** and still make my APREQ or EDCT time?

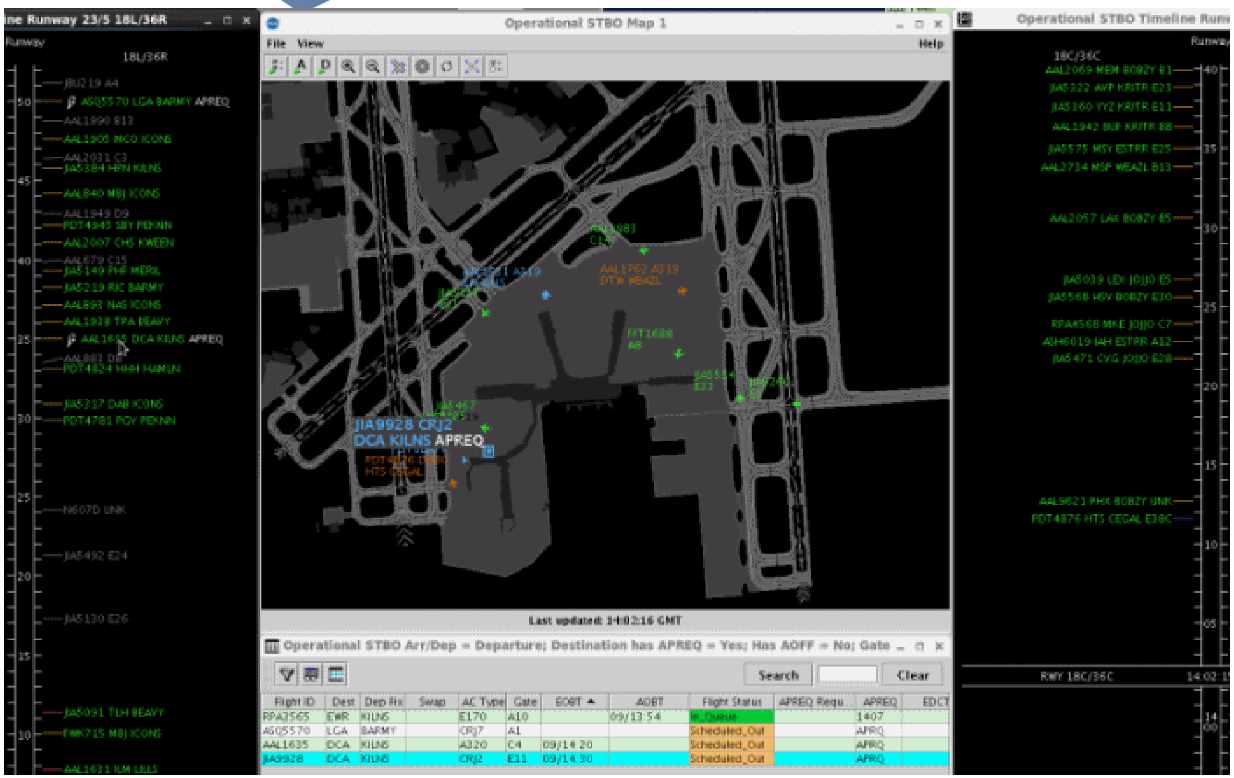
Airline and Airport Operators will gain access to these data elements through TTP SWIM

- *"TargetedOffBlockTime"*
- "TargetMovementAreaEntryTime"

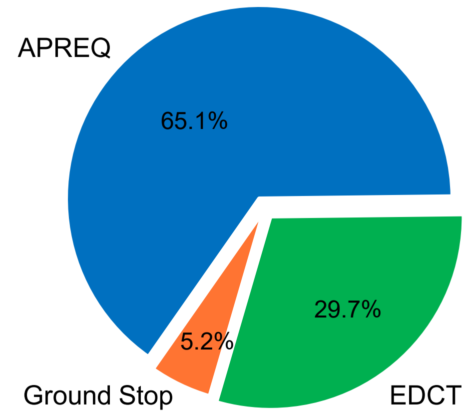
Overhead Stream Operational Integration Benefits through 2018-10-25

110.1 hours of delay saved by electronically renegotiating a better overhead stream time for over 784 flights. Trending upward.

375,987 lbs of fuel saved by scheduling APREQs, EDCTs, and Ground Stops at gate.



Controlled Flight Fuel Savings from Holding at Gate

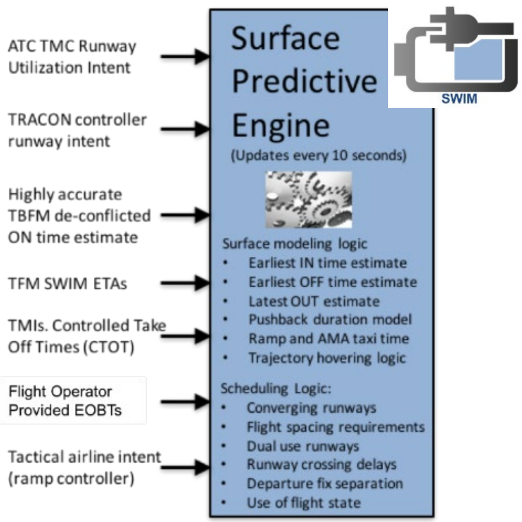


- The benefits described here are associated with better use of existing capacity in the overhead stream, and technology to reduce surface delay.
- These benefits are in addition to (distinct from) surface metering savings.

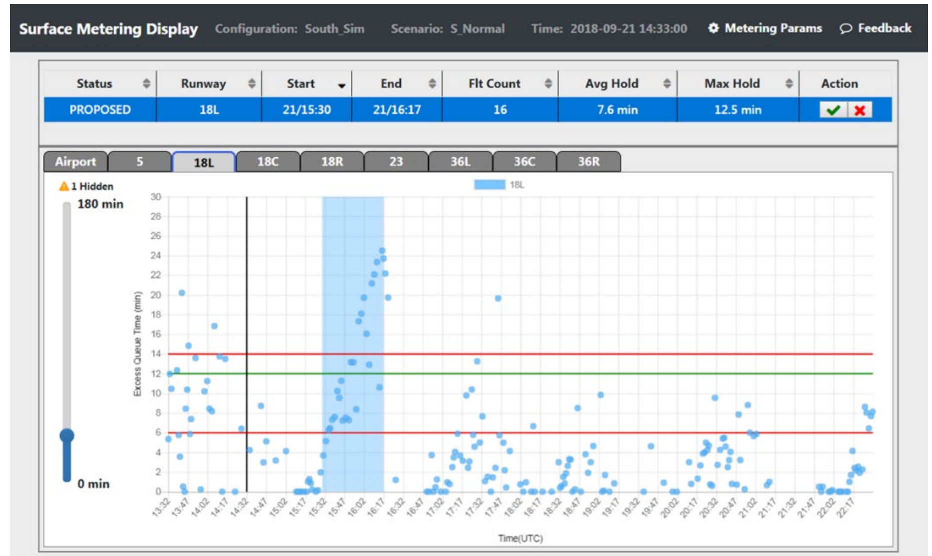
Surface Metering – Process Flow

ATD2 Integrated Arrival/Departure/Surface

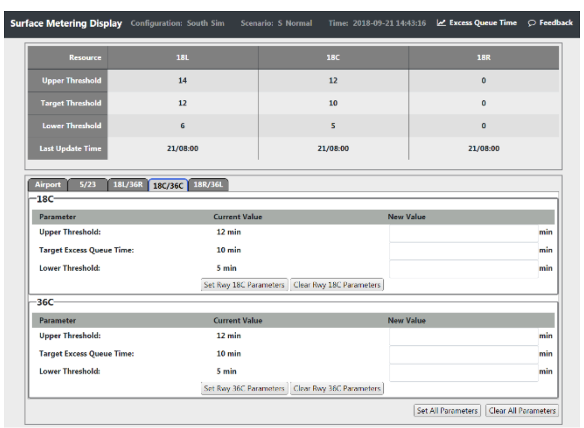
1 Generate Demand and Capacity Predictions



2 Monitor Surface Demand Capacity Imbalances



3 Enable Metering. Set Hold Level

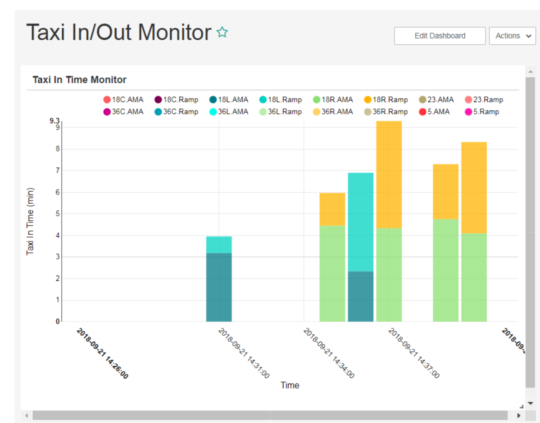


4 Honor TMAT advisories

TOBT Advisory

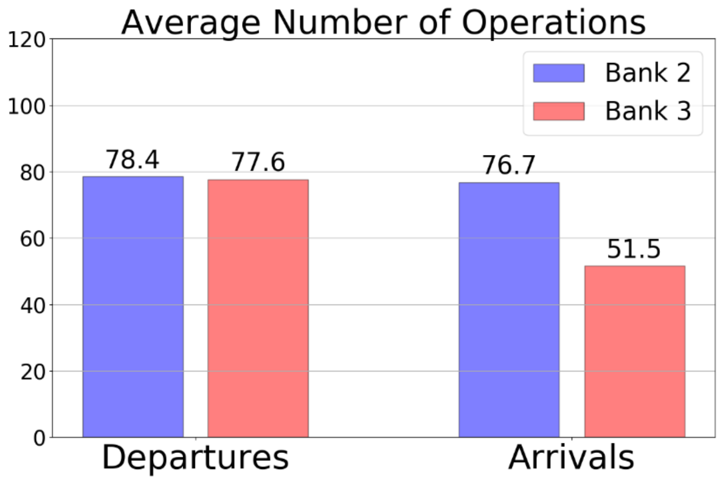
TMAT Advisory

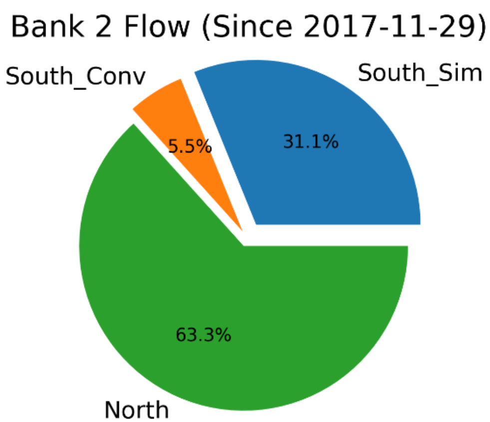
5 Evaluate Metering Effectiveness

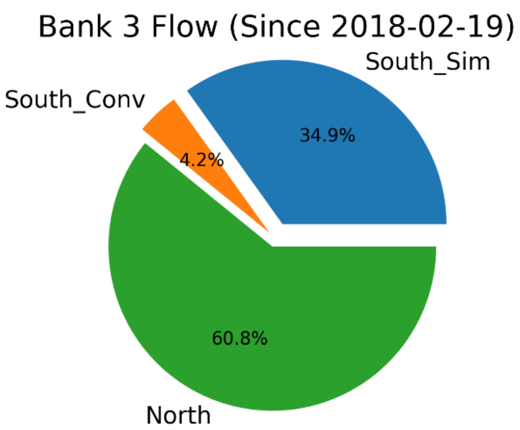


Surface Metering Usage (Data Current Through 2018-09-30)

- Surface metering started in late Nov. 2017 (Phase 1C)
  - Bank 2 was metered in 258 of 303 (85.1%) days since Nov. 29, 2017
  - Bank 3 was metered in 170 of 223 (76.2%) days since Feb. 18, 2018
- Bank 2 and Bank 3 have similar number of departures
- Bank 2 has 48.9% more arrivals than Bank 3, which causes increased surface congestion

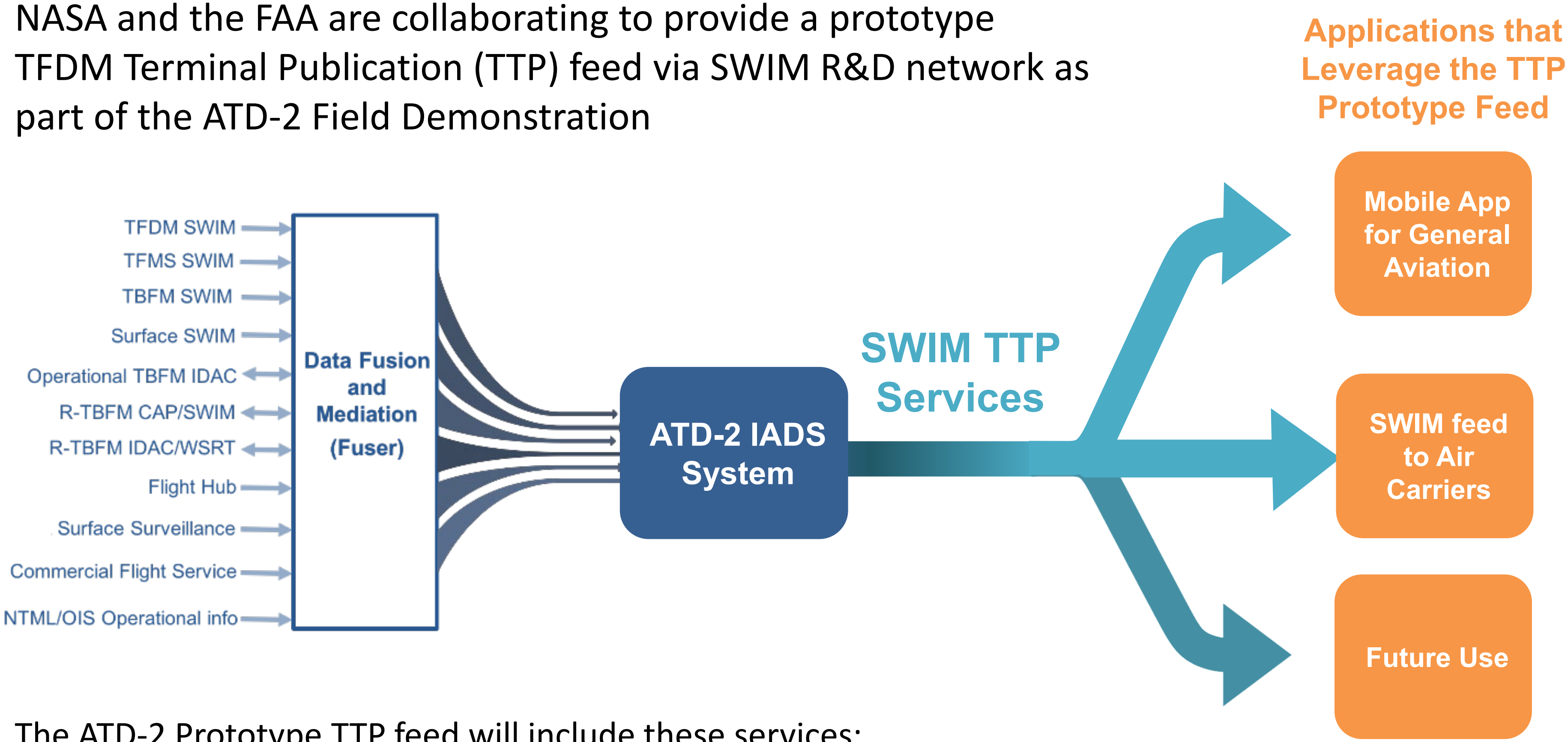






IADS Data Sharing via Prototype TTP

NASA and the FAA are collaborating to provide a prototype TFDM Terminal Publication (TTP) feed via SWIM R&D network as part of the ATD-2 Field Demonstration

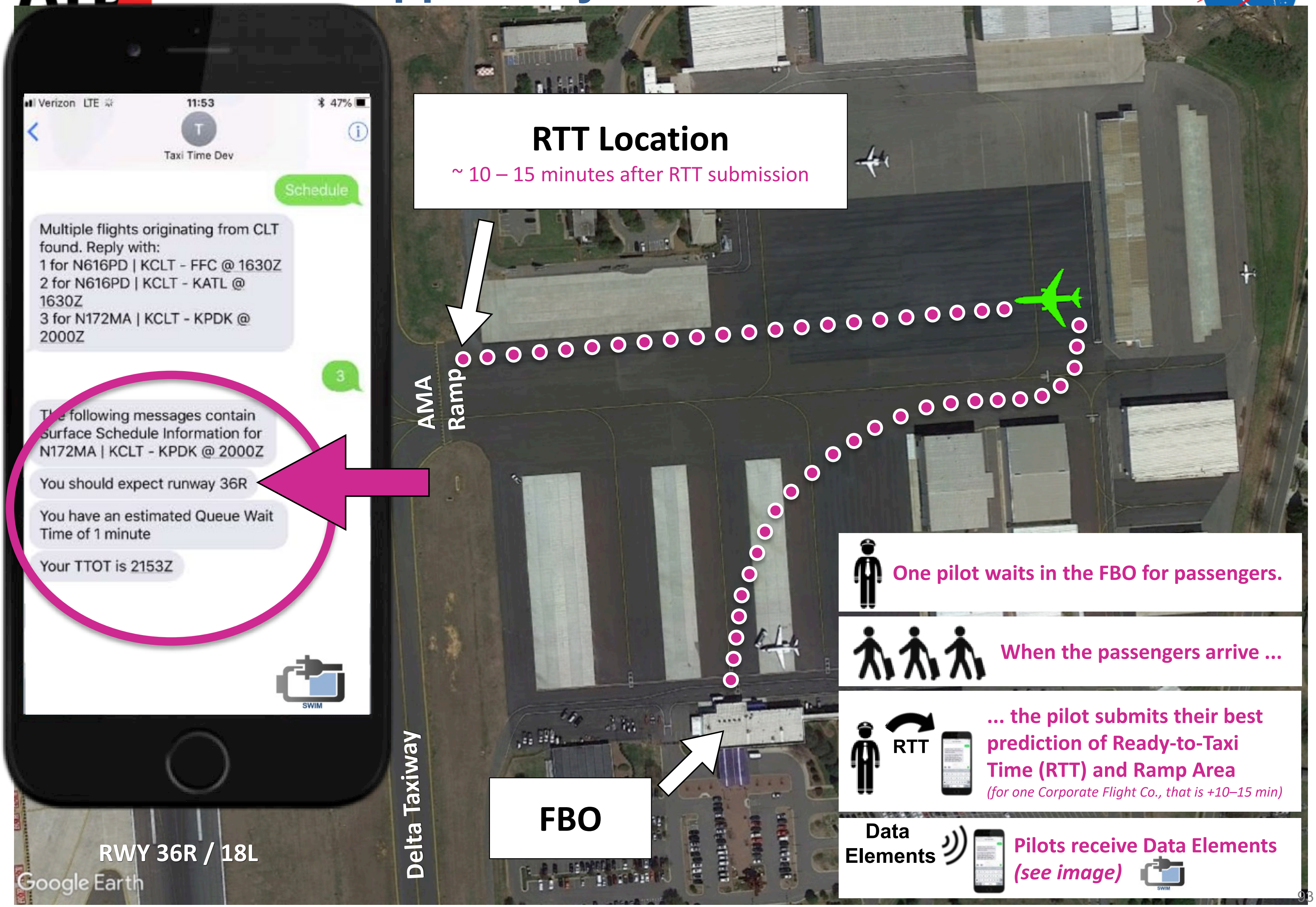


The ATD-2 Prototype TTP feed will include these services:

- Flight Data
- Airport Information
- Traffic Management Restrictions
- Flight Delay
- Operational Metrics

TTP is now available on SWIM R&D for CLT. You are welcome to onboard now!

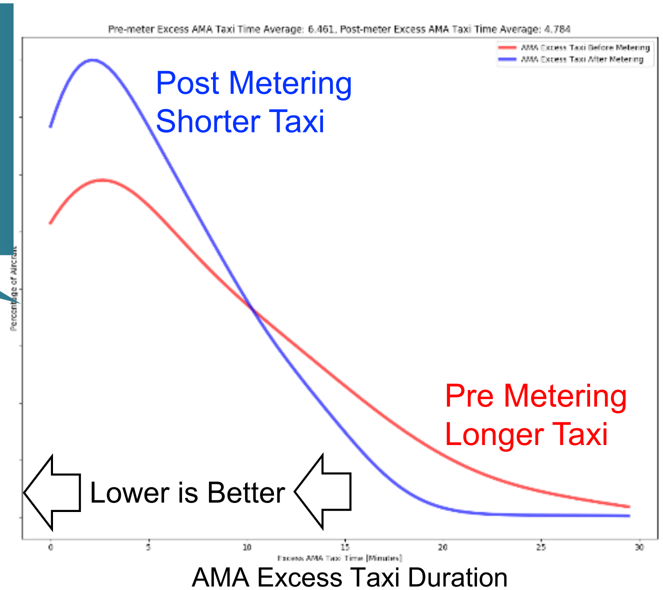
Mobile App Ready-to-Taxi Time Submission



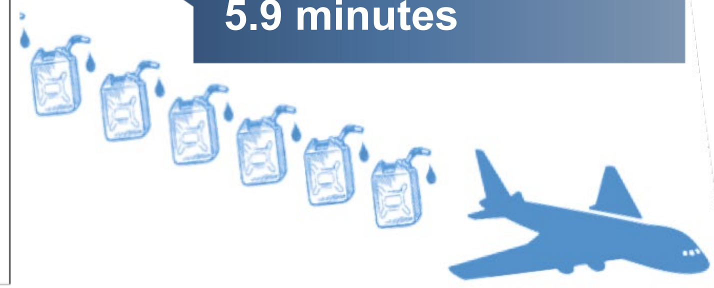
Collaborative Surface Metering Benefits through 2018-10-25

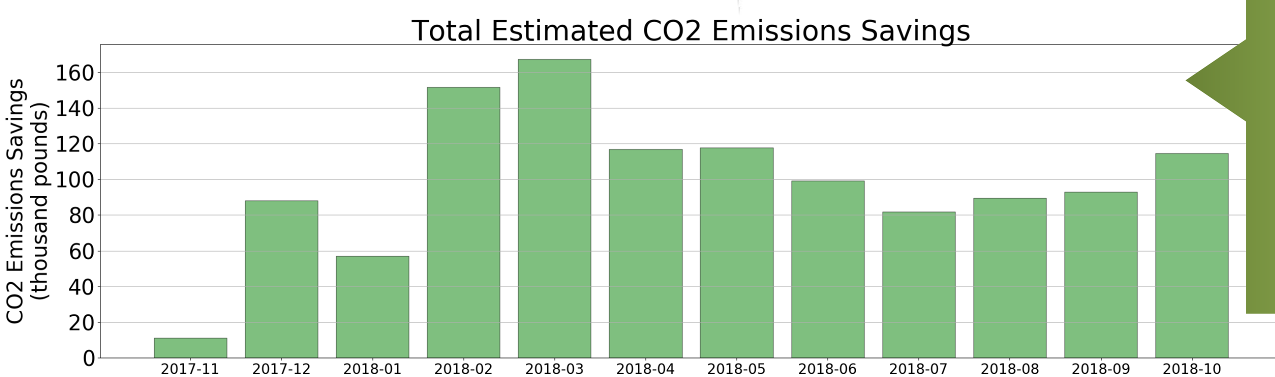
Initial benefits observed from S-CDM surface metering during Bank 2 and 3 at CLT:

Reduced AMA taxi out times during its use via small holds at gate



Saved approximately 385,557 lbs of fuel by holding 13.2% of departures with average gate hold of 5.9 minutes

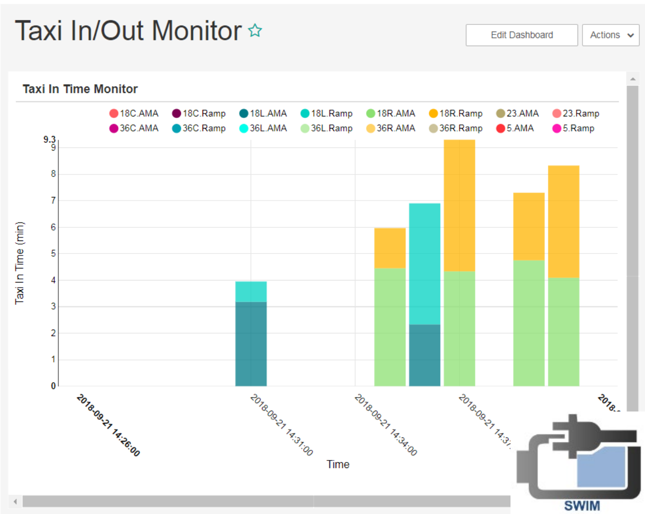




Saved approximately 1,187,516 lbs of CO_2, equivalent to planting 13,811 urban trees

Post-Analysis

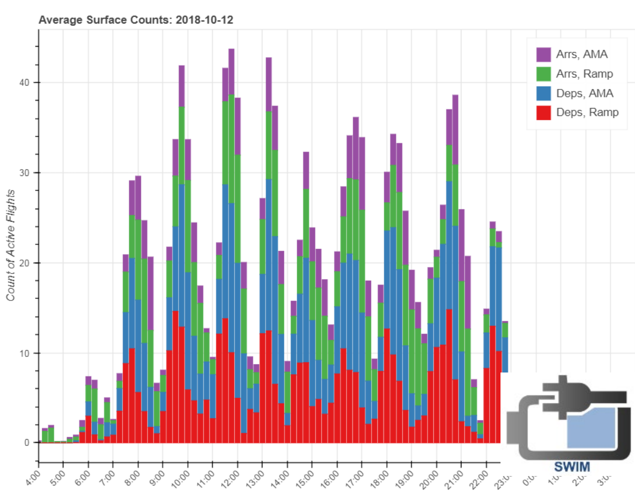
Real-Time Reporting



Post-Bank Metering Reports

EOBT	Pilot Ready Time	TOBT	AOBT	ATOT
10/2/2018 13:14	10/2/2018 13:16	10/2/2018 13:17	10/2/2018 13:16	10/2/2018 13:28
10/2/2018 13:20	10/2/2018 13:24	10/2/2018 13:23	10/2/2018 13:24	10/2/2018 13:53
10/2/2018 13:20	10/2/2018 13:20	10/2/2018 13:25	10/2/2018 13:20	10/2/2018 13:43
10/2/2018 13:25	10/2/2018 13:23	10/2/2018 13:28	10/2/2018 13:31	10/2/2018 14:03
10/2/2018 13:23	10/2/2018 13:25	10/2/2018 13:31	10/2/2018 13:30	10/2/2018 13:59
10/2/2018 13:30	10/2/2018 13:24	10/2/2018 13:31	10/2/2018 13:33	10/2/2018 14:15
10/2/2018 13:35	10/2/2018 13:30	10/2/2018 13:35	10/2/2018 13:30	10/2/2018 13:50
10/2/2018 13:40	10/2/2018 13:34	10/2/2018 13:40	10/2/2018 13:34	10/2/2018 13:55
10/2/2018 13:40	10/2/2018 13:33	10/2/2018 13:40	10/2/2018 13:38	10/2/2018 14:07
10/2/2018 13:40	10/2/2018 13:32	10/2/2018 13:40	10/2/2018 13:32	10/2,[illegible]
10/2/2018 13:40	10/2/2018 13:34	10/2/2018 13:41	10/2/2018 13:40	10/2,[illegible]
10/2/2018 13:40	10/2/2018 13:32	10/2/2018 13:41	10/2/2018 13:38	10/2,[illegible]

Daily Data Digest

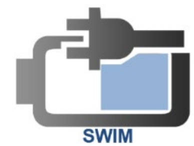


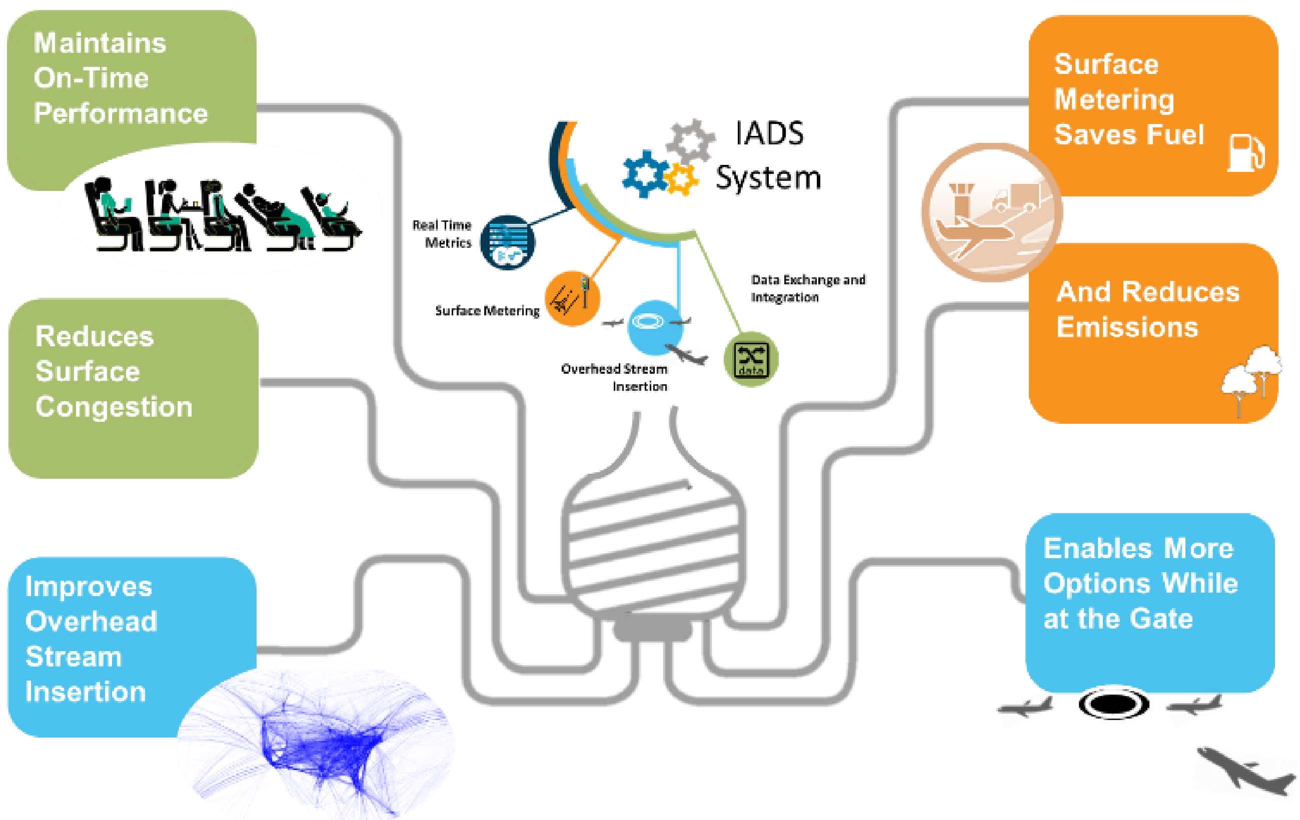
Analysis Data Archive

- flight_summary_kclt_v0_9
  - Columns
    - acid (varchar(2147483647))
    - gufi (varchar(2147483647))
    - isarrival (bool)
    - isdeparture (bool)
    - departure_aerodrome_icao_name (varchar(2147483647))
    - arrival_aerodrome_icao_name (varchar(2147483647))
    - departure_stand_scheduled_time (timestamp)
    - arrival_stand_scheduled_time (timestamp)

Demonstrating Benefits in the Field

- Multiple benefits mechanisms (benefits through 2018-10-25)
  - 843,453 lbs. of fuel saved
  - CO_2 savings equivalent to 30,214 urban trees
  - 110.1 hours of surface delay saved
    - $528,510 passenger value of time
    - $149,760 flight crew costs
  - 1,189 hours of reduced runtime on engines





Industry Workshop Jan. 22-24 – Breakouts

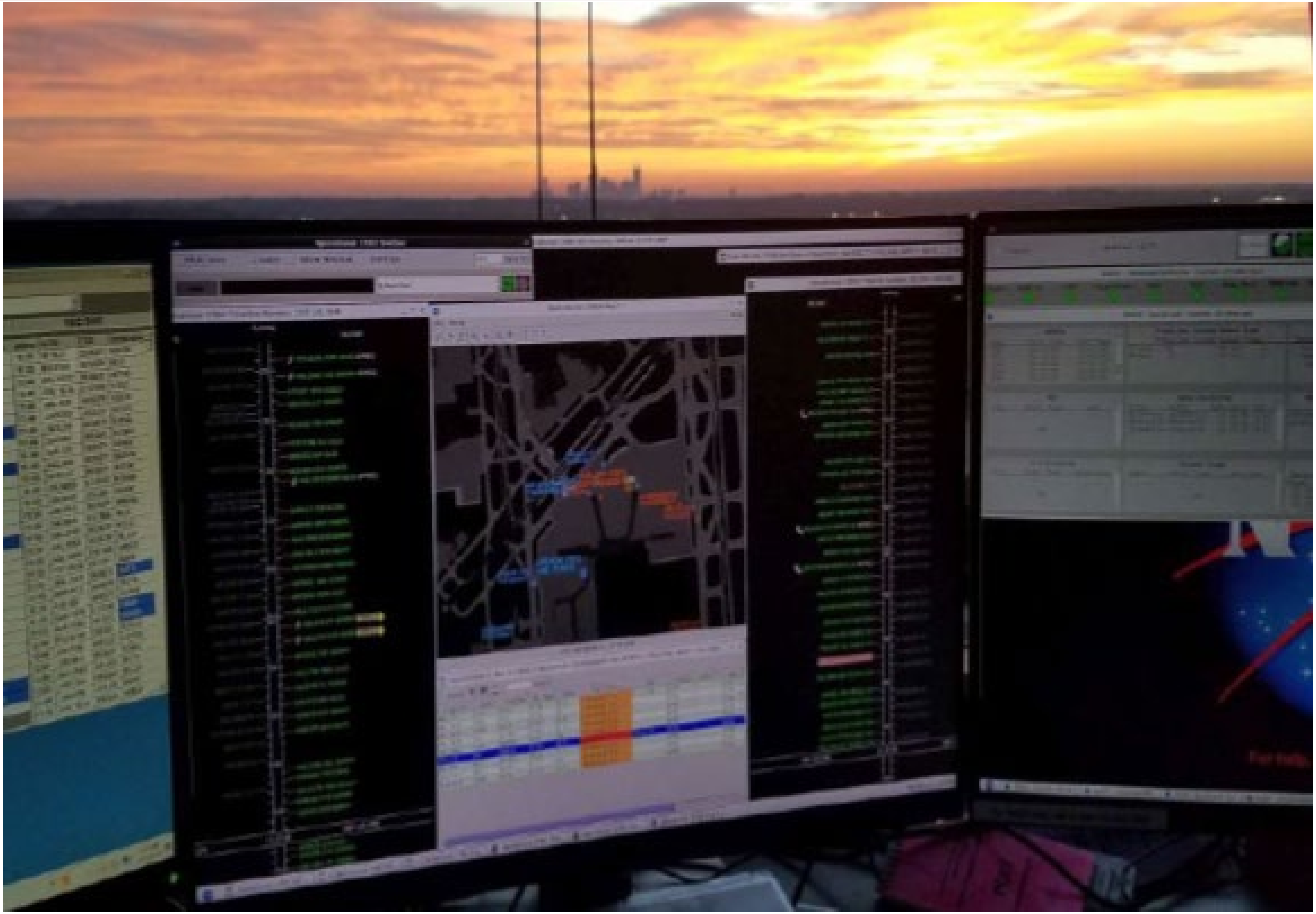
Day	Breakout	Time	Topic A	Topic B	Topic C
23-Jan	1	0830 -0930	Understanding TMIs in the NAS (Part 1)	Learn to SWIM from ATD-2	Surface modeling
23-Jan	2	0930 -1030	Understanding TMIs in the NAS (Part 2)	Fuser—why everyone should have one	Surface scheduling in the overhead stream (software focused)
23-Jan	3	1300 -1400	STBO ramp control system (Part 1)	Fuser—let's get into the weeds	Tactical surface metering
23-Jan	4	1400 -1500	STBO ramp control system (Part 2)	Software available from ATD-2	Strategic surface metering
23-Jan	5	1615 -1715	Mobile applications on the surface	Substituting flights in TFDM with TFCS	Benefits of surface metering and evidence of *do no harm*
24-Jan	6	0830 - 0930	Turning SWIM data into consistent reports for analysts and users	The benefits of good EOBTs to surface metering	Reducing verbal communication of TMIs in the NAS
24-Jan	7	0930 - 1030	TFDM Terminal Publication (TTP)—the data you always wanted but hasn't existed until now	Understanding the performance of surface metering	Pre-scheduling into TBFM with EOBTs (operationally focused)
24-Jan	8	1300 - 1400	STBO ramp control system (Part 1)	Fast time simulation of the surface	
24-Jan	9	1400 - 1500	STBO ramp control system (Part 2)	Using historical data to calibrate the IADS system	

Color	Tracks
Yellow	SWIM Data, Tools and Available Software
Orange	Surface Modeling, Scheduling & Metering
Blue	Data Analysis, Metrics and Modeling
Grey	TMIs and Tools - Operationally Focused
Green	Ramp Control Tools & Lessons Learned

Jan. 22 – 24, 2019 at NASA Ames, CA

Click here for the full agenda.
Click here to register.
Click here for the Workshop web page.
We hope to see you there!

Questions?



NASA Airspace Technology Demonstration 2 (ATD-2)

"SWIM Data Mediation Use Case"

Briefing to SWIM Industry-FAA Team (SWIFT) Workshop

Nov. 15, 2018

Motivation

- Problem
  - With the great new FAA system SWIM feeds, your organization feels they are drowning in data that they do not understand.
  - You need to make ***actional, operational information*** out of this data!

- Solution
  - To accomplish this, you need a framework that can mediate between disparate sources of data, pulling in the ***right data, at the right time***.
  - Need information on which data source is best to use for a specific need.

Why Use Multiple Sources Of Data?

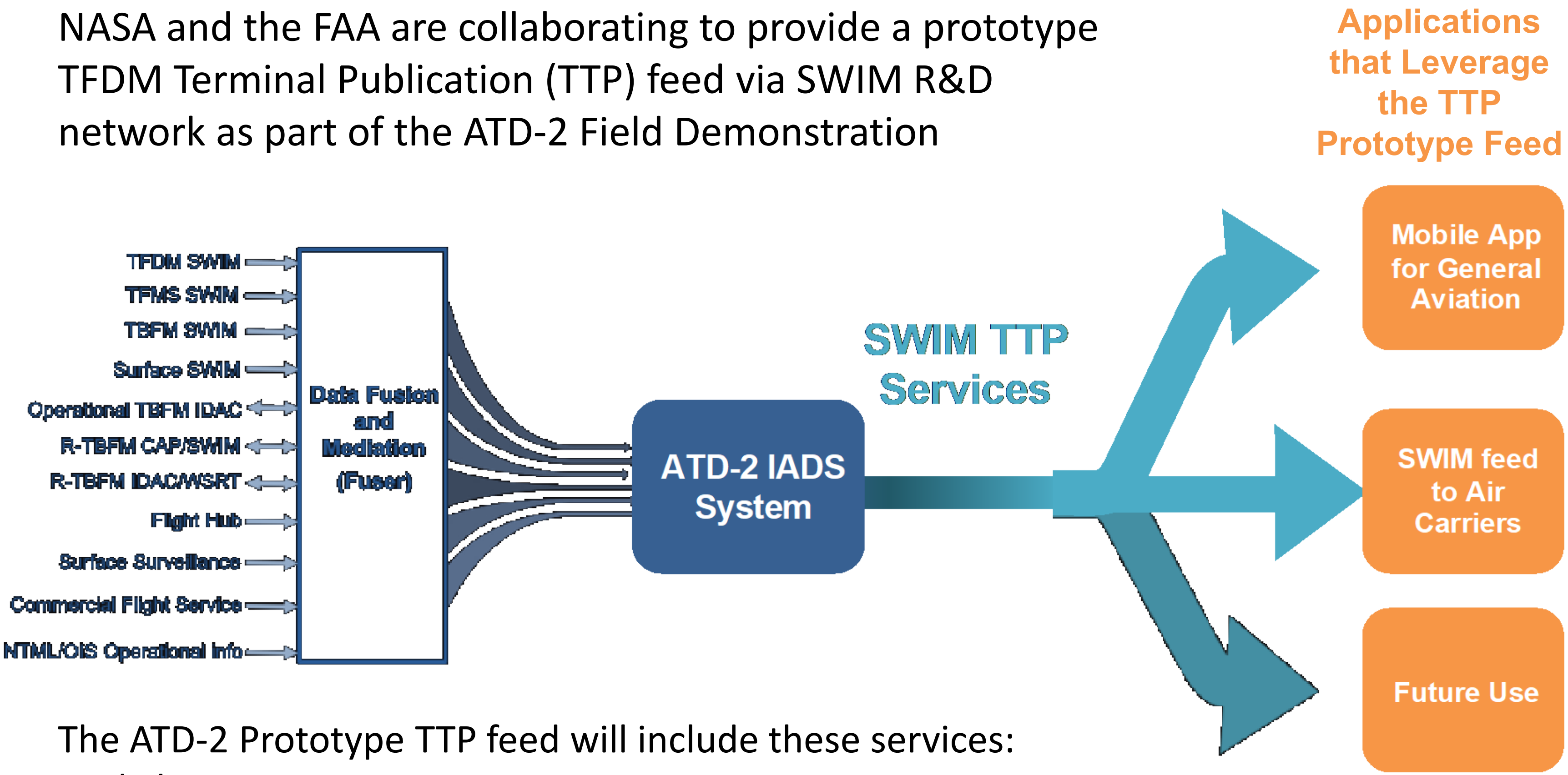
- To cover the entire flight duration and turn-around process
  - If you want the highest quality data available for the entire flight from gate to gate, this requires the use of multiple sources from SWIM
  - In general, the best data comes from the FAA system whose operational mission most closely matches your data need (e.g. if you want strategic constraints and planning info, then TFMS, tactical then TBFM or TFDM)

- Some information only exist, or is higher quality, in certain feeds
  - APREQ Release Times from TBFM SWIM
  - EDCT information from TFM Flow Data SWIM
  - Surface metering times from TFDM Terminal Publication SWIM

- Data redundancy/backup from secondary sources
  - Loss of any one feed still allows data from other feeds to provide value

IADS Data Sharing via Prototype TTP

NASA and the FAA are collaborating to provide a prototype TFDM Terminal Publication (TTP) feed via SWIM R&D network as part of the ATD-2 Field Demonstration



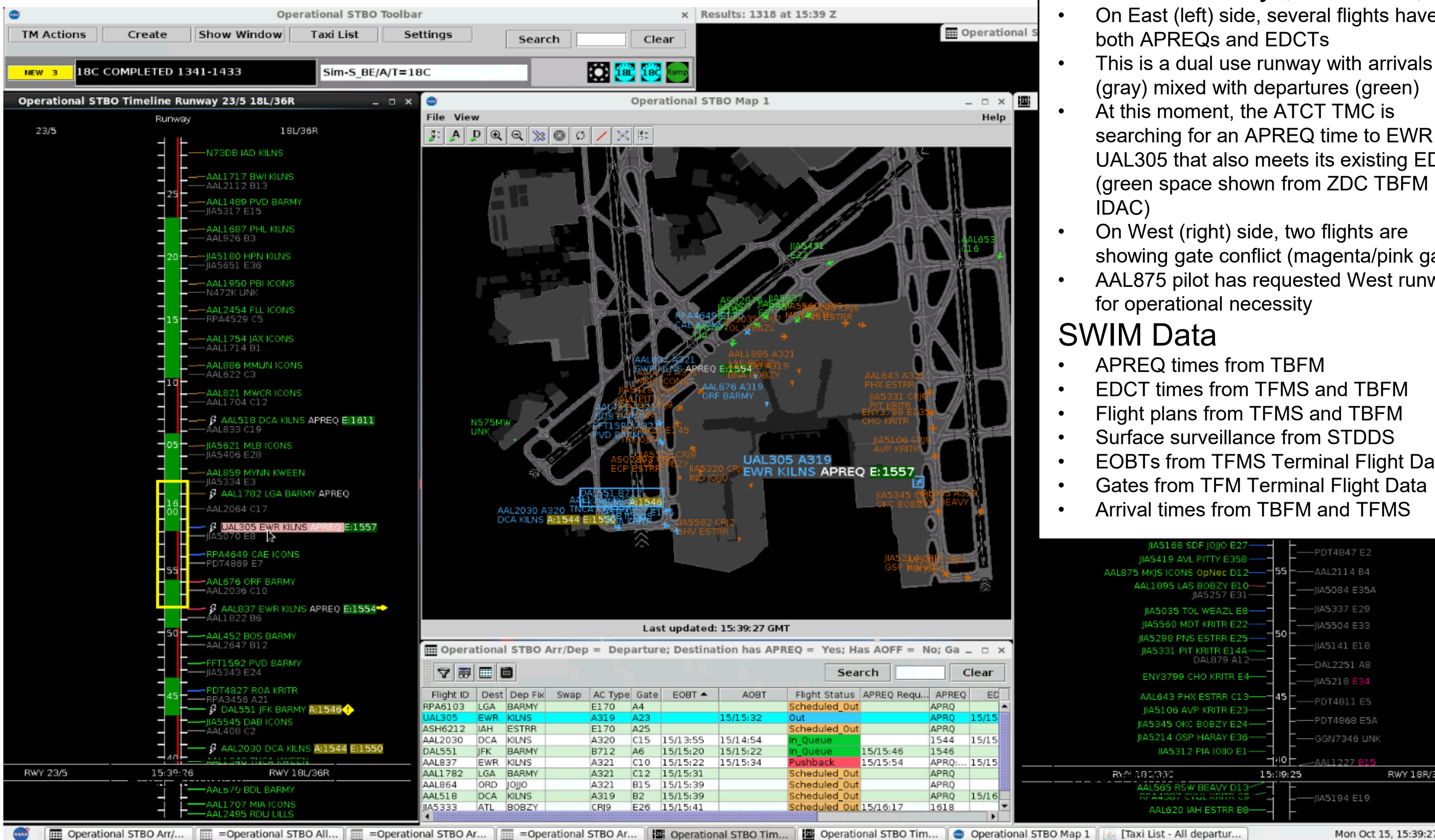
The ATD-2 Prototype TTP feed will include these services:

- Flight Data
- Airport Information
- Traffic Management Restrictions
- Flight Delay
- Operational Metrics

TTP now available for CLT on SWIM R&D
You are welcome to onboard now!

Data Exchange and Integration TMC View

ATD2 Integrated Arrival/Departure/Surface



Quick summary (Oct 15, 2018):

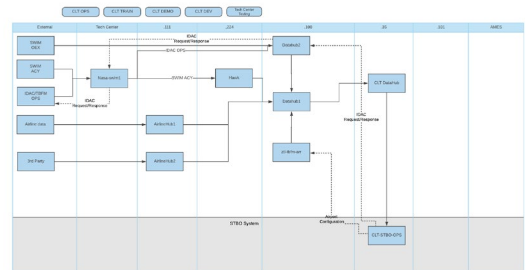
- On East (left) side, several flights have both APREQs and EDCTs
- This is a dual use runway with arrivals (gray) mixed with departures (green)
- At this moment, the ATCT TMC is searching for an APREQ time to EWR for UAL305 that also meets its existing EDCT (green space shown from ZDC TBFM IDAC)
- On West (right) side, two flights are showing gate conflict (magenta/pink gate)
- AAL875 pilot has requested West runway for operational necessity

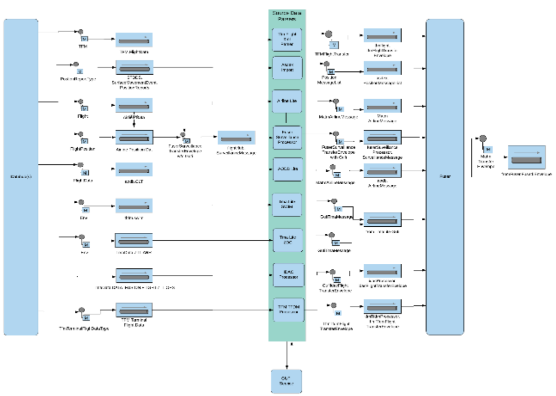
SWIM Data

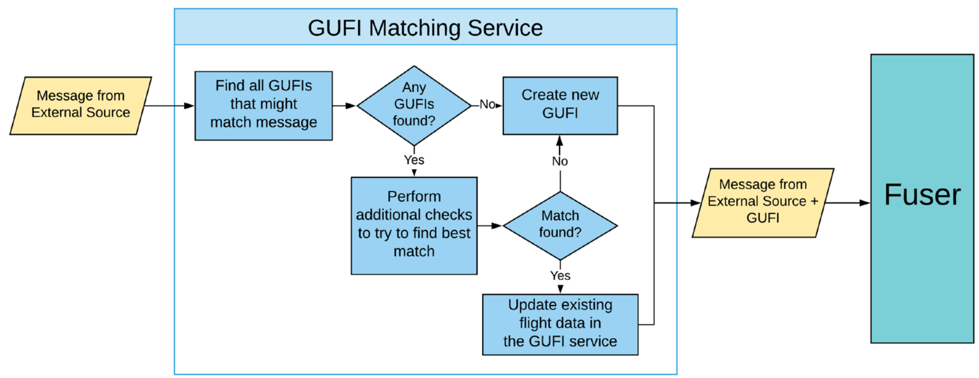
- APREQ times from TBFM
- EDCT times from TFMS and TBFM
- Flight plans from TFMS and TBFM
- Surface surveillance from STDDS
- EOBTs from TFMS Terminal Flight Data
- Gates from TFM Terminal Flight Data
- Arrival times from TBFM and TFMS

Assumptions

- You successfully ..
  - Connected to SWIM
  - Consume the data and keep up
  - Parse the data
  - Correlate the data between multiple sources







- If you are stuck on any of those steps, come to the NASA ATD-2 industry days in January to learn more about what we did to get over those hurdles on ATD-2
  - https://aviationsystems.arc.nasa.gov/atd2-industry-days/

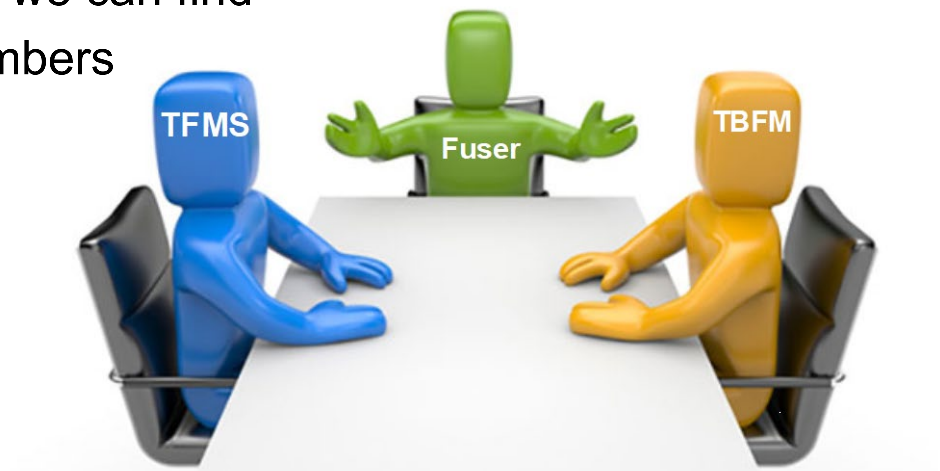
ATD2 Integrated Arrival/Departure/Surface

Decision Time

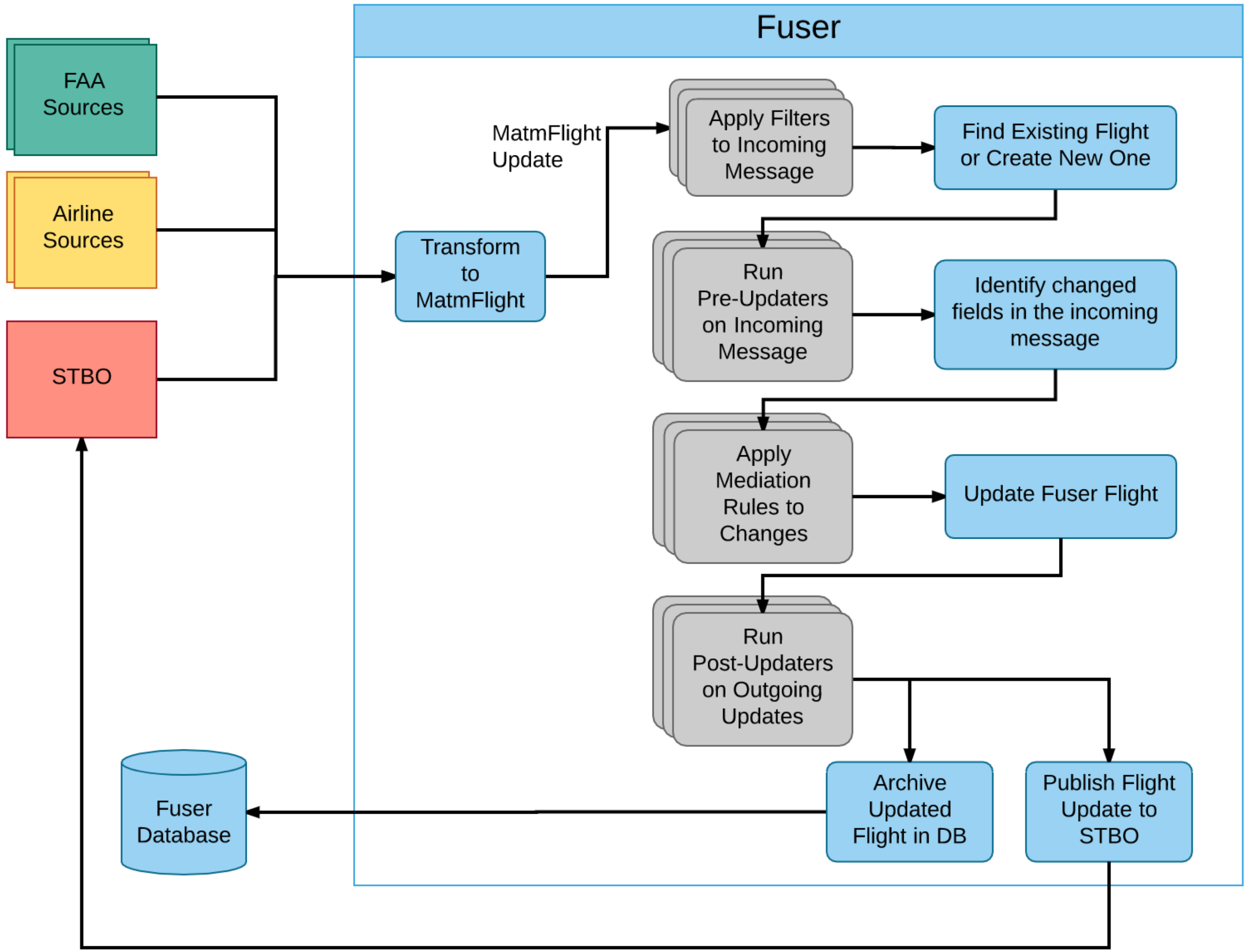
- You managed to get through the initial steps.
- You have all this great data at your disposal.
- Now you have to decide what to use from various feeds and when!

Mediation Challenges

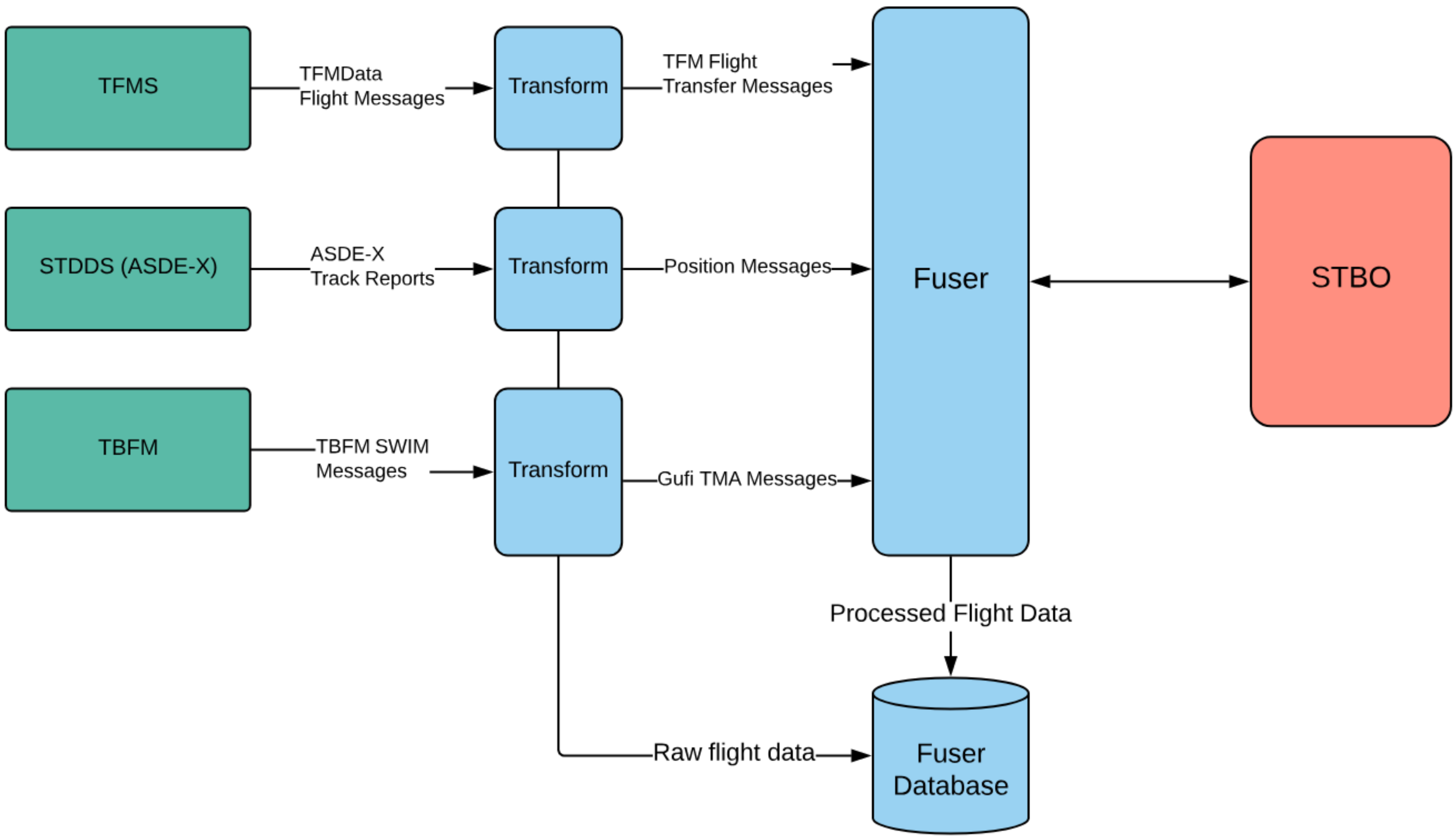
- Challenges
  - Not all feeds are not well documented at the field level
  - Field names vary a great deal between feeds
  - IATA vs ICAO issues
  - Some data is deeply nested
  - Data found in multiple messages in some feeds (TFMS)
  - Precision issues
- Overcoming the challenges
  - Start with whatever documentation we can find
  - Rely on experience from team members
  - Consult subject matter experts
  - Transform data to common format
  - Analysis
  - Testing



ATD-2 Flight Processing



Flight Data Transformations



Data Mapping Challenge

The most common flight identifying field must be consistent across sources, right?

Source System	Term Used
Fuser/MatmFlight	**acid**
TFMS	qualifiedAircraftId.**aircraftId**
TBFM	tmaType.air.flt.**aid**
IDAC	**callsign**
TFM Terminal Flight Data	**acid**
STDDS Position Report (ASDEX)	flightId.aircraftId.value
FIXM	flightIdentification.**aircraftIdentification**

One down, lots to go!

Data Mapping Example

Attribute Name	TFM Flight Transfer Mappings	TMA	TFM TFDM Data Mapping
acid	acid	tmaType.air.flt.aid	acid
aircraftAddress			
aircraftEngineClass	physicalClass	tmaType.air.flt.Eng	
aircraftEquipmentQualifier	acEqpSuffix	tmaType.air.flt.Typ equipment qualifier parsed from TMA element	
aircraftRegistration			acftRegistrationNumber
aircraftType	aircraftType	tmaType.air.flt.Typ aircraft type parsed from TMA element	
altitudeAssigned	altitudeAssigned	tmaType.air.flt.Ara (if tmaType.air.flt.Fps != proposed)	
altitudeFiled	altitudeFiled		
altitudeRequested	altitudeRequested	tmaType.air.flt.Ara (if tmaType.air.flt.Fps == proposed)	
arrivalAerodrome.iataName	arrAirport		Derived from arrArpt/arrArptIcao
arrivalAerodrome.icaoName		tmaType.air.flt.Apt	Derived from arrArpt/arrArptIcao

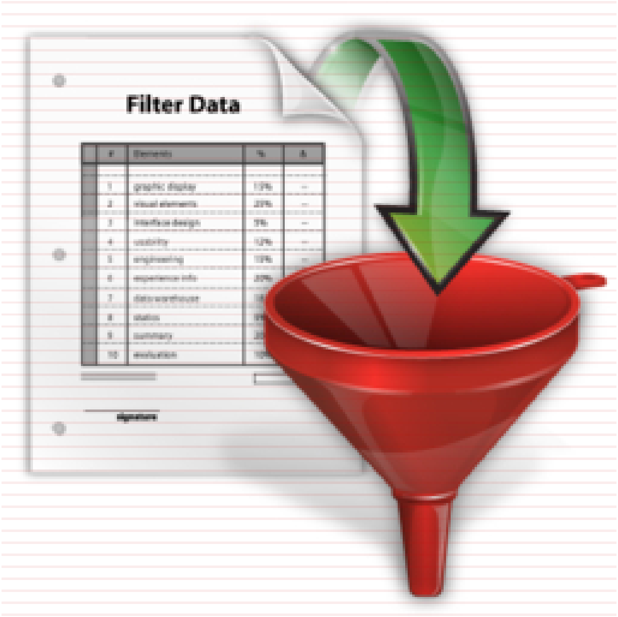
Data mappings will be discussed in more detail at industry day.

Nested Mapping Example

Attribute Name	Handled messageType	Priority 1 Data Field
acEqpPrefix	<none>	
acEqpSuffix	BOUNDARY_CROSSING_UPDATE DEPARTURE_INFORMATION FLIGHT_CREATE FLIGHT_MODIFY FLIGHT_PLAN_AMENDMENT_INFORMATION FLIGHT_PLAN_INFORMATION FLIGHT_ROUTE FLIGHT_SCHEDULE_ACTIVATE FLIGHT_TIMES	flightAircraftSpecs.equipmentQualifier flightStatusAndSpec.aircraftspecification.equipmentQualifier airlineData.flightStatusAndSpec.aircraftspecification.equipmentQualifier airlineData.flightStatusAndSpec.aircraftspecification.equipmentQualifier newFlightAircraftSpecs.equipmentQualifier flightAircraftSpecs.equipmentQualifier flightStatusAndSpec.aircraftspecification.equipmentQualifier flightStatusAndSpec.aircraftspecification.equipmentQualifier flightStatusAndSpec.aircraftspecification.equipmentQualifier
acid	<all>	qualifiedAircraftId.aircraftId
aircraftType	BOUNDARY_CROSSING_UPDATE DEPARTURE_INFORMATION FLIGHT_CREATE FLIGHT_MODIFY FLIGHT_PLAN_AMENDMENT_INFORMATION FLIGHT_PLAN_INFORMATION FLIGHT_ROUTE FLIGHT_SCHEDULE_ACTIVATE FLIGHT_TIMES	flightAircraftSpecs flightStatusAndSpec.aircraftspecification airlineData.flightStatusAndSpec.aircraftspecification airlineData.flightStatusAndSpec.aircraftspecification newFlightAircraftSpecs flightAircraftSpecs flightStatusAndSpec.aircraftspecification flightStatusAndSpec.aircraftspecification flightStatusAndSpec.aircraftspecification

Filtering

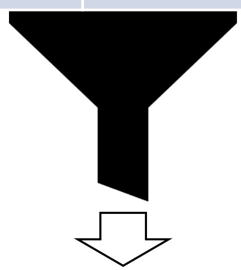
- Filtering is used to remove irrelevant data before further updates to the fused flight information
  - Filtering is based on defined rules
  - Necessary given the volume of data available



Filtering Sample

acid	departure Aerodrome	departure stand estimated time	Arrival Aerodrome	Last update source	System id	Timestamp
ABC1234	CLT	2017-04-05 11:00	DFW	TFMS	TFMS	2017-04-05 10:00
ABC4567	BFE	2017-04-05 11:15	ORD	TFMS	TFMS	2017-04-05 10:00
ABC8999	CLT	2017-04-05 11:30	JFK	TFMS	TFMS	2017-04-05 10:00

In this example, filtering a flight not relevant to CLT



acid	departure Aerodrome	departure stand estimated time	Arrival Aerodrome	Last update source	System id	Timestamp
ABC1234	CLT	2017-04-05 11:00	DFW	TFMS	TFMS	2017-04-05 10:00
ABC8900	CLT	2017-04-05 11:30	JFK	TFMS	TFMS	2017-04-05 10:00

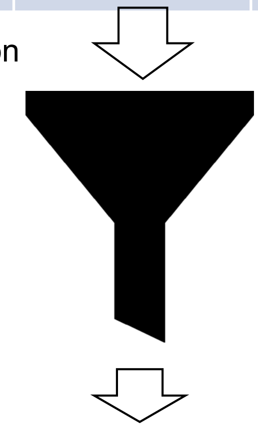
Attribute Filtering

- Attribute filtering:
  - Used to filter out fields before they are applied to the fused flight, based on the defined rules
  - Used when a source is known to have data that is not useful in certain fields

Attribute Filtering Sample

acid	departure stand airline	departure runway actual time	Last update source	System id	Timestamp
ABC1234	B1	2017-04-05 11:30	TFMS	TFMS	2017-04-05 10:00

ATD-2 relies on STBO position derived runway actual times



acid	departure stand airline	Last update source	System id	Timestamp
ABC1234	B1	TFMS	TFMS	2017-04-05 10:00

Mediation By Rules

- Mediation rules are used to define a precedence/authority between sources providing data for the same fields
- Rules are applied on a field by field basis

Mediation Example

- Example of parking gate coming from two sources
  - TFM Terminal Flight Data
  - Airline Source

- Our current precedence order is TFM Terminal Flight Data then Airline Source

Mediation Example Continued

Full State of the Flight as of 10:00

acid	departure stand airline	Last update source	System id	Timestamp
ABC1234	B1	C		2017-04-05 10:00

New Message from Flight Stats at 10:15

acid	departure stand airline	Last update source	System id	Timestamp
ABC1234	A1	AIRLINE	SOURCE_X	2017-04-05 10:15

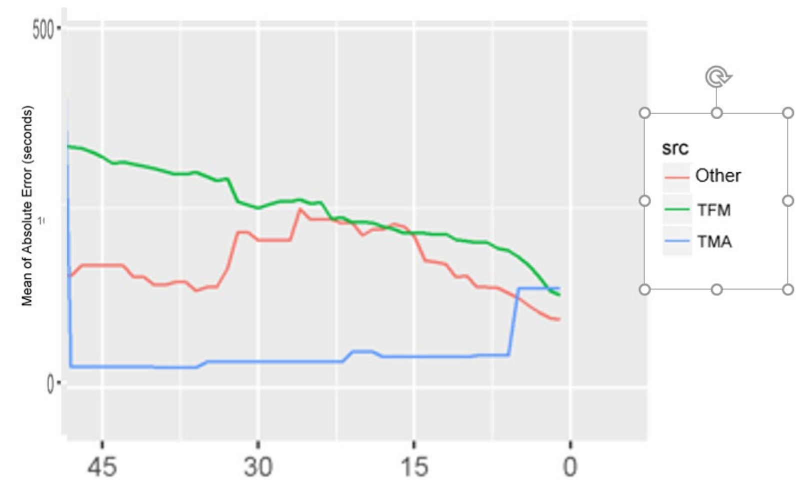
TFM Terminal Flight Data was defined with a precedence over the Airline source so we stick the gate value received from the TFM Terminal Flight Data.

acid	departure stand airline	Last update source	System id	Timestamp
ABC1234	BI	AIRLINE	SOURCE_X	2017-04-05 10:15

After the update is applied the full state of the flight will still contain B1 for the parking gate. A null/blanked out field will not override an existing value

Mediation Example (Arrival Time)

- Arrival time sources
  - TFMS
  - Research TBFM (RTBFM) Arrival System
    - Used here because the adaptation
    - and modeling enhanced for ATD-2
  - Surveillance (actuals)



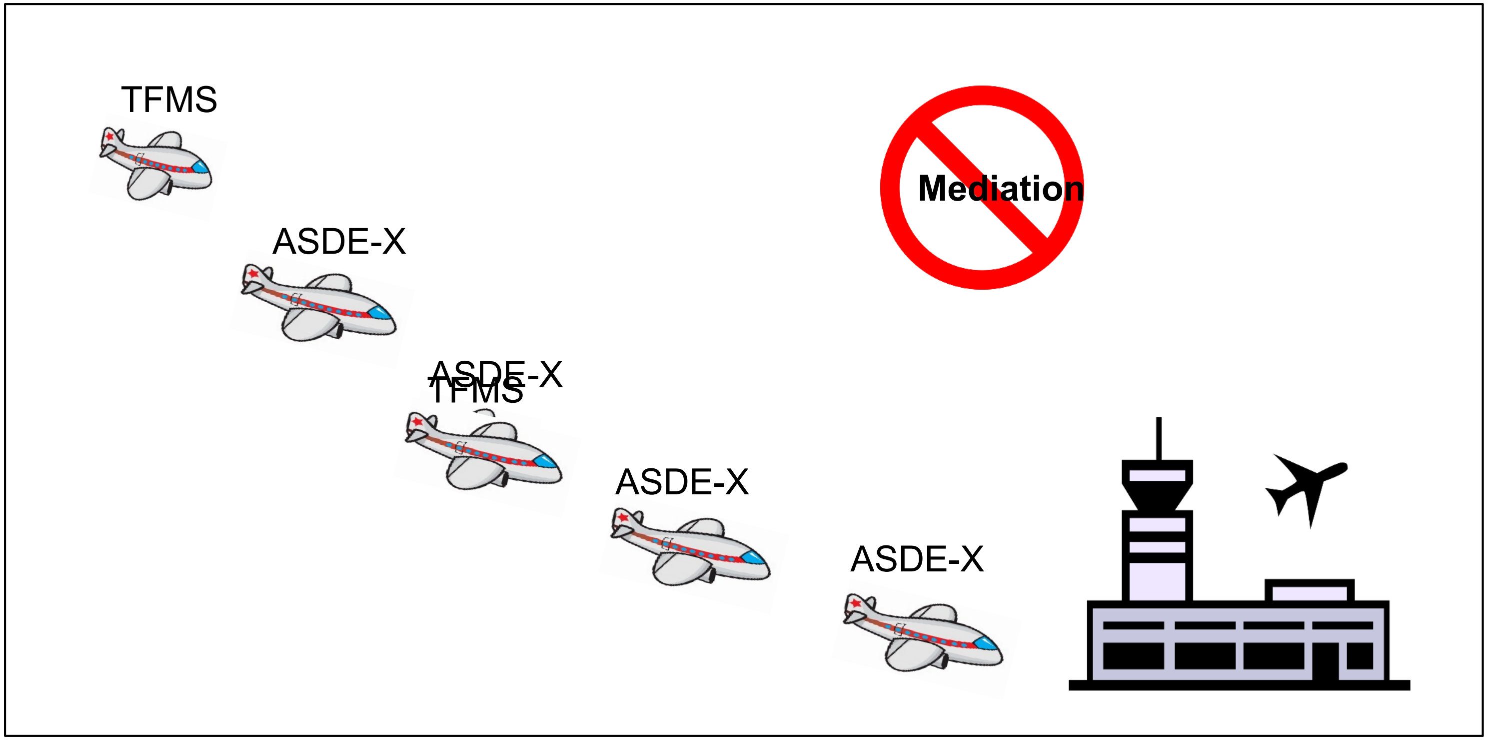
- Arrival Time mediation
  - TFMS ETA when flight is on the ground
  - RTBFM ETA when flight becomes active
  - RTBFM STA if the flight is being metered
  - Actual on time determined via surveillance

Mediation Example (Position Data)

- Mediate to avoid jumpiness in the display and data
  - Define priority
  - Define a timeout
    - transition back to a lower priority source if we quit getting data

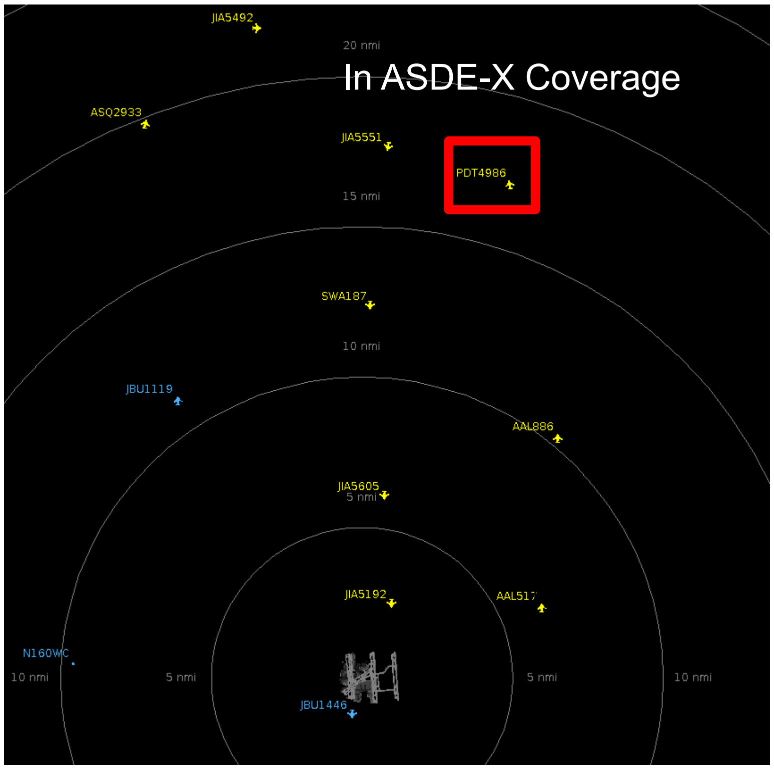
Source	Frequency	Coverage	Priority	Timeout
STDDS (ASDE-X)	1 second	Surface to about 16 miles	1	5 seconds
STDDS TAIS	6 seconds	TRACON	2	30 seconds
SFDPS	12 seconds	NAS by CENTER stops in TRACON	3	60 seconds
TFMS	60 seconds	NAS stops in TRACON	4	60 seconds

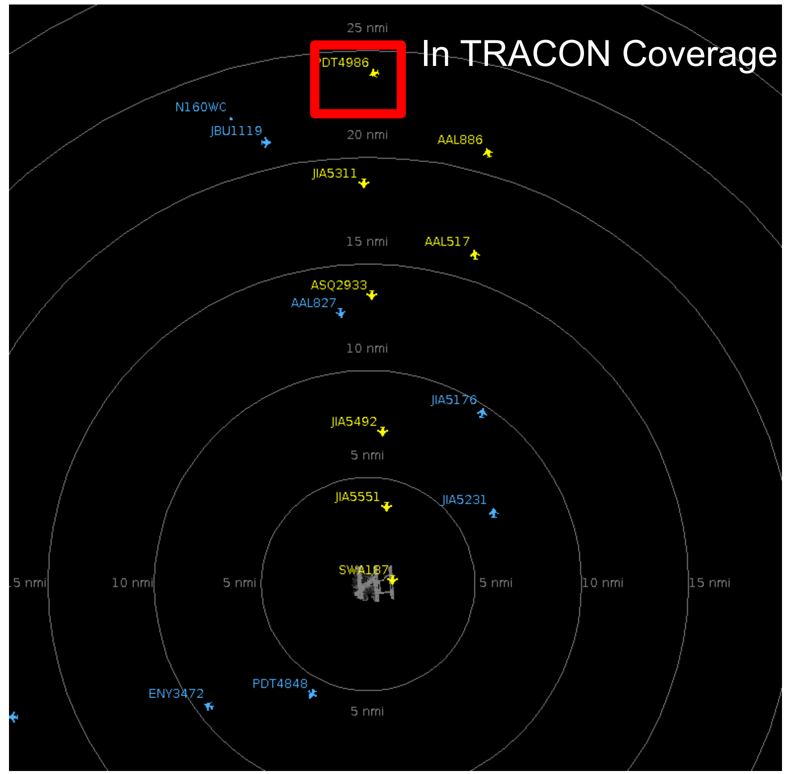
Position Data Jumpiness



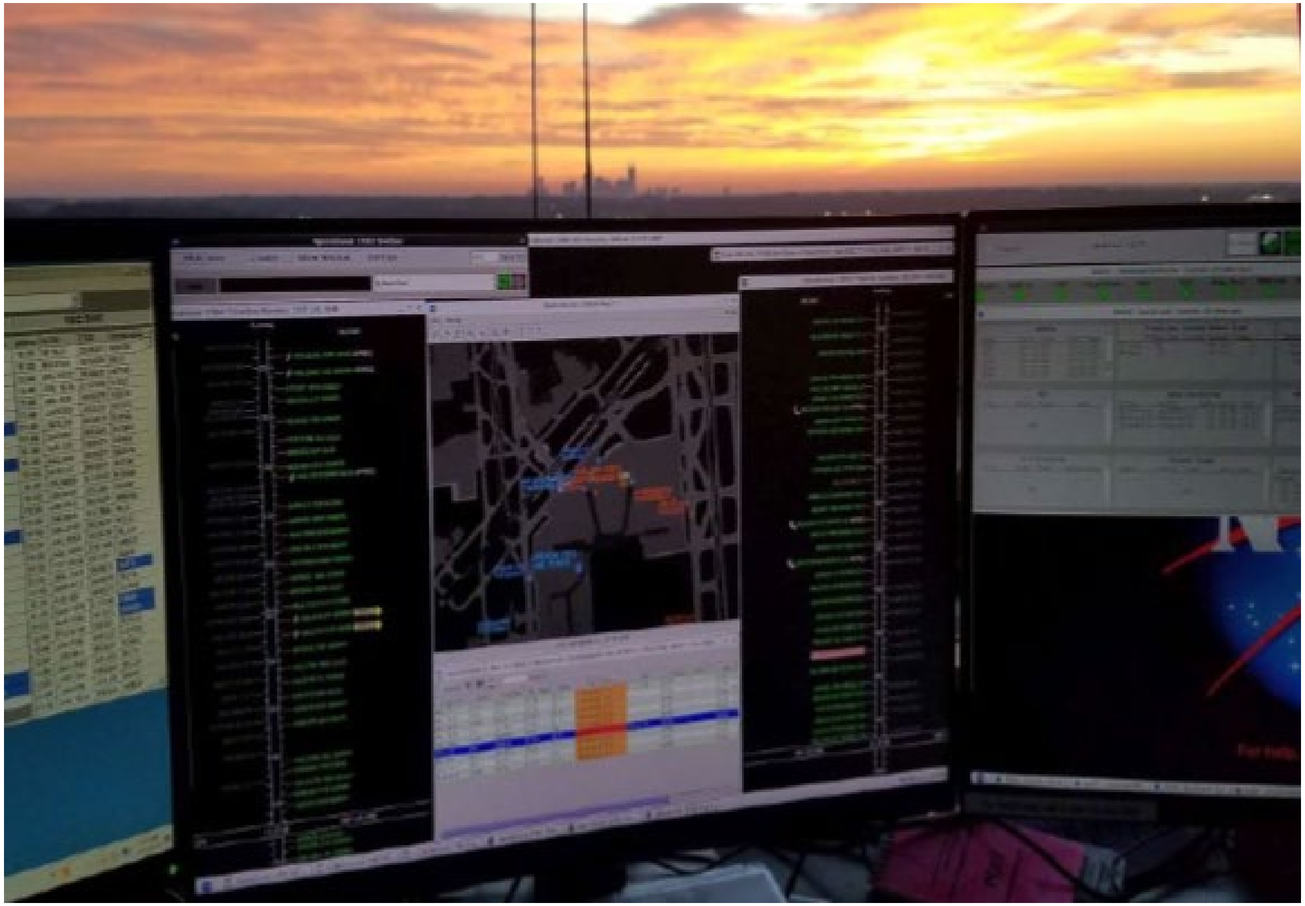
Position Coverage Transition

Example of why a source timeout is necessary





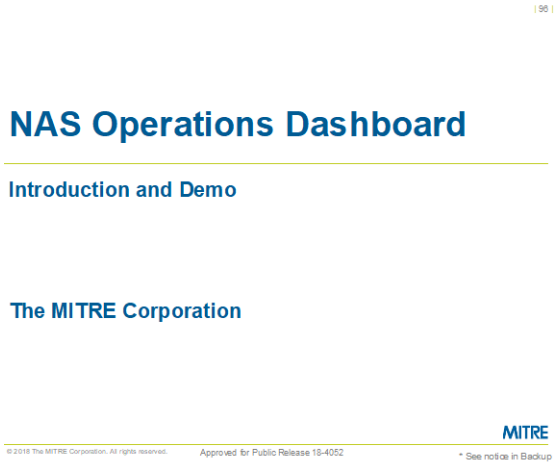
Questions?



Summary & Next Steps

- **FY 19 Focus:**
  - Continue working through Case Studies, business case focus
  - SWIM Data in Motion: Viewing information in operational context
  - Continue building on the communications platform for industry
- **Topics for next meeting:**
  - Additional Case Studies from airspace users & industry
    - Volunteers for February?
    - NBAA? FedEx? Others?
  - Producer Program:
    - SWIM Terminal Data Distribution Service (STDDS)
  - Special Topics:
    - SWIM International
- **Next meeting: February 21, 2019, Location: TBD**

Back Up



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