Airspace Technology Demonstration 2 (ATD-2)

Fuser and Fuser In the Cloud

September 4, 2019

Overview

- Fuser Overview
  - Swim sources
  - What is the Fuser
  - Fuser Flight Data
  - Fuser Flight Processing
  - Fuser in the Cloud

Achieving Full Benefit from SWIM Flight Data

- Many people have worked hard to make SWIM data available (***Thank you***!)
  - Making the data available in a secure, stable platform was a major aviation engineering feat!

- Pre-processing & merging SWIM flight data feeds can be difficult, expensive and error prone
  - FAA decision support systems have valuable output data, but can provide inconsistent information on the same flight that is difficult for consumers to understand
  - Without deep knowledge of the underlying 3T (TFMS, TBFM, TFDM - plus ERAM and STARS) systems, the consumption logic may not lead toward the benefit the community desires
  - If everyone in the aviation industry creates their own SWIM flight data fusion process, many different organizations could come up with different definitions of the 'truth', degrading communication

- The ATD-2 mission required swift progress in field (operational) demonstrations
  - This led to a significant investment in logic that could address SWIM flight data pre-processing and mediation complexities. Much of this work is embodied in the 'Fuser' service.
  - Additional analytical investment was made in post-processing, which evolved over time through an ATD-2 internal data governance process with a feedback loop into the Fuser for more data

Said another way ..

- SWIM contains lots of data
- The data has lots of value
- But consuming that data is challenging
- If only there were some way to fuse the data together…

Fuser Helps Solve SWIM Challenges

- Problem
  - With the great new FAA SWIM feeds, your organization feels they are drowning in data that they do not understand.
  - You need to make ***actionable, 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.
  - Access to the information in common well defined data model

Why Use Multiple Sources Of Data?

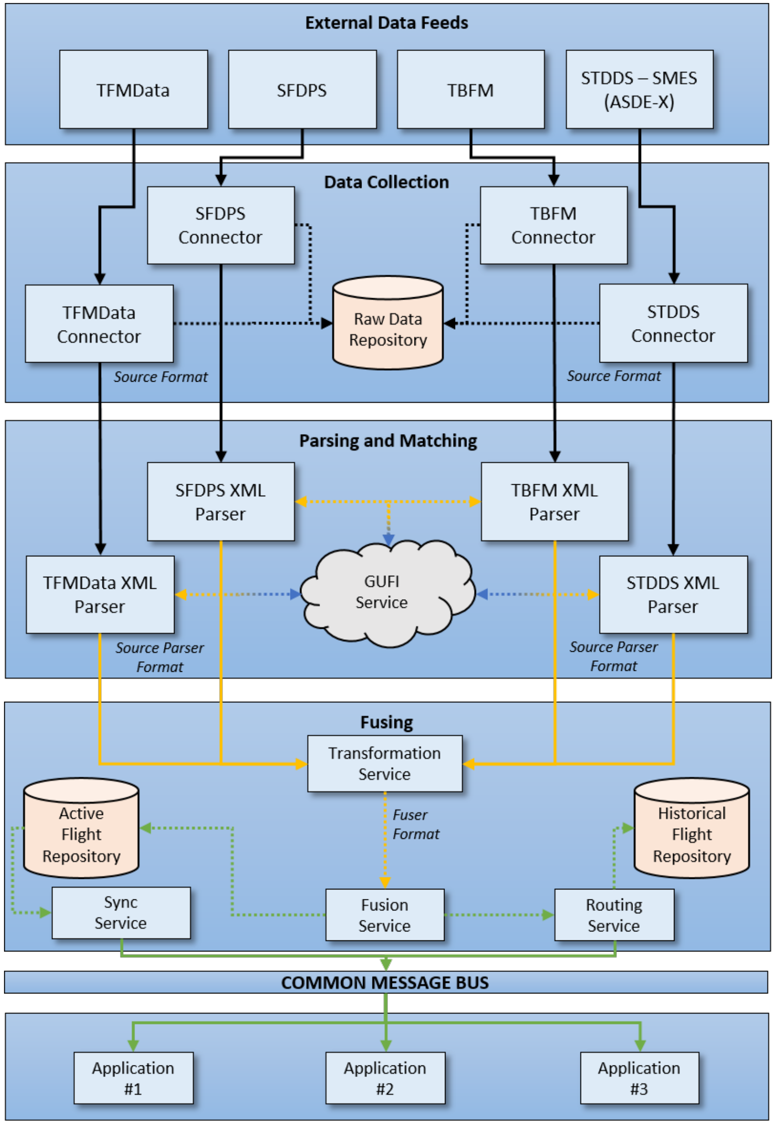
- To cover the entire flight duration and turn-around process
  - If you want the highest quality data available for the entire flight from gate to gate, this requires the use of multiple sources from SWIM
  - In general, the best data comes from the FAA system whose operational mission most closely 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
  - EDCT information from TFM Flight Data
  - Surface metering times from TFDM Terminal Publication
- Data redundancy/backup from secondary sources
  - Loss of any one feed still allows data from other feeds to provide value

What is the Fuser

- Fuser is a system composed of multiple components providing
  - Parsers for various data sources
  - Matching Services
  - Fusion Services
    - Transformation
    - Filtering
    - Updating
    - Mediation
  - Database Loading

- Common well defined schema

Fuser High Level Architecture



External Data Feeds

TFMData

SFDPS

TBFM

STDDS – SMES (ASDE-X)

Data Collection

SFDPS Connector

TBFM Connector

TFMData Connector

Raw Data Repository

STDDS Connector

Source Format

Source Format

Parsing and Matching

SFDPS XML Parser

TBFM XML Parser

TFMData XML Parser

GUFI Service

STDDS XML Parser

Source Parser Format

Source Parser Format

Fusing

Transformation Service

Active Flight Repository

Fuser Format

Historical Flight Repository

Sync Service

Fusion Service

Routing Service

COMMON MESSAGE BUS

Application #1

Application #2

Application #3

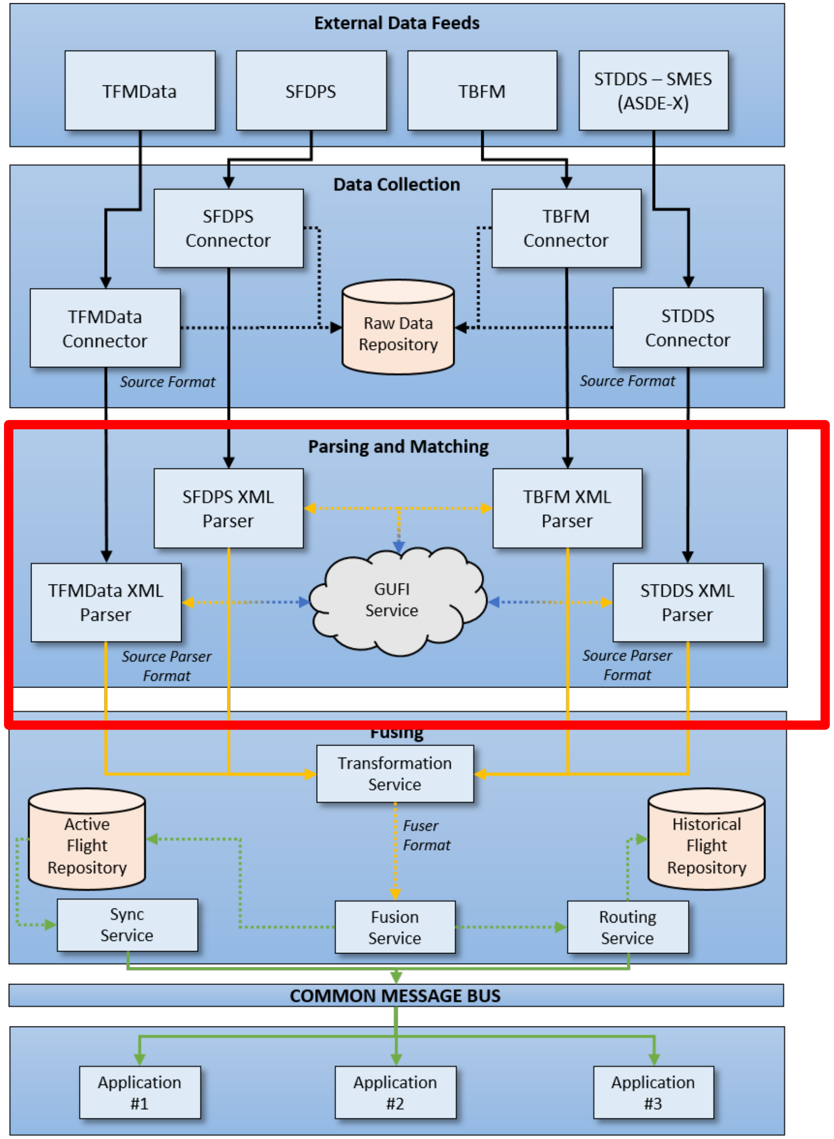
Source Message (raw or internal)

Unmatched

Matched

Matched & Fused

Data Parsers

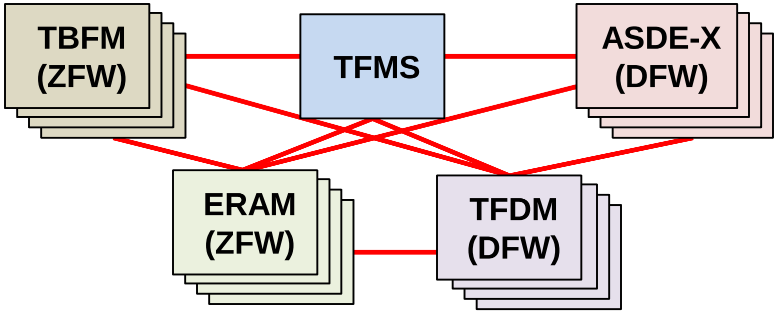


Overview of Data Feeds

Feed	Data Source	ATD-2 Use	Data
TfmData Flight	TFMS	• Schedule data • CDM data • Flight plans • EDCTs • Track data	Flight
STDDS SMES	ASDE-X/ASSC	• Surface track data	Track
TBFM MIS	TBFM	• Release times • EDCTs	Flight Plan
TfmData Terminal	TFMS	• EOBTs • Gates • Tail Numbers	Flight
TfmData Flow	TFMS	• Ground Stops • MIT restrictions (planned)	TMIs
SFDPS	ERAM	• Support for NASA research TBFM	Flight Plan

Overview of Data Feeds

- The NAS systems generating flight data SWIM feeds are interconnected.
  - Basic understanding the NAS architecture helps make sense of the SWIM data.



NAS System	SWIM Feeds	Primary Inputs	Secondary Inputs	Deployments
TFMS	• TfmData Flight • TfmData Flow • TfmData Terminal	• ERAM flight/track data • OAG schedule • Airline CDM messages • ATOP oceanic track	• TBFM release times • STDDS surface times • OIS / NTML • International feeds • TFDM predictions	1
ERAM	• SFDPS	• ATC flight plan data • En route radar track	• TFMS EDCTs • TFMS reroutes	1 per ARTCC (20 total)
TBFM	• TBFM MIS	• ERAM flight/track data (adjacent ARTCCs) • TRACON fight/track data	• TFMS international track • TFDM release time negotiation	1 per ARTCC (20 total)
ASDE-X	• STDDS SMES	• Surface radar track • ERAM flight data		1 per airport (38 total)
TFDM	• TTP	• All the above		1 per airport (future)

Overview of Data Feeds

Source	Flights Included	Earliest Flight Data	Latest Flight Data
TFMData Flight	All IFR	~24 hours before scheduled OAG operation	“Actual” arrival gate time published by Operators (up to 2 hours after taxi in)
TFMData Terminal	Only flights that publish CDM messages including Terminal Flight Data elements	~24 hours before scheduled operation	“Actual” arrival gate time published by Operators (up to 2 hours after taxi in)
SFDPS	All IFR and some VFR	Filed flight plan	Flight lands
TBFM MIS	Impacted by a TBFM arrival (TMA) or departure (EDC) system	Flight plan filed within TBFM adapted region	Track ends or leaves TBFM adapted region
STDDS SMES	Operating at or near ASDEX airport	First correlated flight track	Last correlated flight track

Parsing Data Feeds

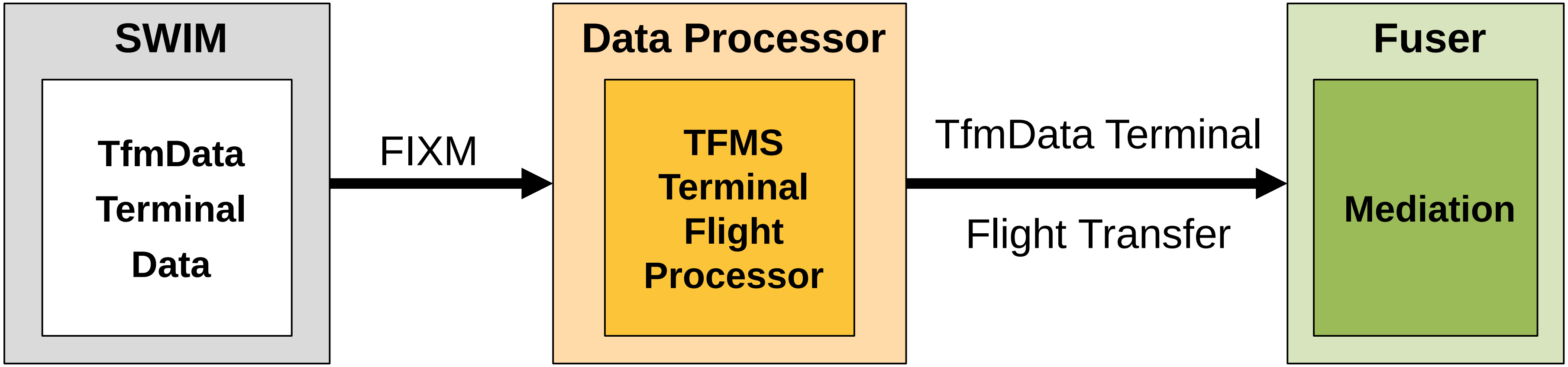
- One parser per feed
  - Transforms raw XML file into flattened object structure
    - Leveraging JAXB with jaxb2-basics to simply XML->Java Object conversion
  - In some cases, perform aggregation against messages from the same source

- Aggregation examples
  - STDDS SMES
    - Track data is sent as diffs
    - Have to aggregate with previous messages for same flight so that complete position update is processed by Fuser

	Previous	Current	To Fuser
Time	12:00:01	12:00:02	12:00:02
Latitude	35.2156	-----	35.2156
Longitude	-80.947**3**	-80.947**5**	-80.947**5**

  - TBFM-MIS
    - Need to be able to handle SYNC messages properly

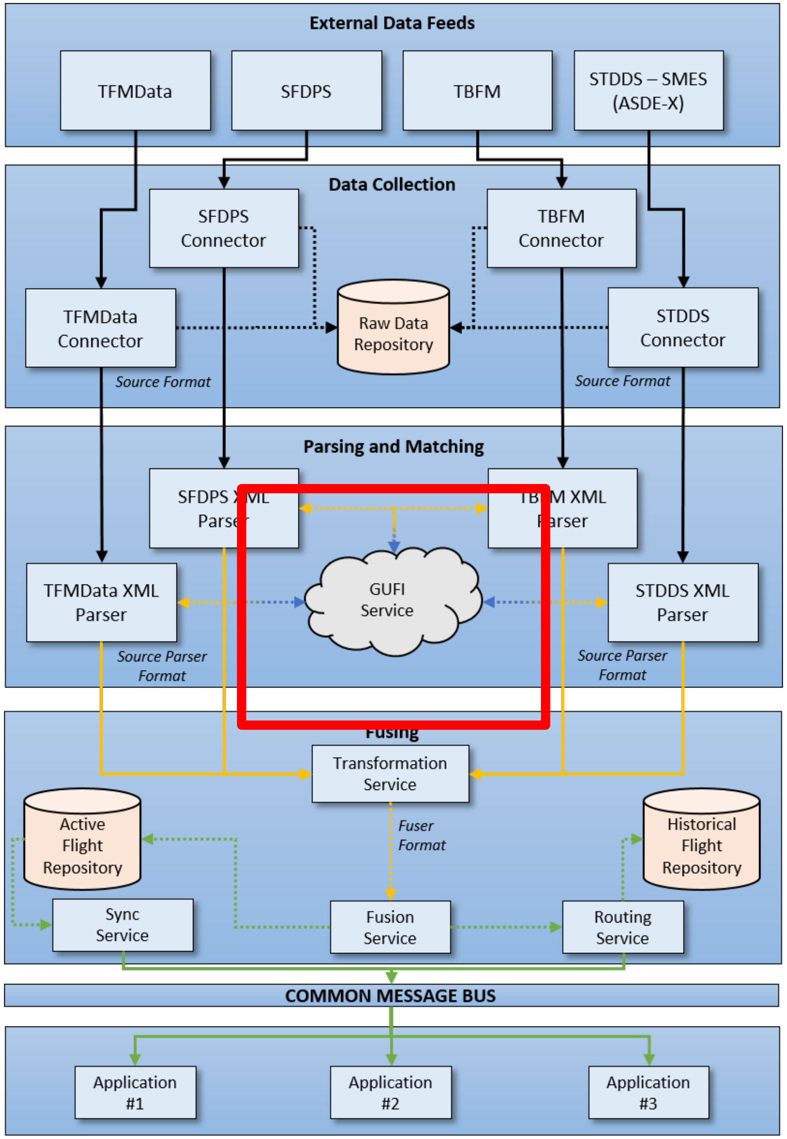
Parsing Data Feeds



flight.getDepartureNas().getStandPositionAndTime().getStandTime().
getActual().getTime()

flight.getActualOffBlockTime()

Flight Matching



Flight Matching: Overview

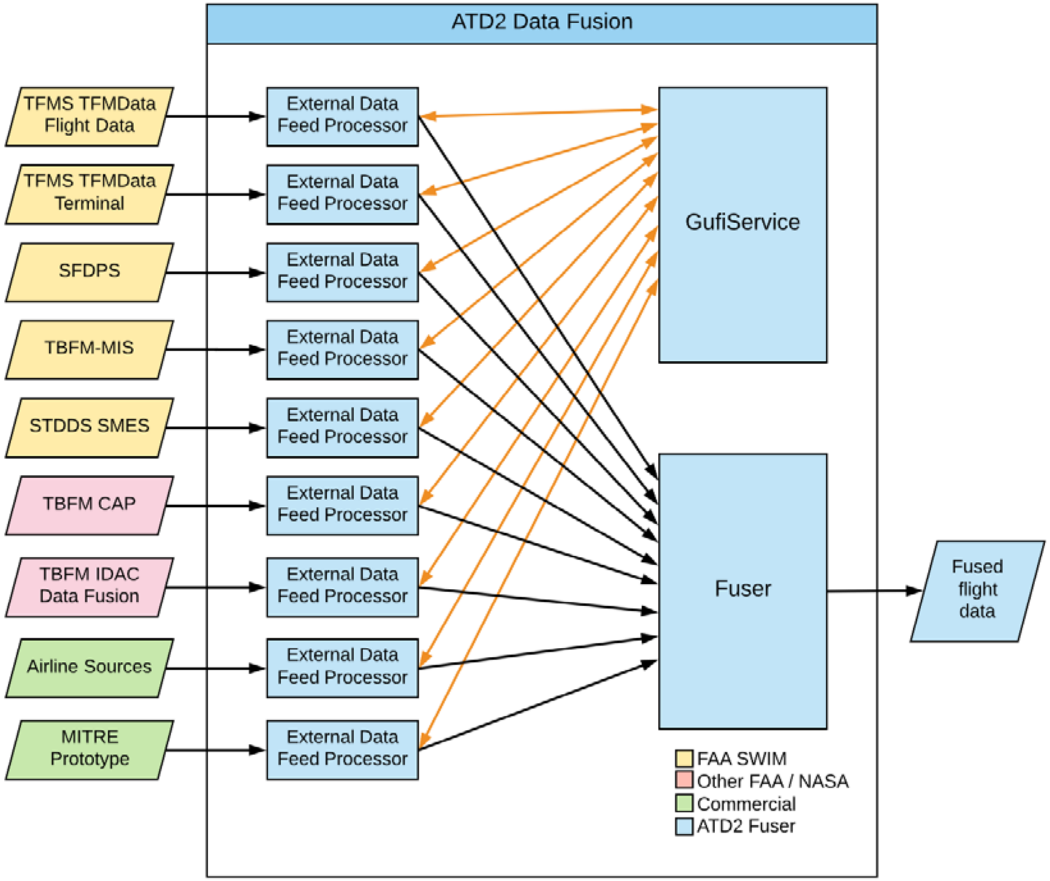
- Goal
  - Assign a Global Unique Flight Identifier (GUFI) to every flight message.
    - Ex: AAL1428.DFW.MCI.190507.1504.0132.TFM

- Why?
  - GUFI links together flight data across all external data feed sources.
  - Crucial precursor to data fusion.

- What is a flight?
  - Flight matching is where the “flight” is defined.
  - ATD2 defines a “flight” as the full lifecycle : starting with the scheduled or planned operation and ending at the arrival gate.

Flight Matching: ATD2 Approach

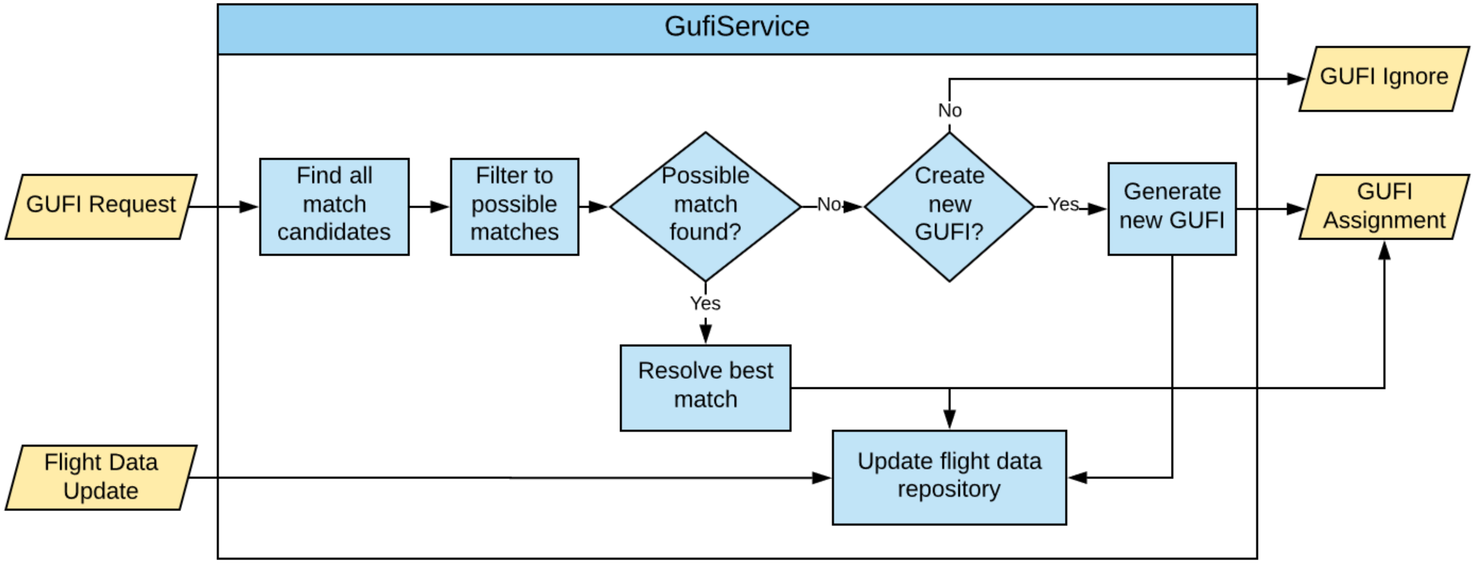
- ATD2 DFW GufiService
  - Handles GUFI requests from over 10 different data sources.
  - Stores the flight data state of each GUFI.
- External data feed processors
  - Request GUFI from GufiService.
  - Messages to Fuser include GUFI.
- GufiService performance (DFW Fuser):
  - Total:
    - ~15M avg messages handled per day. ~170 per second.
    - ~110K avg GUFIs managed per day.
    - ~200 avg messages per GUFI.
  - DFW:
    - ~3.5M avg messages handled per day.
    - ~7,500 avg GUFIs managed per day.
    - ~1,000 avg messages per GUFI.



Flight Matching: ATD2 Approach

- Basic approach to matching a flight
  - Find the best possible flight match, if one exists in the known data.
  - Otherwise, create a new GUFI, if sufficient data exists.

- Core flight matching data
  - Aircraft ID / Callsign (e.g. SWA568).
  - Origin / Destination airports (e.g. DFW -> LGA).
  - Flight time windows (e.g. 9:30 - 13:45).
  - Position (e.g. latitude / longitude / altitude).
  - External data feed system IDs (e.g. TFMData flightRef).
  - Aircraft attributes (e.g. registration number, Mode S transponder)

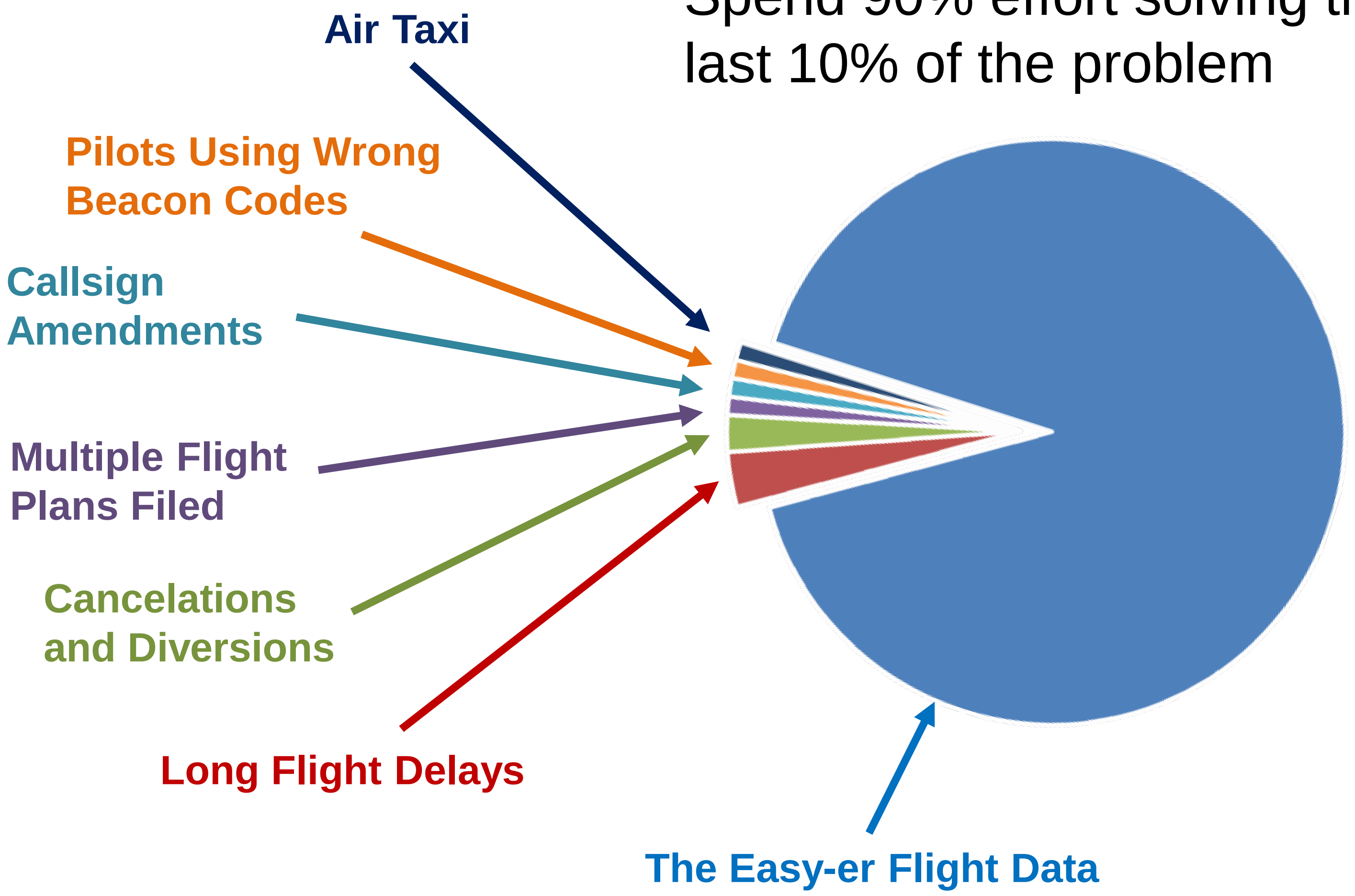


Flight Matching: Example

Time	Message	TFM FlightData	SFDPS	TBFM MIS	STDDS SMES	ATD2 GUFI
Sunday 19:00	**Scheduled flight plan** AAL045 DFW -> CLT Monday 19:00->21:59	X				AAL045.DFW.CLT.021019.1900.0000
Monday 17:00	**Filed flight plan** AAL045 DFW -> CLT Monday 19:00->21:59	X	X	X		AAL045.DFW.CLT.021019.1900.0000
Monday 17:30	**Amend flight plan route** AAL045 DFW -> CLT Monday 19:00->21:59	X	X	X		AAL045.DFW.CLT.021019.1900.0000
Monday 18:30	**CDM times update** AAL045 DFW -> CLT Monday 20:05->22:15	X				AAL045.DFW.CLT.021019.1900.0000
Monday 19:02	**Scheduled flight plan** AAL045 DFW -> CLT Tuesday 19:00->21:59	X				AAL045.DFW.CLT.021119.1902.0000
Monday 19:55	**Surface surveillance** AAL045 ASEX=KDFW				X	AAL045.DFW.CLT.021019.1900.0000
Monday 19:59	**EDCT** AAL045 EDCT=20:24	X		X		AAL045.DFW.CLT.021019.1900.0000
Monday 20:25	**Flight Departure** AAL045	X	X	X		AAL045.DFW.CLT.021019.1900.0000
Monday 20:27	**Airborne surveillance** AAL045	X	X		X	AAL045.DFW.CLT.021019.1900.0000

Flight Matching: Is Simple, Right?

Spend 90% effort solving the last 10% of the problem



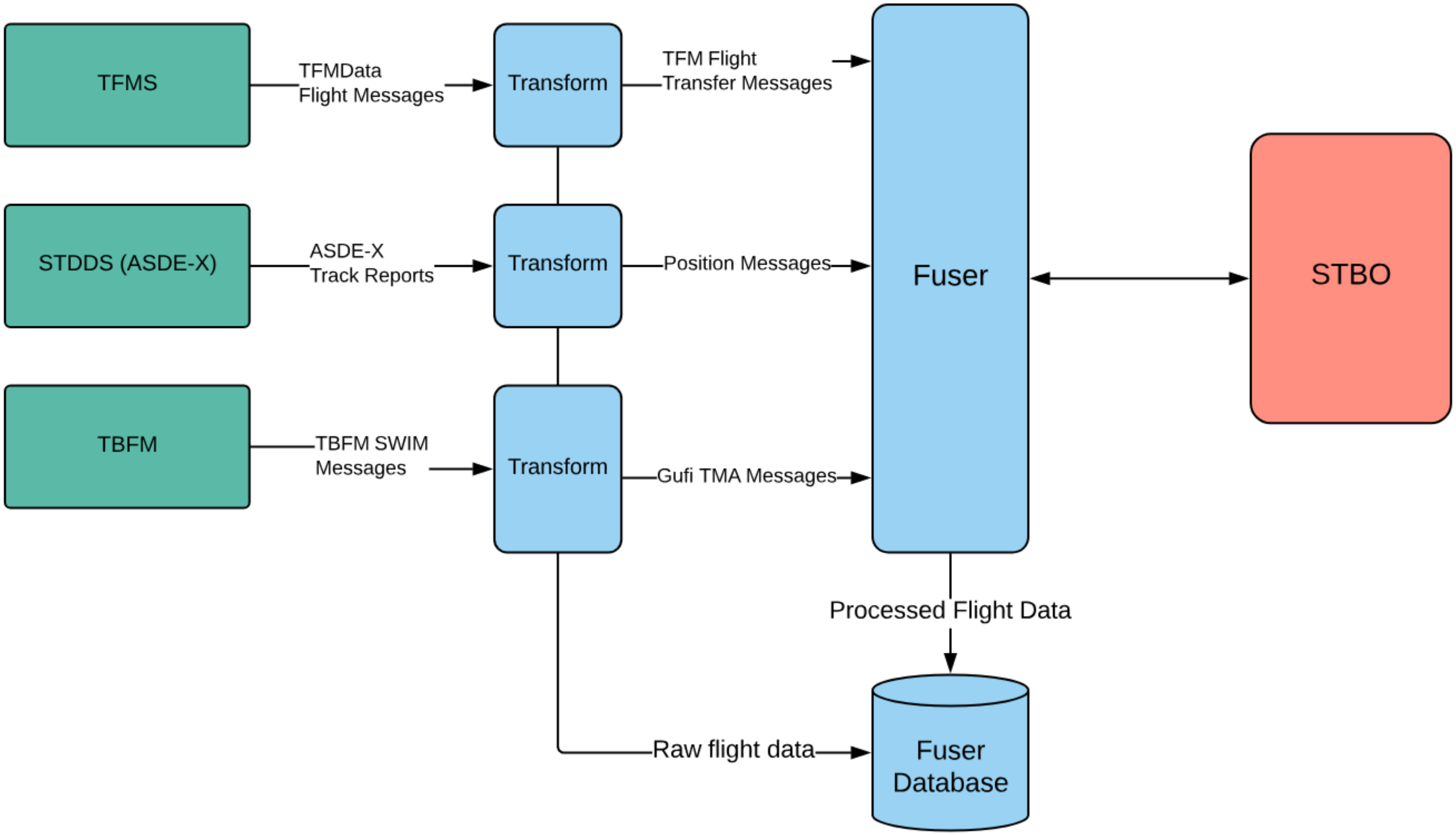
Flight Matching: Regression Testing

- Regression Testing = Key to matching logic improvement
  - Definition: A suite of tests that are required to pass when software changes are made.
  - Matching logic improvement is heuristic-based, adaptive process.
    - There is no 100% solution. Flight data is always scheming to defeat you.
  - Goal is intelligent whack-a-mole – fix one issue without causing another.

- Purpose
  - Emulate full matching process: replaying input messages from mock sub-components through the internal GufiService logic.
  - Reliable debugging of operational use cases.
  - Each test is simple format for analysts/testers to describe a matching problem.
  - Stockpile of regression tests to run against future development.

Image Credit: TPapi

Flight Data Transformations



Overview of Fuser Flight Model

- Standard naming convention used with most data elements in the Fuser Flight
- Naming convention is a based on a flattened version of the Flight Object Data Dictionary (FODD) and FIXM Schema.
- Named so that related elements are close together alphabetically
- Self documenting for the most part
- Each name consists of three parts
  - Information category
  - Resource Type
  - Source Type
- Naming convention: category_resourceType_sourceType
- Examples:
  - arrival_runway_actual_time
  - departure_stand_airline (departure gate from an airline source)

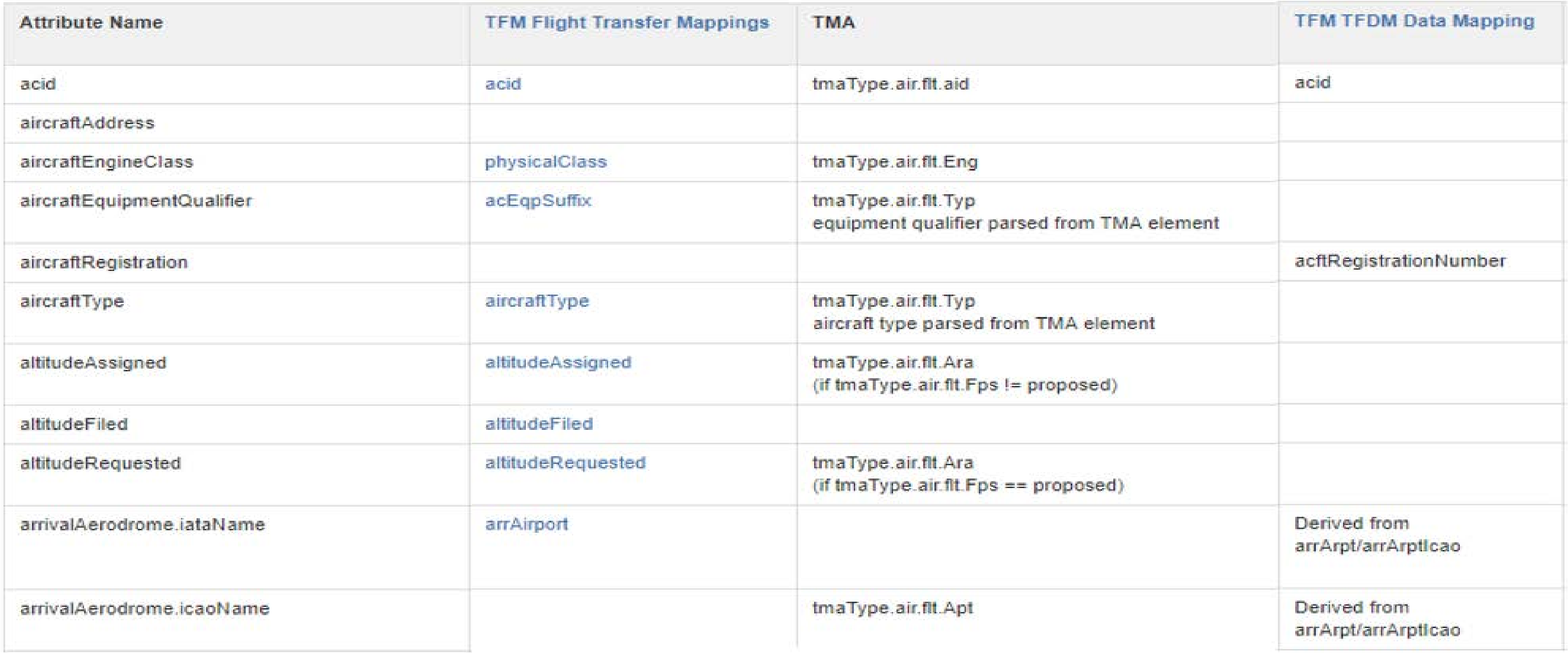
Data Mapping

- In order to transform the data into a common flight definition we first had to do a mapping of all the data

- Challenges
  - Most 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
  - Precision issues
  - Data found in multiple messages in some feeds (TFMS)

- Overcoming the challenges
  - Start with whatever documentation we can find
  - Rely on experience from team members
  - Consult subject matter experts
  - Analysis
  - Testing

Data Mapping Example

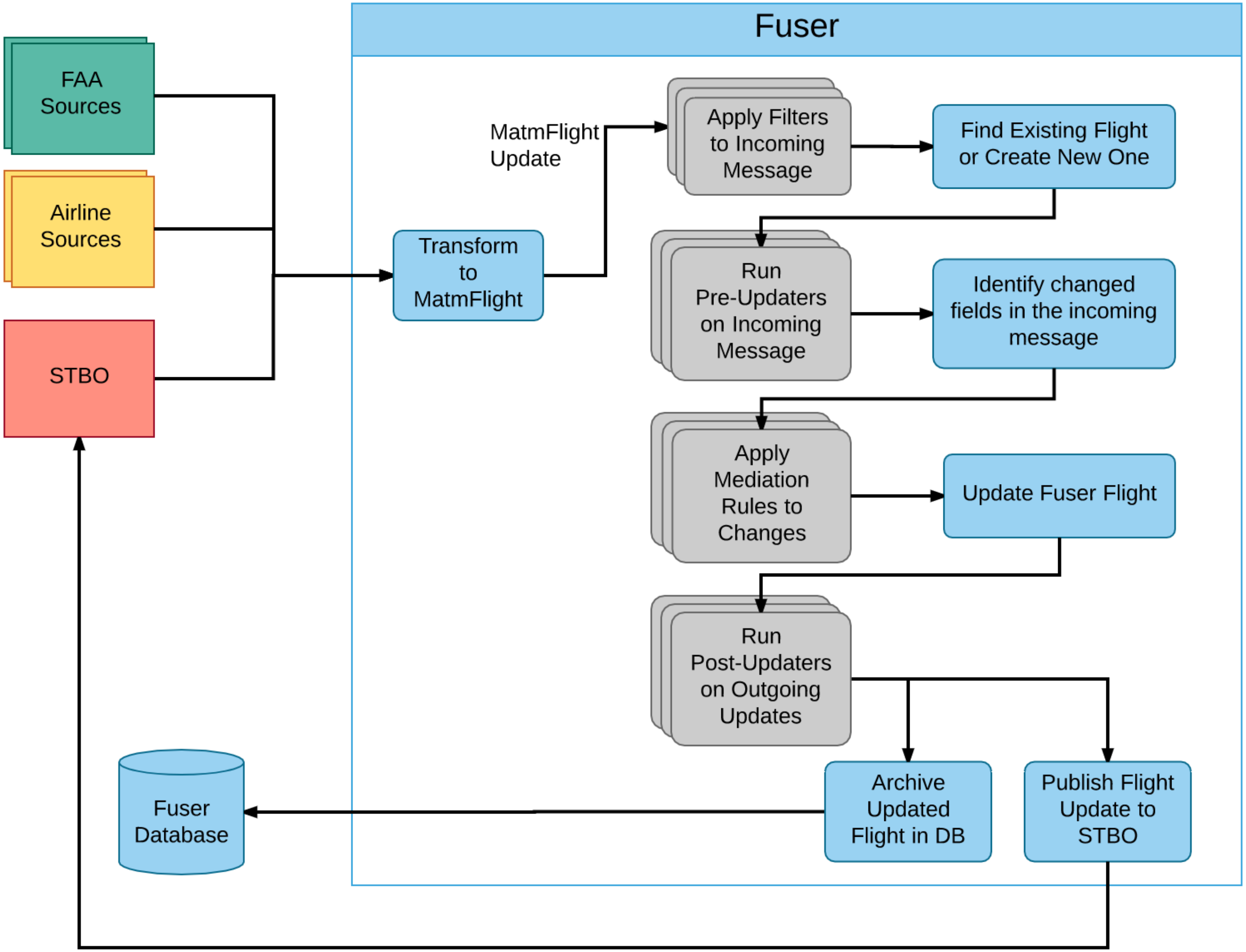


Attribute Name	TFM Flight Transfer Mappings	TMA	TFM TFDM Data Mapping
acid	acid	tmaType.air.flt.aid	acid
aircraftAddress			
aircraftEngineClass	physicalClass	tmaType.air.flt.Eng	
aircraftEquipmentQualifier	acEqpSuffix	tmaType.air.flt.Typ equipment qualifier parsed from TMA element	
aircraftRegistration			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

Full Fuser Mappings Available

https://aviationsystems.arc.nasa.gov/atd2-industry-days/fuser/Fuser-Database-Input-Mapping-Table_85328219.html

Fuser Flight Processing


Fuser
FAA Sources
Airline Sources
STBO
Transform to MatmFlight
MatmFlight Update
Apply Filters to Incoming Message
Find Existing Flight or Create New One
Run Pre-Updaters on Incoming Message
Identify changed fields in the incoming message
Apply Mediation Rules to Changes
Update Fuser Flight
Run Post-Updaters on Outgoing Updates
Archive Updated Flight in DB
Publish Flight Update to STBO
Fuser Database

Filtering

- Filtering is used to filter out an entire update before the data is applied to the fused flight
  - Eliminate unnecessary processing and/or updates that reduce data quality.
  - Filtering is based on defined rules:

Filter Name	Description	Reason
AttributeFilter	See Industry Day Documentation for more details Link.	In certain cases, we know that a source has bad data in certain fields, we don't trust the values, or we feel we will have better data from another source.
FlightPositionFilter	Filter out the position update if that latitude, longitude, or timestamp is null.	The systems needs to have all three to have a valid position. At times we are getting bad data with one of those three fields missing causing problems downstream.
GufiFilter	Filter out any messages that have not been assigned a GUFI (Global Unique Flight Identifier).	These are messages we were unable to match typically due to a lack of information.
LocationFilter	Filter out any messages that are not arriving at CLT, departing from CLT, or a Surveillance target at CLT.	In this case, the Fuser was for an STBO system operating for Charlotte Douglas International Airport (CLT) and Therefore only needed data relevant to CLT. Implemented to keep performance under control by not processing data not relevant to CLT.

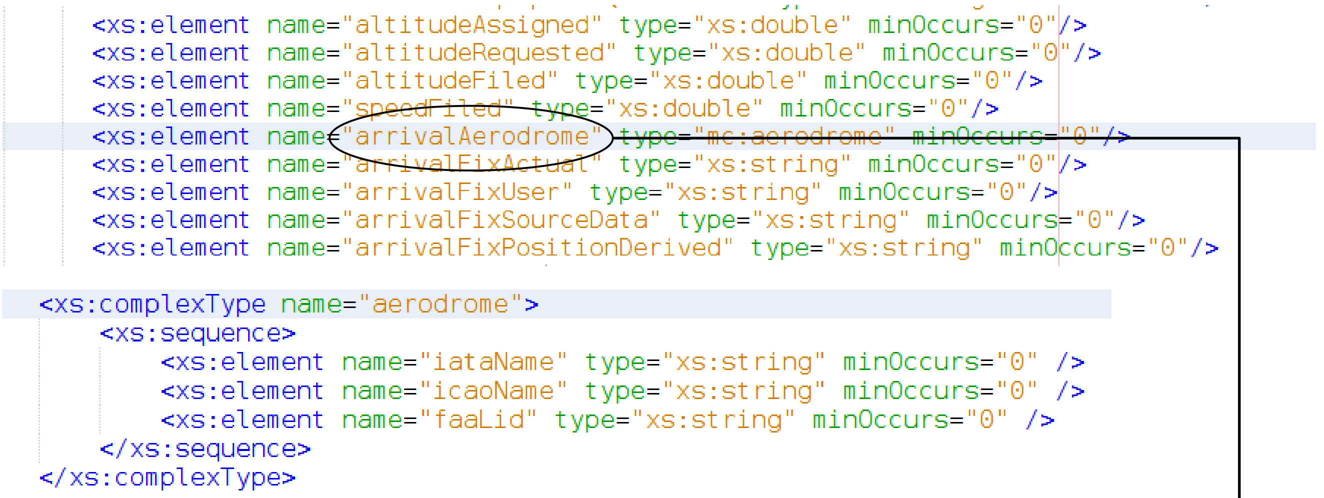
Data Synchronization/Mediation

- Fuser mediation processing
  - Input data correction
    - Data source has known errors or anomalies
  - Value-added data computations
    - Create new data elements not available in the input data source
  - Input data source priority rules
    - Used to define a precedence/authority between sources providing data for the same data elements.
    - Implemented when necessary
      - Default behavior allows any data source to modify a value
    - Filter out data modifications from one data source, if data modifications already exist from a higher priority source.
      - E.g. TFMData messages are more favorable in setting the Fuser schema “routeText” data element than TBFM MIS.
- More information
  - https://aviationsystems.arc.nasa.gov/atd2-industry-days/fuser/Data-Mediation-Overview_85328193.html

Fuser Metadata

- Fuser Metadata
  - In support of the mediation rules, Fuser tracks metadata of each Fuser schema data element:
    - Last modification input data source and message type.
    - Last modification timestamp.

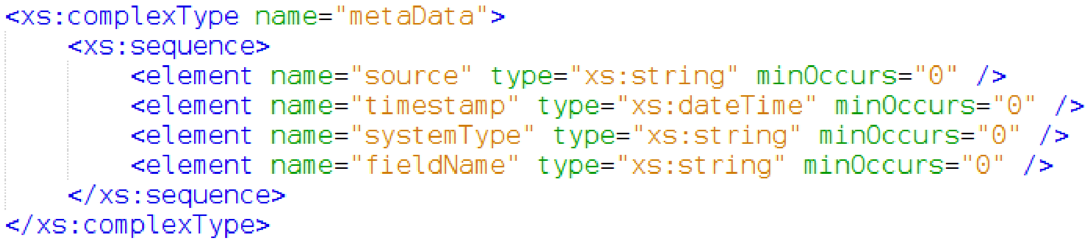
Fuser Schema



```
    <xs:element name="altitudeAssigned" type="xs:double" minOccurs="0"/>
    <xs:element name="altitudeRequested" type="xs:double" minOccurs="0"/>
    <xs:element name="altitudeFiled" type="xs:double" minOccurs="0"/>
    <xs:element name="speedFiled" type="xs:double" minOccurs="0"/>
    <xs:element name="arrivalAerodrome" type="mc:aerodrome" minOccurs="0"/>
    <xs:element name="arrivalFixActual" type="xs:string" minOccurs="0"/>
    <xs:element name="arrivalFixUser" type="xs:string" minOccurs="0"/>
    <xs:element name="arrivalFixSourceData" type="xs:string" minOccurs="0"/>
    <xs:element name="arrivalFixPositionDerived" type="xs:string" minOccurs="0"/>

<xs:complexType name="aerodrome">
    <xs:sequence>
        <xs:element name="iataName" type="xs:string" minOccurs="0" />
        <xs:element name="icaoName" type="xs:string" minOccurs="0" />
        <xs:element name="faaLid" type="xs:string" minOccurs="0" />
    </xs:sequence>
</xs:complexType>
```

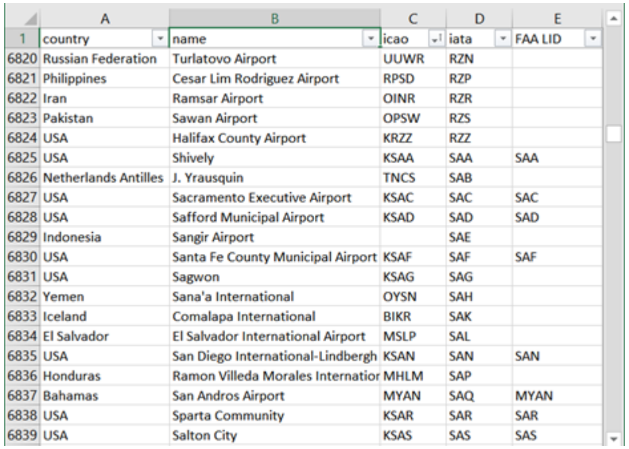
Fuser MetaData



```
<xs:complexType name="metaData">
    <xs:sequence>
        <element name="source" type="xs:string" minOccurs="0" />
        <element name="timestamp" type="xs:dateTime" minOccurs="0" />
        <element name="systemType" type="xs:string" minOccurs="0" />
        <element name="fieldName" type="xs:string" minOccurs="0" />
    </xs:sequence>
</xs:complexType>
```

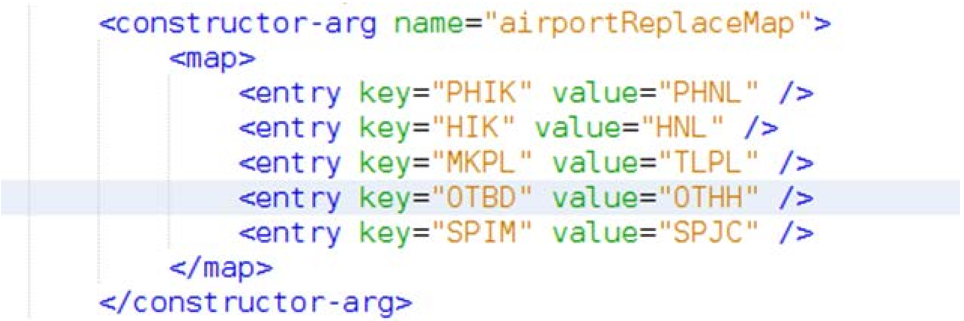
Fuser Airport Mediation Use Case

- Airport Conversion and Correction by Source
  - – Mapping over 27k ICAO / IATA / FAA LID.
  - – Based upon input data source, set ICAO, IATA, and FAA LID values for all messages.



	A	B	C	D	E
1	country	name	icao	iata	FAA LID
6820	Russian Federation	Turlatovo Airport	UUWR	RZN	
6821	Philippines	Cesar Lim Rodriguez Airport	RPSD	RZP	
6822	Iran	Ramsar Airport	OINR	RZR	
6823	Pakistan	Sawan Airport	OPSW	RZS	
6824	USA	Halifax County Airport	KRZZ	RZZ	
6825	USA	Shively	KSAA	SAA	SAA
6826	Netherlands Antilles	J. Yrausquin	TNCS	SAB	
6827	USA	Sacramento Executive Airport	KSAC	SAC	SAC
6828	USA	Safford Municipal Airport	KSAD	SAD	SAD
6829	Indonesia	Sangir Airport		SAE	
6830	USA	Santa Fe County Municipal Airport	KSAF	SAF	SAF
6831	USA	Sagwon	KSAG	SAG	
6832	Yemen	Sana'a International	OYSN	SAH	
6833	Iceland	Comalapa International	BIKR	SAK	
6834	El Salvador	El Salvador International Airport	MSLP	SAL	
6835	USA	San Diego International-Lindbergh	KSAN	SAN	SAN
6836	Honduras	Ramon Villeda Morales Internatior	MHLM	SAP	
6837	Bahamas	San Andros Airport	MYAN	SAQ	MYAN
6838	USA	Sparta Community	KSAR	SAR	SAR
6839	USA	Salton City	KSAS	SAS	SAS

- Special Cases and Data Anomalies
  - – TBFM MIS "airport" can be a waypoint.
    - Airborne IFR filed flight plans.
  - – TFM Schedule flight plan OAG errors.
    - E.g. Doha OTBD airport closed in 2014 (replaced by OTHH), but is published in TFMS Scheduled flight plan messages.

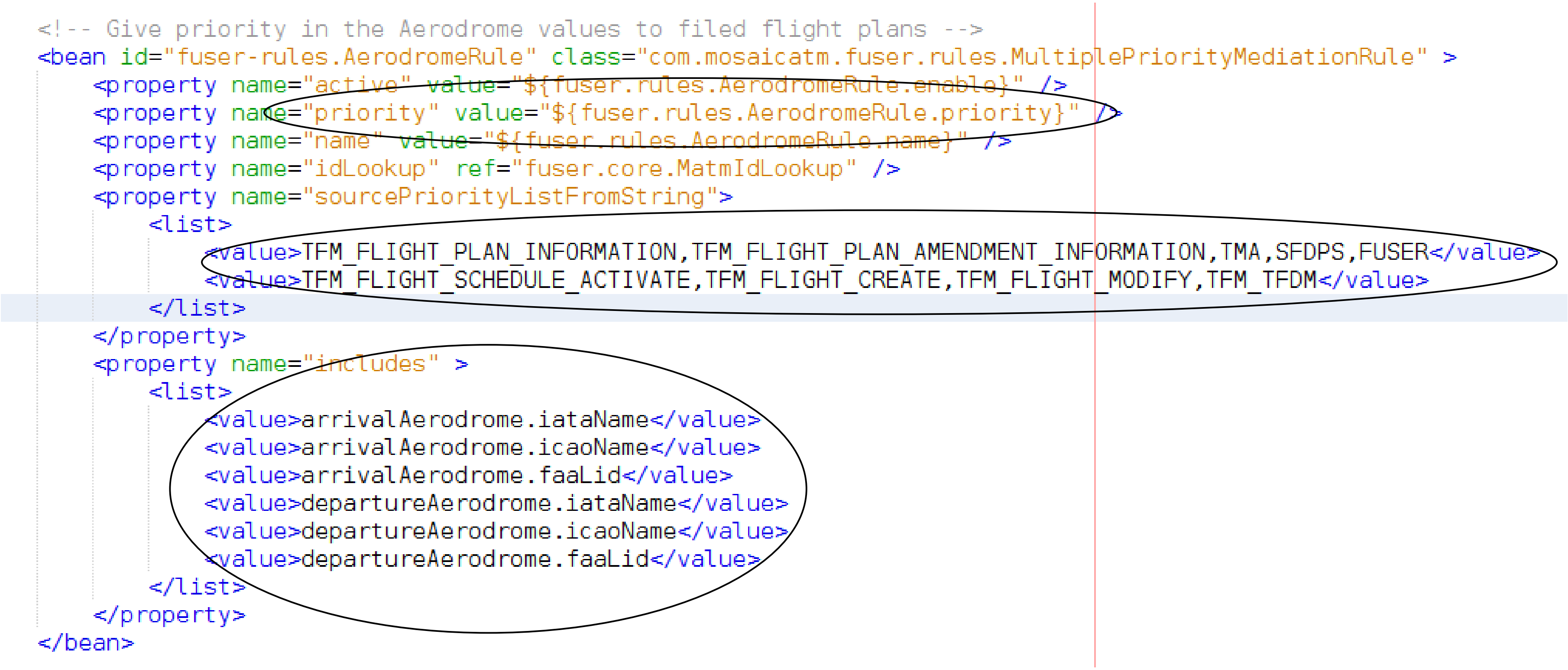


```
<constructor-arg name="airportReplaceMap">
    <map>
        <entry key="PHIK" value="PHNL" />
        <entry key="HIK" value="HNL" />
        <entry key="MKPL" value="TLPL" />
        <entry key="OTBD" value="OTHH" />
        <entry key="SPIM" value="SPJC" />
    </map>
</constructor-arg>
```

Fuser Airport Mediation Use Case

- Fuser Airport Mediation Rule
  - Problem: When flights amend the arrival airport, some TFM messages continue to use the old arrival airport.
    - Without mediation, the arrival airport toggles between the current and old values.
  - Solution: Fuser mediation to ignore data modifications by TFM sources that may use the incorrect arrival airport.

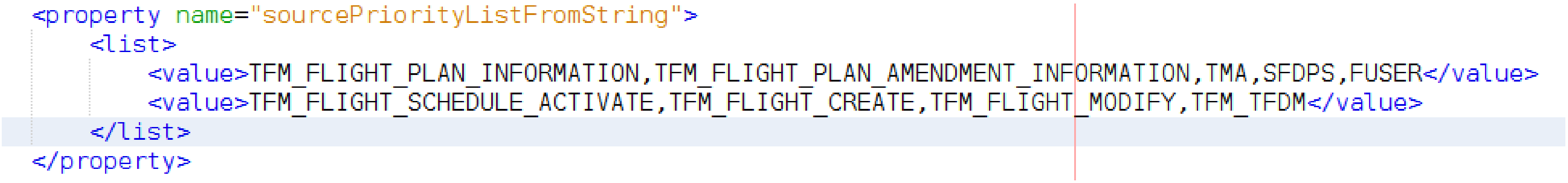
Fuser Mediation Rule



```
<!-- Give priority in the Aerodrome values to filed flight plans -->
<bean id="fuser-rules.AerodromeRule" class="com.mosaicatm.fuser.rules.MultiplePriorityMediationRule" >
    <property name="active" value="${fuser.rules.AerodromeRule.enable}" />
    <property name="priority" value="${fuser.rules.AerodromeRule.priority}" />
    <property name="name" value="${fuser.rules.AerodromeRule.name}" />
    <property name="idLookup" ref="fuser.core.MatmIdLookup" />
    <property name="sourcePriorityListFromString">
        <list>
            <value>TFM_FLIGHT_PLAN_INFORMATION,TFM_FLIGHT_PLAN_AMENDMENT_INFORMATION,TMA,SFDPS,FUSER</value>
            <value>TFM_FLIGHT_SCHEDULE_ACTIVATE,TFM_FLIGHT_CREATE,TFM_FLIGHT_MODIFY,TFM_TFDM</value>
        </list>
    </property>
    <property name="includes" >
        <list>
            <value>arrivalAerodrome.iataName</value>
            <value>arrivalAerodrome.icaoName</value>
            <value>arrivalAerodrome.faaLid</value>
            <value>departureAerodrome.iataName</value>
            <value>departureAerodrome.icaoName</value>
            <value>departureAerodrome.faaLid</value>
        </list>
    </property>
</bean>
```

Fuser Airport Mediation Use Case

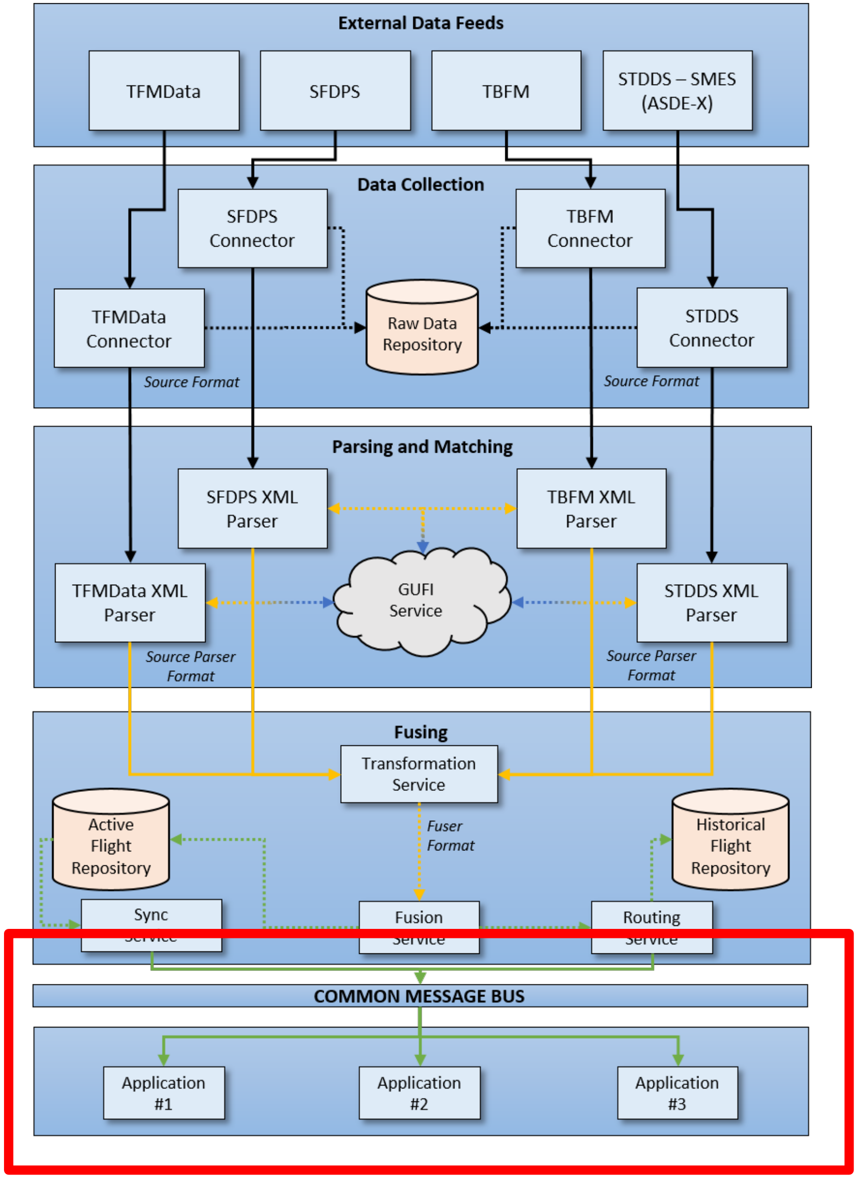
- Arrival Airport Mediation Messaging Example.



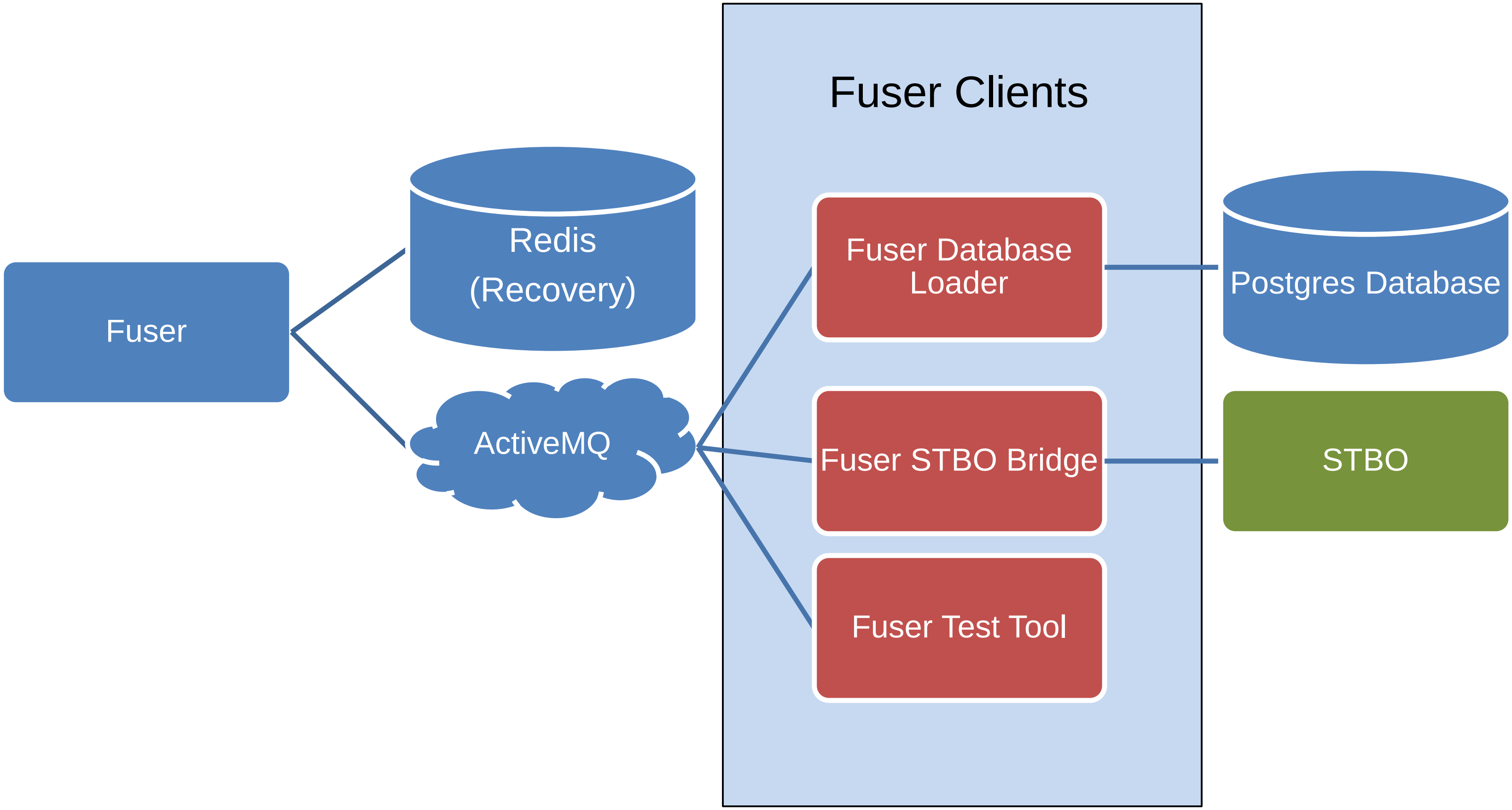
```
<property name="sourcePriorityListFromString">
    <list>
        <value>TFM_FLIGHT_PLAN_INFORMATION,TFM_FLIGHT_PLAN_AMENDMENT_INFORMATION,TMA,SFDPS,FUSER</value>
        <value>TFM_FLIGHT_SCHEDULE_ACTIVATE,TFM_FLIGHT_CREATE,TFM_FLIGHT_MODIFY,TFM_TFDM</value>
    </list>
</property>
```

Input Source				Fuser			
Time	**Source**	**Arrival Airport**		**IATA**	**ICAO**	**FAA**	**MetaData**
1500	TFMData Schedule	OTBD (error)		DOH	OTHH	OTHH	1500 (TFMData Schedule)
0900	Airline Source	DOH		DOH	OTHH	OTHH	1500 (TFMData Schedule)
1100	TFMData Filed Flight Plan	OTHH		DOH	OTHH	OTHH	1100 (TFMData Filed Flight Plan)
1130	TFMData Amend Flight Plan	OMDB		DXB	OMDB	OMDB	1130 (TFMData Amend Flight Plan)
1150	TFMData Flight Modify	OTHH		DXB	OMDB	OMDB	1130 (TFMData Amend Flight Plan)

Flight Matching



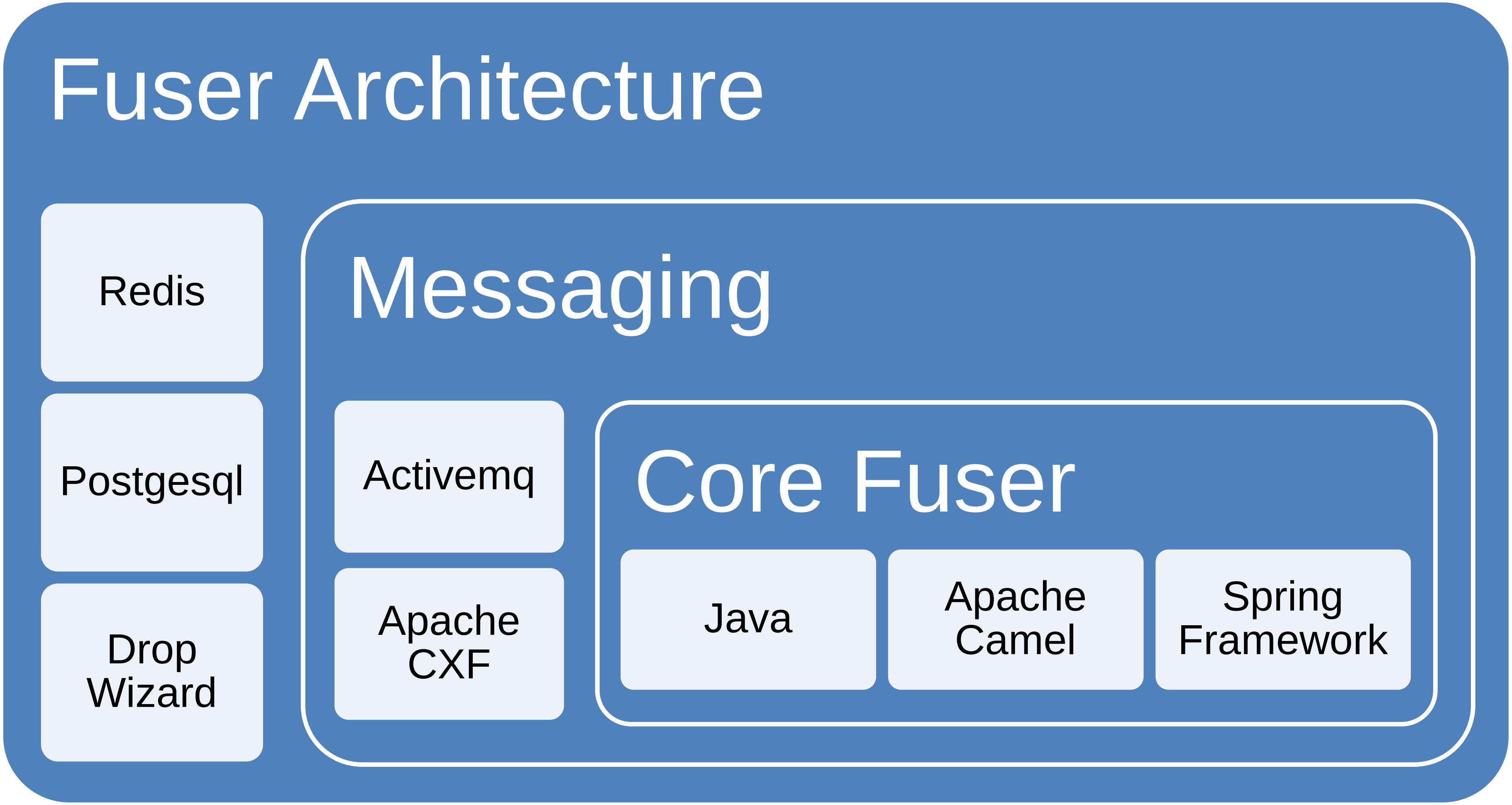
Where does the Fuser Data Go



Additional Benefits

- Flight Management
  - Create, update, delete/remove
- Built in recovery solution using Redis
- Reconstitution available for Fuser clients
- Built in performance monitoring
- Pluggable
  - Pluggable architecture for new data feeds

Technology Stack



Fuser Architecture

Redis

Postgesql

Drop Wizard

Messaging

Activemq

Apache CXF

Core Fuser

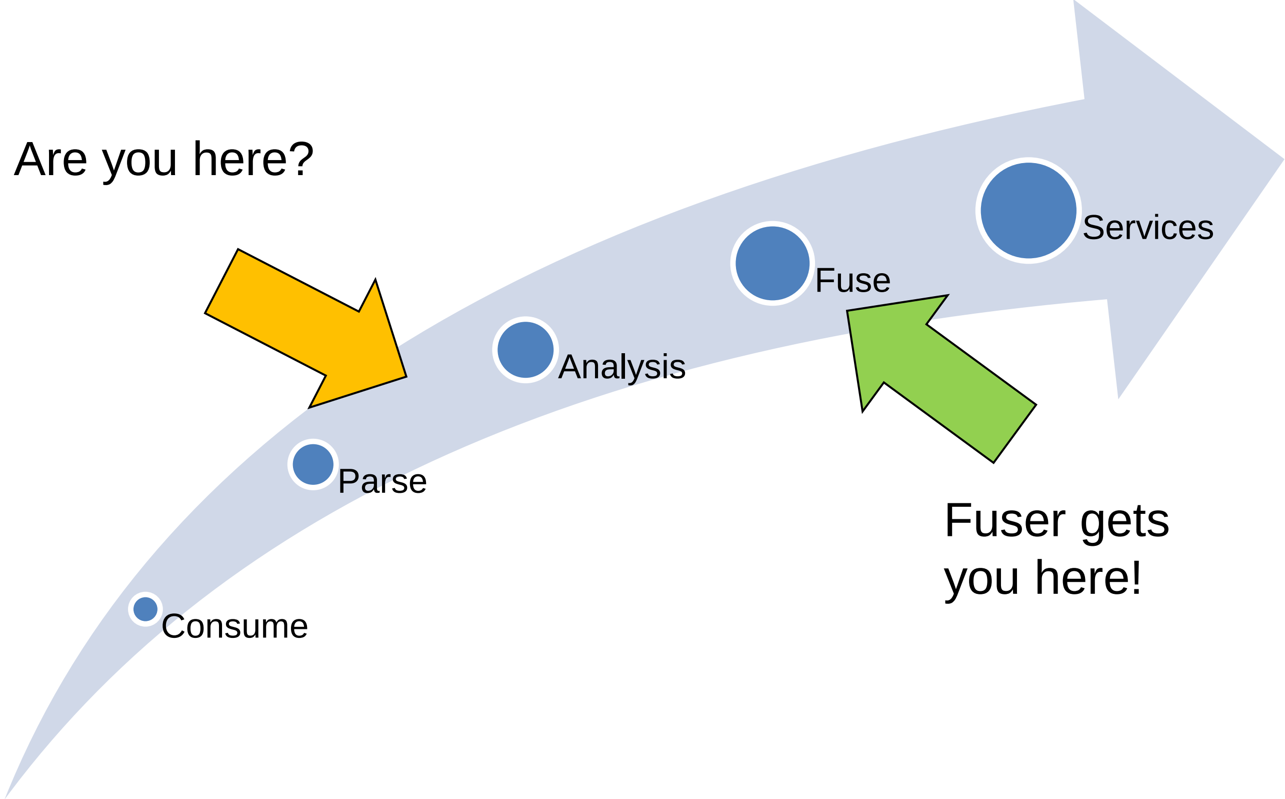
Java

Apache Camel

Spring Framework

Fuser In The Cloud

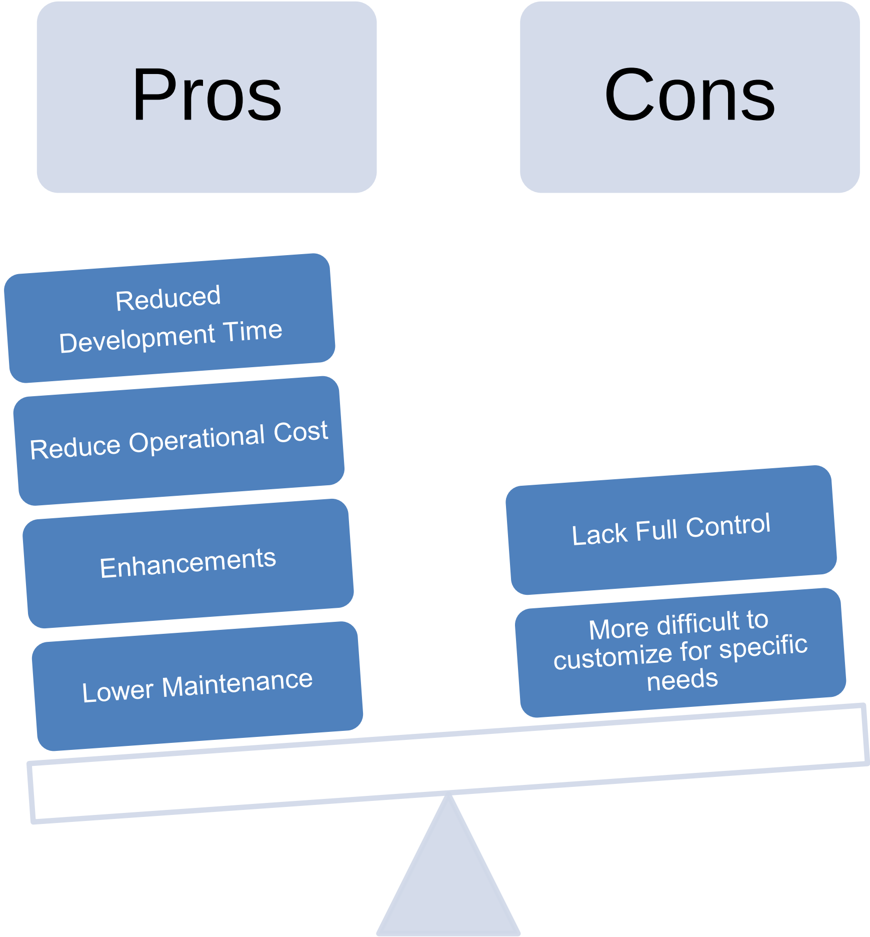
- Fuser in the cloud is the fastest and easiest way to get access to the fuser data (currently also happens to the only way)
- Fuser in the Cloud allows you to test the water before going all in
- Fuser gets you closer to where you want to be faster



Are you here?

Fuser gets you here!

Fuser In The Cloud Benefits



Pros

Cons

Reduced Development Time

Reduce Operational Cost

Enhancements

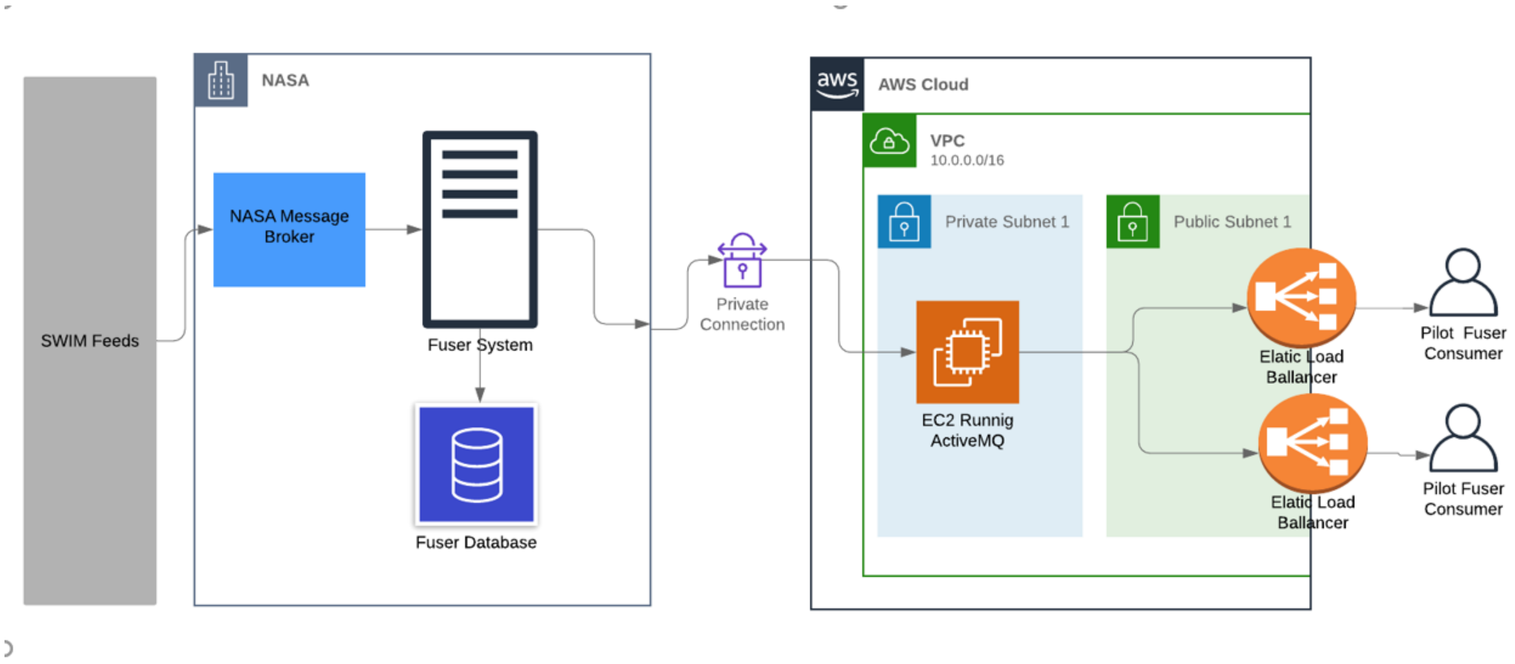
Lower Maintenance

Lack Full Control

More difficult to customize for specific needs

Fuser In The Cloud Architecture

- Running on Amazon Web Services (AWS)
- EC2 instances with Elastic Load Balancers ELBs sitting in front
  - – Users connect to a dedicated ELB
- Activemq is the broker



Fuser In Cloud Pilot Program

- Pilot program still in the early stages
  - Learning how to deal with challenges as we go
  - Most of the challenges have been related to data sharing, security, and process

- Pilot/beta participants
  - Delta Airlines
  - United Airlines
  - American Airlines
  - Southwest Airlines

Connecting to the Fuser

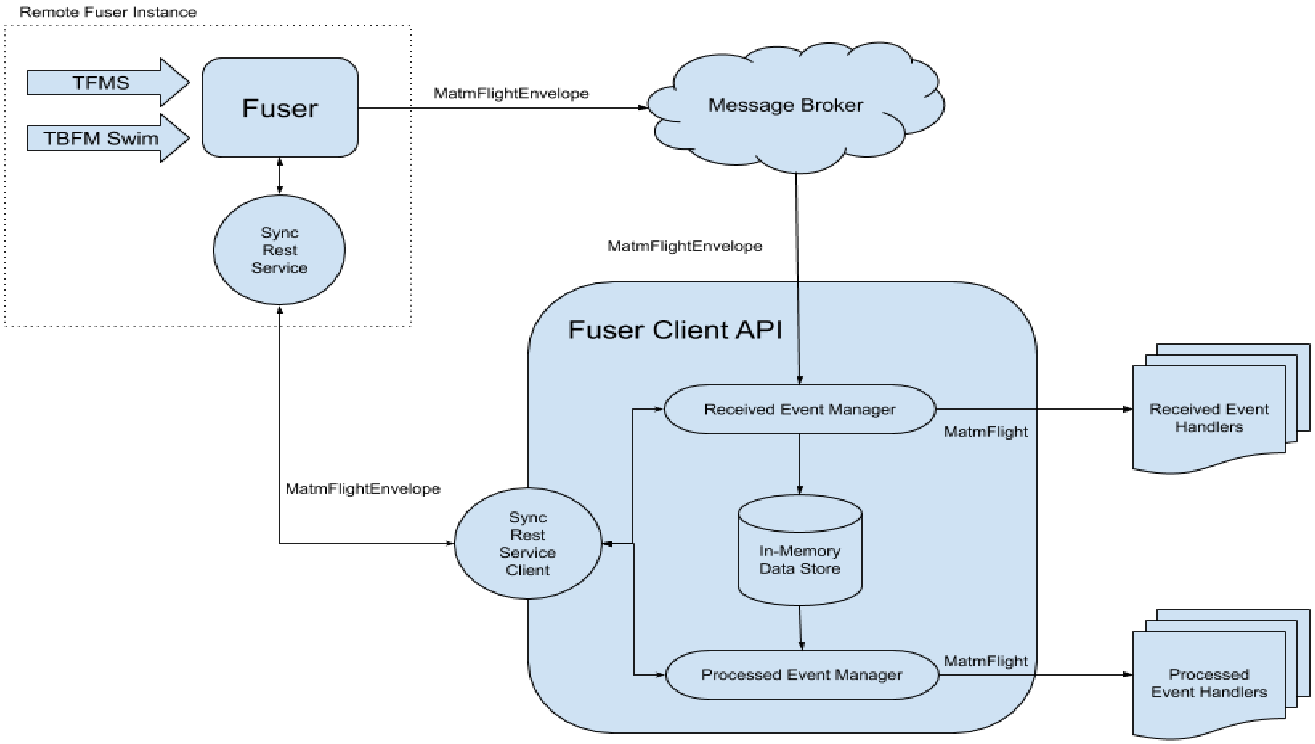
- Develop a fuser client consumer
  - Connect to Fuser Activemq Topic/Queue
  - Consume data
  - Parse Fuser XML data
  - Build your own internal flight repository to manage the data

OR

- Use the Fuser Client API
  - The Fuser Client API is a utility for establishing a connection and interfacing with the Fuser
  - All data consumed from the Fuser will be automatically converted from XML back to a Fuser Flight structure

Fuser Client API

- Quickly develop Fuser driven applications
- Handles connecting and managing the connection
- Parsers the XML
- Creates an in memory repository
- Support for event listeners



Ways to Use the Fuser

- The Fuser is the whole processing backbone of ATD-2

It doesn’t have to be used as your infrastructure backbone

- Use it a single source SWIM feed
  - Schema is easier to work with compared to SWIM schemas
  - Only have to learn how to consume one format. One stop shopping!
  - Flexible enough to filter down to just sources you care about

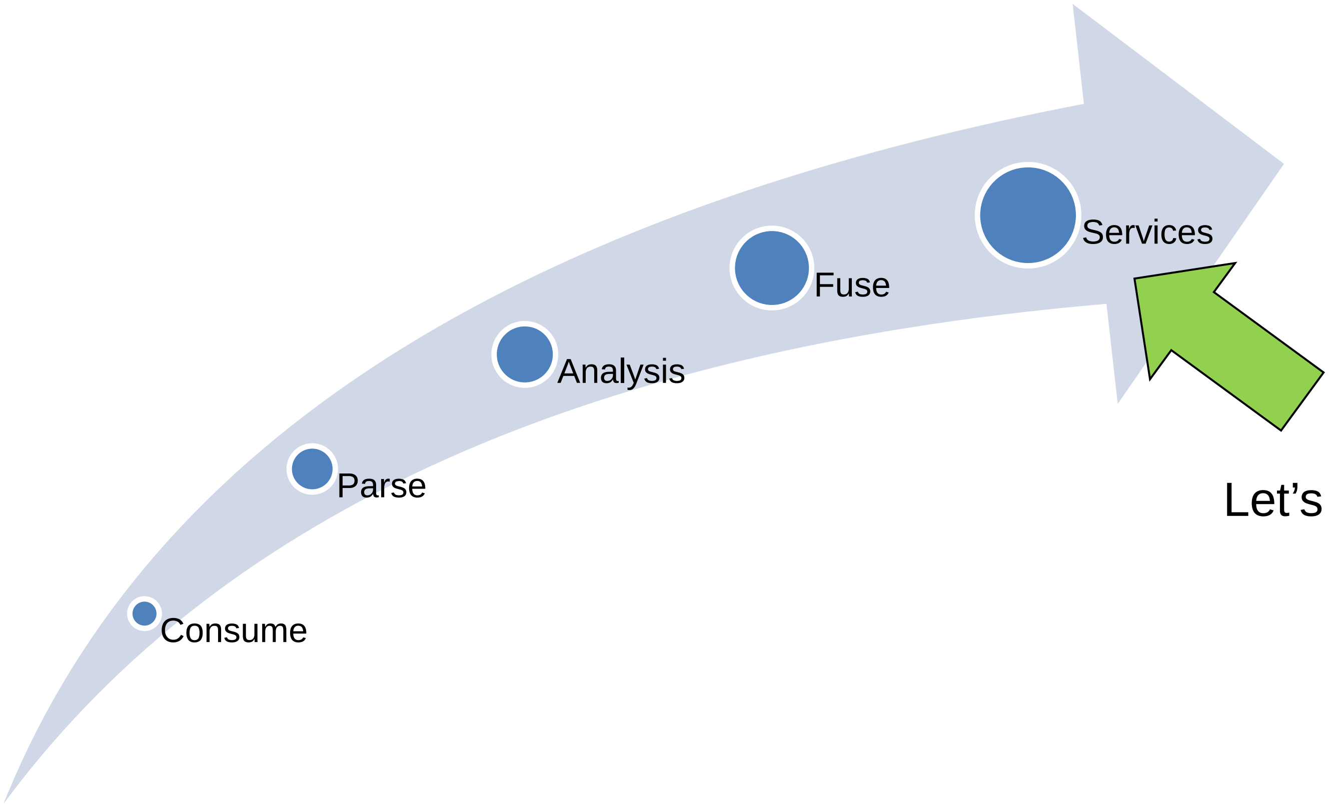
Challenges

- Sharing CDM data requires data sharing agreements to be in place
- Sharing the Fuser Client API may require a data sharing agreement
- Still working on long term hosting solution beyond ATD-2
- Security and process requirements on both the producer and consumer side

*** NASA ATD-2 team is working with the FAA and Industry Partners to solve these challenges ***

Future

- Fuser in the Cloud
- Build Data Services On Top and Make Them Available



Let’s Get Here!

Fuser Industry Days Documentation

- Fuser Overview
- Component Descriptions
- Fuser Data Dictionary
  - Complete list of fields found in the Fuser
  - Field description
    - Most fields were meant to be self documenting
- SWIM data to Fuser Mappings
  - Likely more valuable than the data dictionary itself
- References to other SWIM related documentation
- https://aviationsystems.arc.nasa.gov/atd2-industry-days/fuser/ATD-2-Industry-Day-Documentation-Outline_81565170.html

Questions

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