Airspace Technology Demonstration 2 (ATD-2)
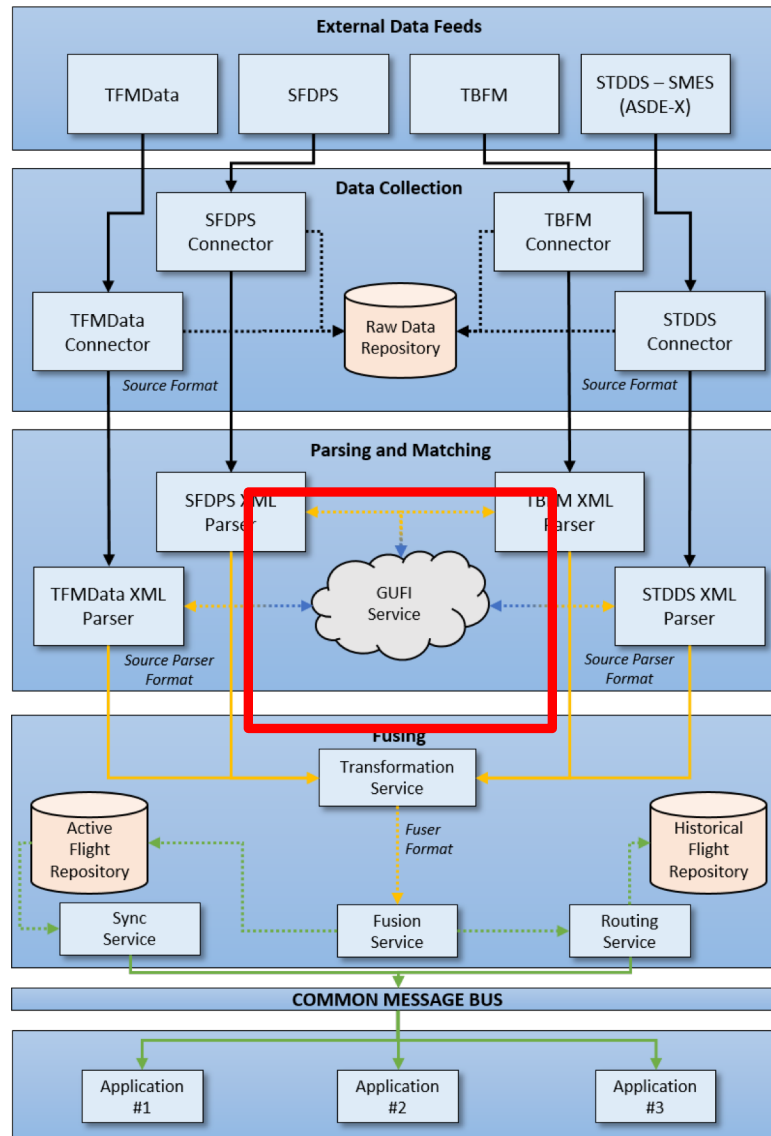
Fuser Deeper Dive (Mediation & Use Cases)

May 22, 2019

Discussion Topics

- Flight Matching
- Fuser Processing
  - Transformation
  - Filtering
  - Mediation
    - Fuser Metadata
   - Use Cases

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.
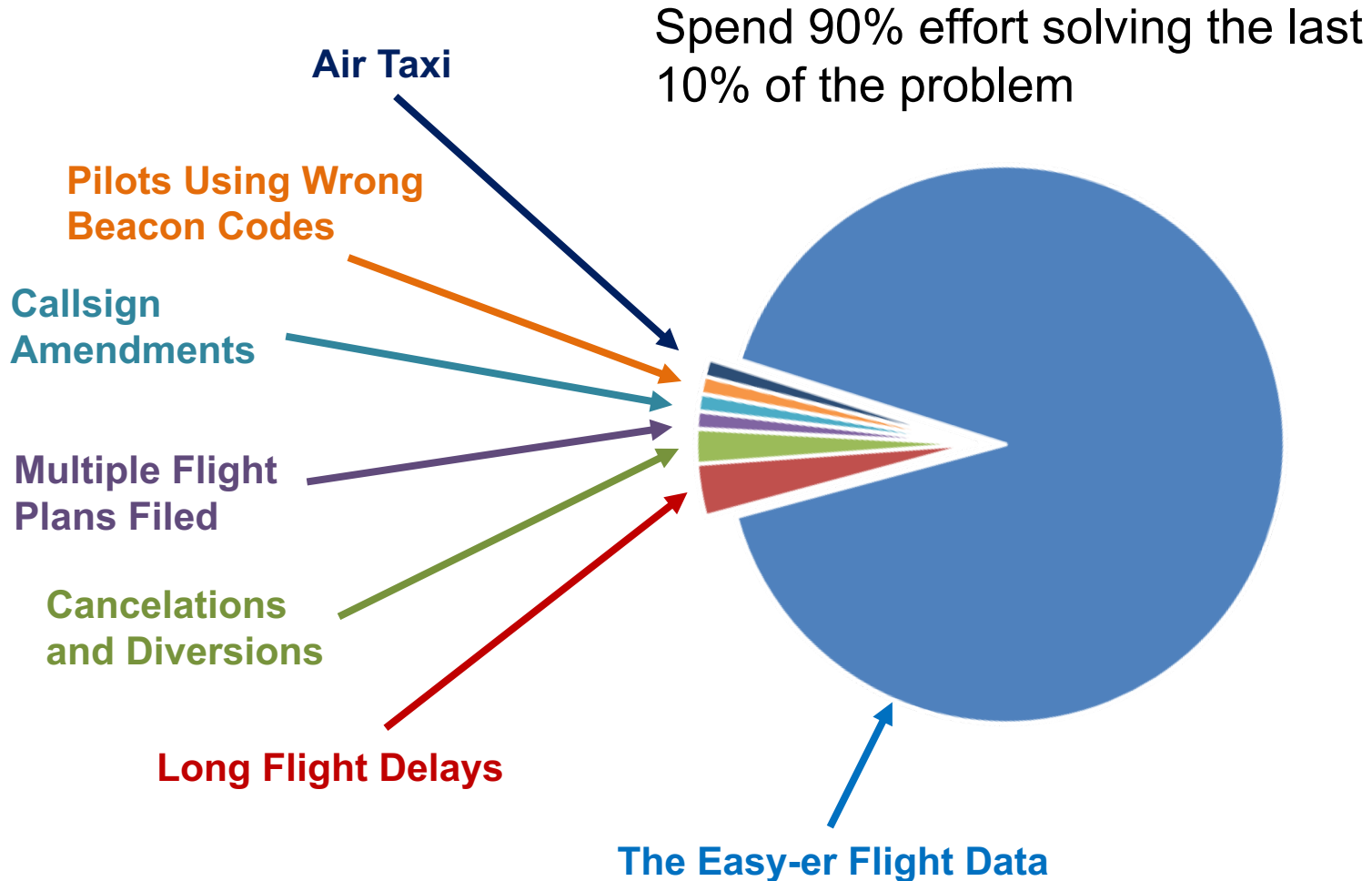
Flight Matching: ATD2 Approach

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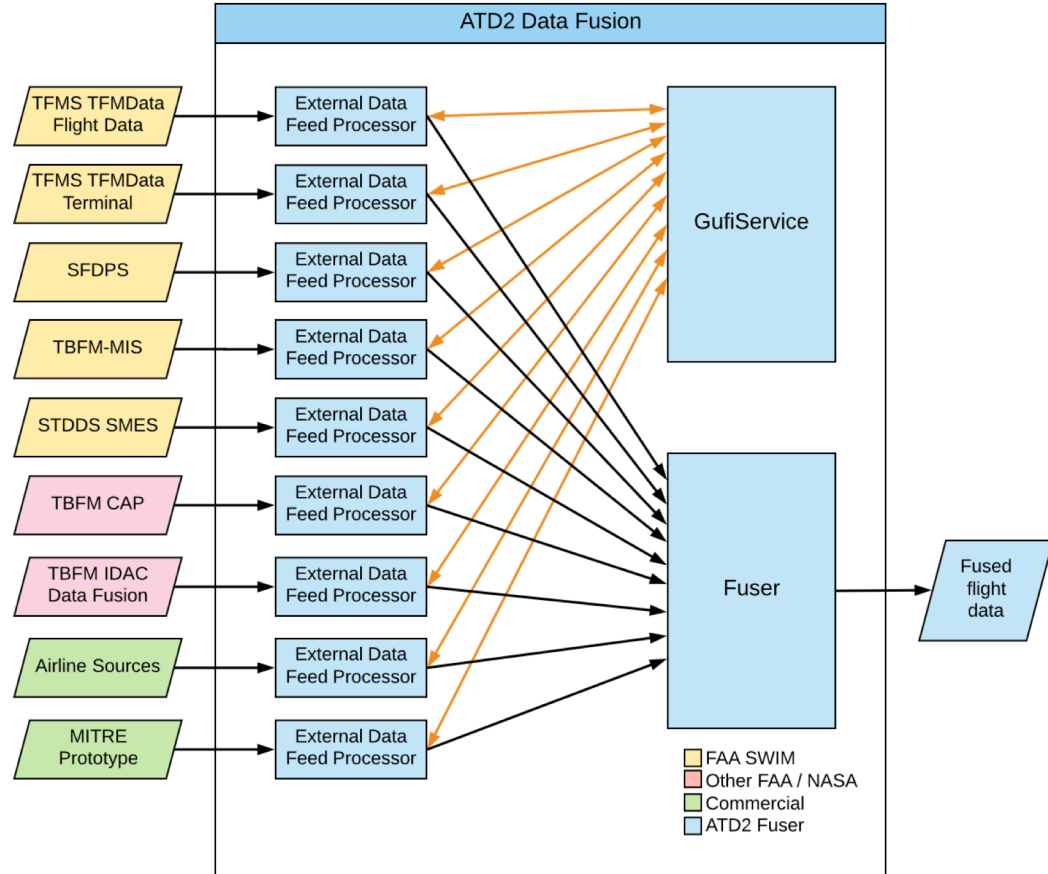
- Basic approach to matching a flight
  - Find the best possible flight match, if one exists in the known data.
  - Otherwise, create a new GUFI, if sufficient data exists.

- 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
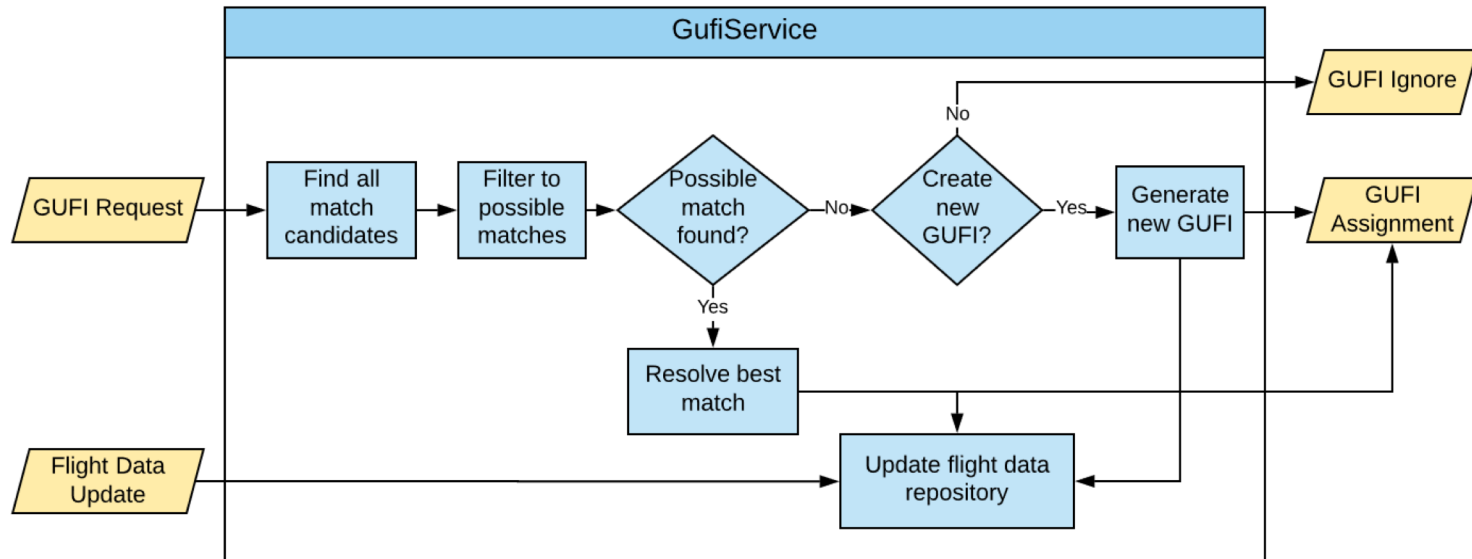
Time	Message	TFM FlightData	SFDPS	TBFM MIS	STDDS SMES	ATD2 GUFI
Sunday 19:00	**Scheduled flight plan** AAL045 DFW -> CLT Monday 19:00->21:59	X				AAL045.DFW.CLT.021019.1900.0000
Monday 17:00	**Filed flight plan** AAL045 DFW -> CLT Monday 19:00->21:59	X	X	X		AAL045.DFW.CLT.021019.1900.0000
Monday 17:30	**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.02==11==19.1902.0000
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

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

Air Taxi

Pilots Using Wrong Beacon Codes

Callsign Amendments

Multiple Flight Plans Filed

Cancelations and Diversions

Long Flight Delays

The Easy-er Flight Data
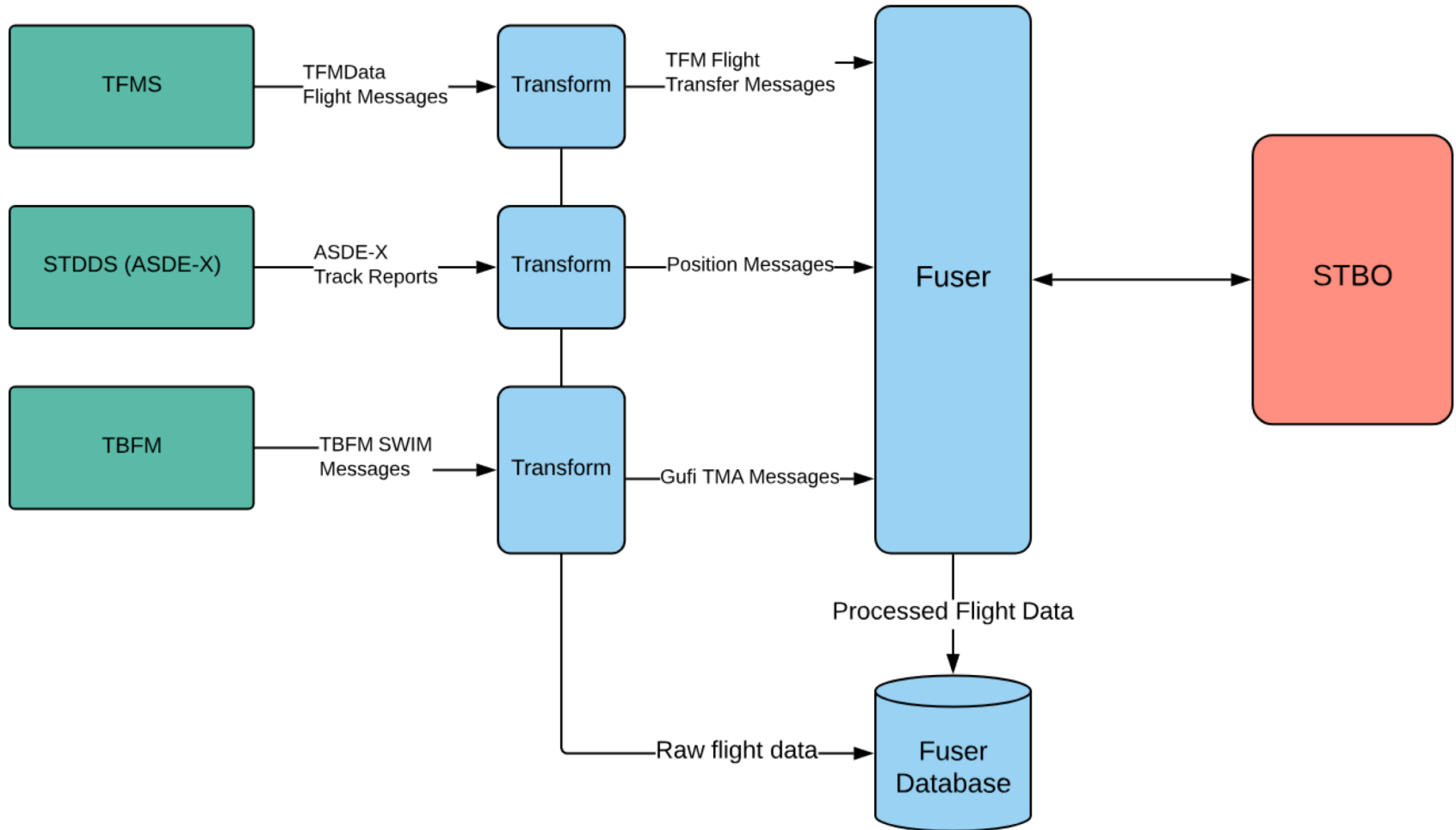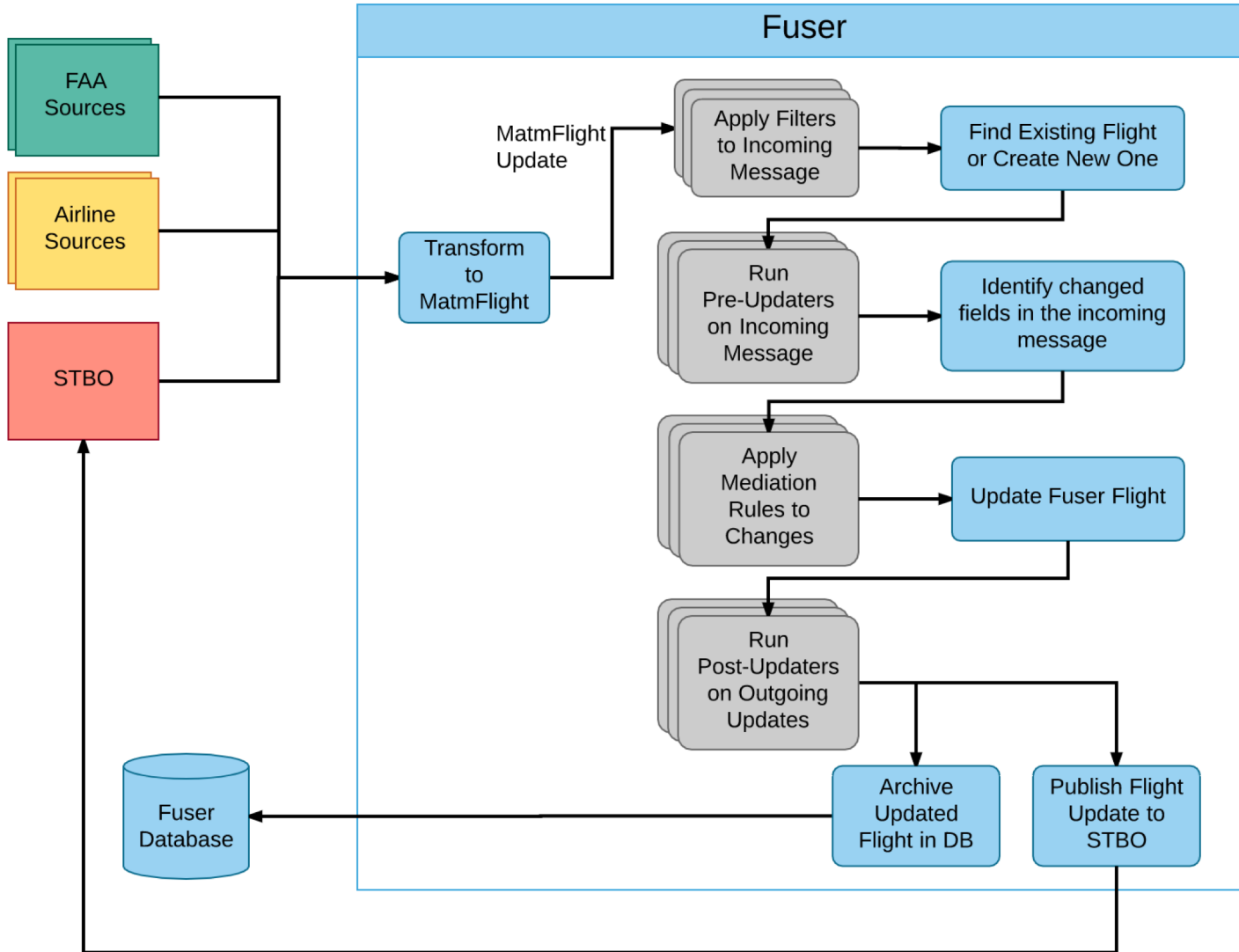
Flight Matching: Regression Testing

- 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 Matching: Regression Testing

- Regression Test Process
    - Leverage database of historical GufiService messages.
    - Build match logic test cases with validated results.
    - GufiMatchTester software drives GufiService with test cases.
        - Currently over 100 regression test cases.
    - Iterate GufiService logic improvements until all tests pass.

GUFI Message Database → **Regression Test Cases** → **GufiMatch Tester** **GufiService**

Flight Data Transformations

Fuser Flight Processing

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.

Filtering Sample

acid	Departure Aerodrome	departure stand earliest time	Arrival Aerodrome	Last update source	System id	Timestamp
ABC1234	CLT	2017-04-05 11:00	DFW	TFM_TFDM	ABC	2017-04-05 10:00
ABC4567	ATL	2017-04-05 11:15	ORD	TFM_TFDM	ABC	2017-04-05 10:00
ABC8999	CLT	2017-04-05 11:30	JFK	TFM_TFDM	ABC	2017-04-05 10:00

Not a flight operating at CLT
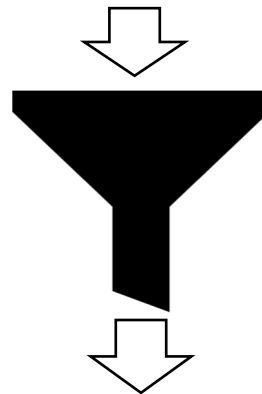
acid	Departure Aerodrome	departure stand earliest time	Arrival Aerodrome	Last update source	System id	Timestamp
ABC1234	CLT	2017-04-05 11:00	DFW	TFM_TFDM	ABC	2017-04-05 10:00
ABC8999	CLT	2017-04-05 11:30	JFK	TFM_TFDM	ABC	2017-04-05 10:00

Attribute Filtering

- Attribute filtering is used to filter out fields before they are applied to the fused flight, based on the defined rules

- Attribute Filtering is used when
  - A source is known to have bad or untrustworthy data in certain fields
  - Better data is likely to exist in another source for certain fields

Field	Excluded by Sources	Reason
arrivalFixActualTime	Airline Data, 3rd Party Data	Relying on STBO detection times for the actual values
arrivalMovementAreaActualTime	Airline Data, 3rd Party Data	Relying on STBO detection times for the actual values
arrivalRunwayActualTime	Airline Data, 3rd Party Data, TFMS_Flight, TFM_Terminal	Relying on STBO detection times for the actual values
departureFixActualTime	Airline Data, 3rd Party Data	Relying on STBO detection times for the actual values
departureMovementAreaActualTime	Airline Data, 3rd Party Data	Relying on STBO detection times for the actual values
departureRunwayActualTime	Airline Data, 3rd Party Data, TBFM, TFMS_Flight, TFMS_Terminal	Relying on STBO detection times for the actual values
departureQueueEntryActualTime	Airline Data, 3rd Party Data	Relying on STBO detection times for the actual values
departureRunwayAssigned	TBFM	The departure runway is only coming with the runway number and not an indication if is L,R, or C. For example 18 instead of 18L..

Attribute Filtering Sample

acid	departure runway assigned	Last update source	System id	Timestamp
ABC1234	CLT_36	TBFM	SWIM	2019-04-05 10:00
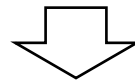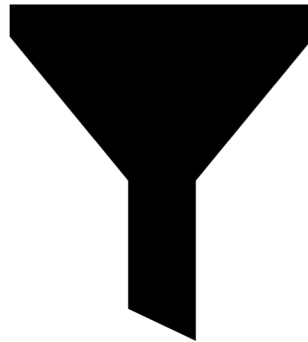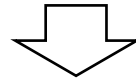
Departure Runway
From TBFM are not
Reliable
(flt.drw)

acid	Last update source	System id	Timestamp
ABC1234	TBFM	SWIM	2019-04-05 10:00

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

```xml
<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"/>
```

```xml
<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

```xml
<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>
```
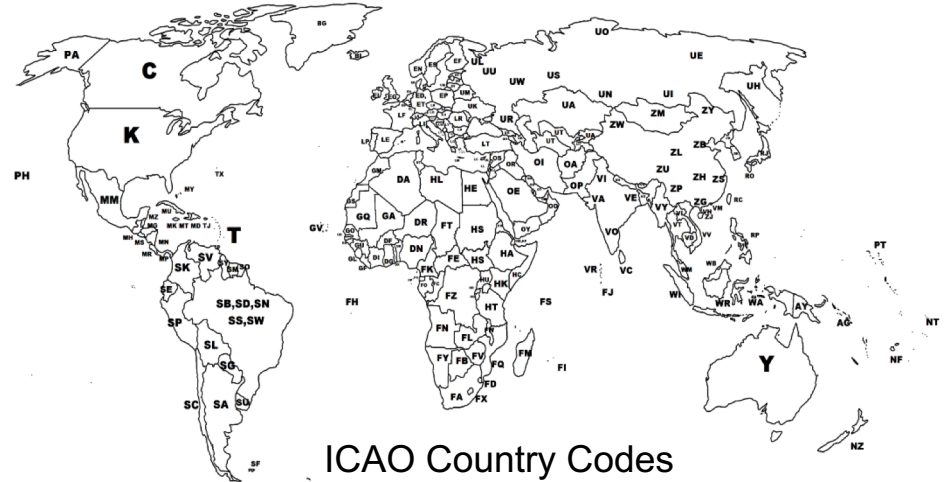
Fuser Airport Mediation Use Case

- ICAO vs IATA
  - ICAO = International Civil Aviation Organization
  - IATA = International Air Transport Association
  - These organizations don't agree on how to name things.
    - FAA generally uses IDs similar to ICAO.
    - Airlines generally prefer IATA.

ICAO Country Codes

	IATA	ICAO	FAA
Dallas Love Field Airport	DAL	KDAL	DAL
Hilton Head Airport	HHH	KHXD	HXD
Ardmore Downtown Executive Airport	AHD		1F0
Gastonia Municipal Airport		KAKH	AKH
Augusta Municipal Airport			3AU
Boeing 737-700 Aircraft Type	73G	B737	B737
Air Carrier	AA	AAL	AAL

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.

- 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.

	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	
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

```
<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

```xml
<!-- 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>
```

- 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)

Mediation Position Data

Position Data Jumpiness

- Position data can come from numerous feeds
- If you combine the feeds without mediation, jumpiness in the data will occur

TFMS

ASDE-X

ASDE-X
TFMS

ASDE-X

ASDE-X

Mediation

Position Coverage Transition
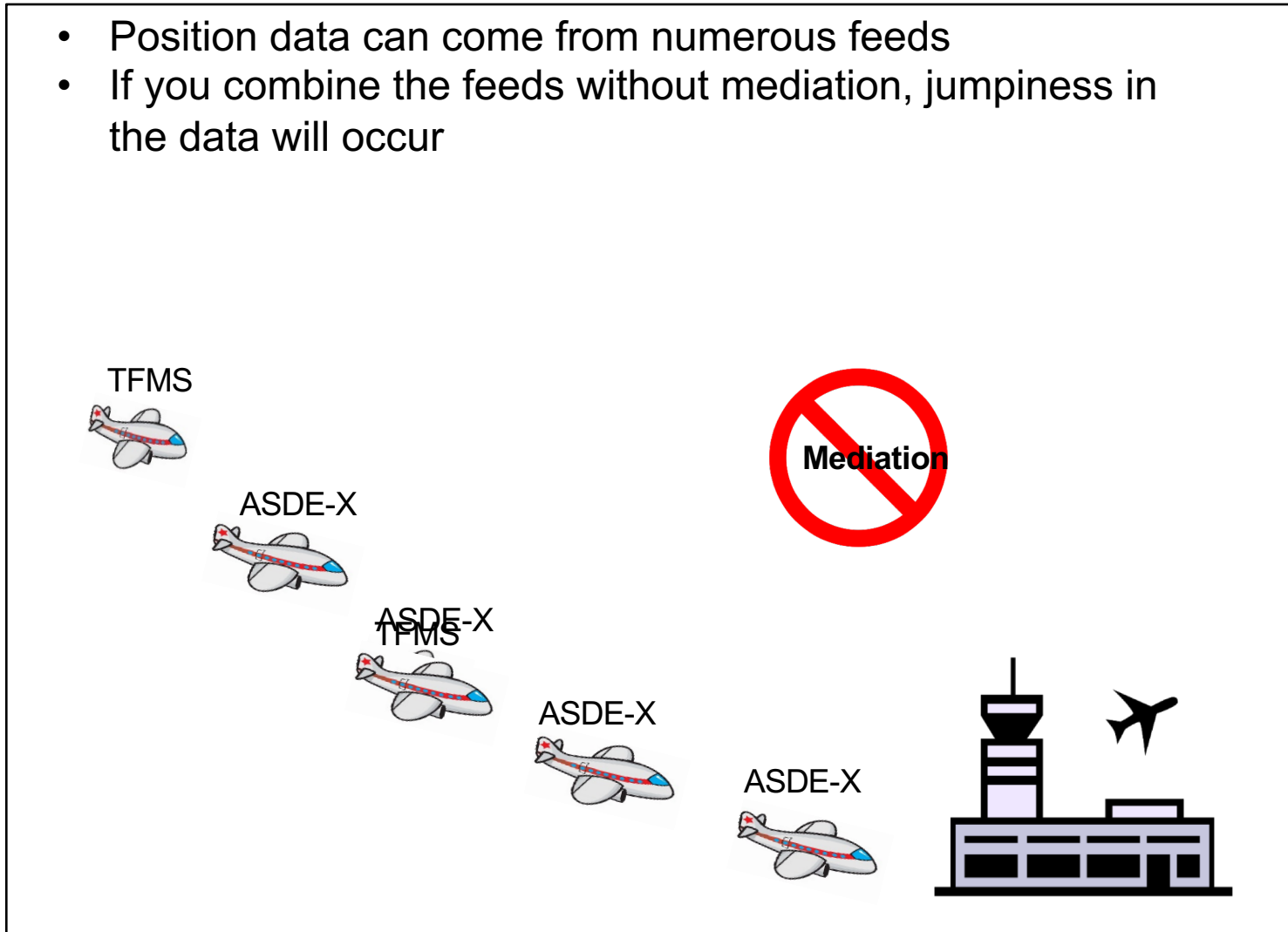
- The images below show the path of a flight in the terminal airspace
- In this case the flight transition from TRACON coverage to ASDE-X back to TRACON and finally back to ASDE-X
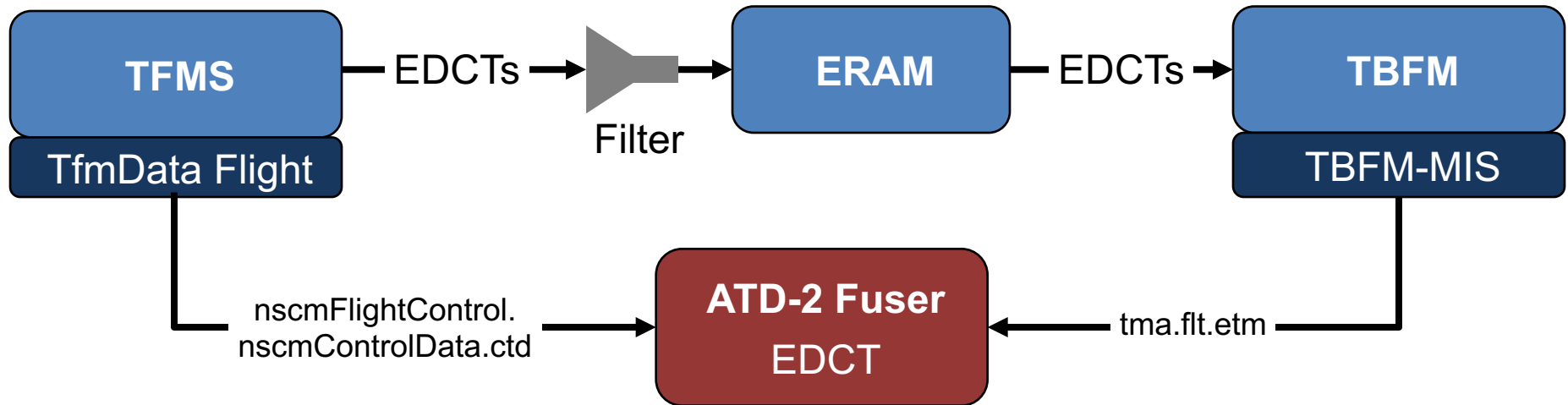
Mediation Example (Position Data)
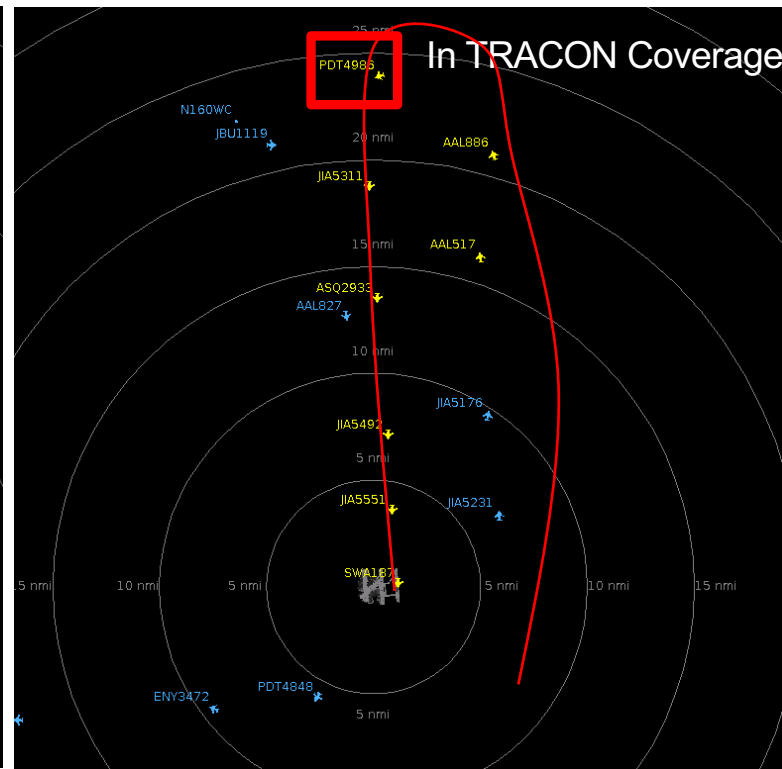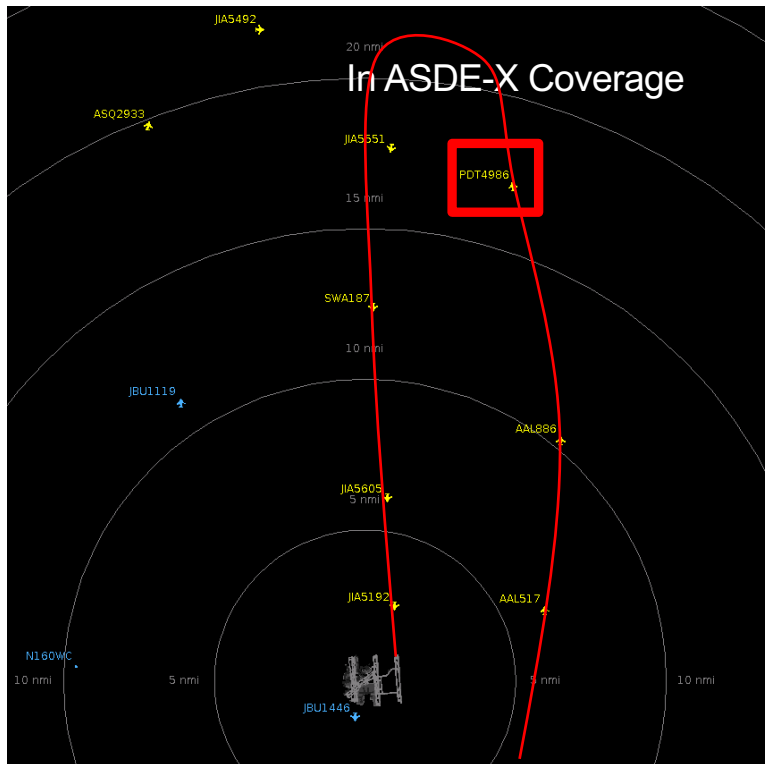
- Mediate to avoid jumpiness in the display and data
  - Define priority
  - Define a timeout
    - Transition back to a lower priority source if we quit getting data

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

Mediation Example EDCTs

- ATD-2 needs EDCTs for common situational awareness and runway predictions

- ATD-2 mediates TFMS and TBFM as equal sources
  - ATD-2 does not have to track filtered EDCTs separately from unfiltered

```
TFMS ──EDCTs──▶ ▷Filter ──▶ ERAM ──EDCTs──▶ TBFM
TfmData Flight                                TBFM-MIS
     │                                            │
     │ nscmFlightControl.        ATD-2 Fuser       │
     └─ nscmControlData.ctd ──▶   EDCT   ◀── tma.flt.etm
```

*TBFM SYNC messages had to be handled as syncs and not updates
    Prevented resetting the EDCT back to an old value
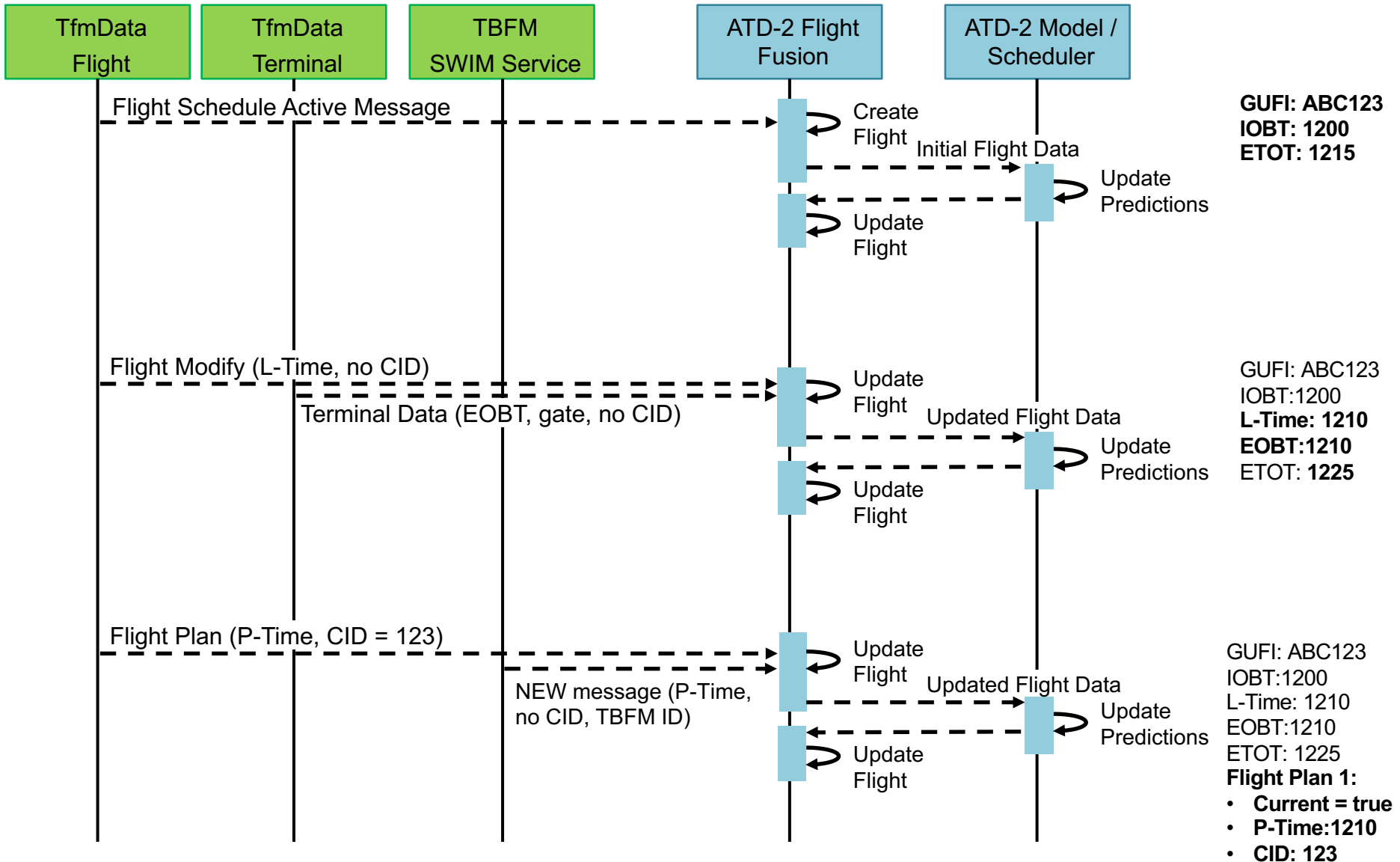
Multiple Flight Plans

ATD-2 Data Elements Tracked per Flight Plan

- ATD-2 tracks individual flight plans for AEFS integration

- ATD-2 manages a list of pre-departure flight plans
  - Tracks when each flight plan was updated
  - Tracks when a flight plan is cancelled
  - Most recently updated, non-canceled, flight plan is used as the current plan for surface modeling and scheduling

- The flight plan specific data elements are tracked per flight plan
  - P-Time, Route, Filed altitude, CID, etc.

- All other data elements are stored for the entire flight regardless of flight plan
  - L-Time, EOBT, TOBT, AOBT, Flight state, EDCT, aircraft position, etc.

- Currently uses TfmData as authoritative source for flight plan status and updates

Multiple Flight Plans
(initially the same as single flight plan use case)

TfmData Flight	TfmData Terminal	TBFM SWIM Service	ATD-2 Flight Fusion	ATD-2 Model / Scheduler

Flight Schedule Active Message

Create Flight

Initial Flight Data

Update Predictions

Update Flight

GUFI: ABC123
IOBT: 1200
ETOT: 1215

Flight Modify (L-Time, no CID)

Update Flight

Terminal Data (EOBT, gate, no CID)

Updated Flight Data

Update Predictions

Update Flight

GUFI: ABC123
IOBT:1200
L-Time: 1210
EOBT:1210
ETOT: **1225**

Flight Plan (P-Time, CID = 123)

Update Flight

NEW message (P-Time, no CID, TBFM ID)

Updated Flight Data

Update Predictions

Update Flight

GUFI: ABC123
IOBT:1200
L-Time: 1210
EOBT:1210
ETOT: 1225
Flight Plan 1:
- **Current = true**
- **P-Time:1210**
- **CID: 123**

Multiple Flight Plans (continued)

Fuser Flight Data

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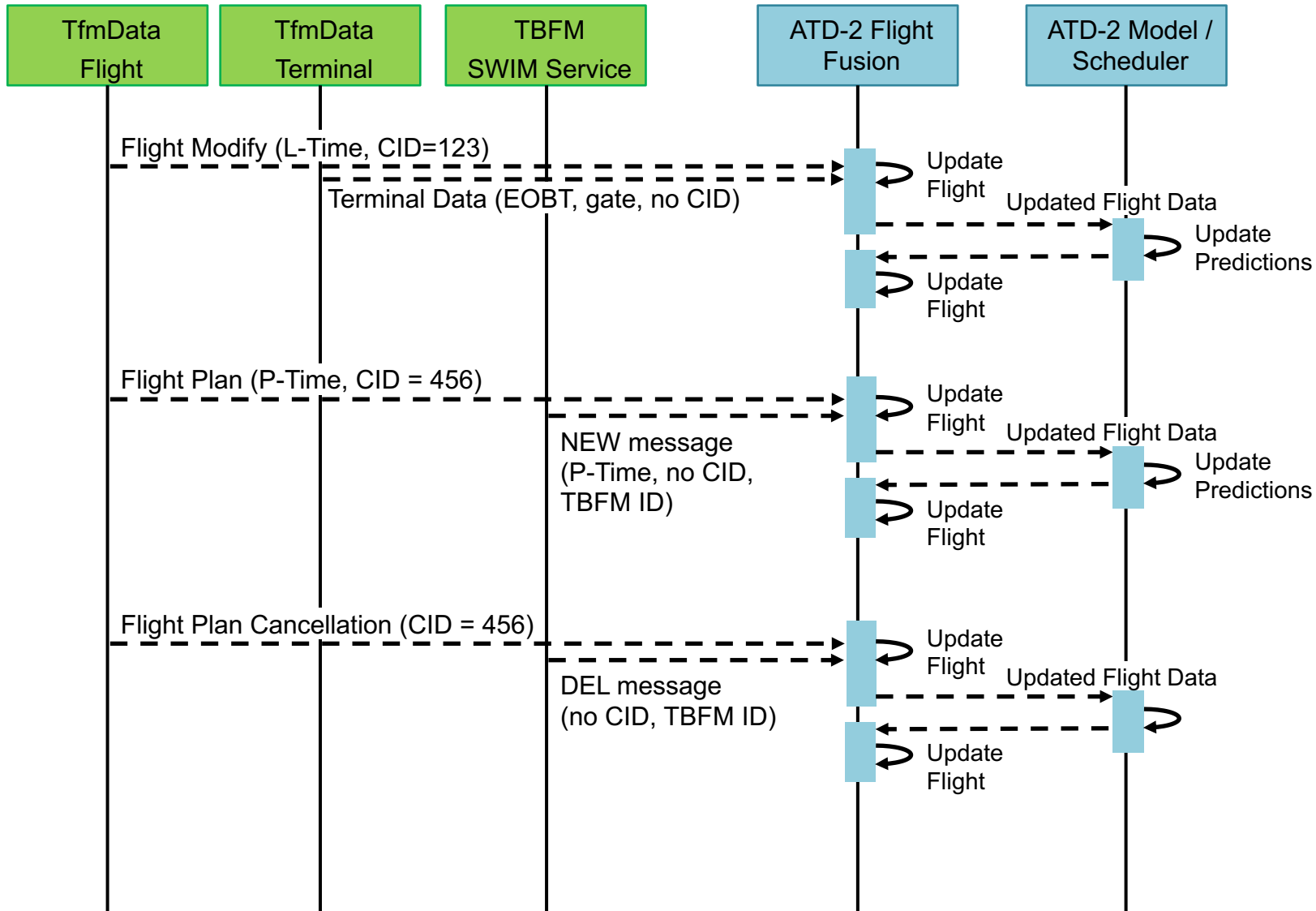
- Standard naming convention used with most data elements in the Fuser Flight
- Naming convention is a based on a flattened version of the Flight Object Data Dictionary (FODD) and FIXM Schema.
- Named so that related elements are close together alphabetically
- Self documenting for the most part
- Each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

Prefix: Information Category

Prefix	Description
aircraft_*	Information about the physical airframe operating the flight
arrival_*	Information about the arrival portion of the flight
departure_*	Information about the departure portion of the flight
position_*	Information about the flight's position
release_*	Information about the APREQ negotiation process

Middle of Name: Resource Type

Resource Type	Description
*_runway_*	The data element related to the runway used by the flight
*_fix_*	The data element related to the fix used by the flight
*_stand_*	The data element related to the parking gate used by the flight
*_movement_area_*	The date element related to the time the flight enters or exits the movement area
*_spot_*	The data element that pertains to the physical location the flight enters or exits the movement area
*_queue_*	The data element that pertains to the time when the flight enters the departure runway queue

Postfix: Source Type

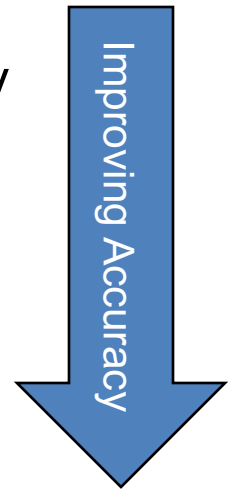| Source Type	Description
*_actual_time	The time the flight actually made use of the resource
*_controlled_time	The controlled time from a TFM TMI (GDP, AFP, GS)
*_earliest_time	The earliest time a flight is expected to use the resource by external sources (EOBT)
*_estimated_time	The time the flight is estimated to use the resource by external sources
*_initial_time	The first event time received for the resource
*_metered_time	The TMA-metered time (STA) that the flight will use the resource
*_proposed_time	The flight time based on the filed flight plan
*_scheduled_time	The time the flight is scheduled to operate by the airline
*_surface_metered_time	The time a flight should comply with as part of a Surface Metering Program
*_targeted_time	The time the flight is predicted to use the resource as set by the scheduler
*_undelayed_time	The unimpeded time the flight would use the resource is not constrained by external restriction

Postfix: Source Type (continued)

Source Type	Description
*_actual	The actual resource used by the flight
*_airline	The resource provided by an airline source or user entering the information in the RTC or STBO client display
*_assigned	The resource set by an FAA controller
*_position_derived	The resource derived from position data and adaptation by STBO
*_model	The resource derived from STBO modeling
*_decision_tree	The resource derived from STBO decision trees

Timestamp Columns

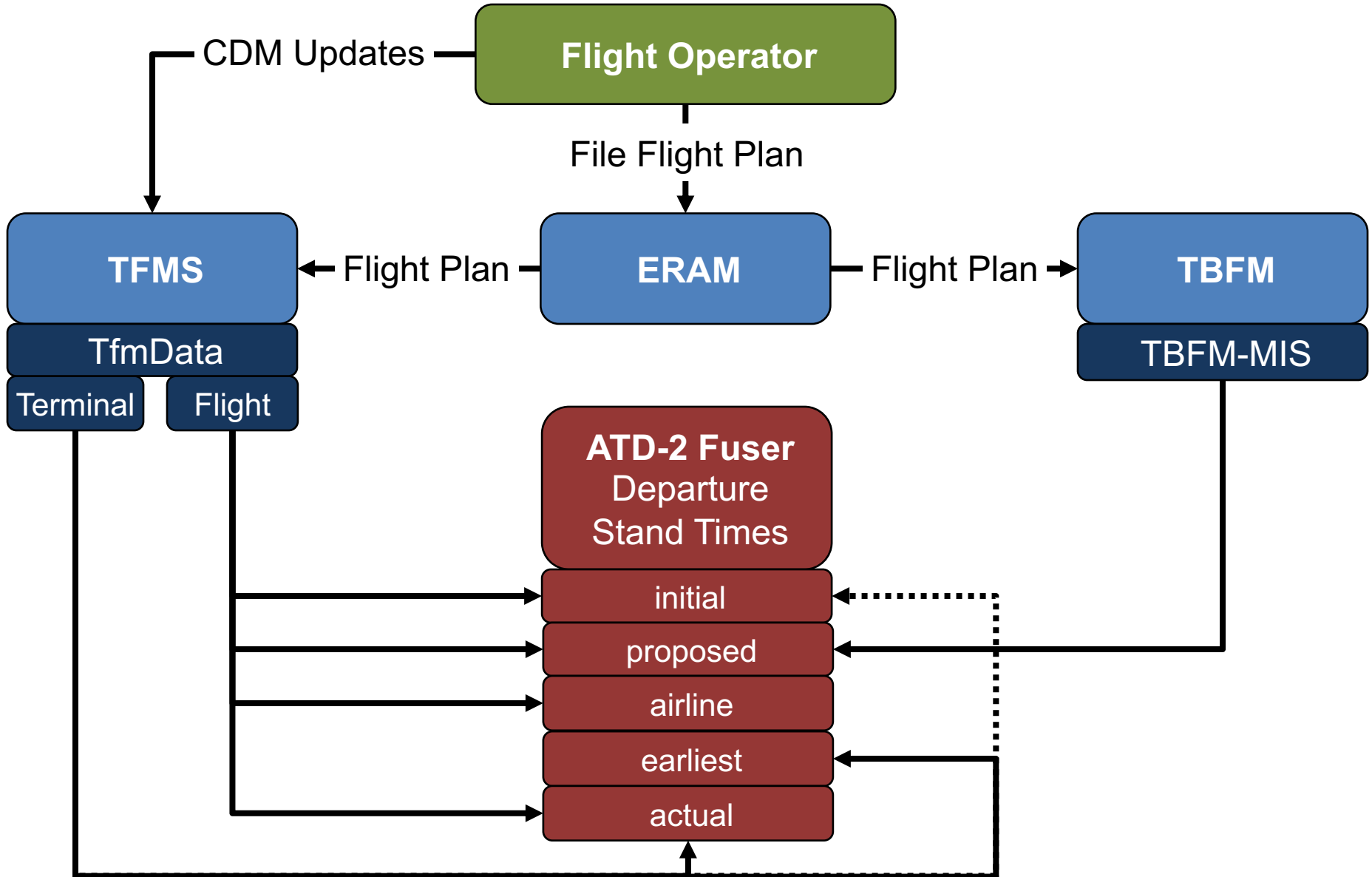| Column Name	Description
timestamp	Typically the timestamp of the source message
timestamp_fuser_processed	The time the fuser finished processing the message
timestamp_fuser_received	The time the fuser received the message
timestamp_source	The timestamp in the message supplied by the source system when available
timestamp_source_processed	The time the message was processed by the data parser
timestamp_source_received	The time the message was received by the data parser

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**
TFM Terminal Flight Data	**acid**
STDDS Position Report (ASDEX)	flightId.aircraftId.value
FIXM	flightIdentification.**aircraftIdentification**

Best Available Out Time

- ATD-2 departure predictions start with when the flight will leave the gate

- There are multiple data elements that provide an estimate of pushback time
  - Some data elements are available in multiple sources

- The Fuser mediates and stores each data element individually
  - departure_stand_initial_time (IOBT / IGTD)
  - departure_stand_proposed_time (P-Time from flight plan)
  - departure_stand_airline_time (L-Time from CDM messages)
  - departure_stand_earliest_time (EOBT)
  - departure_stand_actual_time (AOBT / OUT)

Improving Accuracy

- The ATD-2 prediction engine then uses the best available data element as the start of it's predictions

Best Available Out Time

Best Available Out Time

Departure Stand Time	TfmData Flight*	TfmData Terminal	TBFM-MIS**
Initial	flight.qualifiedAircraftId.igtd	flight.departureNas. runwayDepartureTime. original.time	
Proposed	[flightPlanInformation / flightPlanAmendmentInformation]. coordinationTime.value (if coordinationPoint == departureAirport && coordinationType == PROPOSED)		tma.air.flt.ctm (if tma.air.flt.acs == PROPOSED && tma.air.flt.fps == PROPOSED && tma.air.dap == tma.air.flt.cfx)
Airline	[nscmFlightCreate / nscmFlightModify]. airlineData.flightTimeData. airlineOutTime		
Earliest		flight.departureNas. runwayDepartureTime. earliest.time	
Actual	nscmFlightModify. airlineData.flightTimeData. gateDeparture	flight.departureNas. standPositionAndTime. standTime.actual.time	

* Multiple TfmData Flight message types can contain this data. Only the most common ones are listed here.
** TBFM-MIS mapping not currently used on ATD-2 because of feedback loop between ATD-2 and TBFM

ATD-2 Fuser Mapping

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

Questions

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