Airspace Technology Demonstration 2 (ATD-2)

SWIM-Fused data products used by ATD-2 analysts
for quantifying NAS performance and benefits

ATD-2 reporting agenda

- **Session 1**:
  - Detailed description of approach and scope for *flightSummary* report, the core file used for analysis and reporting on ATD-2 project
  - Lots of questions and answers!

- **Session 2**:
  - Description of other ATD-2 core data files (*tmiSummary* and *tosSummary*)
  - Discussion of reports built on top of core data files
  - Lots of questions and answers!

ATD-2 reporting background

- ATD-2 systems **ingest** huge amounts of SWIM data
- They also **output** huge amounts of data, recording every aspect of the operation

- Besides scale, data contains "noise"
  - e.g., human inputs, complexities of data mediation, order of processing messages, changes from earlier versions of ATD-2 software

- Project has developed standard conventions for measurement that need to be implemented

- *To address these challenges, we have developed a variety of standardized summary files and reports to serve analyst and user needs*

Three basic reports used for analysis and reporting:

- *flightSummary report*
  - Tabular report generated each day, one row per flight, with *many* computed metrics

- *tmiSummary* report
  - Tabular report generated each day, one row per distinct TMI, with data about program characteristics

- *tosSummary* report
  - Tabular report generated each day, one row per flight & TOS route, with many metrics about route stats at different flight milestones

Focus of this session

Motivation for tmiSummary report

- Data on traffic management initiatives (TMIs) in the NAS can be difficult to access in convenient, machine-readable ways

- The ATD-2 system now parses data from the TFMFlow SWIM feed, parses the FAA OIS webpage to gather restriction information, and receives user input to understand TMIs
  - Used in the system to maintain common situational awareness on the display, to update predictions, and to provide foundational data for the TOS system

- Have data on:
  - Ground delay programs (GDP)
  - Ground stops (GS)
  - Miles-in-trail (MIT)
  - Fix closures
  - APREQ

- Raw file is cleaned/formatted and pushed to researchers and users each morning

We capture:

- Creation time

- Planned start/end times

- Actual end time

- Affected resource

- Alternate resource

- MIT spacing

- Associated inclusion/exclusion constraints:
    - Aircraft type
    - Fix / departure gate
    - Filed altitude
    - Airline / ACID

Ground delay program data

- Parameters of GDPs at destinations of flights leaving subject airports
- Example: programs in place at many large airports
  - BOS ran until initially-planned expiration time, all others cancelled early

Creation Time	Start Time	End Time	Actual End Time	End Reason	Duration	Destination	Requesting Facility	Reason	Source	Inclusions	Exclusions
2019-08-28 07:35	2019-08-28 09:00	2019-08-28 15:59	2019-08-28 12:29	CANCELLED	03:29	SFO	ZOA		TFM		
2019-08-28 09:18	2019-08-28 12:00	2019-08-28 21:59	2019-08-28 19:37	CANCELLED	07:37	EWR	ZNY		TFM		
2019-08-28 13:38	2019-08-28 13:35	2019-08-28 21:59	2019-08-28 18:53	CANCELLED	05:18	LGA	ZNY		TFM		
2019-08-28 13:57	2019-08-28 14:00	2019-08-28 23:59	2019-08-28 23:59	EXPIRED	09:59	BOS	ZBW	LOW	TFM		
2019-08-28 16:22	2019-08-28 16:21	2019-08-28 23:29	2019-08-28 17:19	CANCELLED	00:58	JFK	ZNY		TFM		

- Already have history of EDCTs associated with each flight in flightSummary data

Ground stop data

- Parameters of GSs at destinations of flights leaving subject airports

- Example: significant storms rolled across country
  - Each ground stop was cancelled earlier than initially-planned end time

Creation Time	Start Time	End Time	Actual End Time	End Reason	Duration	Destination	Requesting Facility	Reason	Source	Inclusions	Exclusions
2019-07-22 14:43	2019-07-22 14:26	2019-07-22 15:30	2019-07-22 15:26	CANCELLED	01:00	BNA	ZME	THUNDERSTORMS	TFM		
2019-07-22 14:46	2019-07-22 14:31	2019-07-22 16:00	2019-07-22 15:30	CANCELLED	00:59	DCA	ZDC		TFM		
2019-07-22 14:43	2019-07-22 14:32	2019-07-22 16:00	2019-07-22 15:29	CANCELLED	00:57	IAD	ZDC		TFM		
2019-07-22 14:45	2019-07-22 14:33	2019-07-22 16:00	2019-07-22 15:32	CANCELLED	00:59	BWI	ZDC		TFM		
2019-07-22 15:27	2019-07-22 15:13	2019-07-22 16:30	2019-07-22 15:59	CANCELLED	00:46	BNA	ZME		TFM		
2019-07-22 19:22	2019-07-22 19:06	2019-07-22 20:00	2019-07-22 19:35	CANCELLED	00:29	EWR	ZNY		TFM		

- Some revisions to TMIs appear like new programs altogether

- Parameters of MIT restrictions for flights leaving subject airports
- Includes MITs both to fixes leaving D10 (e.g., THHOR) and to destinations (e.g., ATL)
- Example: storms impact west side of North Texas region

Creation Time	Start Time	End Time	Actual End Time	End Reason	Duration	Fix	Miles in Trail	Source	Inclusions	Exclusions
2019-07-22 12:16	2019-07-22 12:15	2019-07-22 15:00	2019-07-22 12:59	CANCELLED	00:44	TYGGR	10	TFM		
2019-07-22 12:59	2019-07-22 12:59		2019-07-22 13:02	CANCELLED	00:02	TYGGR	10	USER		
2019-07-22 13:02	2019-07-22 13:02		2019-07-22 13:06	CANCELLED	00:04	PGLET	10	USER		
2019-07-22 13:02	2019-07-22 13:02		2019-07-22 13:06	CANCELLED	00:04	RBBIT	10	USER		
2019-07-22 13:02	2019-07-22 13:02		2019-07-22 13:06	CANCELLED	00:04	ROOOO	10	USER		
2019-07-22 13:02	2019-07-22 13:02		2019-07-22 13:06	CANCELLED	00:04	TYGGR	10	USER		
2019-07-22 13:30	2019-07-22 13:30	2019-07-22 15:30	2019-07-22 13:36	CANCELLED	00:06	HANUH	10	TFM		
2019-07-22 13:30	2019-07-22 13:30	2019-07-22 15:30	2019-07-22 13:36	CANCELLED	00:06	THHOR	10	TFM		
2019-07-22 13:30	2019-07-22 13:30	2019-07-22 15:30	2019-07-22 15:10	CANCELLED	01:40	TRRCH	10	TFM		
2019-07-22 13:30	2019-07-22 13:30	2019-07-22 17:30	2019-07-22 16:08	CANCELLED	02:38	ZERLU	10	TFM		
2019-07-22 13:56	2019-07-22 13:56		2019-07-22 18:37	CANCELLED	04:41	THHOR	10	USER		
2019-07-22 15:12	2019-07-22 15:15	2019-07-22 18:15	2019-07-22 15:23	CANCELLED	00:08	TRRCH	10	TFM		
2019-07-22 15:23	2019-07-22 15:23	2019-07-22 19:00	2019-07-22 18:32	CANCELLED	03:09	ZERLU	10	TFM		
2019-07-22 17:08	2019-07-22 17:08		2019-07-22 19:02	CANCELLED	01:54	ATL	25	USER		

Fix closure data

- Parameters of fix closure restrictions for flights leaving subject airports
- Data includes alternate fix (and associated "gate" or direction of travel) and source of restriction
- Example: many fixes closed as out-the-gate

Creation Time	Start Time	End Time	Actual End Time	End Reason	Duration	Fix	Alt Fix	Alt Gate	Source	Inclusions	Exclusions
2019-08-27 06:32	2019-08-27 06:30	2019-08-27 07:29	2019-08-27 07:29	CANCELLED	00:59	HANUH	OTG		TFM		
2019-08-27 06:32	2019-08-27 06:30	2019-08-27 07:29	2019-08-27 07:29	CANCELLED	00:59	THHOR	OTG		TFM		
2019-08-27 06:32	2019-08-27 06:30	2019-08-27 07:29	2019-08-27 07:29	CANCELLED	00:59	ZERLU	OTG		TFM		
2019-08-27 07:28	2019-08-27 07:30	2019-08-27 07:45	2019-08-27 07:45	CANCELLED	00:15	ARDIA	OTG		TFM		
2019-08-27 07:28	2019-08-27 07:30	2019-08-27 07:45	2019-08-27 07:45	CANCELLED	00:15	DARTZ	OTG		TFM		
2019-08-27 07:28	2019-08-27 07:30	2019-08-27 07:45	2019-08-27 07:45	CANCELLED	00:15	NELYN	OTG		TFM		
2019-08-27 07:42	2019-08-27 07:45	2019-08-27 07:57	2019-08-27 07:57	CANCELLED	00:12	BLECO	LOWGN	NORTH	TFM		
2019-08-27 07:42	2019-08-27 07:45	2019-08-27 07:57	2019-08-27 07:57	CANCELLED	00:12	GRABE	AKUNA	NORTH	TFM		
2019-08-27 07:57	2019-08-27 08:00	2019-08-27 10:00	2019-08-27 10:00	EXPIRED	02:00	ARDIA	OTG		TFM		
2019-08-27 07:57	2019-08-27 08:00	2019-08-27 10:00	2019-08-27 10:00	EXPIRED	02:00	DARTZ	OTG		TFM		
2019-08-27 07:57	2019-08-27 08:00	2019-08-27 10:00	2019-08-27 10:00	EXPIRED	02:00	NELYN	OTG		TFM		
2019-08-27 08:19	2019-08-27 08:20	2019-08-27 11:06	2019-08-27 11:06	CANCELLED	02:46	PGLET	OTG		TFM		
2019-08-27 08:19	2019-08-27 08:20	2019-08-27 11:06	2019-08-27 11:06	CANCELLED	02:46	RBBIT	OTG		TFM		
2019-08-27 08:19	2019-08-27 08:20	2019-08-27 11:06	2019-08-27 11:06	CANCELLED	02:46	ROOOO	OTG		TFM		

APREQ data

- Parameters of APREQ restrictions for flights leaving subject airports

- Example: typical APREQ restrictions for departures out of North Texas

  - APREQs used here much less than in CLT

Creation Time	Start Time	End Time	Actual End Time	End Reason	Duration	Destination	Requesting Facility	Source	Inclusions	Exclusions
2019-08-28 06:47	2019-08-28 06:47		2019-08-29 03:00	EXPIRED	20:12	DAL		USER		
2019-08-28 06:47	2019-08-28 06:47		2019-08-28 15:19	CANCELLED	08:32	IAH		USER		
2019-08-28 07:26	2019-08-28 07:26		2019-08-28 09:32	CANCELLED	02:05	ORD		USER		
2019-08-28 16:05	2019-08-28 16:05		2019-08-28 20:08	CANCELLED	04:03	IAH		USER		
2019-08-28 16:46	2019-08-28 16:46		2019-08-28 18:15	CANCELLED	01:28	DEN		USER		UAL1493
2019-08-28 17:07	2019-08-28 17:07		2019-08-28 19:45	CANCELLED	02:38	PHX		USER		
2019-08-28 18:15	2019-08-28 18:15		2019-08-28 19:45	CANCELLED	01:30	HOU		USER		

- Already have significant visibility into and reporting on APREQs on a flight-by-flight basis as a result of work for ATD-2 phase 1 & 2

Motivation for tosSummary report

- As ATD-2 transitioned to Phase 3 operations, we needed new capabilities for understanding TOS operations

- Built on infrastructure developed for flightSummary report to create a file that summarized each TOS route for each flight

    - Intended to be independent, but not overlap significantly with content of flightSummary file

- Design to quantify operation, help visualize changes, and understand operator decision making process

Data available in tosSummary file
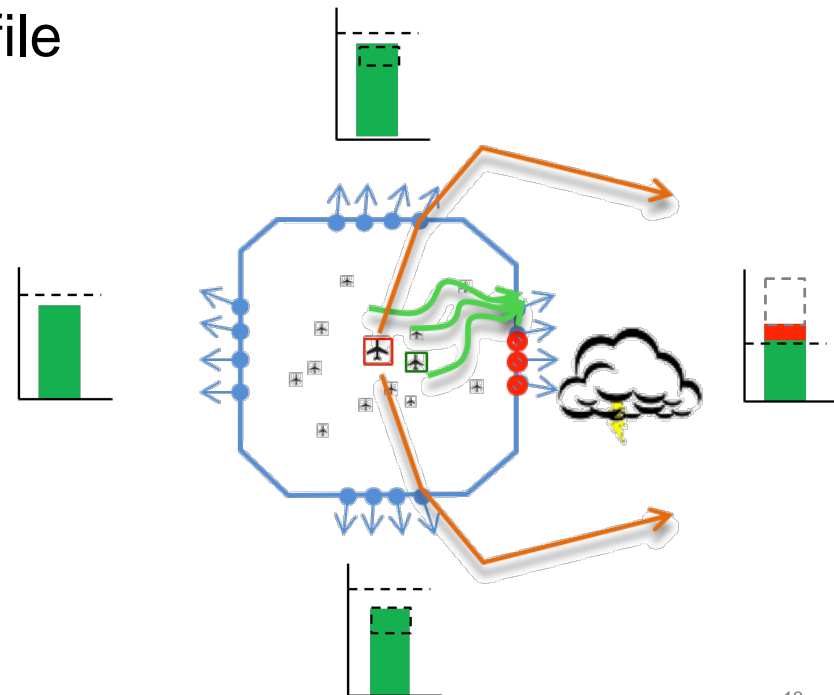
Three primary types of data available in file:

- *"Basic" data*
  - ACID, GUFI
  - Origin/destination
  - Marketing carrier
  - Originally filed route string
  - Final filed route string
  - AOBT, AMAT, ATOT (+ queue entry time)
  - Actual runway
  - Fix, gate, distance (and increase over filed), route string for this TOS route
- *TOS participation level*
- *Predictions at events*

Three primary types of data available in file:

- *"Basic" data*

- *TOS participation level*

  - Was TOS route ever candidate route, submitted, approved, unsubmitted, unapproved

  - Initial/final times of candidate status, final submission/approval times for route and flight

  - Final times transitioning from potential to candidate

- *Predictions at events*

Data available in tosSummary file

Three primary types of data available in file:

- *"Basic" data*
- *TOS participation level*
- *Predictions at events*
  - *At out, spot crossing, queue entry, takeoff, final submission, final approval, final transition between candidate and potential (& reverse)*
  - EOBT
  - UTOT, TTOT, ETOT
  - Undelayed fix time, Estimated fix time
  - Coordination status, eligibility status
  - Filed route, top route
  - RTC, expected runway
  - Various delay measures

- TOS data is also summarized and pushed to users each morning, covering operations on the prior day

- Includes raw data described on previous slide

- Also includes summary of:
  - Number of departures, candidates, submissions, approvals
  - Delay savings for approved flights
  - Relationship of TOS activity to TMIs throughout the day (currently in development)

Wrap-up

- tmiSummary file adds considerable new information for project researchers and users
- Many reports built on top of these base artifacts, and many more in the works!

- Our overall approach is specific to the needs of the project, but uses data elements already generally available in the SWIM data feeds

- *Some data sharing is possible to support collaboration and accelerate innovation*
- *How can others build on our progress?*