Welcome to the NASA Airspace Technology Demonstration 2 (ATD-2) Industry Workshop!
Day 2 Welcome

• Keynote Speaker
  – Lorne Cass

• Current Position
  – Vice President, Operations / Industry Affairs at American Airlines

• Among his many accomplishments
  – Prior to current position, held vice president role of American’s Integrated Operations Center
  – Served as Director of Surface Efficiency within FAA ATO
  – More than 35 years experience in airlines operations control with multiple airlines (including American Airlines, Delta Air Lines, Western Airlines, Northwest)
  – Incredibly diverse aviation leadership experience with certifications as a pilot, dispatcher & air traffic control
NASA ATD-2 Industry Workshop

Airport Surface Management – Working Together to Solve a Complex Problem

Lorne Cass

September 5, 2019
Initial elements of the Pre-IOE Plan
A Simple, Low-Risk Approach with a Foundation in Data Sharing

‘Surface CDM’ Conops Validation
Overarching - completes surface management integration across domains and with industry outreach
Enhances decision making
Establishes common situational awareness
Improves predictability and existing Decision Support Tools

Surface Flow Management
• Procedures, Roles, and Responsibilities
  • Interactive Capabilities
  • Link Surface & Airspace Ops

• Basic ‘Surface Viewer’ Capability
• Data Exchange and Integration

It Started in 2000
The Turn Process
Central Component to Improving Surface Efficiencies

Collaborative management of airport surface traffic flows via data exchange is pivotal to achieving estimated benefits of TFDM
## Today’s Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>0830 - 0940</td>
<td>Discuss early results of ongoing evaluation of Trajectory Options Set (TOS) with Surface for Metroplex departures</td>
<td>Workshop Panel, Texas Learning Center</td>
</tr>
<tr>
<td>0940 - 0950</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>0950 - 1050</td>
<td>BREAKOUT 6 – Topic A</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 5 – Topic B</td>
<td>Trinity II</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 6 – Topic C</td>
<td>Park West E/F</td>
</tr>
<tr>
<td>1050 - 1100</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>1100 - 1215</td>
<td>Opportunity for formulation input into NASA’s future aviation plans (with NASA ATD and ATM-X projects)</td>
<td>NASA ATD and ATM-X Project Representatives, Texas Learning Center</td>
</tr>
<tr>
<td>1215 - 1345</td>
<td>Lunch</td>
<td>Dover’s Grille or Morsels, (Omi) Shuffle to Torchy’s Tacos &amp; nearby eateries</td>
</tr>
<tr>
<td>1345 - 1445</td>
<td>BREAKOUT 7 – Topic A</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 7 – Topic B</td>
<td>Trinity II</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 7 – Topic C</td>
<td>Park West E/F</td>
</tr>
<tr>
<td>1445 - 1455</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>1455 - 1555</td>
<td>BREAKOUT 8 – Topic A</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 8 – Topic B</td>
<td>Trinity II</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 8 – Topic C</td>
<td>Park West E/F</td>
</tr>
<tr>
<td>1555 - 1605</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>1605 - 1705</td>
<td>Workshop wrap-up and discussion on any additional tech transfer needs of the ATD-2 team</td>
<td>AT Capps, Texas Learning Center</td>
</tr>
<tr>
<td>1700 - 1800</td>
<td>Optional Extra-Ingens Q/A Session with ATD-2</td>
<td>ATD-2 Technical Lead Representatives, Trinity I (Demo Room)</td>
</tr>
</tbody>
</table>

| 5-Sep      | 5 0950 – 1050 Industry/FAA future needs/expectations for the implementation of TFDM into the NAS, Understanding TMs in the NAS (Part 2), Simulation and modelling used in surface analysis |
| 5-Sep      | 6 1100 – 1215 Opportunity for formulation input into NASA’s future aviation plans (with NASA ATD and ATM-X projects) |
| 5-Sep      | 7 1345 – 1445 Substituting flights in TFDM with SWIM, Analytical evidence of surface compliance leading to more efficient overhead stream scheduling, Ramp Traffic Console Capabilities and Use in Operational Environment (part 1) |
| 5-Sep      | 8 1455 – 1555 Benefits of good EOBTs to Surface Metering, Metroplex TOS Departures, initial results and next steps input, Ramp Traffic Console Capabilities and Use in Operational Environment (part 2) |
Early Results of Ongoing Evaluation of Trajectory Options Set (TOS) With Surface for Metroplex Departures

• Panel Objectives
  – Discuss the preparation for and the early results of ATD-2, phase 3 testing with FAA and Airline representatives

• Panelists
  – Eric Chevalley (NASA ATD-2 Team)
  – Joseph Friend (DFW Tower)
  – Josh Griffith (Southwest Airlines)
  – Tim Niznik (American Airlines)
  – Ron Ooten (Southwest Airlines)
  – John Short (DFW Tower/NATCA National ATD Representative)
  – Mike Sterenchuk – (American Airlines)
  – Kenny West (Fort Worth Center)

• Panel Format
  – Panel Introductions (10 minutes)
  – Overview of ATD-2 Phase 3 (15 minutes)
  – Questions from moderator (25 minutes)
  – Questions from audience (20 minutes)
Discuss Early Results Of Ongoing Evaluation Of Trajectory Options Set (TOS) With Surface For Metroplex Departures

Discussion Panel
September 5, 2019

Greg Juro and Eric Chevalley
Metroplex Airspace

Overview video online at: http://aviationsystemsdivision.arc.nasa.gov/research/tactical/atd2.shtml
Demand Capacity Imbalances in D10 TRACON Airspace

Fix compression caused by weather events near TRACON airspace

Currently

Load Balancing With TOS
(Trajectory Option Set)
Surface Meets TOS

A set of Capability that:

– Leverages IADS Surface predictive and scheduling technology (Phase 1-2)
– Expands IADS to the terminal boundary
– Provides Trajectory Option Set (TOS) to identify when alternative routes are available to reduce surface delay for departures out of the North Texas region
– Leverages CDM products, such as CDR, Playbook
– Identify potential solutions to bridge 3T technology gaps
Crawl – Walk – Run

• Stormy 19 (Exploratory Research in Summer 2019)
  – Identify Requirements through Shadow Sessions
  – Develop an initial capability in an agile manner
  – Incremental built of capability (3 micro-phases)
  – Test and use incrementally in operational environment
  – Collect data, observation, feedback
  – Identify monetizable benefits
  – Mature capability
  – Identify goals for Stormy 20

• Stormy 20 (Formal Evaluation)
  – Implement Lessons Learn from Stormy 19
  – Identify technology transfer deliverables
  – Develop larger capability leveraging SWIM components
  – Test and Collect data
  – Measure benefits
Before Day-Of Ops. Formulate ‘Static TOS’

- ATC and operators identify acceptable alternative routes to be notified on
- Routes codified in ATD-2 static adaptation
- NASA and operators agree on Relative Trajectory Cost algorithm

```
<TOS_OPTION_LIST>
<TOS_INDEX1></TOS_INDEX1>
</TOS_INDEX>
</REL_TRAJ_COST>
</ROUTE>ACT FL 018 GMN DCT FL 018 SUM DCT TDC 016 MIN
</ATD>
</TOS_INDEX>
</TOS_INDEX_LIST>
```

‘Candidate TOS’ are Presented to Operators

- Assess delay savings on alternative routes
- When the RTC thresholds are met, the operator is informed of ‘candidate TOS routes’
- Operators can then submit an acceptable TOS

Delay savings > Relative Trajectory Cost?

Terminal Predictive Engine Determines Impact

- ATC evaluates the TOS routes for operational feasibility. If approved, all users are notified, the filed route is amended, and pilots are cleared on the revised route

Operator Submitted TOS’s Presented to ATC

- ATC is notified of the Operator approved TOS route
- ATC evaluates the TOS routes for operational feasibility. If approved, all users are notified, the filed route is amended, and pilots are cleared on the revised route

Post Ops Eval

- Benefits
- Lessons
- Refinements
- Data
- Reports
Stormy 19 – Static TOS

CDRs as TOS alternative routes

- DFWLSLC1N +29nm RTC 4-10min
- DFWLGA3J +57nm RTC 8-19min
- DFWLGA1N +60nm RTC 9-20min
- DFWLGA0P 0nm

CDRs as TOS alternative routes
Restriction Handling

• ZFW TMC enters the restriction in NTML
  – ATD-2 system parses the TfmFlow data (SWIM)
    Looks for restrictions for given requesting and providing facilities
  – ATD-2 system then populates the clients with the restriction information

• Alternatively, TMC personnel may enter or modify the restriction in the NASA user interface
Timeline & Graph

Timelines at Runways or Departure Fixes
- Undelayed and Estimated Times
- Delay
- TMIs
- TOS State
- Flight data

Graph at Runways or Departures Fixes
- Undelayed and Estimated demand
# TOS Operation Table & Flight TOS Menu

### TOS Operation Table

<table>
<thead>
<tr>
<th>Flight ID</th>
<th>Rwy</th>
<th>Dest</th>
<th>Route of Flight</th>
<th>Dep Gate</th>
<th>Flight Status</th>
<th>EOBT</th>
<th>ETOT</th>
<th>TMI Info</th>
<th>Top CDR</th>
<th>Top Delay Savings Off</th>
<th>Eligibility State</th>
<th>Coord State</th>
<th>Num TOS Cards</th>
<th>Num TOS Sub</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scheduled Out</td>
<td>27/20:37</td>
<td>27/21:05</td>
<td>FixCsd</td>
<td>EW</td>
<td>WEST</td>
<td>+15</td>
<td>Candidate</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

### TOS Departure - Coord State - Operator Submitted

<table>
<thead>
<tr>
<th>Flight ID</th>
<th>Rwy</th>
<th>Dest</th>
<th>Route of Flight</th>
<th>Dep Gate</th>
<th>Flight Status</th>
<th>EOBT</th>
<th>ETOT</th>
<th>TMI Info</th>
<th>Coord State</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pushback</td>
<td>27/20:18</td>
<td>27/20:46</td>
<td>FixCsd</td>
<td>Operator Sub</td>
</tr>
</tbody>
</table>

### TOS Departure - Coord State - ATC Approved; Coord State - Reroute Filed

<table>
<thead>
<tr>
<th>Flight ID</th>
<th>Rwy</th>
<th>Dest</th>
<th>Route of Flight</th>
<th>Dep Gate</th>
<th>Flight Status</th>
<th>EOBT</th>
<th>ETOT</th>
<th>TMI Info</th>
<th>Coord State</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Taxing, AMA</td>
<td>27/20:12</td>
<td>27/20:39</td>
<td>FixCsd</td>
<td>ATC Approved</td>
</tr>
</tbody>
</table>

---

### TOS Flight Menu

<table>
<thead>
<tr>
<th>Flight ID</th>
<th>Route</th>
<th>CDR</th>
<th>Dep Gate</th>
<th>Rwy</th>
<th>Dist nm</th>
<th>Add nm</th>
<th>RTC</th>
<th>Term Delay OFF</th>
<th>Total Delay OFF</th>
<th>Total Delay Savings Off</th>
<th>ETOT</th>
<th>Eligibility State</th>
<th>Coord State</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUADAM</td>
<td>WEST</td>
<td></td>
<td></td>
<td></td>
<td>1463</td>
<td></td>
<td>+1</td>
<td>+3</td>
<td></td>
<td></td>
<td>21.18</td>
<td>Candidate</td>
<td>Operator Sub</td>
</tr>
<tr>
<td>ROLLS J5</td>
<td>NORTH</td>
<td></td>
<td></td>
<td></td>
<td>1472</td>
<td>+9</td>
<td>+1</td>
<td>-3</td>
<td></td>
<td>+6</td>
<td>21.12</td>
<td>Potential</td>
<td>Not Submitted</td>
</tr>
<tr>
<td>HGARY J</td>
<td>SOUTH</td>
<td></td>
<td></td>
<td></td>
<td>1747</td>
<td>+284</td>
<td>+2</td>
<td>+4</td>
<td></td>
<td>-1</td>
<td>21.19</td>
<td>Potential</td>
<td>Not Submitted</td>
</tr>
<tr>
<td>SAT DLF</td>
<td>SOUTH</td>
<td></td>
<td></td>
<td></td>
<td>1835</td>
<td>+372</td>
<td>+2</td>
<td>+4</td>
<td></td>
<td>-1</td>
<td>21.19</td>
<td>Potential</td>
<td>Not Submitted</td>
</tr>
</tbody>
</table>
As of Aug 26th, we logged 54h during 11 days of operational tests from Mid-July to Mid-August
• 23 alternative routes for 23 flights were SUBMITTED by Flight Operators
  – 8 times when 10-15 MIT (with and without fix closed)
  – 15 times when no TMI
• 3 routes were then unsubmitted

• 16 alternative routes were APPROVED by ATC
  – 7 times when 10-15 MIT (with or without fix closed)
  – 9 times when no TMI

• 10 reroutes were filed (amended) by ATC

• 8 flights actually flew an alternative route
  – Total of 49.5min of estimated delay savings (avg 6.1min)
  – 3 times when MITs – total of 28.5min of estimated delay savings (avg 9.5min)
  – 5 times when no TMI – total of 21.1min of estimated delay savings (avg 4.2min)

• 6 procedural tests were conducted without executing any reroute
• 2 flight crew rejected the reroute based on mx and wx issues
Major Benefits and Needs Identified So Far

• Identified Benefits
  – Parsing and disseminating NTML entries
  – Computation of Demand prediction and Capacity Constraints at the runway and at the departure fixes
  – Identification of Surface Delays and Delay Savings Estimates
  – Awareness of TOS routes
  – Use of data to identify flights that are CPDLC-DCL ready

• Identified Needs (near and far term)
  – Near Term
    • Provide ability to En Route STMCs to Manage/Advise TOS CDR route availability (TMI or WX)
    • Detect when NAS Wide TMI restrictions impact the “O” in the TOS
  – Far Term
    • Submit TOS to SWIM
    • Modify routes as needed (WX)
    • Modify RTC as needed
Panel Discussion
This Morning’s Agenda

AGENDA
WEDNESDAY, SEPTEMBER 4, 2019

<table>
<thead>
<tr>
<th>TIME</th>
<th>DESCRIPTION</th>
<th>PRESENTER</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0730 - 0800</td>
<td>Registration</td>
<td></td>
<td>Fountain View</td>
</tr>
<tr>
<td>0800 - 0815</td>
<td>Welcome</td>
<td>Akbar Sultan, NASA</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td>0815 - 0845</td>
<td>Workshop Overview and Perspectives</td>
<td>Al Capps</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td>0845 - 1000</td>
<td>Preparing for the Transition to TFM and a Data-Driven NAS, Perspectives from Industry and FAA leaders</td>
<td>Workshop Panel</td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td>1000 - 1015</td>
<td>Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1015 - 1130</td>
<td>BREAKOUT 1 – Topic A</td>
<td></td>
<td>Texas Learning Center</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 1 – Topic B</td>
<td></td>
<td>Trinity II</td>
</tr>
<tr>
<td></td>
<td>BREAKOUT 1 – Topic C</td>
<td></td>
<td>Park West E/F</td>
</tr>
<tr>
<td>1130 - 1245</td>
<td>Lunch</td>
<td></td>
<td>Dover’s Grille or Morsels (Omni) Shuttle to Salata &amp; nearby eateries</td>
</tr>
</tbody>
</table>

- **Yellow:** Surface System Capabilities (TFDM precursor lessons learned)
- **Orange:** Understanding and Quantifying NAS Performance and Benefits (Analytical Focus)
- **Grey:** Understanding TFM from a multi-system decision support viewpoint
- **Green:** Future Vision and Needs of the NAS (Enabled by TFM, SWIM and collaboration)

**Table 1: Legend of Available Tracks**

**Breakout Sessions Overview**
Submit your questions online via our NASA Conference I/O tool; see arc.cnf.io links below for each room

<table>
<thead>
<tr>
<th>Day</th>
<th>Breakout</th>
<th>Time</th>
<th>Topic A - Texas Learning Center //arc.cnf.io/sessions/zqnr</th>
<th>Topic B - Trinity II //arc.cnf.io/sessions/zyeb</th>
<th>Topic C - Park West E/F //arc.cnf.io/sessions/hn3b</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Sep</td>
<td>1</td>
<td>1015 – 1130</td>
<td>&quot;Fuser in the cloud&quot; overview and latest updates/needs</td>
<td>Future surface decision support overview (with ATD-2 demo)</td>
<td>SWIM-Fused data products used by ATD-2 analysts for quantifying NAS performance and benefits (part 1)</td>
</tr>
<tr>
<td>4-Sep</td>
<td>2</td>
<td>1245 – 1345</td>
<td>Latest strategic surface metering system and progress status in CLT (extending freeze horizon)</td>
<td>Understanding TMs in the NAS (Part 1)</td>
<td>SWIM-Fused data products used by ATD-2 analysts for quantifying NAS performance and benefits (part 2)</td>
</tr>
</tbody>
</table>
Day 2 Wrap Up

- Summary of feedback and additional ATD-2 tech transfer input

- Ongoing work activities
  - TFDM pre-cursor
  - SWIFT, Fuser in the Cloud, Data-driven Finale
  - Surface meets TOS
  - Future Work Formulation

- Closing
Implementation Sites by Configuration

- Configuration A (27 sites)
- Configuration B (62 sites)

Legend:
- PSS Complete
- SS Complete
- HW Install Complete

Key Sites:
- (PHX) Build 1
- (CLT) Build 2

Pre-Site Survey – PSS Complete
Site Survey – SS Complete
Hardware Install – HW Install Complete
Demand Capacity Imbalances in D10 TRACON Airspace

Fix compression caused by weather events near TRACON airspace

Currently

Load Balancing With TOS (Trajectory Option Set)
• SWIFT Workshop #8:
  – Date: November 7, 2019
  – Location: Delta Airlines @ Atlanta, GA

• https://www.faa.gov/air_traffic/technology/swim/swift/
In this concept, the ‘Fuser in the cloud’ is published to cloud data stream. This allows others to innovate (and validate) with the same data NASA is using to build new community services.

The same Fused data that drives ATD-2 is used to build new services without additional needs on the FAA systems. Examples are described on the following slides.
The input we are requesting today will likely require thoughtful consideration.

We are offering follow-up opportunities to provide input.

You are invited to join the follow-up Webinar on Oct 17th, 10-11:30 Eastern

https://www.aviationsystemsdivision.arc.nasa.gov/research/atd2/remote-demos/index.shtml
Thank you for supporting this Workshop!