Real Time Metrics and Analysis of Integrated Arrival, Departure, and Surface Operations

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Integrated Arrival, Departure, and Surface (IADS) Operations

Airspace Technology Demonstration 2 (ATD-2)
Integrated Arrival, Departure, and Surface (IADS) Operations
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Overview

- Airspace Technology Demonstration 2 (ATD-2) Background
- Motivation for real time monitoring tool and analysis and method of developing requirements
- Description of data sources
- User interface and initial metrics
- Next steps
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Contributing Technologies to ATD-2

Spot and Runway Departure Advisor (SARDA)

Traffic Flow Management System (TFMS)
Decision support system for planning and mitigating demand-capacity imbalances in the NAS.

Time-Based Flow Management (TBFM)
Decision support system for metering based on time to optimize the flow of aircraft.

Terminal Flight Data Management (TFDM)
A new decision support system for airport surface management and ATC tower functions.

Precision Departure Release Capability (PDRC)

CDM
Collaborative Decision Making
ATD-2 Partners
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IADS Data Exchange and Integration

Airline Operations

Ramp Controllers

Airport Operations

ARTCC

TRACON

ATCT

Flow Direction
Runway Utilization
APREQs/CFRs
Runway Assignments
MIT restrictions
EDCTs
Grounds Stops
Runway Closures
Dep Fix Closures
Flight Cancellations
Gate Conflicts
Ramp Closures
Long on Board
Data quality updates
Initially developed as a researcher tool

Prototype development based on S-CDM and TFDM requirements

Field user sessions: agile development process led to user input and refinement of requirements

Held a series of nine user sessions with operational personnel from the Tower, Ramp, Center, and airport operations
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ATD-2 Logical Data Interfaces

Data Fusion and Mediation (Fuser)

ATD-2 System Processing

Real Time Dashboard

TFDM SWIM
TFMS SWIM
TBFM SWIM
Surface SWIM
Operational TBFM IDAC
R-TBFM CAP/SWIM
R-TBFM IDAC/WSRT
AAL Flight Hub
AAL Surface Surveillance
Commercial Flight Service
NTML/OIS Operational info
General Functionality

- Situational Awareness
- Monitoring Metrics
- Benefits Metrics
- Data Fidelity
General Functionality

- Situational Awareness
- Monitoring Metrics
- Benefits Metrics
- Data Fidelity

**Throughput**
- Predicted and actual runway capacity rates
- Delay values
- Arrival and Departure Taxi Time
- Excess Queue Time
General Functionality

- Situational Awareness
- Monitoring Metrics
- Data Fidelity
- Benefits Metrics

CO₂ Savings
Monetary Benefits
General Functionality

- Situational Awareness
- Monitoring Metrics
- Benefits Metrics
- Data Fidelity

Fidelity of incoming data feeds
System wide data deterioration
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Current dashboard features both vertical and horizontal display capability.
Specific metrics will show across the last 15 minutes, the last rolling hour, and the last cardinal hour.
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Next Steps

- Complete requirements for the real time dashboard leading up to Phase I go live date during which a version will be available to center, tower, and ramp controllers

- Constant iteration with operational users on the metric definitions, graphical views, and numerical information conveyed

- Refine requirements for additional features and develop new metrics based on input from operational users focused on predicative information that provides information to mitigate demand capacity imbalances
Phase 1: Baseline IADS Demonstration

Phase 1 Demonstration Goals
- Evaluate the Baseline IADS capability
- Enhance American Airlines CLT “departure sequencing” procedure with ATD-2 surface tactical metering
- Demonstrate improved compliance for a significant percentage of tactical TMIIs
- Mature strategic Surface CDM capability via operational use, analysis, and feedback
- Reduce ATCT workload by replacing paper strips with EFD

ATCT Control
- Baseline electronic flight data capability via TFDM EFD

Ramp Control
- Tactical pushback advisories via RTC/RMTC display

Surface CDM
- Predictive mode: strategic metering info for situational awareness and analysis

Airspace Components
- Tactical departure scheduling via modified TBFM/IDAC

Airline Ops
- Interfaces to external systems via SWIM plus ATD-2 SWIM extensions

Surface Components
- Tactical departure scheduling via modified TBFM/IDAC

= IADS user interface
Surface Metering Process Flow Diagram

1. Generate Demand and Capacity Predictions
   - ATC/TMC Runway Utilization Intent
   - TRACON controller runway intent
   - Highly accuracy TBFM de-conflicted ON time estimate
   - TFM SWIM ETAs
   - TMIs. Controlled Take Off Times (CTOT)
   - Carrier provided EOBTs
   - Tactical airline intent (ramp controller)

2. Monitor Surface Demand Capacity Imbalances
   - Surface modeling logic
     - Earliest IN time estimate
     - Earliest OFF time estimate
     - Latest OUT estimate
     - Pushback duration model
     - Ramp and AMA taxi time
     - Hovering logic
   - Scheduling Logic:
     - Converging runways
     - Flight spacing requirements
     - Dual use runways
     - Runway crossing delays
     - Departure fix separation
     - Use of flight state

3. Enable Metering. Set Hold Level
   - TOBT Advisory
     - 6 min
   - TMAT Advisory

4. Honor TOBT and TMAT advisories

5. Evaluate Metering Effectiveness
IADS Tactical Departure Scheduling

APREQ/CFR departures merging into overhead streams

Flights subject to EDCTs due to downstream flow constraints

IDAC-style scheduling between IADS at CLT and TBFM at ZDC

Washington ARTCC (ZDC)
Concept Overview – Users

Overview video online at:  http://aviationsystemsdivision.arc.nasa.gov/research/tactical/atd2.shtml
### General Functionality

<table>
<thead>
<tr>
<th>Health/Situational Awareness</th>
<th>Monitoring Metrics</th>
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<tbody>
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<td>Configuration and Flow Information</td>
<td>Throughput</td>
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<tr>
<td>Ramp Status</td>
<td>Predicted and actual runway capacity rates</td>
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