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

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

UNCERTAINTY LEADS TO OVERLY CONSERVATIVE SPACING

DELAYS  FUEL  CO2
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

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)
ATD-2 Partners
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IADS Data Exchange and Integration

- **Airline Operations**
- **ARTCC**
- **Airport Operations**
- **TRACON**
- **ATCT**

**Ramp Controllers**

### Data Exchange & Integration

- Runway Utilization
- Runway Assignments
- EDCTs
- MIT restrictions
- Grounds Stops
- Runway Closures
- Dep Fix Closures
- Flight Cancellations
- Gate Conflicts
- Ramp Closures
- Long on Board
- Data quality updates
Development of Real Time Dashboard

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)

TFDM SWIM
TFMS SWIM
TFBFM 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

ATD-2 System Processing

Real Time Dashboard
General Functionality

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

Configuration and Flow Information

Ramp Status

Metering Mode

Situational Awareness

Monitoring Metrics

Benefits Metrics

Data Fidelity
General Functionality

Situational Awareness

Benefits Metrics

Data Fidelity

Monitoring Metrics

Throughput

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

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

CO₂ Savings
Monetary Benefits
General Functionality

Fidelity of incoming data feeds
System wide data deterioration
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Toolbar View

Current dashboard features both vertical and horizontal display capability.

Feedback button with a link to an online form

Consistent configuration information and other icons across the system

Pull down menu with quick look display and in depth metrics
Specific metrics will show across the last 15 minutes, the last rolling hour, and the last cardinal hour.
Dashboard Pull Down Menu Metrics
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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 TMI
- Mature strategic Surface CDM capability via operational use, analysis, and feedback
- Reduce ATCT workload by replacing paper strips with EFD

**Interfaces to external systems via SWIM plus ATD-2 SWIM extensions**

- Baseline electronic flight data capability via TFDM EFD
- Tactical pushback advisories via RTC/RMTC display
- Predictive mode: strategic metering info for situational awareness and analysis
Surface Metering Process Flow Diagram

1. Generate Demand and Capacity Predictions
   - ATC/TMC Runway Utilization Intent
   - TRACON controller runway intent
   - Highly accurate TBFM de-conflicted ON time estimate
   - TFM SWIM ETAs
   - TMIs, Controlled Take Off Times (CTOT)
   - Carrier provided EOBTs
   - Tactical airline intent (ramp controller)
   - IADS Automation Assisted Capacity Predictions
     - 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 flight separation
       - Use of flight state

2. Monitor Surface Demand Capacity Imbalances
   - Runway Delay vs. Time

3. If Surface Metering, Go to Step
   - TOBT Advisory
     - 6 min
   - TMAT Advisory

4. Honor TOBT and TMAT advisories
   - AAL705 A321 E
   - BOBZY-SFO
   - C6 9 18C
   - P1856

5. Evaluate Metering Effectiveness
   - AAL705 A321 E
   - BOBZY-SFO
   - T1941 9 18C

Enable Metering. Set Hold Level

Set Metering
- No Metering
- Departure Sequence Metering
  - Target queue length: 19
- Time-Based Metering
  - Level of hold:
    - Less hold
    - Nominal hold
    - More hold

Apply Cancel
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

## Health/Situational Awareness
- Configuration and Flow Information
- Ramp Status
- Metering Mode

## Monitoring Metrics
- Throughput
- Predicted and actual runway capacity rates
- Delay values
- Arrival and Departure Taxi Time
- Queue length

## Benefits Metrics
- CO₂ Savings
- Monetary Benefits

## Data Fidelity
- Fidelity of incoming data feeds