Airspace Technology Demonstrations (ATD) Project
Industry Day

ATD-2 IADS Metroplex Traffic Management
Overview Brief

Shawn Engelland
ATD-2 Sub-Project Manager
Outline

• Introduction

• Technical Approach

• Technology Transfer

• Partnerships
Key Events During Formulation

Early 2014
NASA begins ATD-2 planning

Oct 2014
FAA and NAC† deliver “NextGen Priorities Joint Implementation Plan” to Congress

Oct – Mar
FAA and NASA explore collaboration on ATD-2

Mar 31
FAA informs NAC† of intent to collaborate with NASA on ATD-2 to evaluate the integration of departure metering that reflects the FAA’s Surface CDM ConOps

April
NASA and FAA jointly assess sites for ATD-2 demonstration

May 12
FAA announces Charlotte Douglas International Airport (CLT) as ATD-2 demonstration site

May 22
Kickoff for FAA-to-NASA Surface CDM tech transfer

Jun 22
FAA/NASA executive deep dive at NTX

Jul 16
VIP Kickoff at CLT

Jul 29
FAA/NASA executive deep dive at ARC

Aug 18-19
Stakeholder summit at CLT

Sep 16-17
Stakeholder deep dive at NTX

Sep 30
Initial draft of ATD-2 Project Plan delivered to FAA/NASA IADS RTT

Oct 15
Stakeholder engagement with Surface CDM Team

Nov 17
Sub-Project Formulation Review before FAA/NASA independent panel

FAA/NASA Collaboration Notes
† FAA NextGen Advisory Committee
⭐ FAA AA for NextGen (ANG-1) events

Sep 2016
ATD-2 system installation at CLT

Sep 2017
ATD-2 demonstration commences
GOAL  ATD-2 will improve the predictability and the operational efficiency of the air traffic system in metroplex environments through the enhancement, development and integration of the nation’s most advanced and sophisticated arrival, departure and surface prediction, scheduling and management systems.

• **Predictability**: Reduce the variability of aircraft movement times
• **Efficiency**: Manage and schedule operations to reduce aircraft movement times and fuel burn by leveraging enhanced predictability
• **Throughput**: Maintain or improve metroplex airspace throughput

OBJECTIVES

• Demonstrate improved aircraft arrival, departure and surface movement predictability and efficiency by integrating evolving collaborative decision-making capabilities with state-of-the-art air traffic management scheduling technologies.
• Enable effective use of collaborative decision making by demonstrating efficiency gains through enhanced two-way sharing of prediction and scheduling information.
• Demonstrate Integrated Arrival/Departure/Surface (IADS) traffic management for metroplex environments.

OUTCOMES

• Demonstrate the ATD-2 technologies in an operationally relevant environment
• Quantify the benefits, performance, acceptability, and limitations of the ATD-2 technology
• Transfer an integrated set of technology to the FAA and airlines, airports, and suppliers.
Operational Environment for the ATD-2 Concept

Center airspace
Terminal airspace
Well-equipped airport
Gate
Spot
OFF Queue
OFF Departure meter points
Arrival meter point
Departure meter points
Center boundary
Overhead stream insertion
Downstream demand/capacity imbalance
Departure meter points
Arrival meter point
Terminal airspace
Less-equipped airports
OFF Departure Metering
OFF Queue
OFF Spot
OFF Gate
Contributing Technologies:
FAA Decision Support Systems

DSS components: 3Ts are the engines of DSS

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.
TFDM Electronic Flight Data (EFD)
• A key element of TFDM is electronic flight data interfaces (a.k.a. electronic flight strips) for Tower controllers
• FAA is deploying the Advanced Electronic Flight Strips (AEFS) prototype as part of TFDM early implementation
• FAA plans to deploy AEFS at: PHX, CLE, EWR, SFO, LAS, and CLT
• ATD-2 depends on FAA deployment of AEFS or alternative TFDM EFD solution at CLT

Surface Collaborative Decision Making (CDM)
• Extend CDM principles to surface domain by developing:
  – Concept of Operations (ConOps)
  – Process, Procedures and Policies (P3)
• Collaboration between FAA and industry led by Surface Office and Surface CDM Team
• ConOps features a ration-by-schedule departure metering algorithm that produces Target Movement Area entry Times (TMATs)
• FAA has transferred Surface CDM concept and technology to NASA for ATD-2
Spot and Runway Departure Advisor (SARDA)
• Builds an optimal runway schedule
• Generates spot release sequence and timing
• Determines when to push back from gates
• 2013-2014 six high-fidelity HITLs of SARDA ramp tool configured for CLT
• Collaboration with US Airways/American Airlines

Precision Departure Release Capability (PDRC)
• Improve tactical departure scheduling through Tower/Center data sharing
• Surface trajectory based OFF times and runways used by TBFM scheduler
• 2012-2013 operational evaluation at DFW
• Follow on PDRC++ work extended tactical departure scheduling to Metroplex:
  – terminal constraints
  – less-equipped airports
Contributing Technologies

Chart focuses on buildup to initial 2017 demo. ATD-2 continues through 2020

- **2010**
  - SARDA ATC Tower
  - PDRC
  - Surface CDM ConOps
  - TFDM pre-acquisition and early implementation
  - TBFM
  - TFMS

- **2011**
  - SARDA Ramp Tower
  - PDRC++

- **2012**
  - ATD-2

- **2013**
  - Surface CDM P3

- **2014**
  - RFP
  - EFD
  - IDAC

- **2015**
  - Release 13

- **2016**
  - FAA DSS
  - R&D
  - Tech Transfer
Operational Concept Graphic (OV-1)

Airspace Components
- Integrate TBFM/IDAC with ATD-2 surface system
- Improve TBFM departure trajectory predictions
- Departures into overhead and metered arrival streams
- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
- Explore departure controller advisory requirements

Surface Components
- TFDM EFD is controller interface to ATD-2 scheduling and metering
- Better predictability improves TMI compliance
- Tactical pushback advisories build on SARDA research
- Manage ramp traffic and meet strategic TMATs
- Ramp and gate status and intent information
- Builds on Surface CDM concept engineering effort
- Identify need to meter and compute ration-by-schedule strategic TMATs
- Accommodate airline priorities
- Earliest off block times
- Airline priorities via CDM
- Flight data
- Airport conditions
- Additional flight operators

External interfaces via SWIM and SWIM extensions
- Strategic TMIs
- Surface delays
- Multi-center coordination
- Information exchange with commercial applications
- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
- Explore departure controller advisory requirements

Industry Apps
- Earliest off block times
- Airline priorities via CDM
- Flight data
- Airport conditions
- Additional flight operators
- Strategic TMIs
- Surface delays
- Multi-center coordination
- Information exchange with commercial applications
- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
- Explore departure controller advisory requirements

Surface CDM
- Tactical departure scheduling builds on IDAC and PDRC
- Manage traffic to satisfy TMIs and departure metering

Ramp Control
- Tactical pushback advisories build on SARDA research
- Manage ramp traffic and meet strategic TMATs
- Ramp and gate status and intent information

Airline Ops
- Earliest off block times
- Airline priorities via CDM
- Flight data

Airline Apps
- Earliest off block times
- Airline priorities via CDM
- Flight data

Airport Ops
- Airport conditions
- Additional flight operators

Surface CDM
- Strategic TMIs
- Surface delays
- Multi-center coordination

Surface CDM
- Information exchange with commercial applications

External interfaces via SWIM and SWIM extensions
- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
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Airspace Components
- Tactical departure scheduling builds on IDAC and PDRC
- Manage traffic to satisfy TMIs and departure metering

ATCT TMU
- Tactical departure scheduling builds on IDAC and PDRC
- Manage traffic to satisfy TMIs and departure metering

ARTCC
- Integrate TBFM/IDAC with ATD-2 surface system
- Improve TBFM departure trajectory predictions
- Departures into overhead and metered arrival streams

TRACON
- Local TMIs and demand predictions for all airports
- Metroplex coordination and planning functions
- Explore departure controller advisory requirements

ATCSCC
- Strategic TMIs
- Surface delays
- Multi-center coordination

Industry Apps
- Information exchange with commercial applications

Surface CDM
- Earliest off block times
- Airline priorities via CDM
- Flight data

Surface CDM
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Surface CDM
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External interfaces via SWIM and SWIM extensions
- Information exchange with commercial applications
Previous investments form a solid foundation for…

**ATD-2 system development and integration.**

**Interface TFDM EFD with ATD-2 System**

**FAA TFDM EFD**
- Early implementation
- AEFS prototype in use at PHX and upgraded version being tested at CLE
- Prototype s/w and h/w requirements provided to NASA

**Industry/FAA Surface CDM**
- 5-year concept engineering effort
- ConOps, requirements, P3 info and prototype system provided to NASA

**Fusion of Surface CDM strategic metering times with SARDA tactical pushback advisories**

**FAA TBFM/IDAC**
- Operational deployment underway
- Latest version running with live data in NASA labs

**Re-implement PDRC to take advantage of IDAC features**

**NASA PDRC research**
- Built on FAA’s TBFM system
- Demonstrated at DFW in 2012-2013

**Re-implement PDRC and SARDA data sharing features to align with FAA SWIM architecture**

**NASA SARDA research**
- High-fidelity CLT simulations in 2013-2014
- Prior groundwork for CLT field evaluation
System Architecture – Simplified
Field Demonstration Strategy

Engineers assess readiness for shadow evaluation by operators
Operators assess readiness for operational evaluation & use

Commitments to FAA
Sep 2016  ATD-2 system installation at CLT
Sep 2017  ATD-2 demonstration commences
Sep 2018  interim technology transfer
Sep 2019  interim technology transfer
Sep 2020  final technology transfer

ATD-2 High Level Schedule – For NASA Internal Use

FY16  FY17  FY18  FY19  FY20
11/4/15

Key Dates
1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q 1Q 2Q 3Q 4Q

Shadow Eval Readiness (SER)
Op Eval Readiness (OER)
System Releases: Major (dark), Minor (light)
Engineering Shadow Eval (ESE)
Operational Shadow Eval (OSE)
Operational Eval & Use Phased System Demos
Tech Transfers (TT)

ATD-2

Chart Legend
Development
Field Activity
Tech Transfer

Development
Phase 1: Baseline IADS
Phase 2: Fused IADS
Phase 3: Metroplex IADS
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 s
- Mature strategic Surface CDM capability via operational use, analysis, and feedback
- Reduce ATCT workload by replacing paper strips with EFD

Airspace Components
- CLT ATCT TMU position
- Tactical departure scheduling capability via SDSS display
- ZDC or ZTL TMU
- Tactical departure scheduling via modified TBFM/IDAC

Surface Components
- CLT ATCT control positions
- Baseline electronic flight data capability via TFDM EFD
- AAL ramp controller and manager positions
- Tactical pushback advisories via RTC/RMTC display
- All positions as needed
- Predictive mode: strategic metering info for situational awareness and analysis

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

Ramp Control
- AAL ramp controller and manager positions
- Tactical pushback advisories via RTC/RMTC display

Surface CDM
- All positions as needed
- Predictive mode: strategic metering info for situational awareness and analysis

ATCT Control
- CLT ATCT control positions
- Baseline electronic flight data capability via TFDM EFD

ATCT TMU
- CLT ATCT TMU position
- Tactical departure scheduling capability via SDSS display

ARTCC
- ZDC or ZTL TMU
- Tactical departure scheduling via modified TBFM/IDAC
Phase 2: Fused IADS Demonstration

Phase 2 Demonstration Goals
- Evaluate the Fused IADS system capability
- Demonstrate benefits of strategic surface metering during periods of significant demand/capacity imbalance
- Enhance tactical surface metering to improve non movement area predictability and throughput
- Evaluate inclusion of IADS data on EFD
- Expand to demonstrate more scheduling scenarios for Washington and Atlanta Centers

Surface Components
- Phase 1 capability plus:
  - Interfaces to external systems via SWIM plus ATD-2 SWIM extensions

ATCT Control
- Phase 1 capability plus:
  - Include IADS info on EFD

Ramp Control
- Phase 1 capability plus:
  - Fused scheduler pushback advisories honor strategic TMATs
  - Prescriptive mode: strategic TMATs applied as constraints in fused scheduler

Surface CDM
- Phase 1 capability plus:
  - Ramp Control

Airspace Components
- Phase 1 capability plus:
  - Improvements as needed
  - Expand to ZTL or ZDC TMU
  - Integrate with arrival metering

ATCT TMU
- CLT TRACON TMU
- ATD-2 UI for TMI entry and situational awareness

ARTCC
- ATCSCC

Airline Ops
- Interfaces to external systems via SWIM plus ATD-2 SWIM extensions
Phase 3: Metroplex IADS Demonstration

**Phase 3 Demonstration Goals**
- Evaluate the Metroplex IADS system capability
- Integrate EFD with ATD-2 scheduling
- Mature and enhance core ATD-2 capabilities
- Enhance CLT tactical surface metering to improve movement area predictability and throughput
- Reduce delay and increase throughput under Metroplex departure constraints  
  [NOTE: Metroplex Coordinator to be demonstrated for DFW TRACON (D10) environment via HIL or field experiment]

**Surface Components**
- ATCT Control
  - Phase 2 capability plus:
  - Integrate EFD with ATD-2 scheduling and metering
- Ramp Control
  - Phase 2 capability plus:
  - Improvements as needed
- Surface CDM
  - Phase 2 capability plus:
  - Improvements as needed

**Airspace Components**
- ATCT TMU
  - Phase 2 capability plus:
  - Improvements as needed
- ARTCC
  - Phase 2 capability plus:
  - Improvements as needed
- TRACON
  - Phase 2 capability plus:
  - Metroplex coordinator implemented for DFW TRACON (D10) environment

Interfaces to external systems via SWIM plus ATD-2 SWIM extensions
Facility Utilization

• **CLT Operational Facilities (CLTops)**
  - FAA Air Traffic Control Facilities
    • CLT ATCT, CLT TRACON, Atlanta ARTCC (ZTL), Washington ARTCC (ZDC)
  - Air carrier operational facilities
    • AAL CLT Ramp Tower, AAL Integrated Operations Control (IOC), other air carrier facilities [possible]

• **ATD-2 Field Laboratory (CLTlab)**
  - A dedicated NASA computer laboratory on the premises CLT airport
  - CLTlab will support shadow evaluations, training, data collection, and other on-site ATD-2 activities

• **NASA Ames facilities**
  - North Texas Research Station (NTX)
    • Shakedown testing to reduce risk prior to deploying ATD-2 systems to CLT
  - Verification and Validation Lab (V&V Lab)
    • Unit-level and system-level testing for all ATD-2 system releases
  - Simulation facilities

• **FAA William J. Hughes Technology Center (WJHTC)**
  - Data feeds including primary SWIM interface for ATD-2
  - May support regression and non-interference testing of ATD-2 modifications to TBFM and TFDM EFD
Technology Transfer Strategy

• Intentional approach to technology transfer
  – Technology transfer is a Level 1 requirement
  – ATD-2 system architecture is designed to facilitate tech transfer
    • Uses FAA TBFM/IDAC (v4.4) system with minimal enhancements
    • Leverages FAA TFDM system requirements and interface specifications
    • Uses Surface Data Elements delivered via FAA TFMS (Release 13)
    • Follows FAA SWIM model for data feeds and external communication
  – Follows ATD-1 model for development of system requirements and design documents to facilitate technology transfer

• NASA to FAA technology transfer
  – NASA will engage with FAA AJV and AJM organizations via IADS RTT to ensure that timing and content of technology transfers are aligned with FAA needs
  – Enhancements to FAA Decision Support Systems tools (i.e. 3Ts) and SWIM will be fully documented as deltas to reference versions known to the FAA

• NASA to industry technology transfer
  – Regular engagement with industry partners
  – ATD Industry Day set for 13 Jan 2016
  – System architecture designed to enable industry solutions
Current Partnerships

Federal Aviation Administration (FAA) multiple organizations led by NextGen (ANG)
- Interagency partnership coordinated via IADS RTT provides for:
  - Participation by and routine access to SMEs at participating facilities
  - Data (flight plan, surveillance, TMI, SWIM, etc.) for all participating facilities
  - Decision support system (e.g. TBFM, TFMS, etc.) s/w and information
  - Surface CDM departure metering prototype s/w and information
  - ATD-2 user interfaces in operational areas at all participating facilities
  - TFDM EFD system interfaced to ATD-2 at participating Towers

American Airlines (AAL)
- FAA-designated lead carrier for ATD-2
- Nonreimbursable Space Act Agreement (originally with US Airways) provides for:
  - Participation by and routine access to SMEs at participating facilities
  - Data for all participating facilities
  - ATD-2 user interfaces in operational areas at all participating facilities

Charlotte Douglas International Airport (CLT)
- Nonreimbursable Space Act Agreement (under development) provides for:
  - Dedicated ATD-2 computer laboratory space
  - Airport information and data feeds
  - Communications and logistics support

National Air Traffic Controllers Association (NATCA)
- FAA/NATCA agreement provides for designated NATCA representatives to serve in a collaborative and expert capacity in the planning, development, and testing of all air traffic control modernization projects including ATD-2
- Statements of support and the cooperation of NATCA Leadership
Summary

• Technical approach builds on solid foundation
  – Leverages previous investments by NASA, FAA, and industry

• Sub-project status
  – Formulation review complete and implementation underway

• Partnerships
  – Collaboration with key partners underway
  – Exploring opportunities for additional partnerships
## Acronyms (1 of 3)

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<th>ACRONYM</th>
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<tr>
<td>3T</td>
<td>TFMS, TBFM, and TFDM</td>
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## Acronyms (2 of 3)

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<td>Federal Aviation Administration</td>
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<td>Integrated Display System</td>
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<td>LGA</td>
<td>LaGuardia Airport</td>
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<td>Minutes-in-Trail</td>
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<td>Measure of Performance</td>
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<td>N90</td>
<td>New York TRACON</td>
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<tr>
<td>NAC</td>
<td>NextGen Advisory Committee (FAA)</td>
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<td>NARP</td>
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<td>Next Generation Air Transportation System</td>
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<td>NM or NMI</td>
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<td>NASA Procedural Requirement</td>
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<td>OEU</td>
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<td>OIA</td>
<td>Operational Integration Assessment</td>
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<td>Other Government Agency</td>
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<td>PDC</td>
<td>Pre-departure Clearance</td>
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<td>Precision Departure Release Capability</td>
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<tr>
<td>PIC</td>
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<tr>
<td>PM</td>
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<td>RBS</td>
<td>Ration By Schedule</td>
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<td>ACRONYM</td>
<td>ACRONYM DEFINITION</td>
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<td>Runway Departure Rate</td>
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<td>RTC</td>
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<td>RTCA</td>
<td>(formerly) Radio Technical Committee on Aeronautics (not in Form. Review or ConUse)</td>
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<td>SA</td>
<td>System Architect</td>
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<td>Science Applications International Corporation</td>
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<td>SARDA</td>
<td>Spot and Runway Departure Advisor</td>
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<td>SBIR</td>
<td>Small Business Innovative Research</td>
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<td>SDSS</td>
<td>Surface Decision Support System</td>
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<td>Scheduled Departure Time</td>
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<td>SE</td>
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<td>Strategic Implementation Plan</td>
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<td>Safety and Mission Assurance</td>
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<td>SOA</td>
<td>Surface Operation Automation</td>
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<td>SOAR</td>
<td>Sharing of Airspace Resources</td>
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<td>Sub-Project Manager</td>
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<td>SRR</td>
<td>Systems Requirements Review (not in either)</td>
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<td>STAR</td>
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<td>STARS</td>
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<td>STBO</td>
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<td>STMC</td>
<td>Supervisory Traffic Management Coordinator</td>
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<td>SUA</td>
<td>Special Use Airspace (not in either)</td>
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<th>ACRONYM DEFINITION</th>
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<td>Time Based Flow Management</td>
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<td>TC</td>
<td>Technical Challenge</td>
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<td>Terminal Flight Data Manager</td>
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<td>TFM</td>
<td>Traffic Flow Management</td>
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<td>TFMS</td>
<td>Traffic Flow Management System</td>
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<td>TIM</td>
<td>Technical Interchange Meeting</td>
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<td>Traffic Management Advisor</td>
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<td>TMAT</td>
<td>Target Movement Area entry Time</td>
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<td>TMC</td>
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<td>TMI</td>
<td>Traffic Management Initiative</td>
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<td>Traffic Management Unit (FAA)</td>
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<td>Target Off Block Time</td>
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<td>TOC</td>
<td>Top Of Climb (?)</td>
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<td>TOD</td>
<td>Top of Descent (?)</td>
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<td>Terminal RADAR Approach Control</td>
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<td>TRL</td>
<td>Technology Readiness Level</td>
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<td>TSAS</td>
<td>Terminal Sequencing and Spacing (formerly, TSS)</td>
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<td>TT</td>
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<td>Target Takeoff Time</td>
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<td>UI</td>
<td>User Interface (?) (slide #29, Form. Review)</td>
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<td>ZTL</td>
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