Airspace Technology Demonstration 2
(ATD-2)

ATD-2 CLT Pilot Community Engagement
Feb 23, 2017

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Objectives of This Meeting

• Introduce ATD-2 to the CLT pilot community

• Describe likely areas of procedural change (and benefit) to current day CLT procedures in ATD-2 Phase 1

• Identify ATD-2 representatives from each organization

• Describe opportunities for future engagement

• Survey data elements and capability pilots may desire in later phases of ATD-2
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Field Demo Partners
Goals of ATD-2

1. **Predictability**
2. **Aircraft Movement Efficiency**
3. **Delays**
4. **Fuel Usage**
3T Data Exchange & Integration
- Integrated Arrival/Departure/Surface (IADS) footprint
- Onboard into overhead stream (TFDM with IDAC)
- New data shared between FAA & Industry
- TFDM Electronic Flight Data (EFD) integration
- Real-time dashboard for situational awareness
- Use of controller assigned runway and time on surface

Surface modeling, scheduling & metering
- Trajectory based model of airport operations
- Latest predictions of flight scheduled out/off/on/in
- Scheduling for tactical and strategic timeframes
- Surface Collaborative Decision Making (S-CDM)
- Predictive capacity estimation technology
**Field Demonstration Strategy**

Evaluation Requirements Freeze (FRZ) assesses current system capability against Field Demo Partner desires and constraints. A joint decision establishes parameters for the upcoming demonstration phase.

### ATD-2 High Level Schedule – For NASA Internal Use

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<thead>
<tr>
<th>FY16</th>
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<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
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<tr>
<td>1Q</td>
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<td>SER0</td>
<td>V1.0</td>
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<td>ESE0</td>
<td>ESE1</td>
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<td>OER1</td>
<td>OER2</td>
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<td>FRZ1</td>
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<td>FRZ3</td>
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<td>V3.x</td>
<td>V4.x</td>
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<td>V.1x</td>
<td>V.2x</td>
<td>V.3x</td>
<td>V.4x</td>
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### Key Dates

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

### Decision Points

- **Phase 1: Baseline IADS**
- **Phase 2: Fused IADS**
- **Phase 3: Metroplex IADS**

### Commitments to Demo Partners

- 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

IADS = Integrated Arrival, Departure, and Surface Operations
Working our Way Up the S-CDM Pagoda

Today’s Focus

Procedures, Roles and Responsibilities

Surface Metering

Surface Scheduling

Surface Modeling

Surface Surveillance

Data Exchange and Integration

Departure Reservoir Management
Tactical Surface Metering Concept

- Estimates capacity of current and future runway resources
- Builds an efficient runway schedule based on readiness, EOBT and RBS
- Calculates spot advisories that support the metered runway schedule
- Provides push back advisories from gates that support the spot advisories
TRACON estimated to start offloading flights to 18C here, which lowers 18C departure rate for the remainder of the departure push.

TRACON scratchpad entries are helpful for arrival runways, but only about 12-15 minutes prior to landing.
Runway utilization intent from ATC is used by the tactical scheduler to determine the capacity for a bank.

Information used in tactical scheduler capacity estimate:
- Use of converging runway
- Arrival crossings
- Mixed/dual use runways
- Meteorological conditions (IMC, VMC)
- Flight separation rules (wake vortex, departure fix)
- Flights subject to FAA restriction (MIT, EDCT, APREQ)
- Runway and taxiway outages
- Arrival ON time and runway information from R-TBFM
Phase 1 Initial Deployment for Metering

Flights on surface vs. Time of Day (z)

- 18C
- 36C
- 18L
- 36R

Bank-2
Key Events – 6 Month Forward Look

- Feb 22 & 23 – Shadow 7 - CLT pilot engagement
- Week of Mar 5th – HITL at NASA Ames leading to FRZ1
- Week of Mar 20 – Shadow Area Q&A at CLT leading to FRZ1
- Mar 28 – Open lab (all day)
- Mar 29 – Demonstration Requirements Freeze (FRZ1)
- Apr 25-27 – Engineering Shadow Evaluation 1 (ESE1) - A
- May 30-June 1 – ESE1 - B
- June 27-29- ESE1 – C and OSE1 readiness decision
- July-Sept Operational Shadow Evaluation 1 (OSE1)
## Agenda

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What does ATD-2 mean for Pilots?

Goals of ATD-2

Our goal is to minimize pilot procedural changes while maximizing benefits for pilots. To do this, we need your input:
- How will ATD-2 affect your procedures?
- What training will pilots need?
- What information do pilots need; when and how?
- How can pilots help support the overall goals of ATD-2?
ATD-2 Goal: Support efficient operations (from gate to overhead-stream insertion) using Coordinated Surface-Management Technology, and Collaborative-Decision Making.
Increased System Efficiency: What does it mean for Pilots?

- Earlier identification of gate conflicts
- Hold at gate rather than at runway; Shorter runway queues
- Less stop-and-go taxi
- Conformance to ATC-issued take-off times to meet flow control

Pilot Benefit: Coordinated transit from Gate to Overhead Stream for more efficient taxi with less delay
Goal: Increase Predictability

ATD-2 Goal:
- Provide accurate and reliable estimates of gate hold times.
- Provide predictable take-off times and queues
Increased Predictability: What does it mean for Pilots?

Manage work flow:
- Start 2\textsuperscript{nd} engine
- Cabin preparation
- Checklists

Manage delay; Deciding when to:
- Board passengers
- Add fuel
- Push or wait at gate with engines off

Managing Passenger Expectations

Manage time constraints:
- Wheels-Up times
- Long-on-board times
- Crew-duty times

Pilot Benefit:
- Accurate and reliable estimates of gate hold times and delay
- Take the guess-work out of meeting EDCT and wheels-up times
Goal: Early and Accurate Information

ATD2 Goal: Share information among all operators in a timely manner to support efficient operations.
Early and Accurate Information: What does it mean for Pilots?

Improved Safety
- Reduce pilot workload during taxi
- Reduce eyes-in time

Improved Efficiency
- Reduce possibility of arriving at departure runway before ready to take-off

Pilot Implication: Receive accurate information earlier (i.e., at the gate, not at the spot or during taxi).
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Phase 1: Procedures

1. Communicating Expected Runway
2. Surface Metering
3. Tactical Flow Control / Wheels-Up Time (APREQ/CFR)
4. Expect Departure Clearance Time (EDCT)
5. Departure Fix Closures
Runway Assignment

Communicating earlier and more consistently:
• Expected runway assignment,
• Specification of runway for operational necessity,
• Runway requests for convenience / efficiency
### Runway Assignment

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| Pilots learn about their runway assignment in a variety of ways:  
  a. Knowledge of KCLT ops  
  b. Ramp Control  
  c. Ground Control | • Ramp will be equipped with ATC’s planned runway assignment  
  • Expected runway will be incorporated in pushback clearance phraseology | Pilot  
  Ramp  
  ATC | No  
  Yes  
  Yes |

**What does it mean for pilots?**

**Early and Accurate Information:** Pilots will know their runway earlier, allowing more time to prepare for departure.
Runway Assignment: Phase 1

Airline transmits EOBT to ATD-2 Scheduler

ATD Scheduler generates TTOT, TMAT, and TOBT

Scheduled Pushback Time

Push-30

Receive Departure Clearance

Call Ramp when ready to pushback

Ramp: Cleared to Push Expect Rwy 18C

EOBT = Earliest Off Block time (Aircraft Ready Time)
TTOT = Target Take-Off Time
TMAT = Target Movement Area Time (Release from Spot onto Airport Movement Area)
TOBT = Target Off-Block Time (Pushback)

Pushback without delay
## Runway Assignment

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<td>Operational Necessity</td>
<td>Pilots may specify need to Ramp or Ground Control. If ramp, Ramp communicates need to ATC.</td>
<td>Pilots should specify Operational Necessity to Ramp while at gate. Ramp will electronically communicate need to ATC.</td>
<td>Pilot Yes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Ramp Yes</td>
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<td></td>
<td></td>
<td></td>
<td>ATC Yes</td>
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### What does it mean for pilots?

**Early and Accurate Information:** Pilots will know their runway earlier (at gate), allowing more time to prepare for departure.

**Better Efficiency:** Early runway requests can be scheduled earlier and more efficiently.
Operational Necessity: Phase 1

Airline transmits EOBT to ATD-2 Scheduler

ATD Scheduler generates TTOT, TMAT, and TOBT

Receive Departure Clearance

Contact Ramp to specify Op. Necessity

Ramp Controller inputs runway to update ATD-2 scheduler

As soon as known

Scheduled Pushback Time

Call Ramp when ready to pushback

Pushback without delay

Ramp Traffic Console

Ramp Traffic Console

Ramp: Cleared to Push, Expect Rwy 18C
Surface Metering

Gate-hold metering may be applied when traffic demand exceeds runway capacity
Surface Metering

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| • In previous surface metering programs at KCLT, gate holds began when the number of aircraft at runway queue surpassed a static value. | • Predictive (Time-based metering) algorithms will consider a number of variables targeted at operational efficiency  
  • Ramp will be equipped with pushback advisories for each aircraft: Push or Hold for ‘x’ minutes. | Pilot Yes  
  Ramp Yes  
  ATC No |

What does it mean for pilots?

**Better Predictability:** The length of the gate hold will be known and reliable. Runway queue will be shorter and more predictable.

**Better Efficiency:** Delay will be taken at the gate, when possible, instead of at the runway. Less congestion in the ramp and AMA, reduced runway queue, reduced fuel burn and emissions.
### Surface Metering

<table>
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<tr>
<th>What is it?</th>
<th>The ramp controller will be using pushback advisories to release aircraft from the gate. The pushback advisory indicates either immediate pushback or gate-hold with a hold time.</th>
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| Which flights will be affected? | • In Phase 1, surface metering will begin in Bank 2 (~ 8:30 a.m. to 10:00 a.m.), this may expand to other banks.  
• All flights that do not have EDCT or Flow Control times will be subject to Metering. (No double delay)  
• Approximately 50% of the flights will receive gate holds |
| How will Pilot Procedures Change? | • There is no change in how/when pilots initiate contact with ramp control for pushback  
• If ramp clears the flight to pushback, flight proceeds as normal  
• If ramp issues a gate hold, remain at gate and contact ramp again at the specified time for immediate pushback |
Surface Metering: Phase 1

Airline transmits EOBT to ATD-2 Scheduler

ATD Scheduler generates TTOT, TMAT, and TOBT

Ramp Traffic Console

Pushback without delay

Scheduled Pushback Time

Receive Departure Clearance

Call Ramp when ready to pushback

No Gate Hold

Ramp: Cleared to Push, Expect Rwy 18C

Gate Hold

Ramp: Gate-Hold 3 minutes *

* 3 minute hold is an example only

Ramp Traffic Console

Wait 3 minutes Call Ramp

Ramp Traffic Console

Wait 3 Call Ramp

Ramp: Cleared to Push, Expect Rwy 18C

PUSH

PUSH

PUSH
Tactical Flow Control (APREQ/CFR)

Controlled Take-Off Times are negotiated between ATC and Center to slot aircraft into the overhead stream.

Typically negotiated close to departure time (~ 10 minutes)

ATC’s goal is to depart aircraft within a -2 minute / + 1 minute window

APREQ/CFR = Approval Request / Call for Release
Tactical Flow Control (APREQ/CFR)

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| Ramp Control is unaware of wheels-up times.                          | Flow control restrictions will be negotiated between ATC and Center and electronically communicated to Ramp. | Pilot  
Ramp  
ATC | TBD  
Yes  
No |
| No tools are available to help ramp / pilots meet wheels-up time.    | Ramp control tools will support pushback coordination and flight prioritization.                      | |
| Pilots are often unaware that they have a wheels-up time until AMA spot | These flights will not be subject to surface metering to avoid double delay.                         | |

**What does it mean for pilots?**

**Early and Accurate Information:** Pilots will know the wheels-up time at gate, before pushback.

**Better Predictability:** Ramp will know when to push aircraft in order to meet wheels-up time.

**Better Efficiency:** Delay can be taken at the gate, when possible, instead of at the runway. Improved scheduling into overhead stream.
Tactical Flow Control (APREQ/CFR): Phase 1

Airline transmits EOBT to ATD-2 Scheduler

ATC and Center negotiate Controlled Take-Off Time (CTOT)

ATD Scheduler generates TMAT, and TOBT to meet CTOT

Airline receives

Departure Clearance with Expect Flow Control

Contact CD for Wheels-Up Time

CD: Wheels-Up Time 2100

Ramp Console displays Wheels-Up Time (2100)

Call Ramp when ready to pushback

Ramp: • Cleared to Pushback
• Expect Rwy 18C
• ATC-Advised Wheels-Up Time of 2100

Pushback

Push -30 min

Pushback without delay
**Expect Departure Clearance Time (EDCT)**

**EDCT** is the runway release time (“Wheels Up”) assigned to aircraft due to Traffic Management Initiatives (TMIs) that require holding aircraft on the ground at the departure airport.

EDCT’s are typically known at least 30 minutes in advance, and are included in the PDC.

ATC’s goal is to depart aircraft within a -5 minutes / + 5 minute window.
## EDCT

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<td>• Pilots receive EDCT from company, CD, or PDC.</td>
<td>• No change</td>
<td>Pilot No</td>
</tr>
<tr>
<td>• Pilots estimate when to push to meet EDCT based on traffic congestion etc.</td>
<td>• Ramp will be equipped with tools and pushback advisories to enable EDCT conformance.</td>
<td>Ramp No</td>
</tr>
<tr>
<td>• Dispatch, ramp, ATC, CD, don’t always have the same EDCT times</td>
<td>• Ramp, and ATC share the same current EDCT information.</td>
<td>ATC No</td>
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<td>• EDCT flights are not subject to surface metering</td>
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**What does it mean for pilots?**

**Better Predictability:** Pilots will know when to pushback in order to meet EDCT time. Delay can be taken at the gate, when possible, instead of at the runway.
EDCT: Phase 1

Airlines transmit EOBT to ATD-2 Scheduler

EDCTs generated as per current operations

ATD Scheduler generates TMAT, and TOBT to meet CTOT

ATD Scheduler

Ramp Traffic Console

Receive Departure Clearance with EDCT

Call Ramp when ready to pushback

Ramp Console displays EDCT (2100)

Pushback

Pushback without delay

Ramp: Cleared to Push, expect Rwy 18C

Pushback, Taxi to Hardstand

Ramp: Cleared to Push, Taxi to hardstand

Hardstand

Ramp: Gate-Hold 30 minutes*

Gate Hold

Ramp: Clear to Push, expect Rwy 18C

Ramp Traffic Console

Monitor Ramp for release

Ramp tools manage hardstand release time

* example only

Wait 30 minutes Call Ramp

Push without delay

E2100

AAL705 A321 E BOBZY-SFO C6 9 18C P1856

AAL705 A321 E BOBZY-SFO T1941 9 18C
Communicating Long-On-Board Time

- Airline transmits EOBT to ATD-2 Scheduler
- ATD Scheduler generates TTOT, TMAT, and TOBT
- Airline transmits Off-block time

Receive Departure Clearance with EDCT
Call Ramp when ready to pushback
Pushback, taxi to Hardstand
Ramp: Cleared to Push, Taxi to hardstand
Ramp tools manage hardstand release time

60+ min
90+ min
120+ min
Departure Fix / Route Amendments

Departure Fixes may be closed or combined due to weather. This frequently occurs with short notice and therefore may require a change to the previously issued departure clearance.
## Departure Fix / Route Amendments

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| Departure fix closures are typically communicated to pilots by Ground Control, at the spot. | • Ramp will be equipped with Departure Fix Closure information  
• Ramp Control will communicate to pilots when departure fixes are closed and instruct pilots to contact CD | Pilot Yes  
Ramp Yes  
ATC No |

### What does it mean for pilots?

**Early and Accurate Information:** Pilots will know their departure route earlier, allowing more time to communicate with dispatch/clearance delivery and/or prepare for departure.
Departure Fix Change: Phase 1

Airlines transmit EOBT to ATD-2 Scheduler

ATD Scheduler generates TTOT, TMAT, and TOBT

ATC inputs Departure Fix closures and issues new route

Scheduled Pushback Time

Push-30

Receive Departure Clearance

Call Ramp when ready to pushback

Ramp Traffic Console

Fix Closed, Contact CD for new route.

Ramp: Clear to Push, Departure Fix Closed, Contact CD

Hold at Gate

AAL 1799 SFO- 24:15 18C

Pushback

Call Clearance Delivery

AAL 1799 TBD SFO- 24:15 18C

Fixed closed, No new route available

Ramp: JOJJO Closed, Stand-by for further instructions

Ramp: JOJJO Closed, Stand-by for further instructions

Hold at Gate

AAL 1799 SFO- 24:15 18C

Hold at Gate

AAL 1799 TBD SFO- 24:15 18C
Phase 1 Pilot Training Needs: Starting the Discussion

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<td>1. Runway Assignment</td>
<td>- Expected runway will be provided by Ramp</td>
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<td>- Pilot should specify operational necessity before pushback</td>
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<tr>
<td>2. Surface Metering</td>
<td>- Expect gate holds when Surface Metering is on</td>
</tr>
<tr>
<td></td>
<td>- Contact ramp promptly</td>
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<tr>
<td></td>
<td>- Push without delay when cleared</td>
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<tr>
<td>3. Tactical Flow Control</td>
<td>- Contact CD for wheels-up time</td>
</tr>
<tr>
<td>Wheels-Up Times</td>
<td>- Contact ramp and pushback promptly</td>
</tr>
<tr>
<td>4. EDCT</td>
<td>- Ramp will coordinate pushback to meet EDCT,</td>
</tr>
<tr>
<td></td>
<td>- Aircraft will remain at gate, unless gate conflict.</td>
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<tr>
<td>5. Departure Fix Closures</td>
<td>- Fix closures will be communicated by Ramp</td>
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<tr>
<td></td>
<td>- Flight will be held at gate if route not available, unless gate conflict</td>
</tr>
</tbody>
</table>
## Data Sharing Overview (Phase 1)

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Element</th>
<th>From Pilot/Airline</th>
<th>To Pilot</th>
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</thead>
<tbody>
<tr>
<td><strong>Runway Assignment</strong></td>
<td>Expected Runway Assignment</td>
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<tr>
<td></td>
<td>Operational Necessity Specification</td>
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<tr>
<td></td>
<td>Taxi for Convenience Request; on/off</td>
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<tr>
<td><strong>Airport Configuration</strong></td>
<td>Runway Utilization / Flow Direction</td>
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<tr>
<td></td>
<td>Departure fix closed/combined</td>
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<tr>
<td><strong>Aircraft/ Flight</strong></td>
<td>Long-on-board time</td>
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<td></td>
<td>Crew duty time</td>
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<tr>
<td><strong>Surface Metering</strong></td>
<td>Surface Metering on/off</td>
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<tr>
<td></td>
<td>Earliest Off Block Time (EOBT), Flight Ready time</td>
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<tr>
<td></td>
<td>Target Off Block time (TOBT), Pushback time</td>
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<td>Target Movement Area Time (TMAT), Spot Release</td>
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<td>Target Take-Off Time (TTOT), Departure Clearance</td>
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<tr>
<td><strong>Controlled Take-Off Times</strong></td>
<td>Expected Departure Clearance Time (EDCT)</td>
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<tr>
<td></td>
<td>Flow Control Wheels-Up time (APREQ / CFR)</td>
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<td></td>
<td>Miles In Trail (MIT)</td>
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</table>
# Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter</th>
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</thead>
<tbody>
<tr>
<td>0800</td>
<td>Opening Remarks and Introductions</td>
<td>Shawn Engelland</td>
</tr>
<tr>
<td>0830</td>
<td>ATD-2 Background and Context</td>
<td>Al Capps</td>
</tr>
<tr>
<td>0915</td>
<td>Current Operations and ATD-2 Solutions Primer</td>
<td>Becky Hooey</td>
</tr>
<tr>
<td>1000</td>
<td>Break</td>
<td>Break</td>
</tr>
<tr>
<td>1015</td>
<td>Phase 1 Procedures, Training expectations</td>
<td>Becky Hooey</td>
</tr>
<tr>
<td>1200</td>
<td>Lunch</td>
<td>Lunch</td>
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<tr>
<td>1300</td>
<td>Phase 1 Procedures, Training expectations (cont.)</td>
<td>Becky Hooey</td>
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<tr>
<td>1430</td>
<td>Future Opportunities to Engage, Q&amp;A</td>
<td>Al Capps</td>
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<tr>
<td>1445</td>
<td>Break</td>
<td>Break</td>
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<tr>
<td>1500</td>
<td>Research on Integrated Mobile Technology</td>
<td>FAA/MITRE</td>
</tr>
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</table>
Key Events – 6 Month Forward Look

- Feb 22 & 23 – Shadow 7 - CLT pilot engagement
  - Week of Mar 5th – HITL at NASA Ames leading to FRZ1
  - Week of Mar 20 – Shadow Area Q&A at CLT leading to FRZ1
  - Mar 28 – Open lab (all day)
  - Mar 29 – Demonstration Requirements Freeze (FRZ1)
  - Apr 25-27 – Engineering Shadow Evaluation 1 (ESE1) - A
  - May 30-June 1 – ESE1 - B
  - June 27-29- ESE1 – C and OSE1 readiness decision
  - July-Sept Operational Shadow Evaluation 1 (OSE1)
Backup

• Backup
Operational Concept Graphic (OV-1)

**Airspace Components**
- ARTCC
- TRACON
- 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**
- Ramp Control
- 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

**ATCT Control**
- TFDM EFD is controller interface to ATD-2 scheduling and metering
- Better predictability improves TMI compliance

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

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

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

**Airport Ops**
- Airport conditions
- Additional flight operators

**Industry Apps**
- Information exchange with commercial applications

**External interfaces via SWIM and SWIM extensions**

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

**Ramp Control**
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**Industry Apps**
- Information exchange with commercial applications

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**External interfaces via SWIM and SWIM extensions**
Operational Environment for the ATD-2 Concept

- Center boundary
- Center airspace
- Terminal airspace
- Departure meter points
- Arrival meter point
- Arrival meter points
- Departure meter points
- Downstream demand/capacity imbalance
- Overhead stream insertion
- Operational Environment for the ATD-2 Concept
- Less-equipped airports
- Well-equipped airport
- Departure Metering
- Queue
- Spot
- Gate
ATD-2 combines existing and emerging FAA technologies with technologies developed through NASA research to create an Integrated Arrival/Departure/Surface (IADS) traffic management system for the metroplex.

**ATD-2 IADS System**

- **TFDM** Terminal Flight Data Manager
  - Emerging tower tool with electronic flight data and Surface CDM capabilities

- **TBFM** Time Based Flow Management
  - Existing en route tool for time based scheduling of arrivals and departure into constrained flows

- **SARDA** Spot and Runway Departure Advisor
  - Tactical surface modeling and scheduling plus user interfaces for ramp area traffic management

- **PDRC** Precision Departure Release Capability
  - Uses trajectory-based surface information to improve en route tactical departure scheduling