



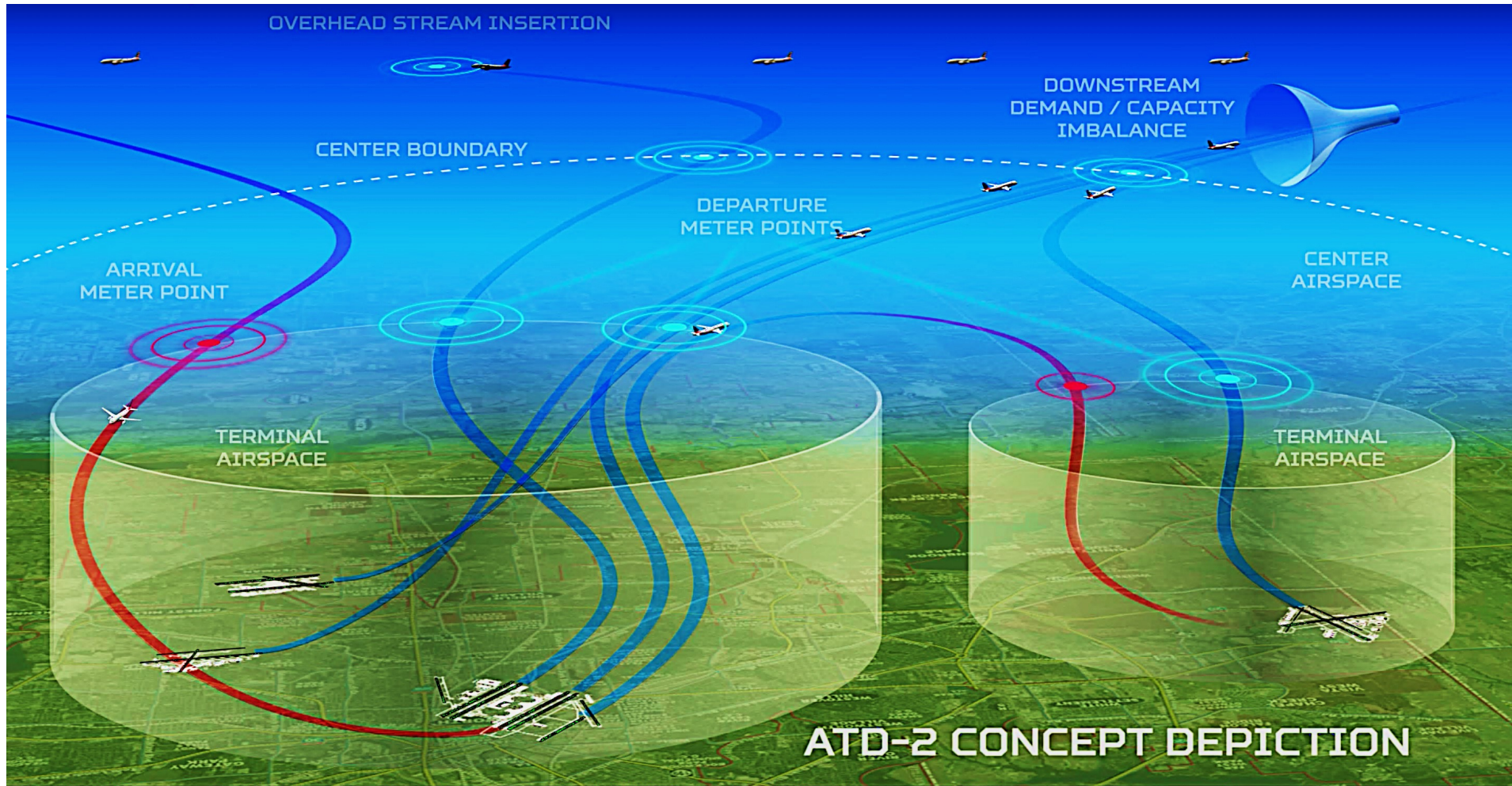
AERONAUTICS
WITH YOU WHEN YOU FLY

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

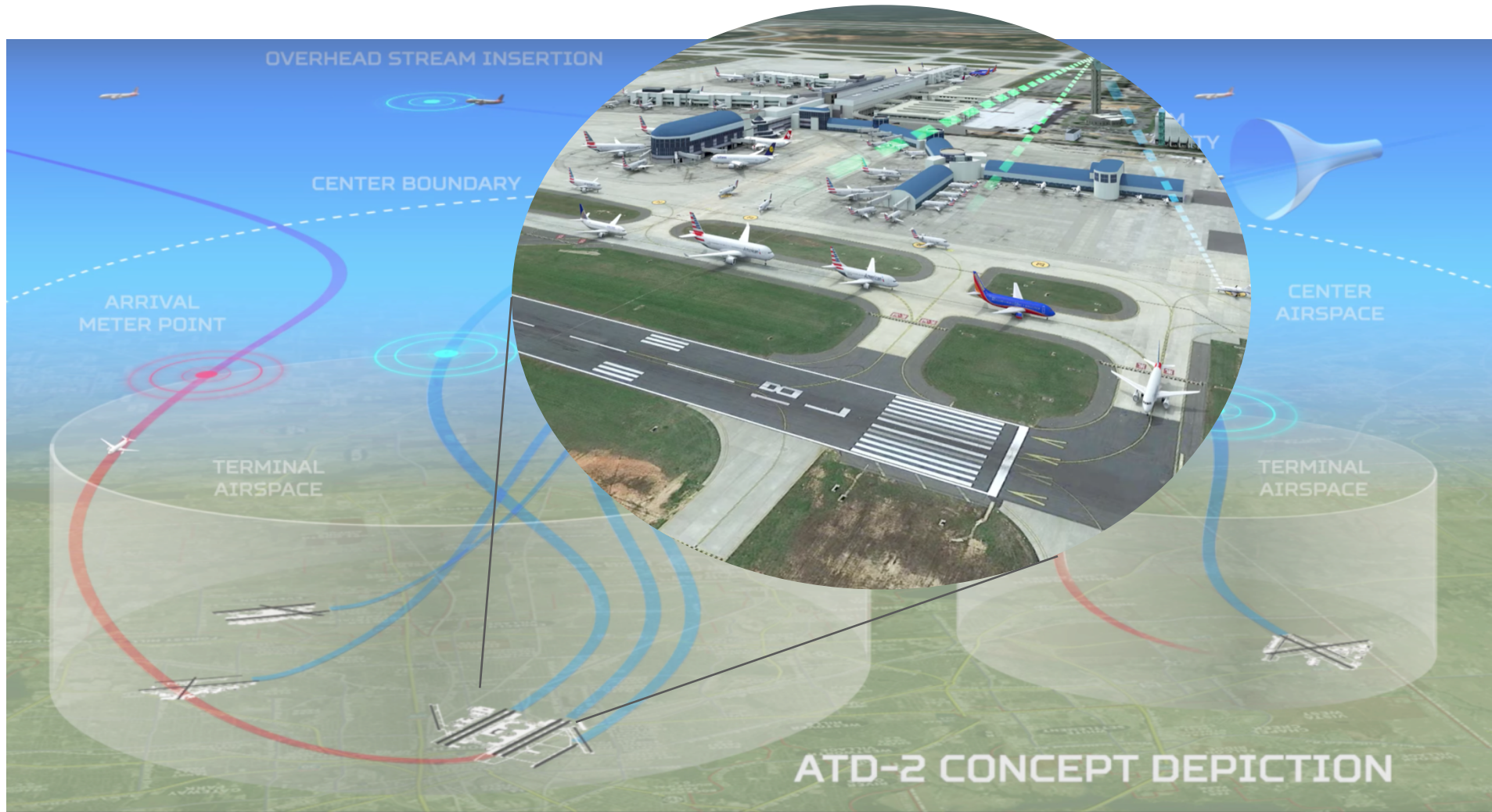
Shivanjli Sharma
NASA Ames Research Center

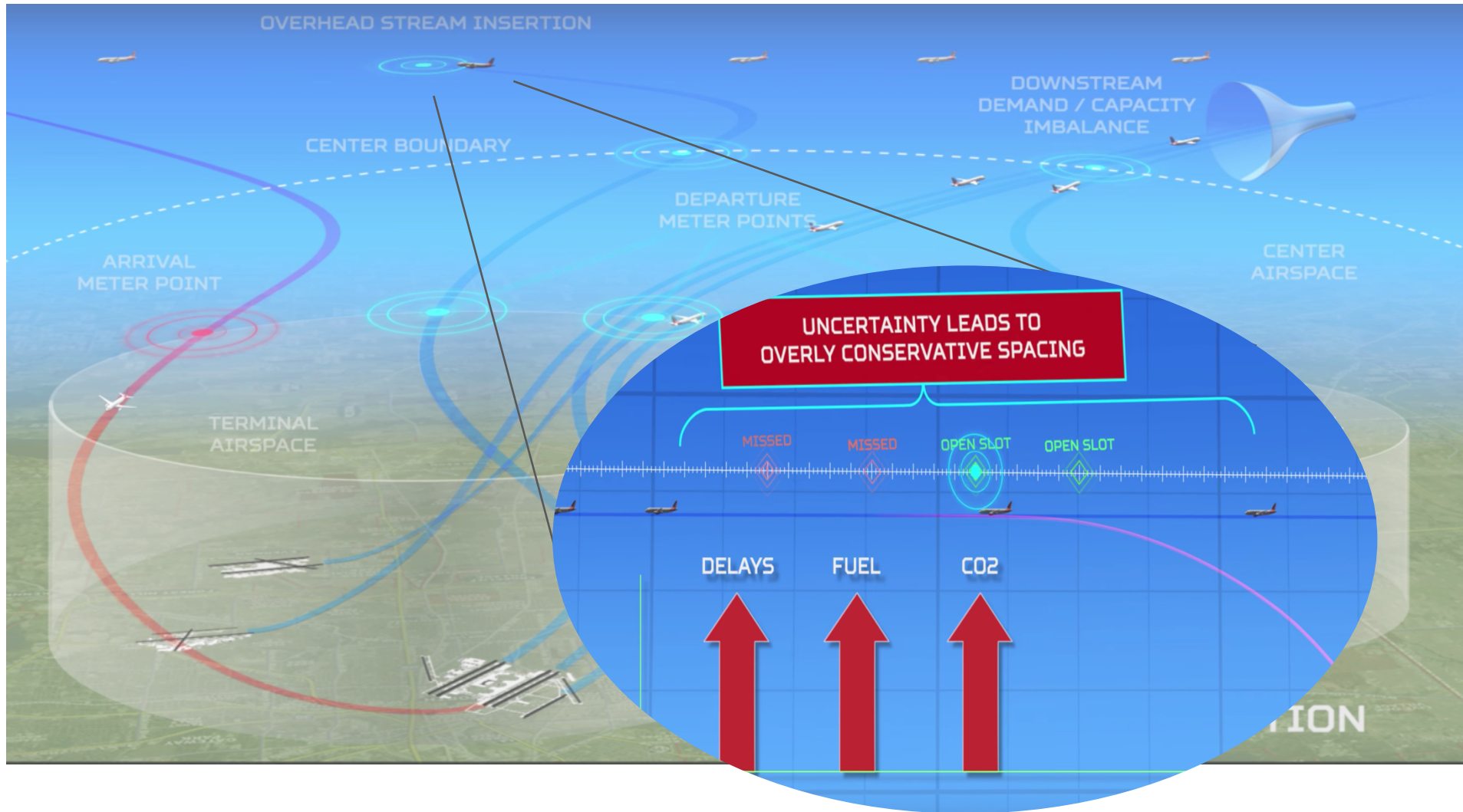
John Fergus
Human Solutions Inc

Aviation 2017, June 5-9, 2017



Airspace Technology Demonstration 2 (ATD-2)







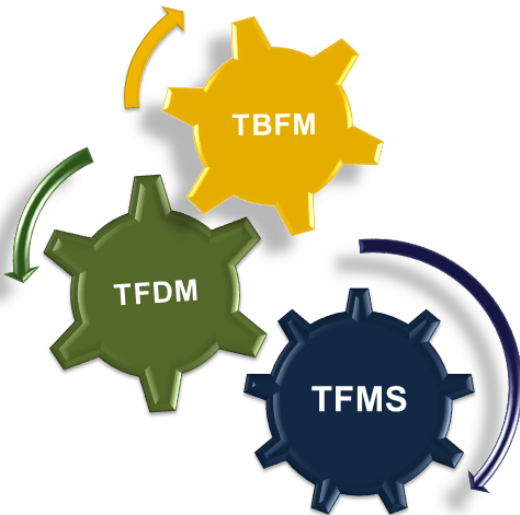
- Airspace Technology Demonstration 2 (ATD-2) Background
- Motivation for real time monitoring tool and analysis and method of developing requirements
- Description of data sources
- User interface and initial metrics
- Next steps



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CDM
Collaborative
Decision Making



Traffic Flow Management System (TFMS)

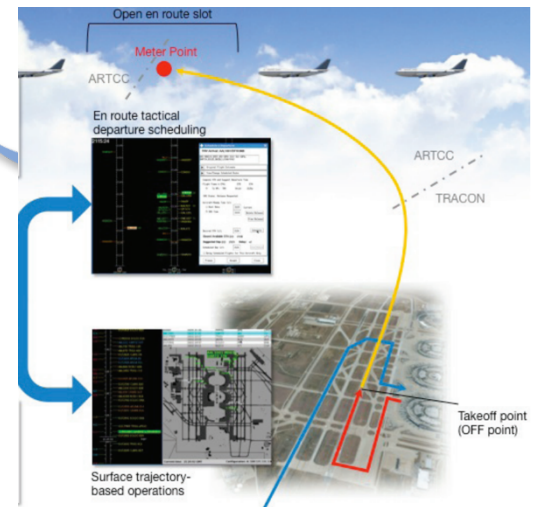
Decision support system for planning and mitigating demand-capacity imbalances in the NAS.

Time-Based Flow Management (TBFM)

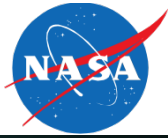
Decision support system for metering based on time to optimize the flow of aircraft.

Terminal Flight Data Management (TFDM)

A new decision support system for airport surface management and ATC tower functions.



Precision Departure Release Capability (PDRC)



ATD2



Charlotte-Douglas
INTERNATIONAL AIRPORT

American Airlines





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Airline Operations

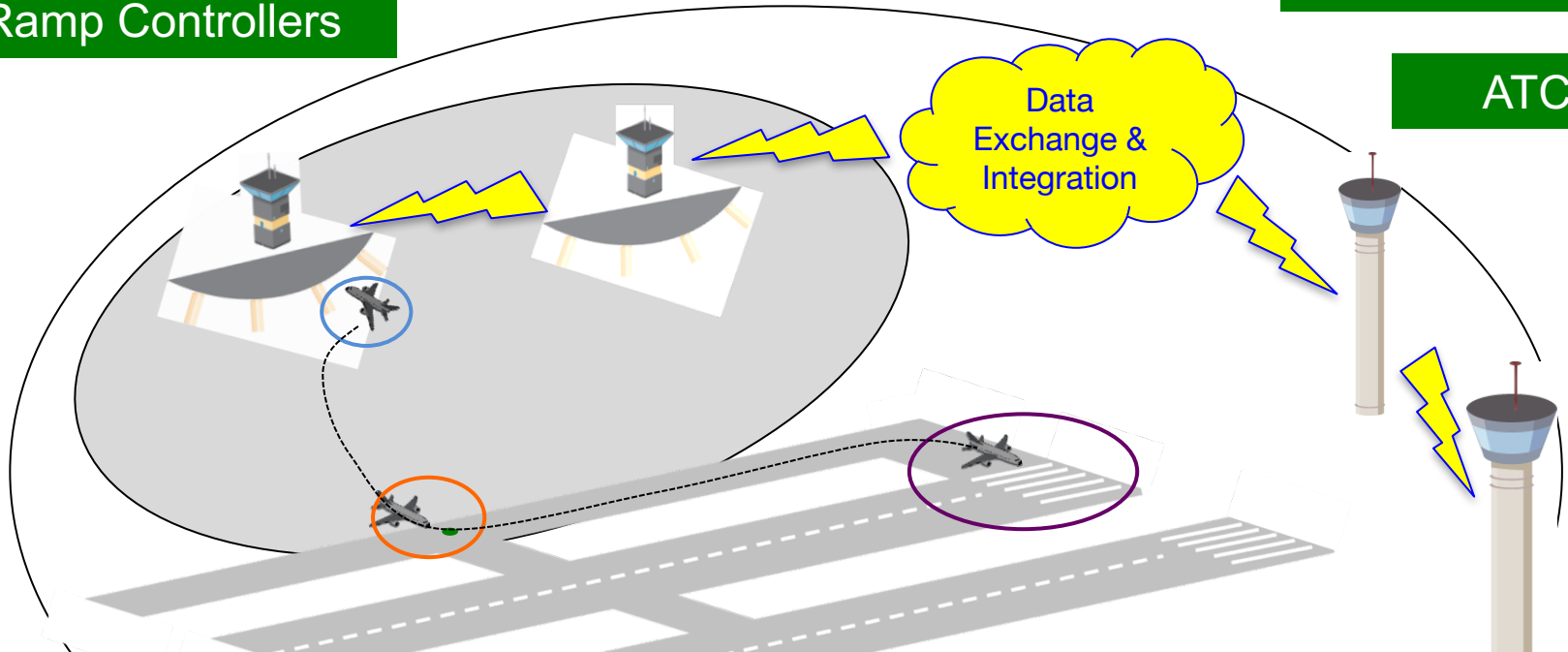
ARTCC

Airport Operations

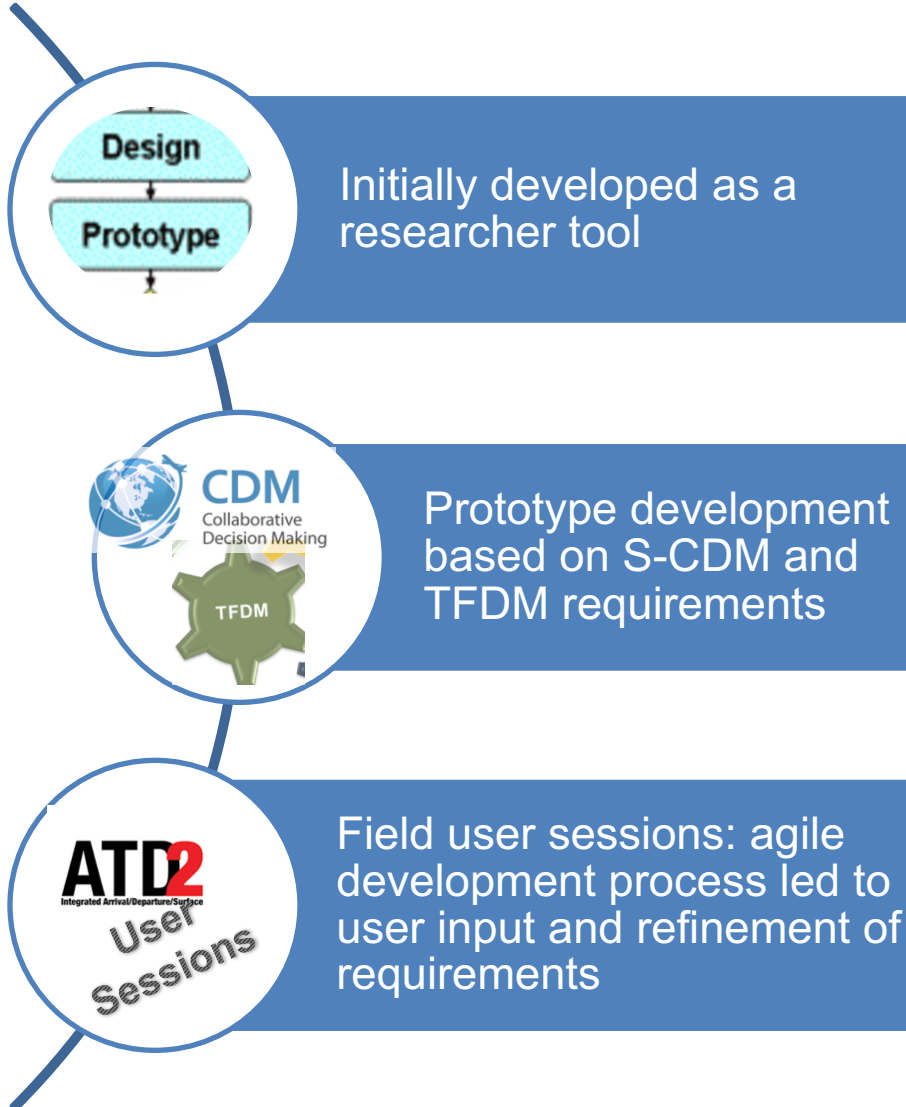
TRACON

Ramp Controllers

ATCT



<i>Flow Direction</i>	<i>APREQs/CFRs</i>	<i>MIT restrictions</i>	<i>Grounds Stops</i>	<i>Dep Fix Closures</i>	<i>Gate Conflicts</i>	<i>Long on Board</i>
<i>Runway Utilization</i>	<i>Runway Assignments</i>	<i>EDCTs</i>	<i>Runway Closures</i>	<i>Flight Cancellations</i>	<i>Ramp Closures</i>	<i>Data quality updates</i>



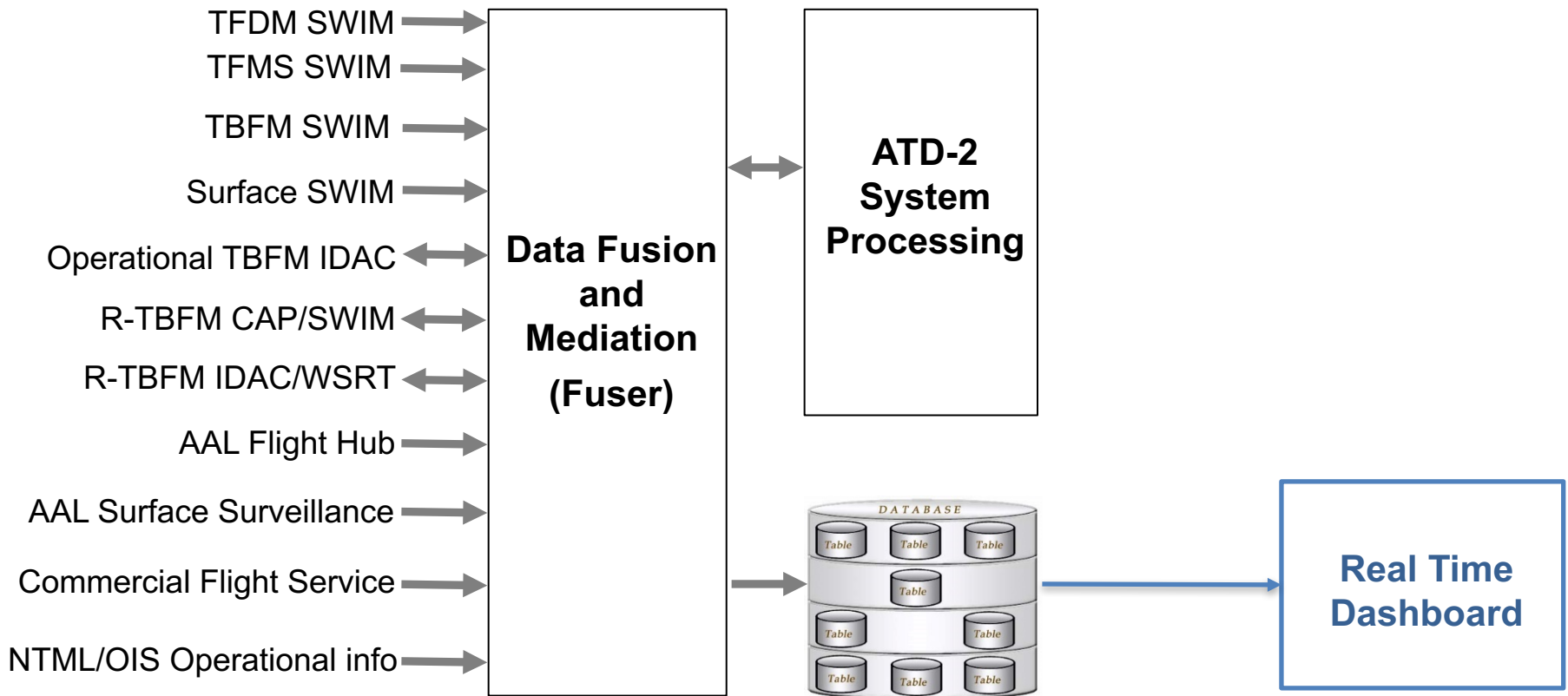
ATD2
Integrated Arrival/Departure/Surface
User Sessions

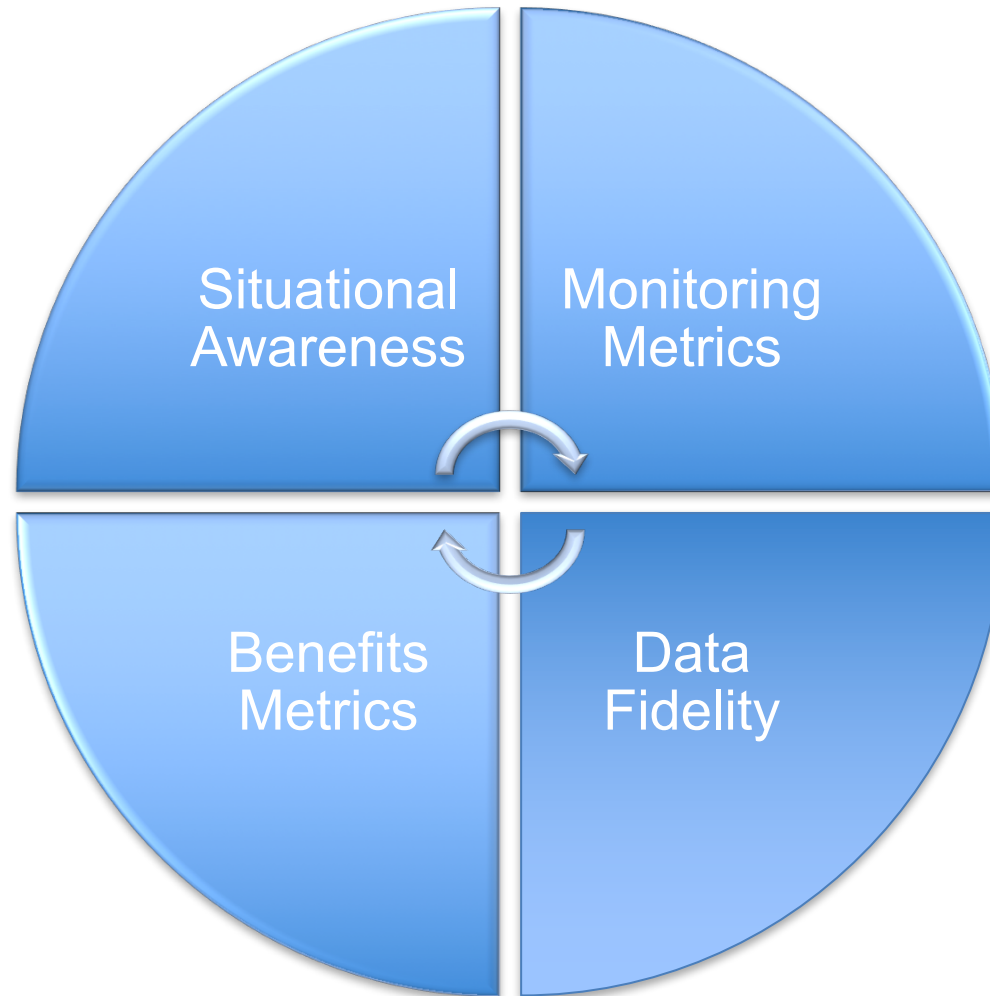


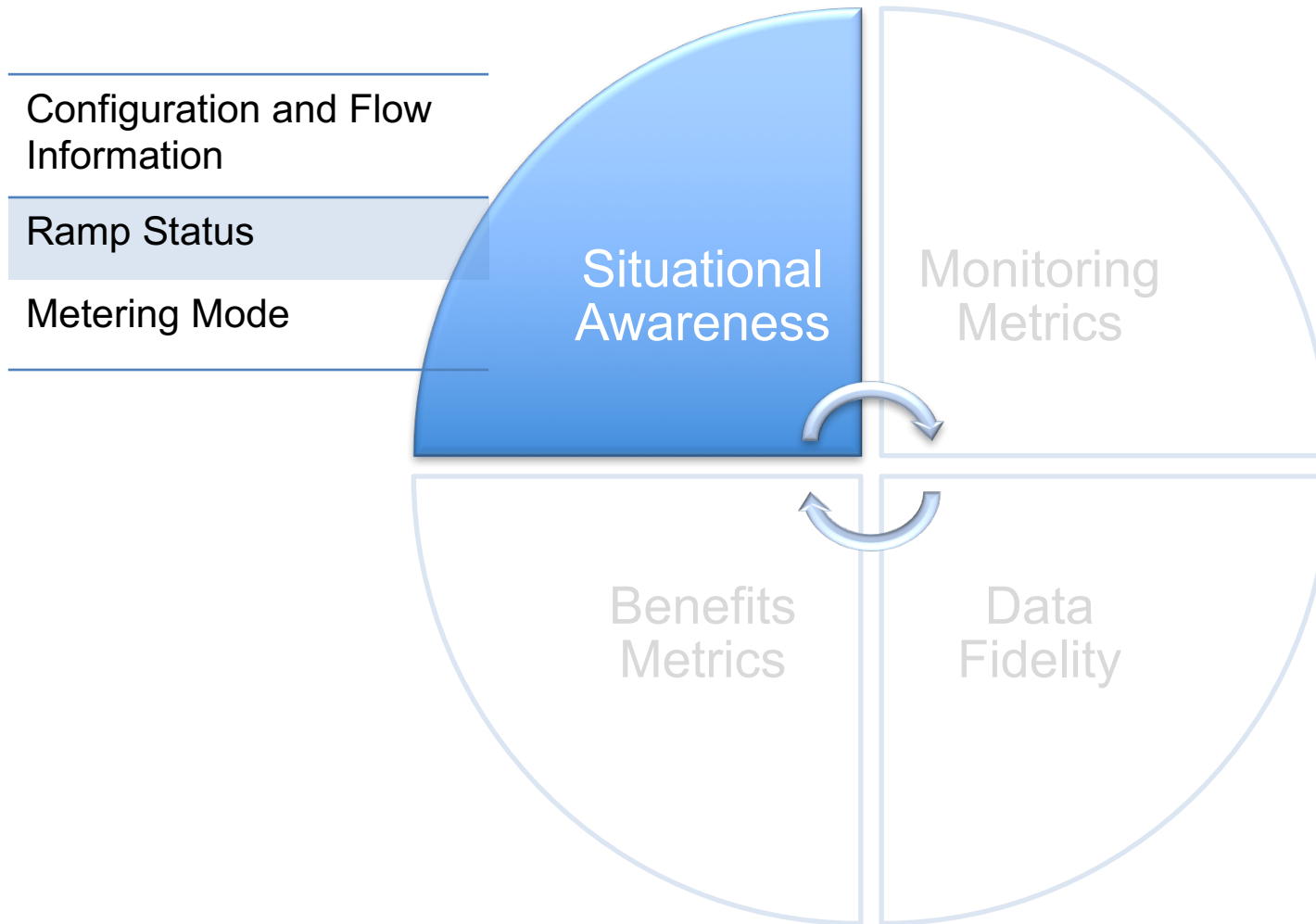
Held a series of nine user sessions with operational personnel from the Tower, Ramp, Center, and airport operations

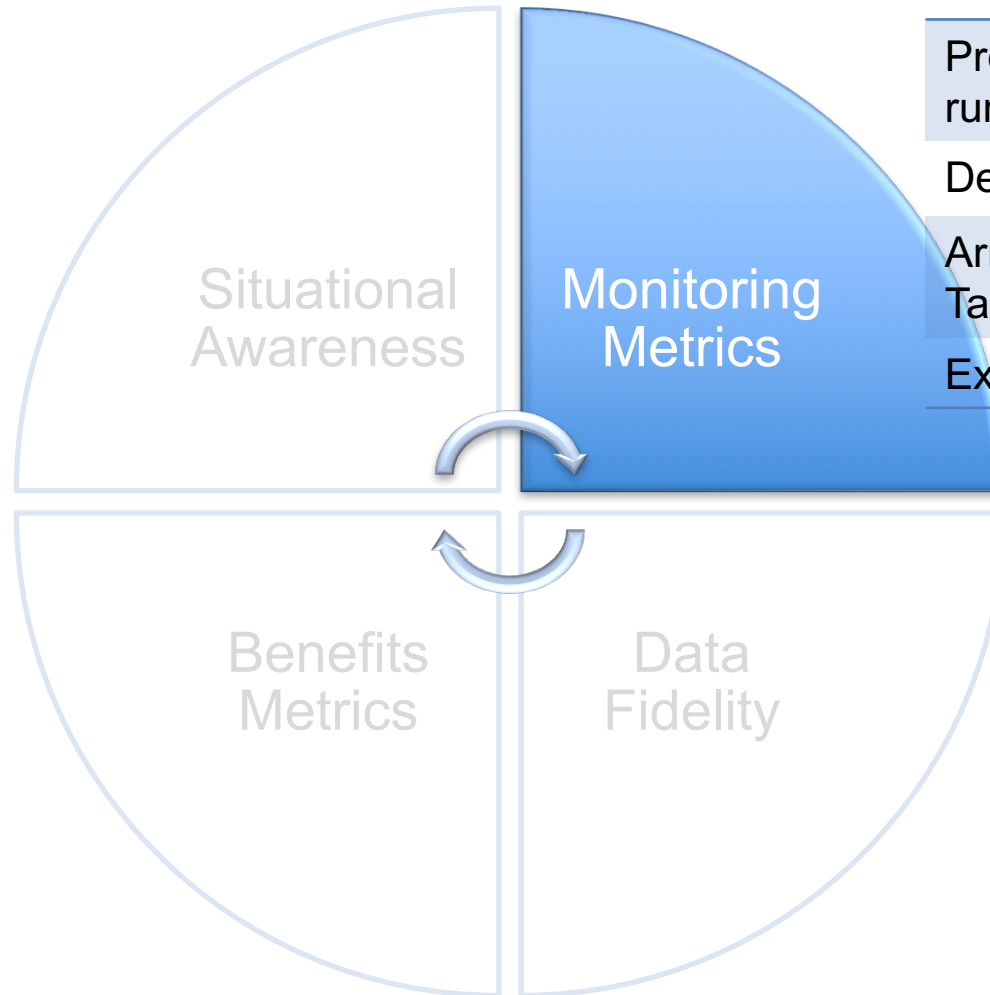


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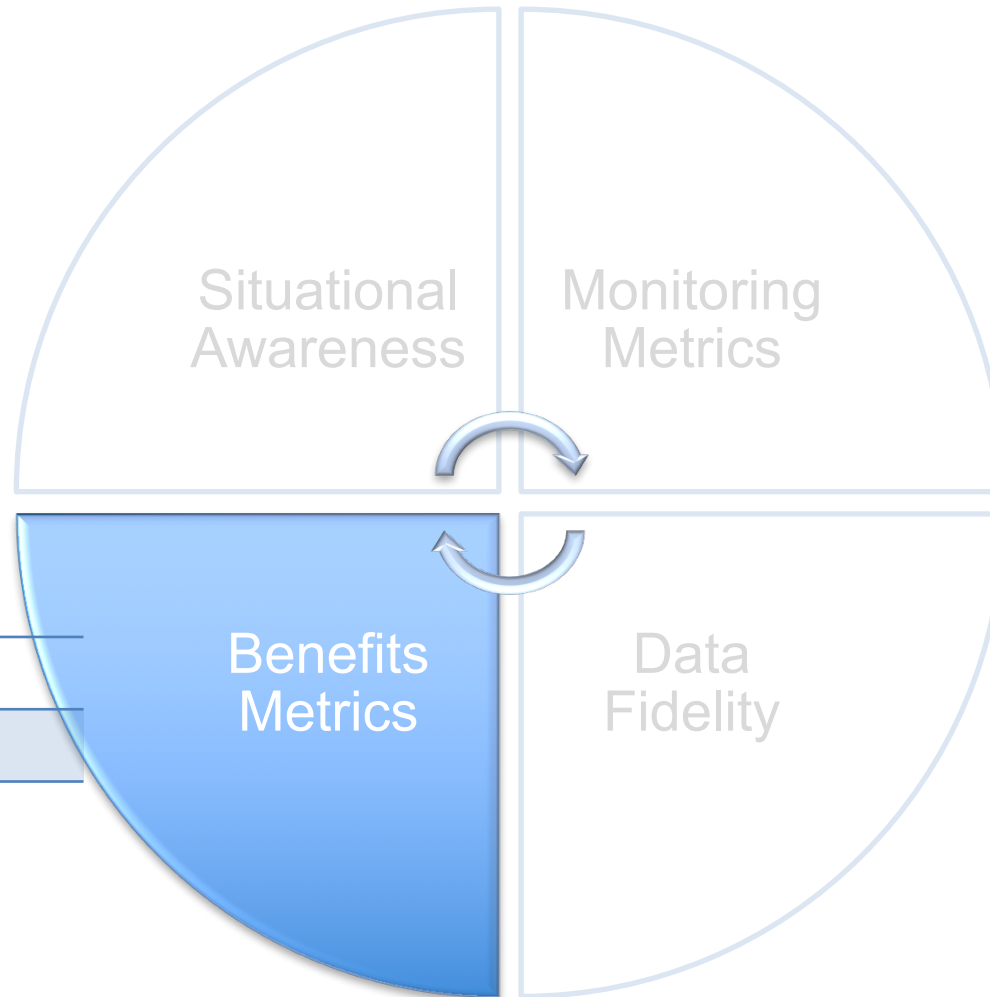






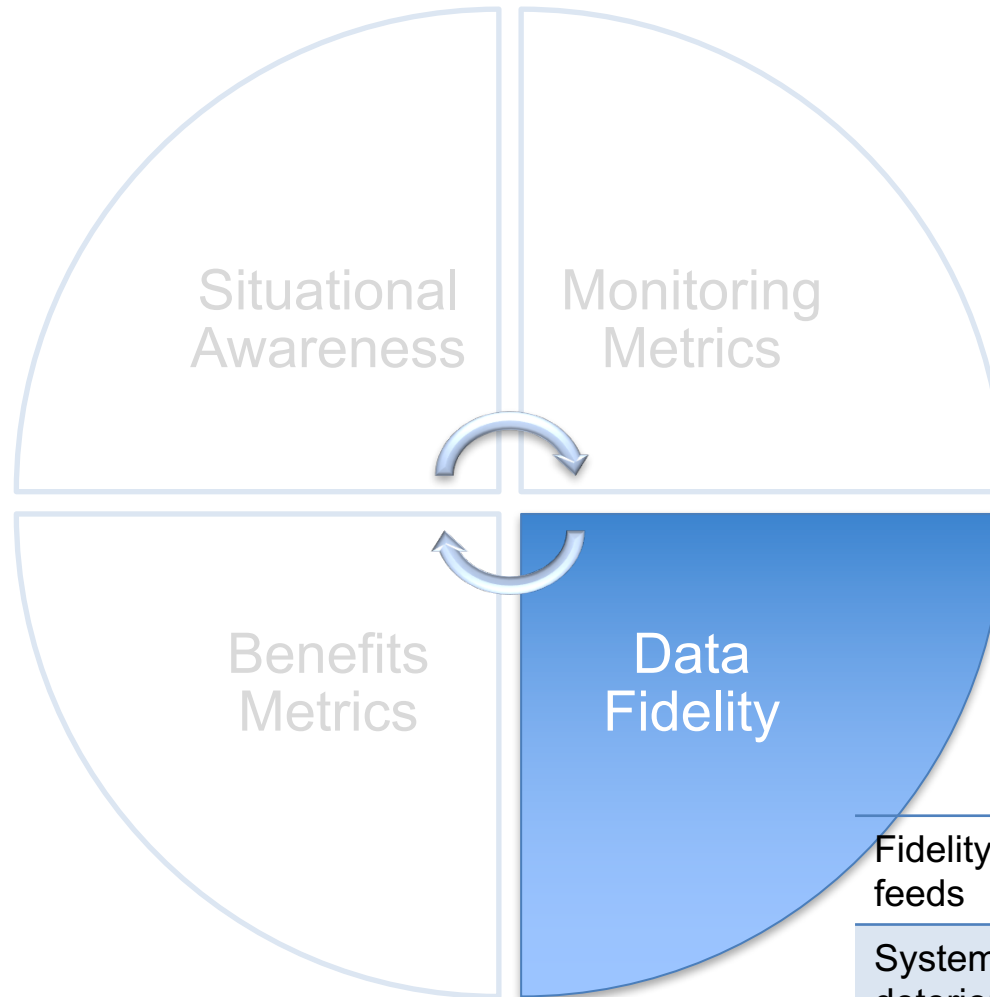


- Throughput
- Predicted and actual runway capacity rates
- Delay values
- Arrival and Departure Taxi Time
- Excess Queue Time



CO₂ Savings

Monetary Benefits



Fidelity of incoming data feeds

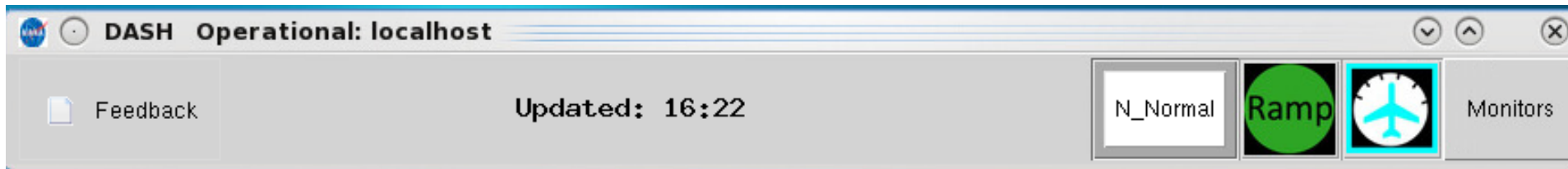
System wide data deterioration



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Current dashboard features both vertical and horizontal display capability

Consistent configuration information and other icons across the system



Feedback button with a link to an online form

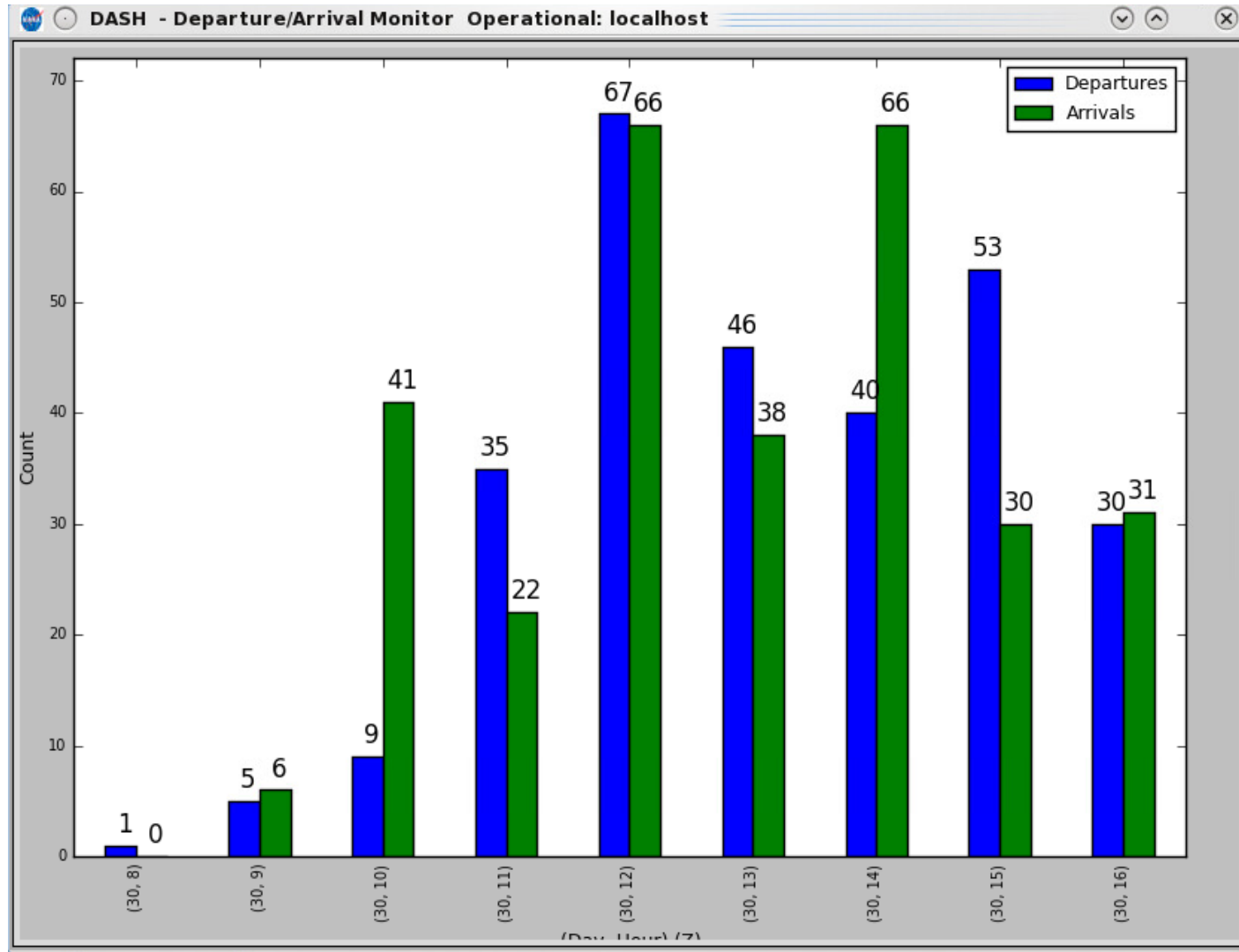
Pull down menu with quick look display and in depth metrics

APREQ			Predicted Excess Queue Time	Taxi Time			
Dest	Start Time	End Time		TaxiOut-Hour	NMA	MA	Tot
DCA		31/02:00		36C	0	26	26
LGA		31/02:00		36R	8	11	19
EWR		31/02:00					

MIT			Excess Queue Time	Arrival/Departure Rate		
Fix	Start Time	nmi	Excess Queue Times	Rate		Actual
BOBZY		30	NA	ARRIVAL	92/h	51
				DEPARTURE	69/h	73

Fix Closures			Gate Conflicts	Throughput	
Fix	Start Time	Alternate		Throughput	Direction
				124	North

Specific metrics will show across the last 15 minutes, the last rolling hour, and the last cardinal hour





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- 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





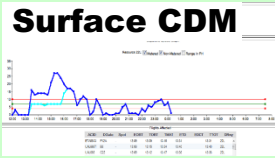
ATCT Control

- Baseline electronic flight data capability via TFDM EFD



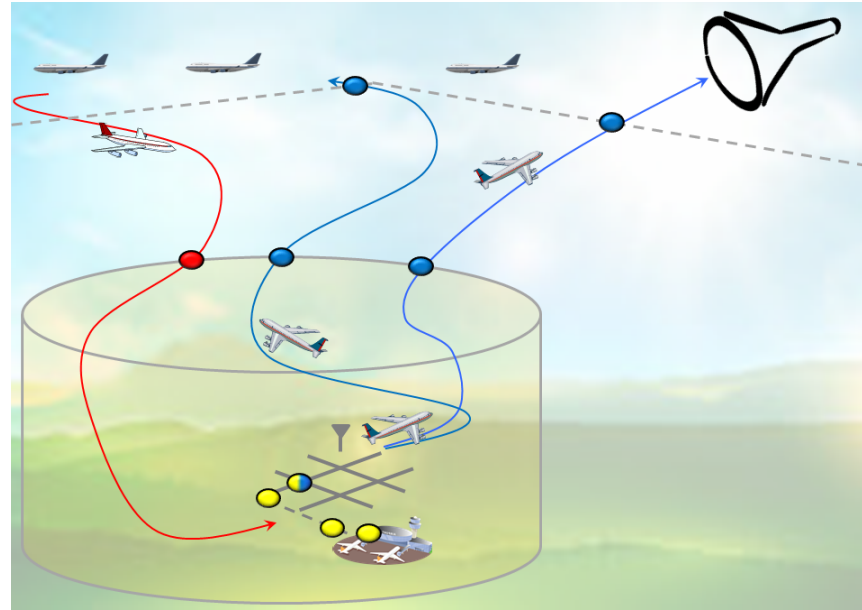
Ramp Control

- ★ Tactical pushback advisories via RTC/RMTC display



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

Surface Components



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 TMLs
- Mature strategic Surface CDM capability via operational use, analysis, and feedback
- Reduce ATCT workload by replacing paper strips with EFD



ATCT TMU



- Tactical departure scheduling capability via STBO display



ARTCC



- Tactical departure scheduling via modified TBFM/IDAC

Airspace Components

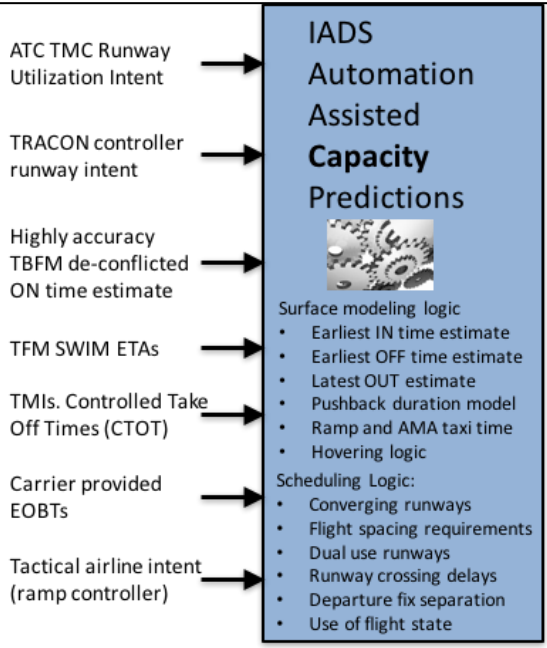
Interfaces to external systems via SWIM plus ATD-2 SWIM extensions



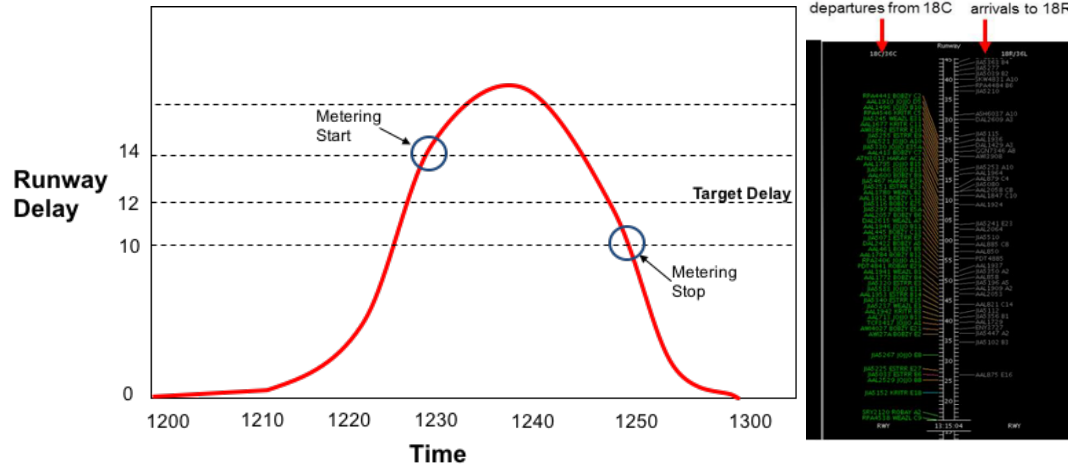
Airline Ops

★ = IADS user interface

1 Generate Demand and Capacity Predictions

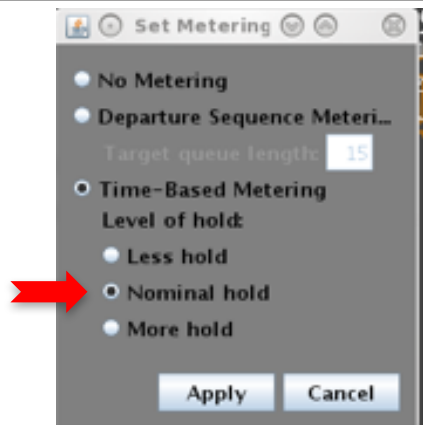


2 Monitor Surface Demand Capacity Imbalances

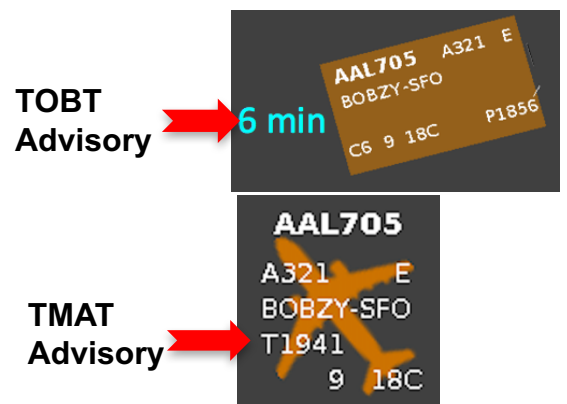


If Surface Metering, Go to Step **3**

3 Enable Metering. Set Hold Level



4 Honor TOBT and TMAT advisories

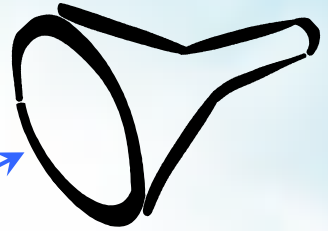


5 Evaluate Metering Effectiveness



IADS Tactical Departure Scheduling

APREQ/CFR departures merging into overhead streams

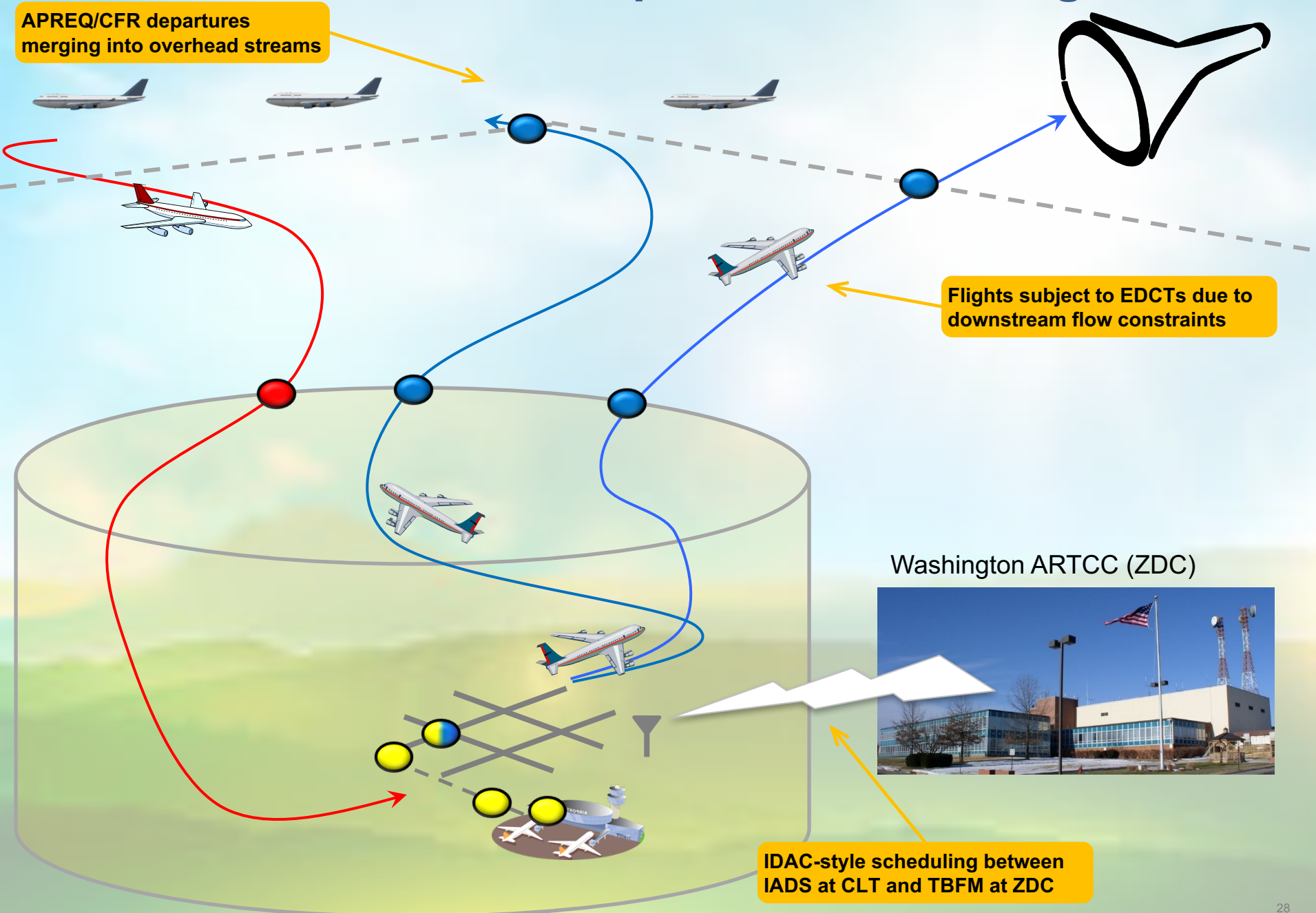


Flights subject to EDCTs due to downstream flow constraints

Washington ARTCC (ZDC)



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





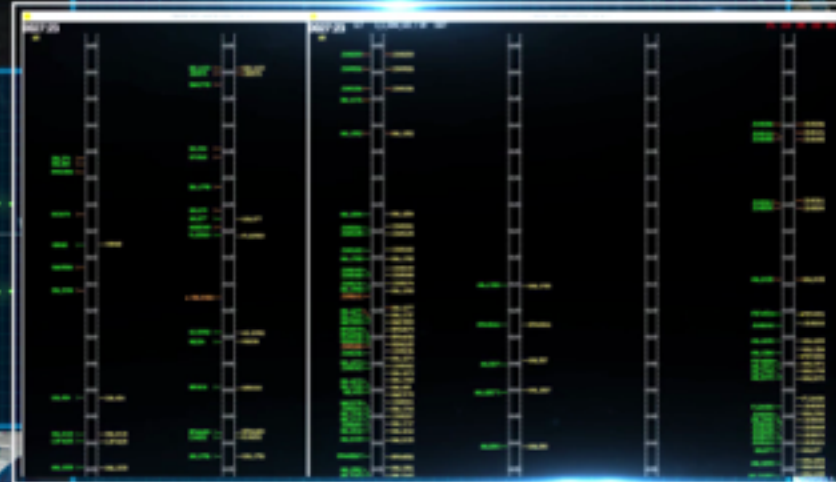
TOWER



TERMINAL



RAMP



ATD-2 SCHEDULERS



CENTER



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