Spot and Runway Departure Advisor (SARDA)

Dr. Yoon Jung
NASA Ames Research Center

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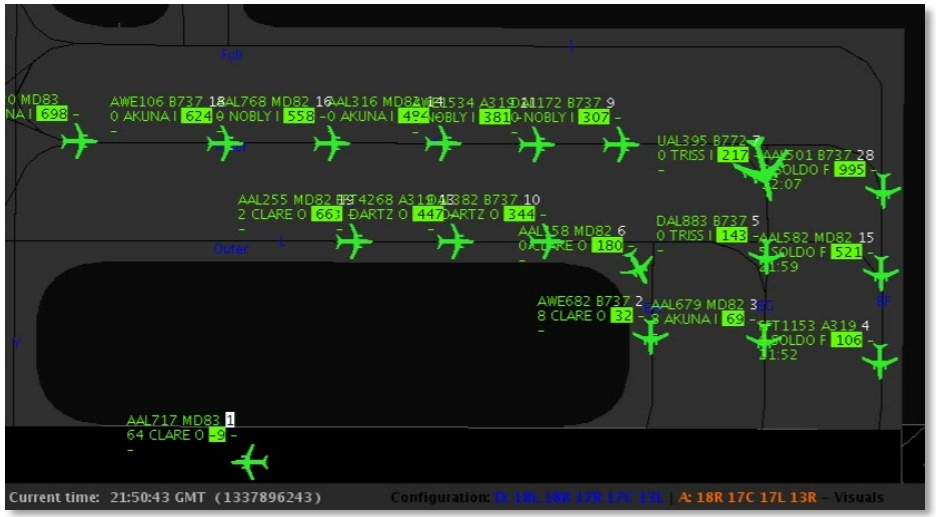
SARDA Overview

SARDA technology highlights from NASA simulations

What are the problems?

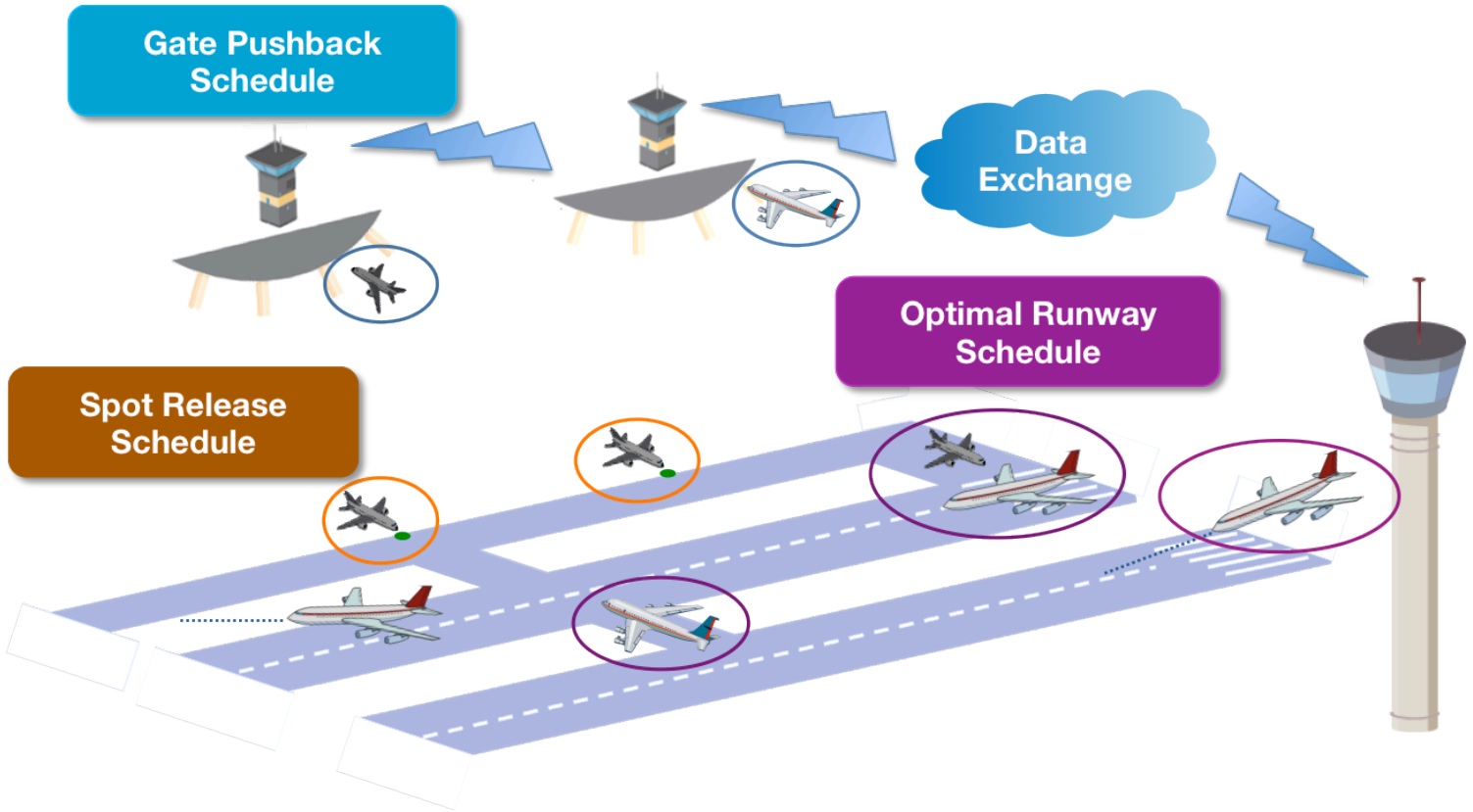
- **Today's Airport Surface Operations:**
  - Demand-capacity imbalance at major airports
  - Uncertainties in surface events
  - Lack of shared situational awareness and coordination
- **Consequences:**
  - Surface congestion and long queues
  - Excessive taxi delay and fuel/emissions
  - Poor predictability



SARDA Concept

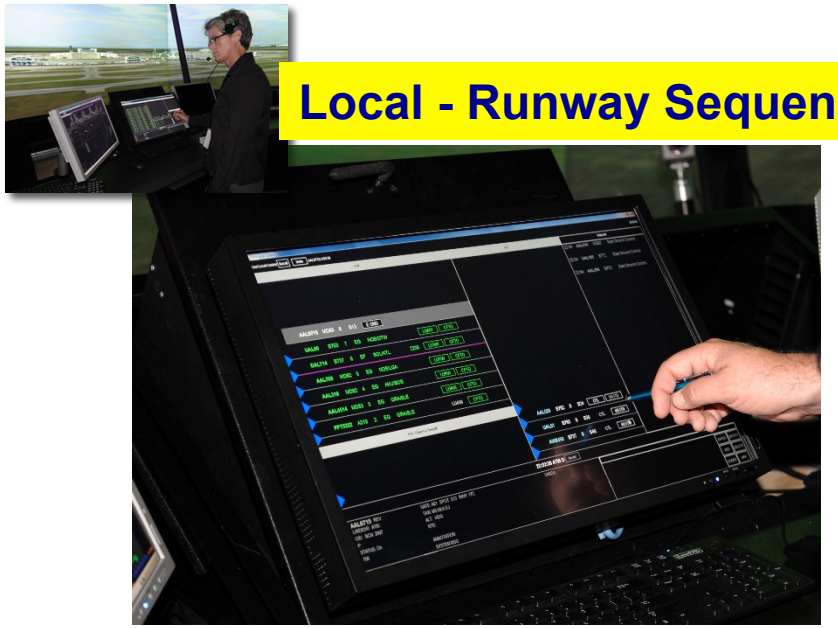
NASA's Departure Management Tool Based on Intelligent Surface Scheduling

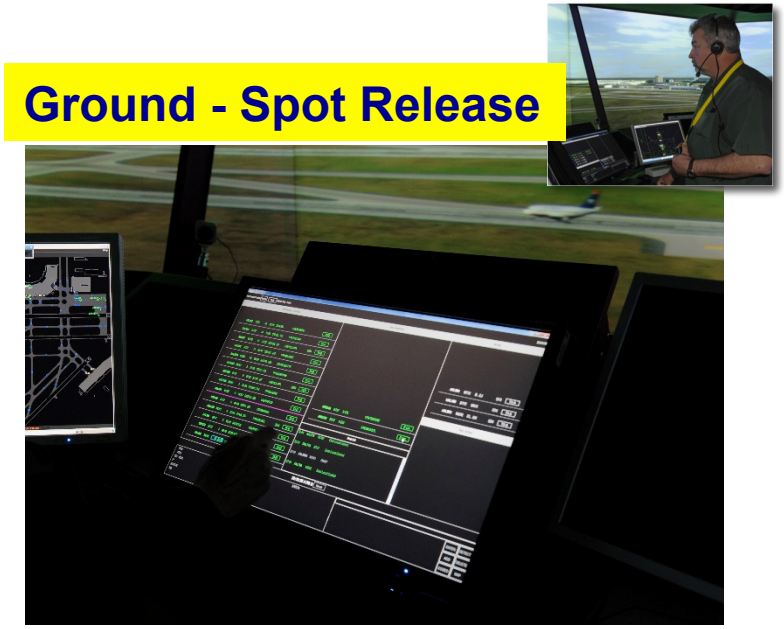
- **Builds an optimal runway schedule**
- **Generates spot release sequence and timing**
- **Determines when to push back from gates**



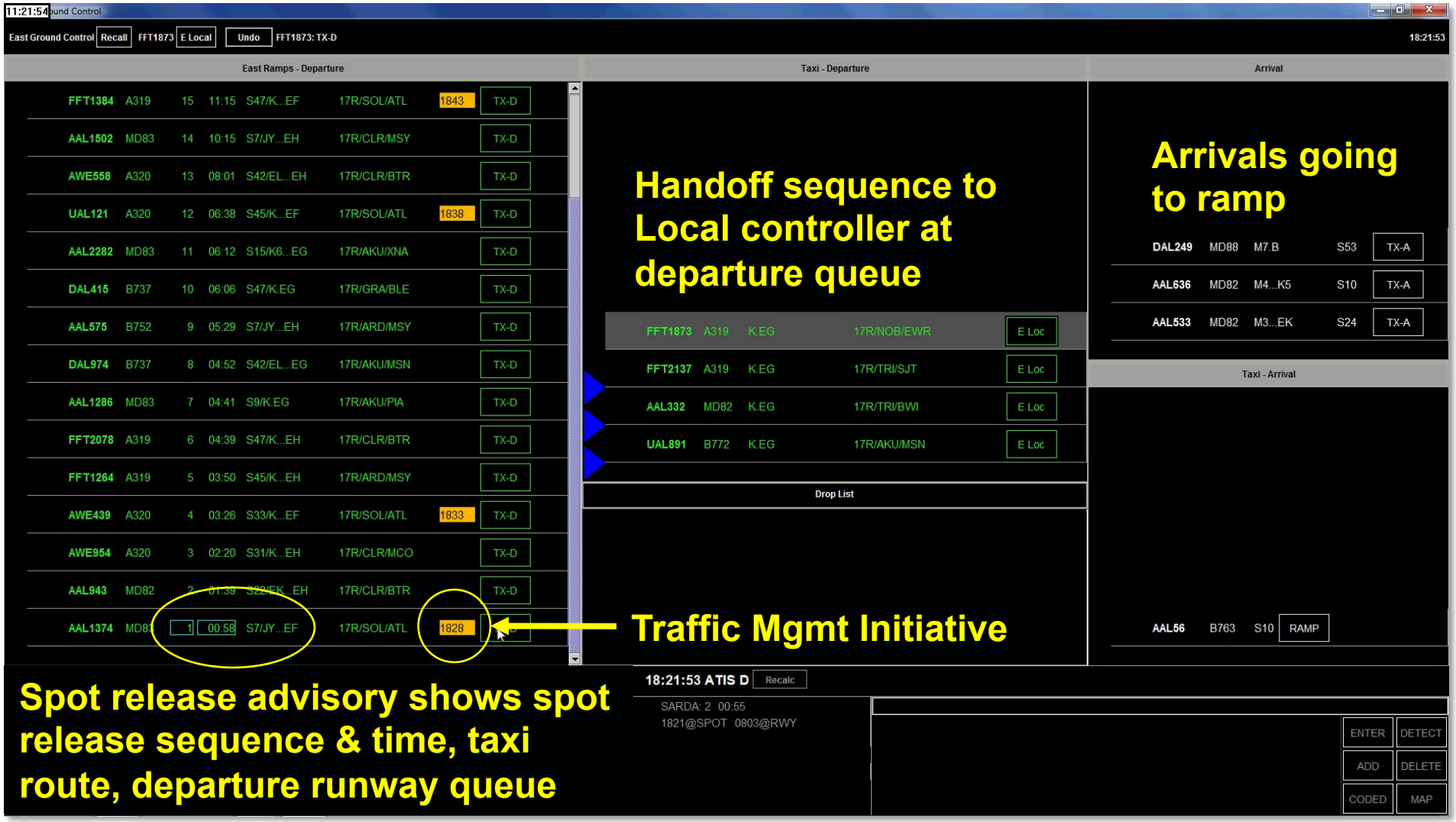
SARDA as ATC Tower Tool

SARDA takes inputs from multiple sources and computes advisories for runway usage and spot release

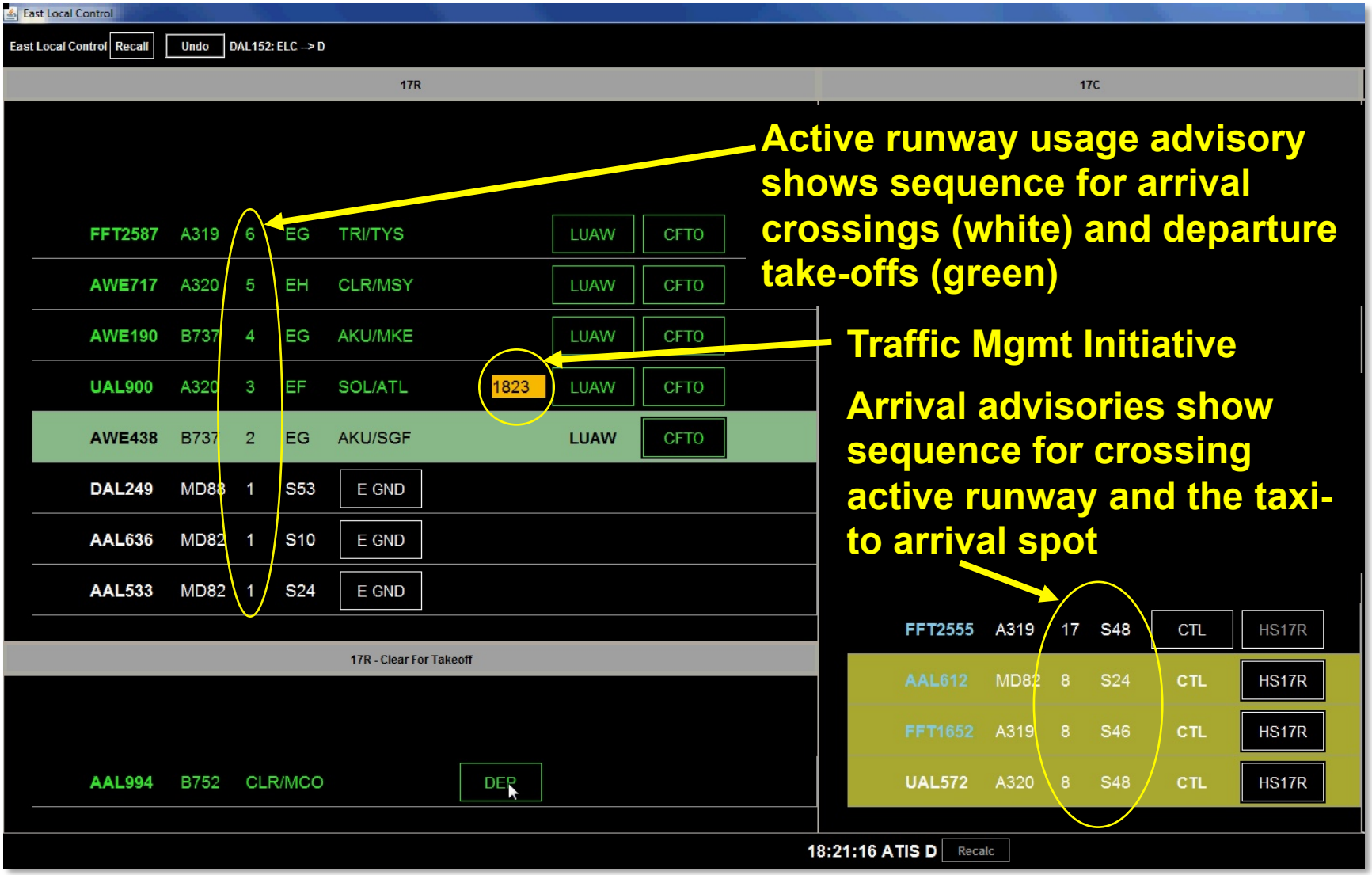




SARDA Ground Controller Advisories



SARDA Local Controller Advisories

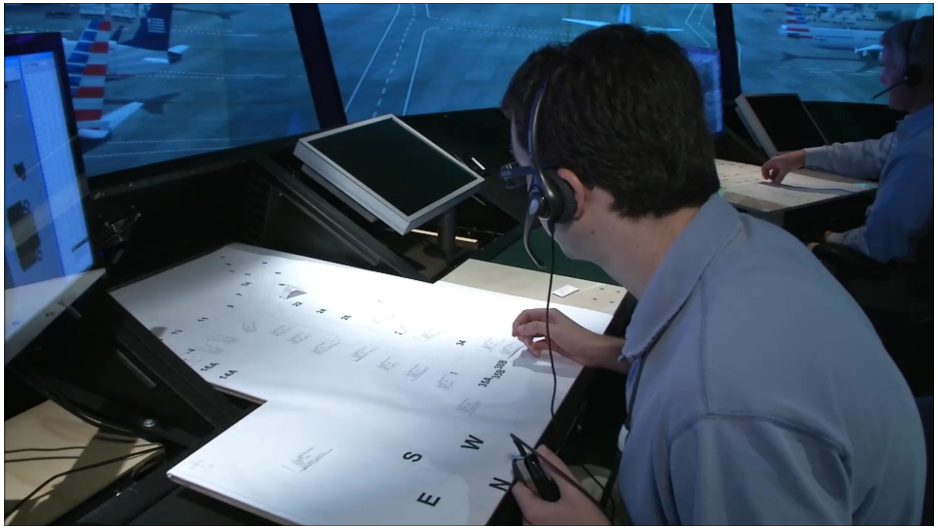


SARDA as Ramp Tool

SARDA takes input from multiple sources and computes advisories for gate pushback

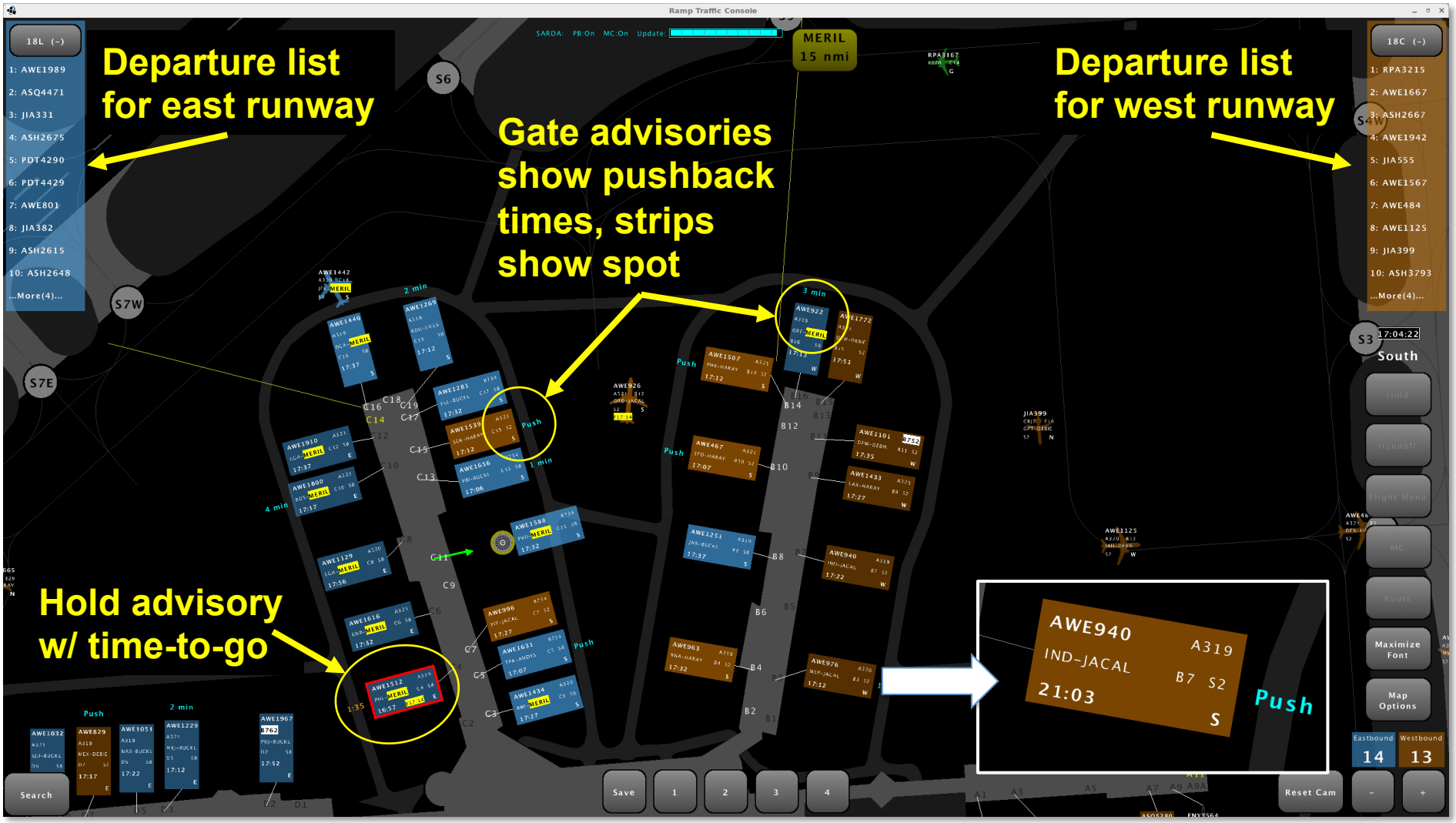
Today's Operation:
- **Paper ramp area map**
- **Paper flight strips**

SARDA Ramp Tool:
- **Electronic Flight strips**
- **Surface map & surveillance**
- **Pushback advisories**



SARDA Ramp Controller Advisories

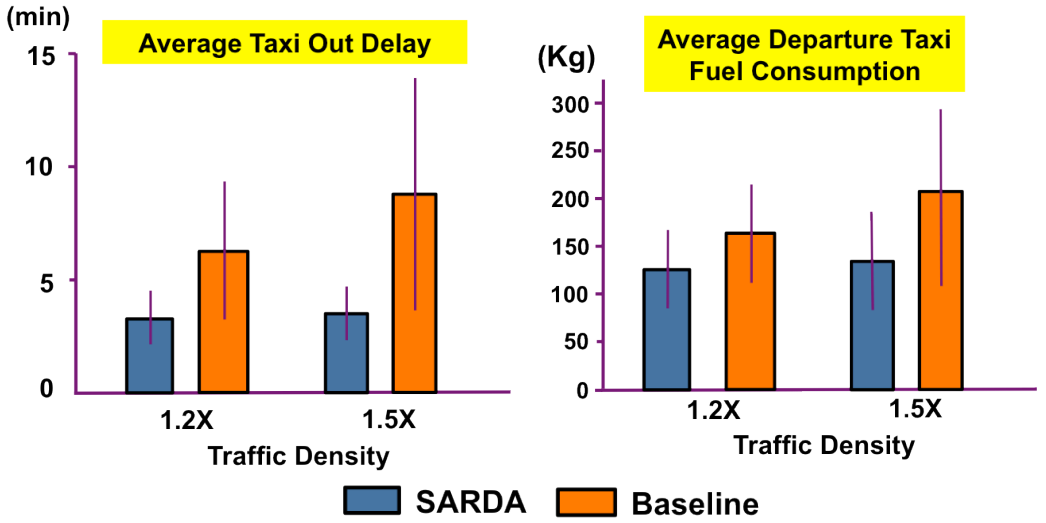
Ramp Traffic Console (RTC) displays SARDA advisories on ramp surface map



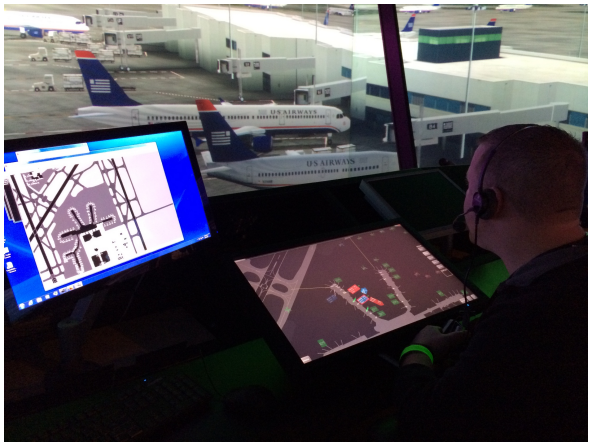
SARDA Benefits – ATC Tower Tool

- Reductions in departure taxiing delay (45% - 60%) and variability
- Reductions in fuel consumption (23 - 33%) and variability
- Consistent and accurate prediction of takeoff time
- Decreased controllers workload, less sensitive to the traffic load

Human-in-the-loop Simulation for Dallas-Fort Worth Airport (2012)

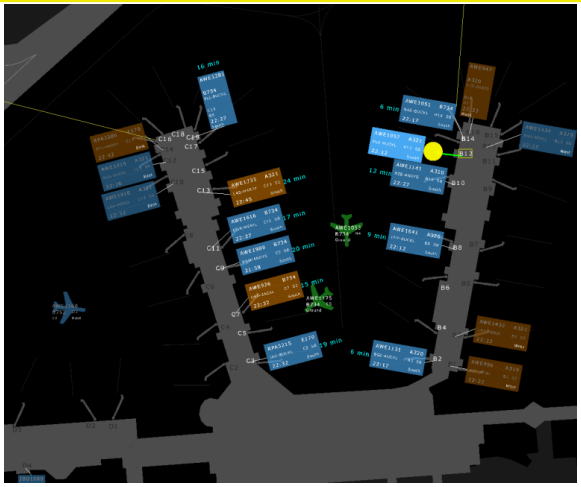


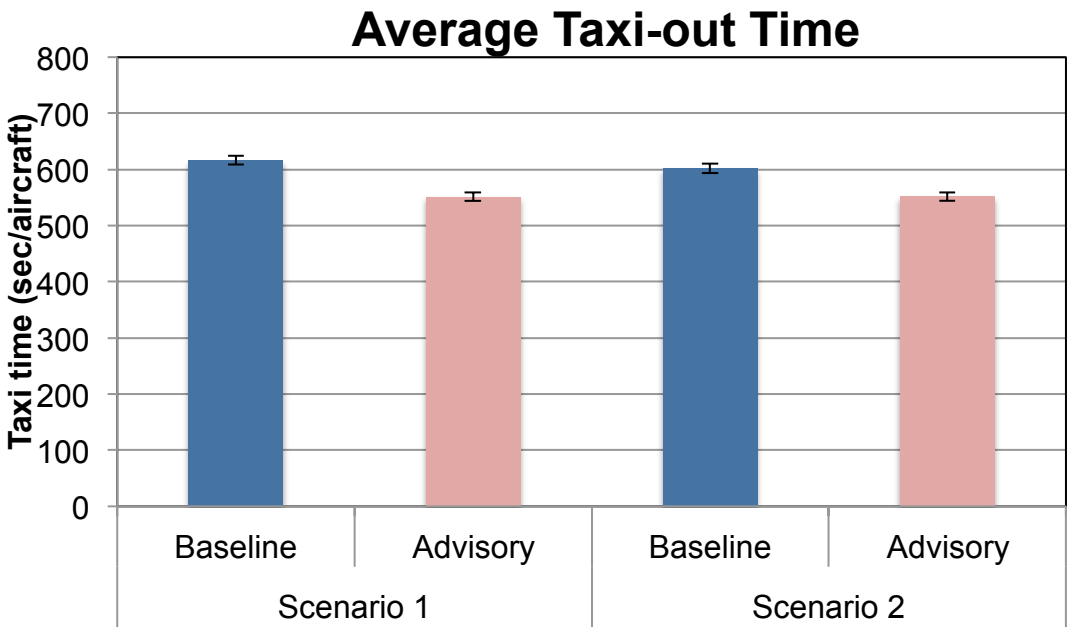
HITL - Ramp Controller Tool for CLT



- 27” touchscreen
- Virtual strips
- Ground radar information
- Dynamic SARDA pushback time advisories

Ramp Traffic Console (RTC)

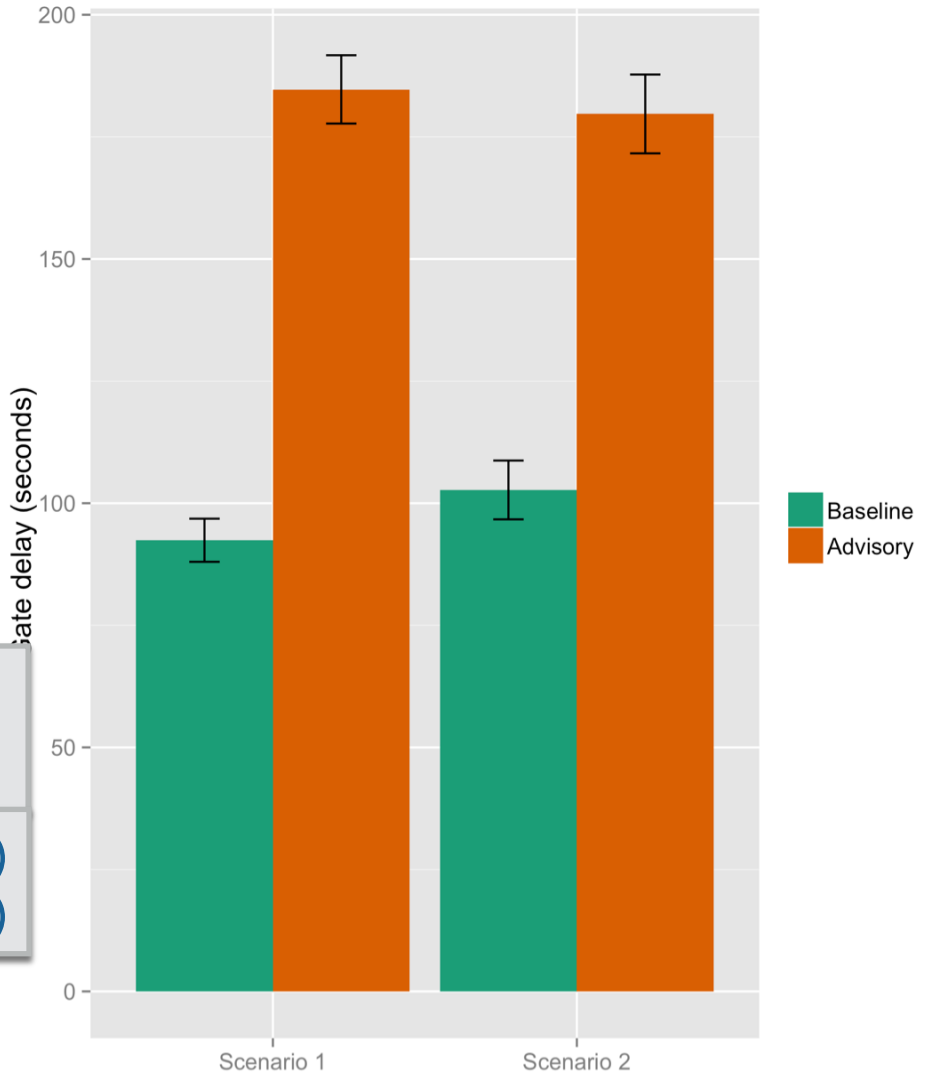




1.1 min reduction in Scenario 1 (10.5%)
0.8 min reduction in Scenario 2 (8.3%)

Gate Hold

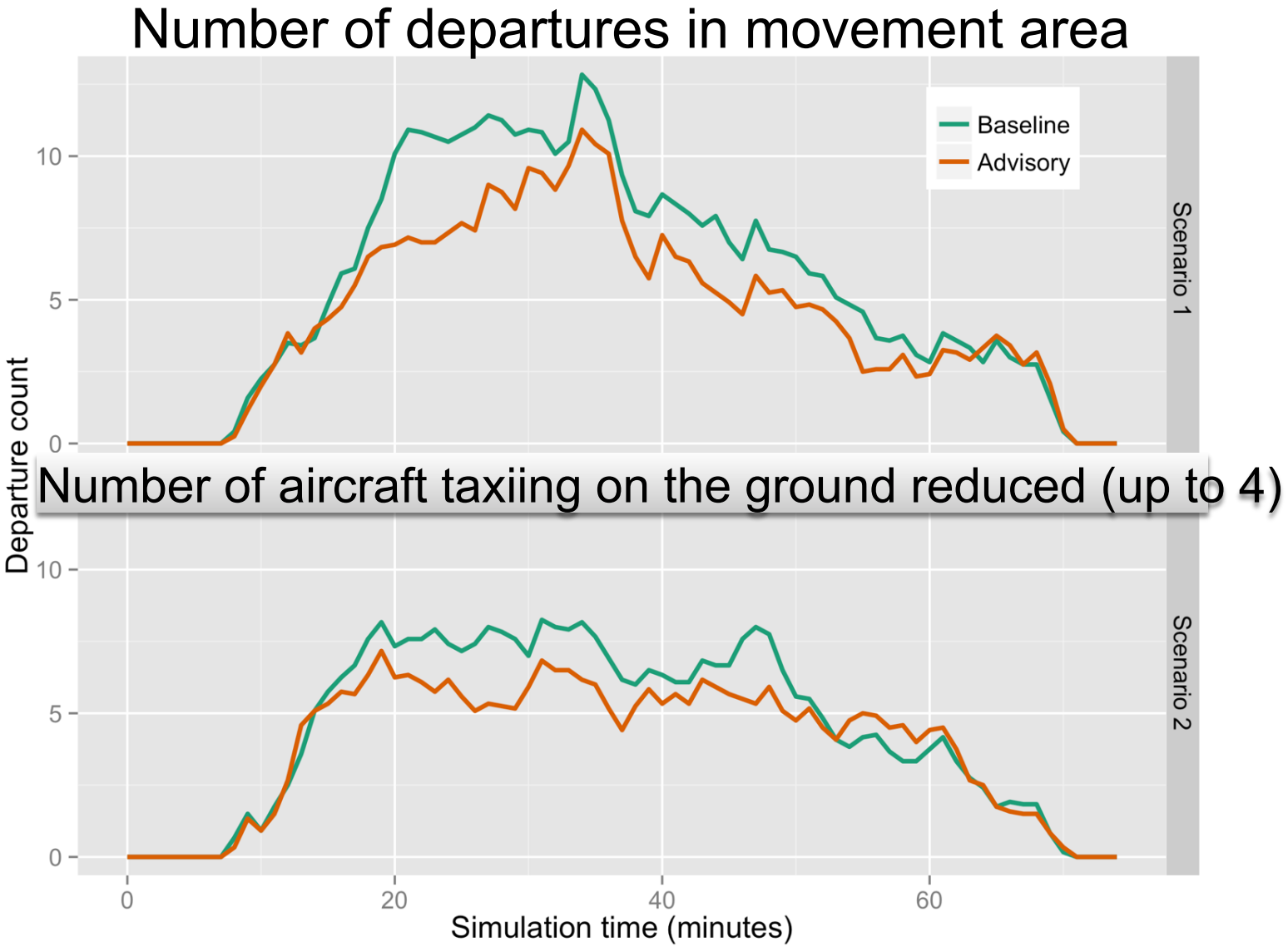
gate_delay = actual_out_time –
pushback_ready_time



Departures are held at gates longer in Advisory runs

1.53 min increase in Scenario 1 (99.7%)
1.29 min increase in Scenario 2 (75.4%)

Surface Congestion



Real-Time Workload Ratings

Linear Mixed Model repeated-measures analysis:

- In Advisory runs, the FAA tower controllers' ratings were reduced by 0.23 in 7 point scale (p = 0.021).

- The CLT ramp controllers' ratings:

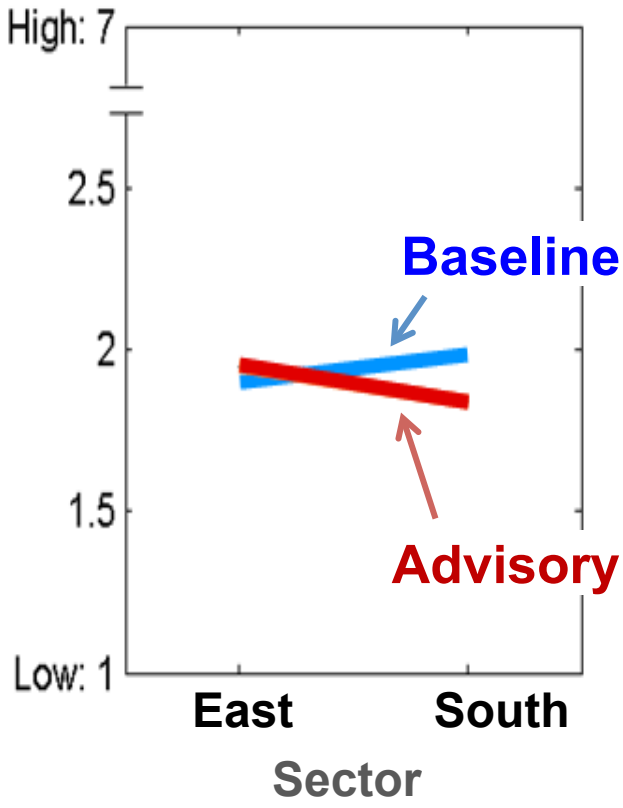
  In South Sector:

  Advisory < Baseline

  In East Sector:

  Advisory ≅ Baseline

CLT Ramp Controllers' Real-Time Workload Rating
(p = 0.008)



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-

CLT Ramp Controllers' Real-Time Workload Rating
(p = 0.008)

"More difficult to manage the EDCTs with paper strips"

"RTC wraps the information up all in one package"

"Easier to plan with RTC"

"Easier to visualize what is going on across the whole ramp using RTC"

"Paper strips and maps should be put in a time capsule"

Summary and Next Steps

- SARDA provides a departure metering capability by optimally scheduling aircraft on airport surface.
- SARDA enables reduction in engine-on time by holding departures at their gates and provides better predictability.
- Human-in-the-loop simulation results of both ATC and ramp tools showed reductions in taxi delay, queue size, and fuel use.
- Currently, ramp controller advisory tool is used to provide the tactical surface scheduling capability for ATD-2 IADS technology demonstration.

Thank you!

For more information go to:

www.aviationsystems.arc.nasa.gov