National Aeronautics and Space Administration

Airspace Systems Program Newsletter

QUARTER 1: OCT–DEC 2011

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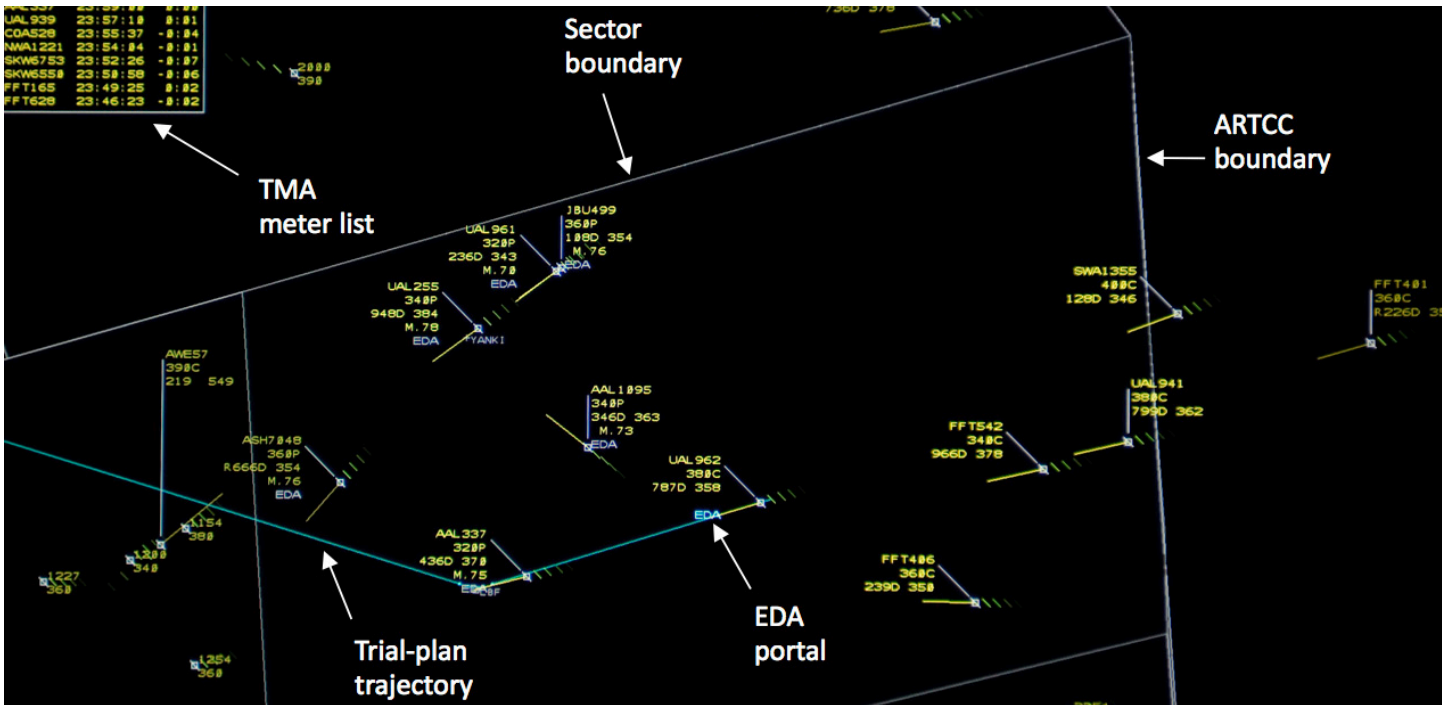
// Technical/Programmatic Highlights

Figure 2: A picture of a controller's computer screen during the simulation shows how the Efficient Descent Advisor indicates cruise speed, descent speed and path components.

Efficient Descent Advisor Achieves Technology Transfer

The Efficient Descent Advisor (EDA) was transferred to the FAA on November 30, 2011, culminating a three-year collaborative effort between NASA, FAA, Boeing and airline partners to develop and transition automation for efficient arrival operations during capacity-constrained conditions. Launched under a Research Transition Team (RTT) in 2008 that later became known as the 3D-Path Arrival Management (3D-PAM) activity, EDA was developed as a decision-support tool for sector controllers in the Air-Route Traffic Control Center (ARTCC). The automation was developed for deployment in the 2014–2018 timeframe, in support of mid-term NextGen operations.
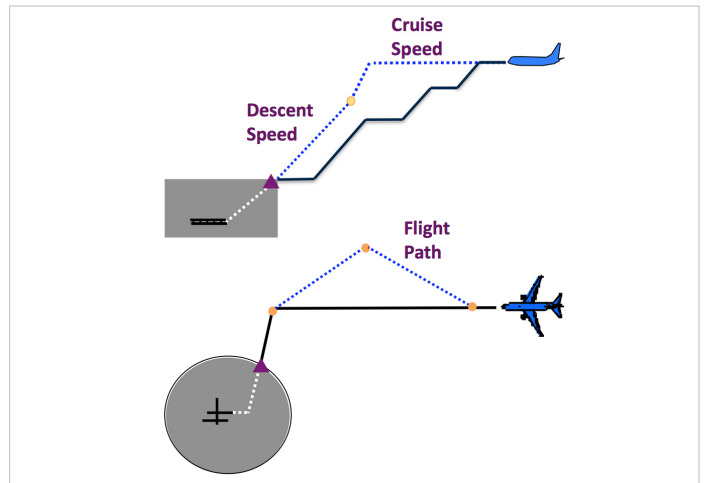

Figure 1: This graph shows the different advisories generated by 3D-PAM involving a combination of cruise-speed and descent-speed (top), and descent-speed and routing adjustments (bottom).

Figure 3: Two air traffic controllers use Efficient Descent Advisor during the simulation in the Crew-Vehicle Research Facility at NASA's Ames Research Center.

Concept: EDA leverages core elements of NASA's Center-TRACON Automation System (CTAS) to develop strategic arrival solutions over time horizons of up to 30 minutes. Solutions are sought that allow aircraft to perform fuel-efficient, continuous descents at low engine power while satisfying time-based-metering constraints at the TRACON boundary computed by the Traffic-Management Advisor (TMA) – a previous CTAS tool that is now deployed at all 20 ARTCC facilities in the United States. Whenever possible, EDA computes trajectory solutions that are predicted to be conflict free in order to minimize interruptions to an otherwise continuous descent. Once computed, EDA's trajectory solutions are decomposed into specific maneuver advisories, which are presented to the radar-side sector controller upon request. In the final prototype delivered under 3D-PAM, advisories involve a combination of cruise-speed, descent-speed and routing adjustments, as depicted in Figure 1. Although EDA is designed to deliver aircraft to the TRACON boundary, it facilitates continuous descents to the runway by reducing the need for unnecessary delay absorption within TRACON airspace.

Figure 2 illustrates a controller's use of EDA in a Human-in-the-Loop (HITL) simulation conducted in support of 3D-PAM. In this example, a controller has clicked on the EDA portal for a flight near the center of the display. The EDA portal is located at the bottom of the aircraft's flight-data block. Once a portal is clicked, a separate window opens on the controller's

Figure 4: The flight deck crew of FAA's Global 5000 prep for flight tests to model trajectory-prediction uncertainty.

display containing the advisory information. The trial-plan route associated with this advisory is also displayed, which includes the location of the aircraft's predicted top-of-descent point (not visible in Figure 2 due to scale). EDA advisories become available once aircraft have crossed an arc where the TMA scheduled time-of-arrival has been frozen. This arc, known as the freeze horizon, is typically 20 minutes or more from the TRACON-boundary meter fix, adjustable for traffic and airspace conditions within the TMA system. Once aircraft have crossed the freeze horizon, controllers are alerted to the availability of EDA advisories by blue-colored EDA portals. In the example shown in Figure 2, the EDA advisory consists of cruise speed, descent speed, and path components. Path advisories

are typically issued whenever advised slow downs are insufficient for absorbing the delay needed to meet TMA-scheduled times. EDA ensures that path-stretch maneuvers do not cross lateral sector boundaries in order to minimize controller workload associated with inter-sector coordination.

The format, phraseology and procedures associated with EDA advisories and clearance delivery were designed to be compatible with current air-traffic operations and flight-deck equipage. Once received on the flight deck, pilots enter EDA clearances directly into the Flight Management System (FMS) for precision guidance and control along the intended trajectory. As the aircraft progresses along the trajectory, EDA continuously monitors conformance to the scheduled arrival time at the meter fix and provides controllers with corrective advisories if necessary.

Research Approach: Technology transfer of EDA was based primarily on the iterative design and development of a research prototype, validated using HITL simulation (Figure 3). For added fidelity, these simulations included trajectory-prediction uncertainty, modeled using results from two flight tests conducted at Denver Center in which revenue flights operated by United, Continental and Skywest were issued predefined EDA speed clearances. These flight tests also involved an FAA aircraft – a Global 5000 business jet – that was issued a combination of speed and path clearances (Figure 4).

Seven HITL simulations were conducted in the NASA Ames Crew-Vehicle Research Facility (CVSRF).
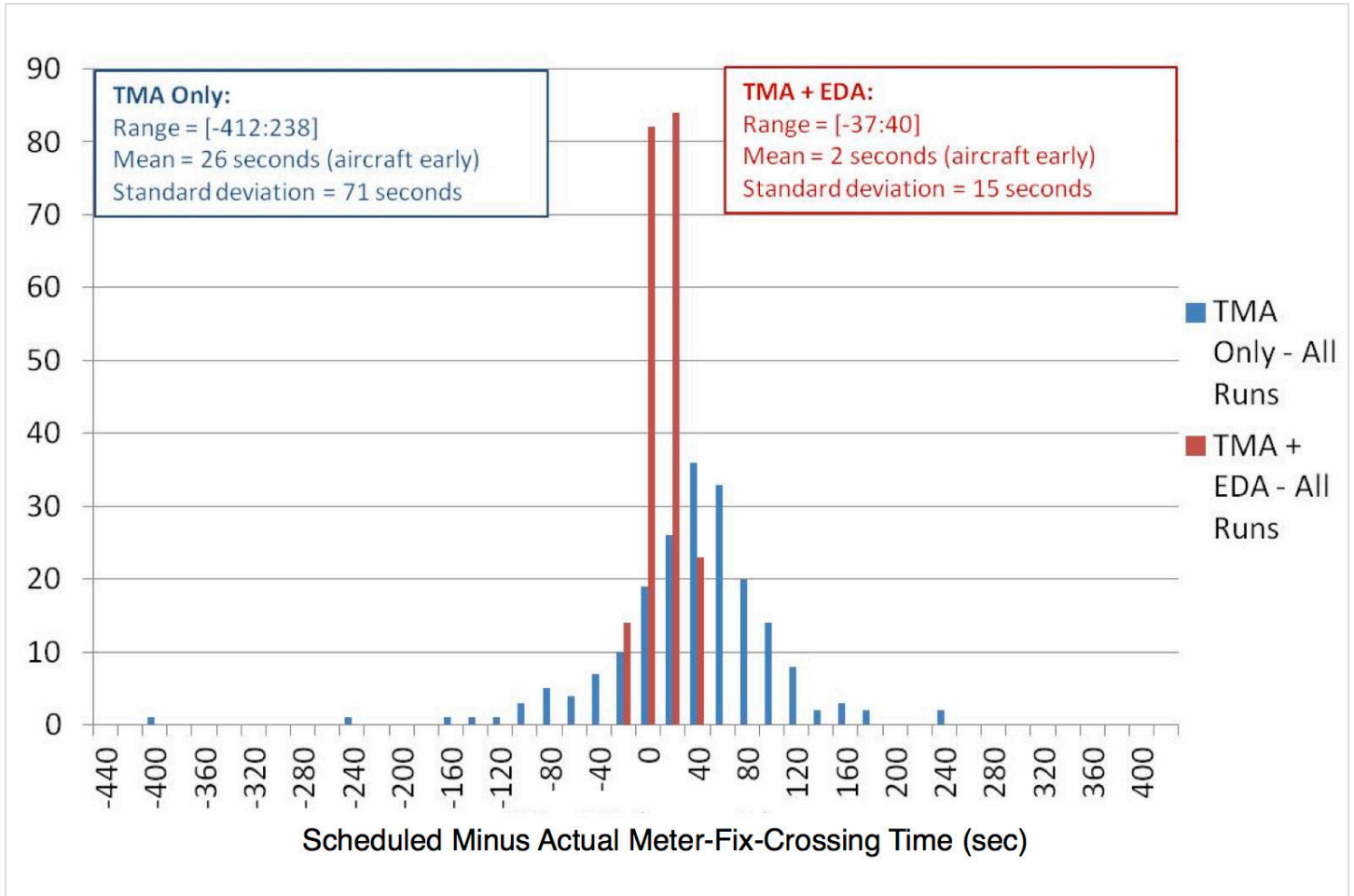
Figure 5: This graph shows how adding Efficient Descent Advisor's capabilities to the Traffic Management Advisor improved the aircraft's arrival time accuracy and precision.

These simulations involved controllers from the Denver ARTCC, with later simulations including controllers representing the National Air Traffic Controllers Association. While NASA focused on ground-based automation and procedures, Boeing focused on airborne automation and procedures by running separate experiments in their Seattle laboratories as part of the joint 3D-PAM activity.

Research Findings and Deliverables: The majority of the HITL simulations were intended to facilitate prototype development by comparing various design alternatives. For example, simulation #3 evaluated the use of intermediate altitude for arrival-time conformance and conflict resolution. Although altitude advisories were effective in resolving conflicts, the workload and procedures required for implementing them proved
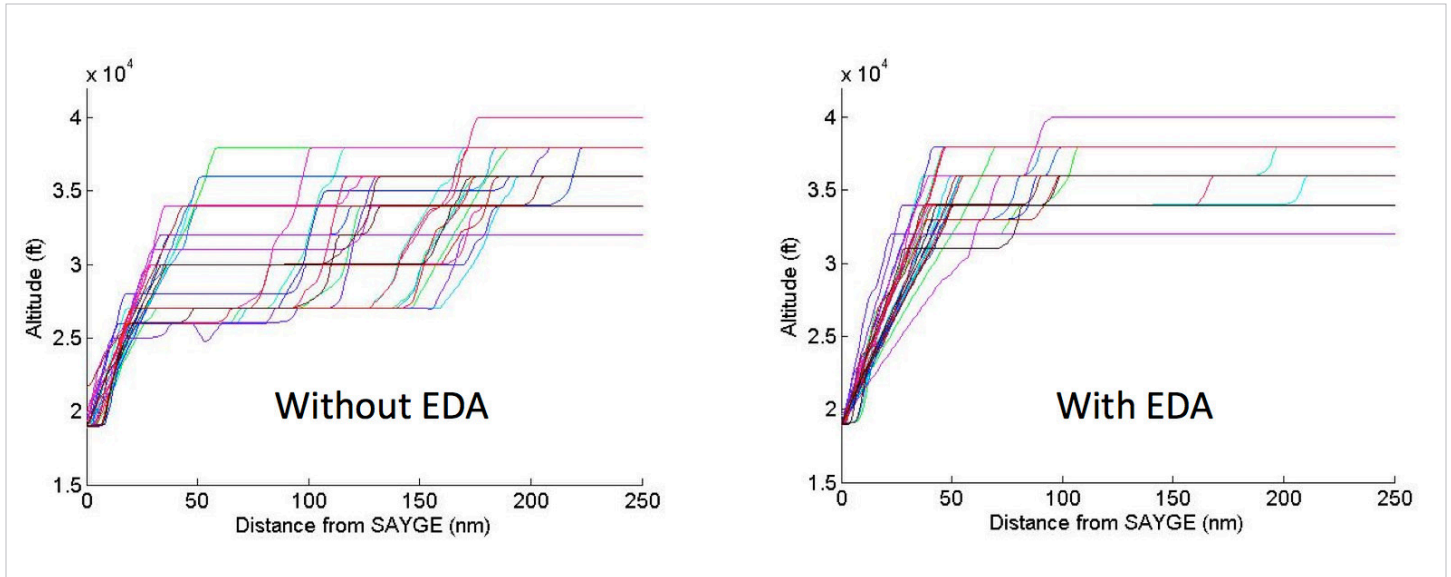
Figure 6: This graph shows that Efficient Descent Advisor reduced the average number of maneuver-related arrival clearances per flight by 60 percent.

impractical for controllers. Other design studies looked at variations on path-stretch anchor points and the use of EDA during all traffic conditions as opposed to only when demand exceeds capacity. Controllers favored the use of EDA during all traffic conditions because of the consistent procedures that it afforded and the knowledge of arrival intent that it provided. In simulation #5, the use of conflict-probe automation alongside EDA was evaluated to aid in the detection and resolution of conflicts up to 25 minutes away. Results showed that controllers benefited from strategic conflict probe automation in terms of both performance and workload.

The final HITL simulation, completed in September 2011, examined the benefits of EDA compared to baseline operations with TMA alone. The final simulation also included airline pilots who flew the Boeing 747

and 737 cockpit simulators at the CVSRF. This was the first simulation to make use of the new B737 model installed in the CVSRF's Advanced Concepts Flight Simulator. Results showed substantial improvement in arrival-time accuracy and precision at the meter fix with EDA, as shown by the error histogram in Figure 5. Results also showed a 100% reduction in number of manual sequence adjustments required by the controller for managing traffic with EDA, which suggests further capacity benefits through the preservation of the sequence assigned by TMA for optimal runway throughput. Preliminary results also indicate a reduction in controller workload and fuel consumption with EDA. The average number of maneuver-related arrival clearances issued per flight was reduced by 60% with EDA. A reduction in maneuver clearances can be

At the EDA technology transfer ceremony, (left to right) Dr. Jaiwon Shin, NASA ARMD associate administrator; Victoria Cox, assistant administrator for Next Gen, FAA; and David Grizzle, chief operating officer, FAA's Air Traffic Organization.

seen in Figure 6, which shows how controllers managed arrival traffic with fewer tactical altitude instructions with EDA. A reduction in altitude assignments also contributed to an estimated fuel savings of 180 lbs per flight with EDA averaged across all aircraft types in the busier of the two traffic scenarios evaluated.

The findings from each simulation and field-test activity were delivered in reports to the FAA. NASA also delivered a detailed specification of the final EDA prototype design. This deliverable served as the foundation for the transfer of EDA technology to the FAA and the culmination of the government/industry 3D-PAM activity launched by the RTT in 2008.

Next Steps: The FAA Air Traffic System Concept Development Group, which led the 3D-PAM activity, is currently engaging the FAA's service-level organizations in discussions pertaining to EDA deployment. In particular, planning is underway to address a requirement for new ground-based automation in 2014, stemming from the FAA's Trajectory-Based Flow Management Office. This office is interested in deploying EDA technology to extend the capabilities of the current TMA system in support of NextGen. *(POC: Rich Coppenbarger)*

Wakenet USA Meeting, October 2011

Neil O'Connor, Ed Johnson, Nash'at Ahmad, Randy Vanvalkenburg, and Fred Proctor attended the Wakenet USA meeting at the United Airlines Flight Training Center in Denver. Don Delisi, David Lai, and Matt Pruis from Northwest Research Associates also attended under the sponsorship of a NASA NRA contract. Approximately 70 people attended the meeting representing government agencies, airlines, airframe manufactures, industry, academia, and international agencies. Subject areas included mid- and long- term wake solutions for aircraft spacings, Recategorization of Aircraft Spacings (RECAT), enroute wake recognition and mitigation, the details of an agreement for the FAA to obtain in-flight wake data from the National Research Laboratory (Canada), and a briefing of the aviation safety reporting system for wake encounters. *(POC: Neil O'Connor)*

Presentations from the NASA team at this workshop included:

1. Proctor, F.H., 2011: Transport and Decay of Wake Vortices under the Influence of Crosswind Shear. Wakenet USA, 18-19 October, Denver, Colo., Powerpoint Presentation, 18pp.

2. Pruis, M., and D. Delisi, 2011: Update on the NASA Probabilistic Model. Wakenet USA, 18-19 October, Denver, Colo., Powerpoint Presentation, 17pp.

3. Johnson, E., and C. Lunsford, 2011: Progress in Including Aircraft Meteorology Data in ADS-B Message Sets. Wakenet USA, 18-19 October, Denver, Colo., Powerpoint Presentation, 13pp.

4. Lai, D., 2011: A Lidar Simulator Tool for Vortex Measurements. Wakenet USA, 18-19 October, Denver, Colo., Powerpoint Presentation, 17pp.

5. O'Connor, N., and D. Delisi, 2011: New NASA Research Announcement for Wake. Wakenet USA, 18-19 October, Denver, Colo., Powerpoint Presentation, 12pp.

NASA Researchers Awarded Session Best Papers at 30th DASC, October 2011

"Integration of Weather Avoidance and Traffic Separation," a paper by Maria Consiglio, Jim Chamberlain, and Sara Wilson, won the Best Paper of the session award from the ATM Efficiency Track at the Digital Avionics Systems Conference (DASC). Jim Chamberlain presented the paper which was based on the Weather Integration and Scheduling Performance (WISP) Study. The paper describes a dynamic convective weather avoidance concept that compensates for weather motion uncertainties, the integration of this weather avoidance concept into a prototype 4-D trajectory-based Airborne Separation Assurance System (ASAS) application, and test results from a batch (non-piloted) simulation of the integrated application with high traffic densities and a dynamic convective weather model.

The weather model can simulate a number of pseudo-random hazardous weather patterns, such as slow- or fast-moving cells and opening or closing weather gaps, and also allows for modeling of onboard weather radar limitations in range and azimuth. The weather avoidance concept employs nested "core" and "avoid" polygons around convective weather cells, and the simulations assess the effectiveness of various avoid polygon sizes in the presence of different weather patterns, using traffic scenarios representing approximately two times the current traffic density in en-route airspace. Results from the simulation experiment show that the weather avoidance concept is effective over a wide range of weather patterns and cell speeds. Avoid polygons that are only 2-3 miles larger than their core polygons are sufficient to account for weather uncertainties in almost all cases, and traffic separation performance does not appear to degrade with the addition of weather polygon avoidance. Additional "lessons learned" from the batch simulation study are discussed in the paper, along with insights for improving the weather avoidance concept. The paper can be found at: *http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20110020261_2011018011.pdf*

"Effects of Scheduling and Spacing Tools on Controller's Performance and Perceptions of their Workload," authored by Lynne Martin, Harry Swenson, Alex Sadovsky, Jane Thipphavong, Liang Chen and Anthony Seo, was awarded Best Paper in session within the Human Factors Track. The paper documented recent Terminal Area Precision Spacing and Scheduling (TAPSS) system human-in-the-loop simulation experiments and the positive system performance and workload benefits. The TAPSS system research has been focused on investigating potential benefits for NextGen mid-term operations and forms the basis for the Airspace Technology Demonstration-1. The paper can be found at *http://www.aviationsystemsdivision.arc.nasa.gov/publications/2011/DASC2011_Martin.pdf*

Additional participation included Will Johnson chairing the Software Applications session in the Avionics Design track and presentation of nine other papers by researchers from the Airspace Systems Program in areas of Air Traffic Management research.
(POC: Sandy Lozito)

Boeing 737-800W Model Integrated with Advanced Concepts Flight Simulator, October 2011

The Simulation Laboratories (SimLabs) recently completed a successful integration of the Boeing 737-800W airframe model with the Advanced Concepts Flight Simulator (ACFS). Both were then utilized for the seventh and final simulation of EDA. To facilitate


The B747-400 Simulator at NASA's Ames Research Center.

the accurate descent trajectories required for the simu-lation, the Boeing 737 autopilot functionality was implemented and integrated with the simulator's GE Aviation simulated Flight Management System (sFMS). The high-fidelity engine and fuel-burn models avail-able with the 737 and 747 simulation models allowed comparison of the fuel used during descent, with and without EDA. The initial integration and testing of the B737-800W model on the ACFS was funded by an American Recovery and Reinvestment Act task order. *(POC: Bimal Aponso)*

Successful Test of En Route Trajectory Automation Integrated with FANS-1/A and En Route Automation Modernization, October 2011

Two-way air/ground data-link communication (data comm) using today's actual data comm network (ARINC) and actual Boeing 777 flight hardware was demonstrated using NASA ground-based trajectory automation from the Center/TRACON Automa-tion System (CTAS) at Ames, and a B777 simulator equipped with integrated Flight Management System (FMS)/data comm at Boeing in Seattle, Wash. The Boeing "Gateway" application enabled a variety of route and altitude messages anticipated to be typical in future NextGen data comm operations, such as log-on and log-off needed to establish and discontinue data comm, route and altitude uplink and downlink mes-sages and their associated wilco and/or unable mes-sages, and downlink of aircraft flight plan intent and FMS trajectory intent data. The work completes an
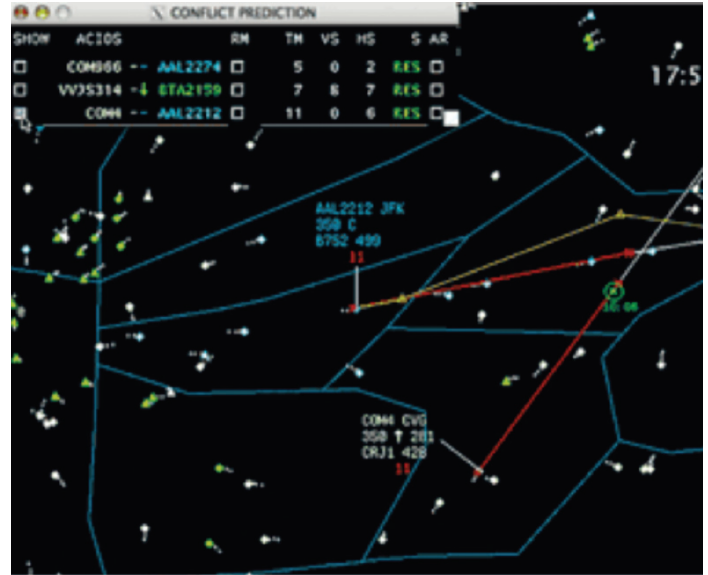
This screen shot captures the controller display from the Trajectory-Based Automation System.

FY10/11 American Reinvestment and Recovery Act task to prototype the integration of NASA ground-based trajectory automation with today's integrated FMS/data comm and the FAA's En Route Automation Moderniza-tion (ERAM) system. Similar testing in August 2011 at Lockheed-Martin (Rockville, Md.) demonstrated two-way communication between CTAS and ERAM. Lockheed and Boeing together have proposed to NASA that this integrated CTAS/data comm/ERAM system be the basis for operational trials of trajectory-based auto-mation with data comm in the FY13/14 time frame. *(POC: Dave McNally)*

SOSS Released, October 2011

The Surface Operations Simulator and Scheduler (SOSS), a fast-time surface modeling and simulation software developed by NASA, was released to a

private organization for the first time since the software was created. The SOSS source code and associated documents were released to Saab Sensis, which is using the software for modeling airports and conducting benefit assessments of the surface functions developed by NASA. Future plans include wider release of the software.
(POC: Yoon Jung)

NASA/FAA Collaborative Research to Improve Tactical Departure Scheduling, October and November 2011

Development, evaluation, and transition of the Precision Departure Release Capability (PDRC) continued with a new NASA Research Announcement (NRA) contract and further collaboration with the FAA. At an NRA contract kickoff meeting held October 21st,
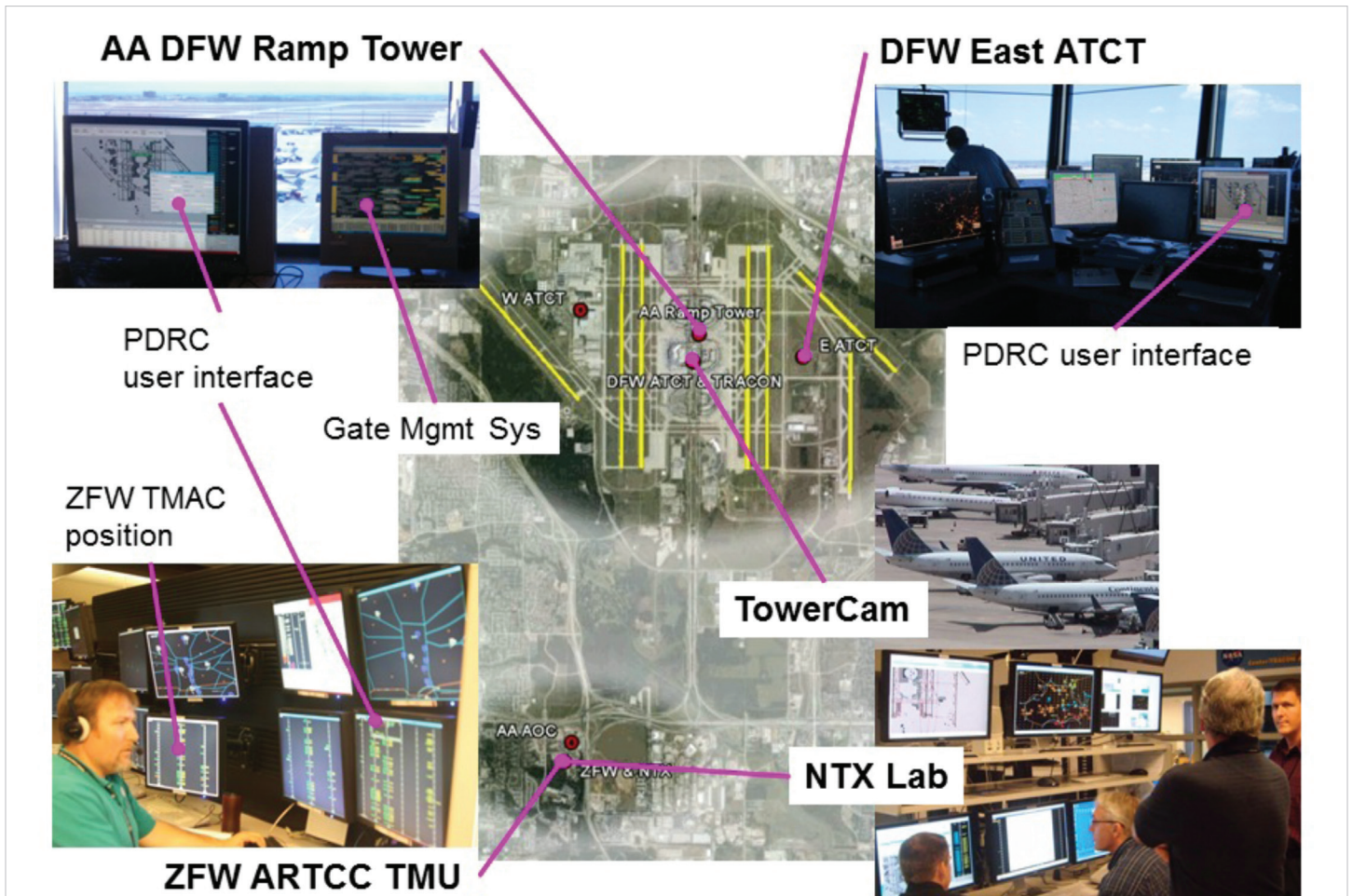
This graphic shows the PDRC field test observation positions in the vicinity of DFW airport.

Mosaic ATM, Inc. presented plans to enhance and extend the PDRC concept, collect quantitative PDRC benefits data via operational evaluations, and support transition of NASA-developed PDRC technology to the FAA. In a separate but related event on October 25th, FAA headquarters stakeholders visited the NASA/FAA North Texas Research Station to assess the maturity of the PDRC concept and discuss how best to transfer PDRC technology for implementation in the National Airspace System. NASA presented recently published results and provided a live-traffic demonstration of the PDRC system. During the follow-on meeting in November the FAA recipients for this NASA technology and the specific transfer deliverables were identified. An overview of the PDRC field evaluation in July was also discussed, and plans were presented for how to proceed with possible follow-on field evaluations and development of the transition deliverables.
(POC: Shawn Engelland)

Assessment of Environmental Impacts Due to Air Traffic, October 2011

A research team led by Metron Aviation, which includes the Logistics Management Institute and Purdue University, presented their plans to continue NASA supported research to assess environmental impacts. SEACAT (System-level Environmental Assessment of Concepts and Technologies) will refine the estimates of the effects of new ATM technologies and perform a more extensive analysis of how each technology contributes to the trades between environmental impacts, enabling more projected throughput, and reducing delay. SEACAT is also exploring the potential benefits of alternative fuels and reducing greenhouse gas impact of aviation. The team presented results on CO_2 emissions and noise results based on simulation runs. During the meeting, NASA provided feedback and the SEACAT team presented their research plans and deliverables for the year.
(POC: Neil Chen)

System Oriented Runway Management Quarterly Review, November 2011

The 10th quarterly review of the three-year contract supporting System Oriented Runway Management (SORM) research focused on the work of expanding the SORM algorithms to consider Runway Configuration Management (RCM) for multiple airports where there are dependencies based on physical proximity or flight paths (i.e. metroplexes). Mosaic ATM, Inc., the principal investigator, and team members LMI, AVMet, and College of William & Mary presented: (1) results from initial testing of a metroplex RCM algorithm; (2) progress on the New York metroplex modeling and simulation; (3) LMI's work on studying whether or not including environmental factors will be important for SORM airport configuration decisions; (4) AvMet's work on the relationship between weather events and airport configuration decisions; and (5) the College of William and Mary's work on an alternative

mathematical technique for more quickly solving the tactical RCM problem. The review concluded with a discussion of plans for completing the current contract and new topics such as an integrated NASA simulation incorporating SORM with air-traffic-management tools being developed at Ames.
(POC: Gary Lohr)

Prototype of Improved Terminal Area Scheduling Model, November 2011

An initial prototype of the Event-Based Stochastic Simulation of Terminal Airspace OpeRations (ESS-TOR) has been completed. This new simulation is an extension of the Stochastic Terminal Area Scheduling Simulation (STASS), which has been used for fast-time simulations to investigate aircraft arrival concepts. ESSTOR is event based, which will eventually enable the simulation of multiple, concurrent schedulers. It currently models the FAA's Traffic Management Advisor scheduler with greater fidelity than the previous STASS simulation. An effort is currently underway to develop input data sets from recorded TMA data.
(POC: Larry Meyn)

FAA Conflict Resolution Advisory Simulation, November 2011

NASA was invited to participate in the FAA's human-in-the-loop experiment devoted to conflict resolution automation. The technical interchange provided a rare opportunity for NASA to interact with a variety of

separation assurance researchers and FAA research managers. NASA's representative was provided a detailed look at FAA's technology and development plans for conflict resolution automation, and NASA was afforded an opportunity to share information about its latest technology, plans, and recent simulation results. By engaging with the FAA at this early stage, NASA is seeking to foster a collaborative relationship with the FAA on conflict resolution technology for the future, and that goal was achieved. NASA has been invited to attend the next FAA activity, a large-scale human-in-the-loop experiment scheduled for March 2012.
(POC: Confesor Santiago)

FAA Attends T-SAFE Discussions, November 2011

FAA members of the Minimum Safe Altitude Warning/Conflict Alert (MSAW/CA) Safety Board visited NASA Ames to learn how NASA-developed Terminal-Tactical Separation Assured Flight Environment (T-TSAFE) could resolve problems seen with the legacy tactical conflict detection tool, Conflict Alert (CA). The FAA briefed NASA on current problems with CA, which includes late and false alerts causing controllers to become desensitized to the tool and ignore it. T-TSAFE (adapted from en-route TSAFE) uses flight intent information to improve loss-of-separation prediction and significantly reduce false alerts. NASA researchers briefed the FAA on the initial evaluation of T-TSAFE algorithms in a human-in-the-loop

simulation. NASA also briefed the FAA on an analytical comparison of CA with a newly improved severity-based T-TSAFE, which has the potential to address difficulties associated with mixed Instrument and Visual flight separation rules. The FAA invited NASA researchers to deliver briefings at the next official MSAW/CA Safety Board meeting to be held at NASA Ames Research Center on February 7-9, 2012. *(POC: Shannon Zelinski)*

NASA Updates RTMA, November 2011

In cooperation with the FAA, NASA updated its modifiable research version of the FAA's operational Traffic Management Advisor called the Research Traffic Management Advisor (RTMA). RTMA is directly derived from the Traffic Management Advisor software currently deployed across the United States for time-based arrival metering and tactical departure scheduling. RTMA includes modifications needed to build and run in a Linux research environment, without the monitor and control infrastructure found in the deployed software. RTMA currently supports many NASA research activities including PDRC and the FAA terminal metering research at Dallas Love Field. By using a platform similar to the FAA's most current version of the operational TMA, air traffic research concepts and technologies developed using RTMA will be more easily transferred to the FAA for field-testing and deployment. *(POC: Shawn Engelland)*

Community Interest Follows Release of Autonomous Flight Rules (AFR) Concept Definition, November 2011

An Autonomous Flight Rules (AFR) Concept has been proposed as a new set of operating regulations in which aircraft navigate on tracks of their choice while self-separating from traffic and weather. AFR would exist alongside Instrument and Visual Flight Rules (IFR and VFR) as one of three available flight options for any appropriately trained and qualified operator with the necessary certified equipment. Historically, ground-based separation services evolved by necessity as aircraft began operating in the clouds and were unable to see each other. Today, technologies for global navigation, airborne surveillance, and on-board computing enable the functions of traffic conflict management to be fully integrated with navigation procedures on-board the aircraft. By self-separating, aircraft can operate with more flexibility and fewer restrictions than are required when using ground-based separation. The AFR concept, described in detail in NASA/TP-2011-217174, provides practical means by which self-separating aircraft can share the same airspace as IFR and VFR aircraft without disrupting the ongoing processes of Air Traffic Control. The AFR Technical Paper has generated genuine community interest both in the concept itself and in NASA's air traffic management research. Multiple requests for the paper have been received, including a request from the JPDO Trajectory Based

Operations (TBO) Study Team. The paper can be found at: *http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20110023668_2011023330.pdf*
(POC: David Wing)

SARDA Benefit Assessments, December 2011

To further the surface functions developed by NASA, Saab Sensis Corp was selected to perform a systematic benefit assessment of the Spot and Runway Departure Advisor (SARDA) tool at three airports. After extensive surveys and criteria development, John F. Kennedy International Airport, Boston Logan International Airport, and Charlotte Douglas International Airport were selected. Next steps include modeling the selected airports, evaluating the performance of NASA-developed surface schedulers emulated from the SARDA tool, and applying them to the airports. These activities will support the April 2012 human-in-the-loop simulation and future collaboration with an industry partner for a potential field evaluation of a decision support tool for airline, tower and ramp operators.
(POC: Yoon Jung)

Second Aviation Climate Change Research Initiative (ACCRI) Symposium, December 12-15, 2011

The symposium, sponsored by the FAA Office of Environment and Energy, focused on the modeling of chemistry climate impacts of aviation, contrails and metrics. NASA's Banavar Sridhar presented a paper on the integration of simple climate models, contrails and metrics with air traffic simulation in the United States. The simulation was used to develop route optimization methods and to study the impact of cross-polar traffic on emissions. The paper, which provided context to the topics discussed in the symposium, was very well received and cited as an example of interdisciplinary research. It was suggested that the route optimization methodology could be used to reduce the exposure to cosmic radiation during polar flights. During the symposium, Banavar met with Ulrich Schumann (DLR), Pat Minnis (LaRC) and John Murray (LaRC). The topics discussed included route optimization with environmental impacts, convective weather/volcanic ash and wake vortex research. These topics are a continuation of ongoing conversations between NASA Headquarters and DLR. Both sides have complementary information to contribute including the air traffic simulation and optimization work at NASA, and DLR expertise in the modeling of contrails and their project, Reducing Emissions from Aviation by Changing Trajectories for the benefit of Climate (REACT4C). The proposed visit of DLR scientist Volker Grewe to NASA's Ames Research Center during the summer of 2012 should provide an opportunity to enhance the NASA/DLR collaboration.
(POC: Banavar Sridhar)

Researchers Achieve Significant Improvement in Climb Trajectory Prediction with Actual Flight Track Data, December 2011

A new algorithmic technique developed by NASA researchers has reduced climb-trajectory prediction errors by about 15% in evaluations with actual host radar track data. Aircraft climb trajectories are arguably the most difficult to project; large errors in these predictions increase the rate of false and missed alerts from separation assurance automation and reduce the potential operational benefits of some advanced concepts for NextGen. The algorithm improves climb-trajectory prediction accuracy by dynamically adjusting the aircraft weight modeled for trajectory predictions based on observed track data. This past fall, researchers implemented this adaptive climb-trajectory prediction algorithm in CTAS, NASA's real-time ground-based research system. Initial tuning of the algorithm was conducted using Fort Worth Center air traffic data from the week of November 28. Then, the algorithm was evaluated using air traffic data in the same Center from the following week. Results indicate the algorithm was able to reduce the altitude error by 6-25% (or roughly 80-220 feet). Future work will include stress testing the algorithm over a wider range of traffic and environmental conditions, including high wind uncertainty, low and high wind shear, etc. Additional enhancements to the algorithm may also include the development of logic to infer aircraft climb profile characteristics, including capture speeds.

(POC: David Thipphavong)

Air Traffic Collaborations with the State of Alaska, December 2011

Alaska's deputy commissioner of the Aviation Division, along with the project manager for the Statewide Mapping Initiative from the Alaska Department of Transportation, conducted a follow-up visit to NASA regarding collaborations related to air traffic management. Three proposals were presented by NASA, to which the Alaska officials provided feedback and next steps to further solidify the collaborations. One proposal, the Traffic and Atmospheric Information for General Aviation (TAIGA) Android-based tool, would display weather, air traffic management, and terrain data on a smartphone device. The aircraft's position would be updated using built-in GPS technology within the smartphone. A second proposal would provide weather mitigation strategies to minimize the impact of fog or other visibility constraints for Anchorage arrivals. This proposal will use the NASA-developed Future Air traffic management Concepts Evaluation Tool (FACET) combined with Anchorage weather forecasts and strategic scheduling algorithms. The third proposal would provide state-of-the-art conflict alert capability to the Anchorage TRACON using NASA's Terminal Tactical

Separation Assured Flight Environment (T-TSAFE) technology. The airspace around Anchorage is complex and, in addition to the Ted Stevens International Airport, includes within ten miles of each other a seaplane 'seaport,' a busy air force base (Elmendorf AFB), and a general aviation airport (Merrill Field).
(POCs: Shon Grabbe, Joey Rios)