



AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

APR-JUN 2019 | Quarter 3



UTM Completes TCL4 Testing in Reno, Nevada 4

Patent Issued for UTM 21

AOSP IN THE NEWS

[After 737 MAX Crashes, Boeing CEO Asks For Board Review Of Airplane Design Processes](#)

Seattle Times (4/5, Gates) reports “addressing criticism of the design of the Boeing 737 MAX’s flight-control systems, the company’s board of directors has created a committee to review how the jet maker designs and develops its new airplanes. ... and the FAA has set up a review chaired by former National Transportation Safety Board Chairman Chris Hart and including experts from the FAA, NASA, and international aviation regulatory authorities to evaluate all aspects of MCAS, including its design and how pilots interact with the system.”

[NASA, Nevada Institute to Test Drones In Downtown Reno](#)

Washington Times (5/8) reports “Drones will be buzzing around parts of downtown Reno the next two weeks for urban testing by NASA and the Nevada Institute for Autonomous Systems. Reno officials announced Tuesday that the city is helping to facilitate the testing, which will be conducted in the downtown area May 11-24 and result in some road closures and pedestrian restrictions. According to the city’s announcement, NASA earlier this year selected the Las Vegas-based institute to participate in drone operations that will test flying in higher-density urban areas.”

[FAA Asks For NASA’s Help In Boeing 737 MAX Safety-upgrade Review](#)

Seattle Times (5/7) reports “the Federal Aviation Administration is convening a panel of outside experts from the Air Force, NASA and a Transportation Department center to review Boeing’s software fixes for the grounded 737 MAX. The agency announced the new Technical Advisory Board in a statement on Tuesday. The panel’s recommendations will ‘directly inform the FAA’s decision concerning the 737 MAX fleet’s safe return to service,’ the agency said.”

[NASA Invites Media to Watch Drone Traffic Management Testing](#)

SpaceRef (5/16) reports “NASA is entering the final stage of testing its Unmanned Aircraft Systems Traffic Management (UTM) platform and invites media to learn more and watch drone demonstrations Tuesday, May 21, in Reno, Nevada. The agency’s research into drone traffic management focuses on operations within a city, at an altitude of 200 feet or higher, and the unique challenges presented when flying in an urban area. Media will have the opportunity to interview NASA leadership and researchers about this important work.”

[New Airspace Concepts Evolving Around ‘Non-Traditional’ Entrants](#)

Aviation Week (5/20) reports “new air traffic management (ATM) constructs are taking shape around drones, commercial spacecraft and urban air mobility (UAM) vehicles, known collectively, at least for now, as ‘non-traditional’ entrants into the airspace. The NASA-led Unmanned Aircraft System (UAS) Traffic Management (UTM) project to develop a low-altitude traffic management system for drones started its final phase of testing in May.

[NASA Puts Drone Delivery System to The Test In Reno, Nevada](#)

CNBC (5/21) reports “NASA is testing its drone traffic control system in Reno, Nevada in a new push to bring package delivery, emergency medicine and more. The system would help drones communicate with each other to navigate cities and neighborhoods, and will be tested in Reno through July 2019.”

[NASA’s Ambitious Drone Air Traffic Control Trial Faces Its Toughest Challenges](#)

SlashGear (5/22) reports “NASA’s automated air traffic control for drones project is headed into its final – and most challenging – year, and the future of UAV deliveries, automated flying taxis, and more could

AOSP IN THE NEWS

hinge on just how well the trials pan out. The Unmanned Aircraft Systems Traffic Management project (UTM) has been running since 2015, NASA's experiment in collaboration with the FAA and other agencies to explore how piloted and self-flying drones and other unmanned aircraft can cohabit in the skies."

[NASA's First-Of-Kind Tests Look to Manage Drones In Cities](#)

AP News (5/24, Sonner) reports "NASA has launched the final stage of a four-year effort to develop a national traffic management system for drones, testing them in cities for the first time beyond the operator's line of sight. Multiple drones took to the air at the same time above downtown Reno this week in a series of simulations testing emerging technology that someday will be used to manage hundreds of thousands of small unmanned commercial aircraft."

[NASA Begins Testing System to Manage Drone Traffic In Cities](#)

The Hill (5/24, Bowden) reports "NASA is reportedly testing a national system to manage the air traffic of commercial drones as more companies look to make deliveries to consumers via unmanned aerial vehicles (UAVs). The Associated Press reported Friday that NASA researchers flew

multiple drones in downtown Reno, Nev., this week as part of a test of an unmanned flight system."

[NASA Develops Drone Management System](#)

WESH-TV (6/4) reports "with many more drones than airplanes predicted, a different system is needed. Instead of a human controller giving a drone clearance, NASA created a peer to peer awareness system telling a drone not where it can be, but where it cannot. Later this summer NASA will hand over its final decisions to the FAA, which will create the rules of the road for a highway a few hundred feet overhead."

[Reno Streets Closing As NASA Resumes Urban Drone Testing](#)

Associated Press (6/13) reports "the city of Reno has announced some downtown street closures as NASA resumes a series of drone tests in high-density urban settings. ... It's part of the final stage of a four-year effort to develop a national drone traffic management system. NASA and the Nevada Institute for Autonomous Systems conducted initial tests last month, flying drones for the first time above Reno streets beyond the operator's line of sight."

[Urban Air Mobility, Alternate Propulsion Among NASA Research At Aviation Forum](#)

Business Insider (6/18) reports "NASA's cutting-edge aeronautics research continually delivers new concepts and technologies to the aviation industry, many of which will be the focus of agency discussions and demonstrations at this year's American Institute of Aeronautics and Astronautics (AIAA) annual Aviation Forum and Exposition, otherwise known as Aviation 2019. The five-day conference takes place June 17-21 at the Hilton Anatole Hotel, 2201 N. Stemmons Freeway, in Dallas."

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

UTM Completes TCL 4 Testing in Reno, Nevada

POC: [RON JOHNSON](#) AND [KATHY LEE](#)

This quarter marked a significant achievement for the Unmanned Aircraft Systems (UAS) Traffic Management (UTM) project as they completed Technical Capability Level 4 (TCL 4) testing in Reno, Nevada. In leading up to this event several hurdles had to be overcome. A kickoff meeting with the Nevada UAS test site and the Nevada

Institute for Autonomous Systems (NIAS) took place in Reno, Nevada, on February 4. The purpose of the visit was to review NIAS' progress on TCL 4 test preparation since being awarded the test site contract on December 21, 2018. Eight UTM team members participated in this face-to-face meeting held in Reno's City Hall to discuss the details and test plans of the flights in and around the City of Reno that were planned for this test. Reno Mayor Hillary Schieve paid a visit and

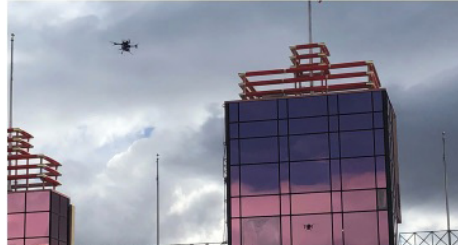
underscored the city's commitment to successful testing. The team also visited sites in Reno to be used for takeoffs and landings, flight paths, and contingency areas. Following development and preparations, initial shakedown was conducted from May 13-23. The NIAS managed the test for NASA to demonstrate the UTM system in a complex urban environment. During these efforts, several UAS (small drones) were outfitted with onboard systems to investigate



From left to right: Marcus Johnson, Tiffany Blake, Jeff McCandless, Huy Tran, Cheryl Quinn, Ron Johnson, David Korsmeyer (all from NASA Ames); Reno Mayor Hillary Schieve; Darryl Waller (also from NASA Ames); NIAS Executive Director Chris Walach.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

performance of command and control communications with the ground, Global Positioning System (GPS) navigation, collision avoidance, vehicle-to-vehicle communication, and safety parachutes. As the outfitting and integration was completed, each vehicle went through functional test flights and an aviation flight safety review board conducted by Nevada with NASA participation. Pilot training with the modified vehicles took place that week in May at the Reno-Stead airport and included takeoffs and landings from rooftops. UAS Service Supplier (USS) providers were also onsite at Reno-Stead to check integration and data transfers between the UAS and USS as well as between the USS and NASA data collection systems. Approvals from the Federal



Drone flying in downtown Reno, Nevada — TCL 4 on May 21, 2019.

Aviation Administration were also received that week for flying in the Reno airspace below 400 ft., and for conducting beyond visual line of sight operations by the pilot with additional safety visual observers. These were key approvals for testing to occur at three test ranges (Idlewild Park, Oxbow Park, and downtown Reno) inside Reno city limits. Overall, seven days of flying were achieved – somewhat shortened due to weather and typical technical problems expected

in shakedown testing. These flight tests were the first of its kind anywhere with flying multiple drones under beyond visual line of sight conditions in an urban environment. In conjunction with the shakedown tests, the NASA UTM project hosted a Media Day on May 21, to demonstrate UTM operations in downtown Reno for national and local media. The press contingent included cable network CNBC, the Associated Press, and several local Reno television stations. Demonstration flights of drones were performed and a press conference held, hosted by the Public Affairs Office of the NASA Ames Research Center in California. Speakers representing the UTM tests included Huy Tran, director of aeronautics at NASA Ames, and Ron Johnson, project manager for UTM. David Korsmeyer, associate center director for research and technology, also gave a briefing and was interviewed.

Examples of media stories of this event are at:

<https://www.ktvn.com/story/40510988/nasa-holds-watch-drone-traffic-management-testing-in-reno1>

<http://nbr.com/2019/05/22/nasa-explores-the-use-of-drones/>



CNBC reporter Jane Wells, reporting on TCL 4 testing in Reno, Nevada.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



The UTM team at the UTM lab at Ames.

Following the successful shakedown tests, the UTM project completed TCL 4 flight tests from June 17-28. This testing was the first of its kind with multiple UAS flying simultaneously under beyond visual line of sight operations in a true urban environment. The testing (coordinated by NIAS) included 18 industry partners. The testing had five live UAS flying 150 missions in downtown Reno and a nearby park. Additionally, there were over 500 simulated flights that were flown simultaneously with the live flights to create high-density UAS operations. As during the shakedown tests, the UAS were outfitted with onboard systems to investigate their communication, navigation, and identification performance. Five industry

partners provided USS connected to the NASA Flight Information Management System that controlled the drone air traffic through multiple scenarios including remote launch and land, building rooftop-to-rooftop operations, emergency responder operations, and airspace volume restrictions. Early results showed the UTM system performed well in traffic management functions and pointed out the challenging effects on future UAS designs for intense ambient radio frequency interference on UAS controls, GPS errors due to tall buildings, and micro-weather in urban canyons. On June 17, Eugene Tu, NASA Ames Center director, visited the NIAS Command Center for the TCL 4 test and met with team members, including NIAS

Executive Director Chris Walach. UTM will be conducting similar tests in Corpus Christi, Texas in August to collect additional data on UTM system performance in operating in an urban environment.

Fourth Trajectory-Based Operations Technical Exchange Meeting

POC: [BRYAN BARMORE](#), [AL CAPPS](#), [YOON YUNG](#) AND [JEREMY COUPE](#)

From April 2–3, the NASA Ames Research Center in California hosted the Fourth Trajectory-Based Operations (TBO) Technical Exchange Meeting (TEM) to coordinate research activities, results, and needs between the FAA, NASA, and the MITRE Corporation. TBO is the key operational improvement for airspace users to realize the benefits of the FAA's NextGen plans. NASA and MITRE have been developing and testing TBO concepts and technologies for integration into the FAA's acquisition plans, for eventual testing and deployment by the FAA. This series of TEMs started at the request of the FAA to get key researchers together to exchange relevant research ideas and results. TEMs also allow the FAA Technical Center personnel early oversight of the research cycle which can lead to easier transitions of research results to final testing and evaluation. Previous TEMs were hosted by the NASA Langley

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



Attendees of the Fourth TBO TEM toured facilities at Ames.

Research Center in Virginia, MITRE, and the FAA Technical Center. This TEM was attended by 57 people, including 17 remote attendees. The FAA and their support contractors numbered 28. The FAA presented specific aspects of their vision for TBO, as well as research, testing, and evaluation capabilities they have developed. MITRE presented ongoing research into key TBO topics such as site adaptation of time-based management and performance-based navigation procedures and future data communications. NASA presented the status of Integrated Demand Management (IDM), Airspace Technology Demonstration-2

(ATD-2) Phase 3, and Dynamic Routes Around Weather. The ATD-2 briefing included overhead stream insertion benefits assessments, Phase 3 plans, and upcoming events and stakeholder engagements. An open discussion period focused on questions researchers should be asking in early development to enable smooth transition deployment, including considerations for user training, deployment risk reduction early in the research process, better understanding of behaviors when things break, and best practices for interconnected studies. A living white paper will be produced over the next couple of months capturing the outcomes and recommendations

from the discussion. The attendees toured NASA's Air Traffic Control laboratory, Airspace Operations Laboratory, and Crew-Vehicle Systems Research Facility. The next meeting will likely be hosted by NASA, at its North Texas Facility in Dallas, Texas, in late summer.

ATD-2 Assessment of Ramp Times 4 Human-in-the-Loop Simulation

POC: [LINDSAY STEVENS](#) AND [YOON JUNG](#)

The Airspace Technology Demonstration-2 (ATD-2) experiment team completed the Assessment of Ramp Times (ART) 4 human-in-the-loop (HITL) simulation testing at the NASA Ames Research Center in California's FutureFlight Central (FFC), from April 22 – May 3. The ART studies focus on testing various research questions for ramp controllers and managers during surface metering events. The corresponding results are used along with user feedback collected during the runs to refine the ATD-2 tools for field operations. Four retired Dallas-Fort Worth International Airport (DFW) FAA Air Traffic Control Tower (ATCT) controllers, two active FAA/National Air Traffic Controllers Association DFW traffic management coordinators, and eight American Airlines (AAL) ramp controllers (five active and three retired), as well as 12 pseudo-pilots

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



Lindsay Stevens gives Carl Bureson an overview of ATD-2 ART 4 HITL Simulation at FFC.

participated in the ART 4 HITL simulation. Participants managed traffic per normal DFW operations while the ramp control participants worked to meet surface metering advisories for pushing aircraft off the gate areas as well as for delivering aircraft to the spot between the ramp and the airport movement area. The simulation environment at FFC includes a 360-degree tower cab to simulate airline ramp operations, and a 270-degree out-the-window view to simulate the ATCT. Three traffic scenarios were built based on live DFW operations during the summer of 2018. The ramp

and ATCT controllers managed surface traffic in the simulation using the ramp tower console, ramp manager tower console, and the surface trajectory-based operations client ATD-2 user interfaces. The ATD-2 experiment team also hosted visitors and observers from various organizations during the simulation, including the acting Deputy FAA Administrator Carl Bureson, the FAA timed-based flow management advisor, AAL's Operations Systems and Planning department, and FAA Technology Development & Prototyping Division, ANG-C52.

Enabling Autonomous Flight and Operations in the NAS Workshop 1

POC: [PARIMAL KOPARDEKAR](#)

From April 23–24, the NASA Ames Research Center in California hosted the “Enabling Autonomous Flight and Operations in the National Airspace System (NAS) Workshop–1.” The inaugural workshop looked at research issues related to enabling autonomous flight operations in the future. Almost 200 attendees (40 from NASA) gathered at the Ames Conference Center to hear keynote speakers, including Jaiwon Shin, NASA; Sebastian Thrun, Kitty Hawk; Sanjiv Singh, Near Earth Autonomy; Raj Singh, JetBlue Technology Ventures; Joseph Keegan, Boeing; and Michael Romanowski and Carl Bureson, FAA. John Cavolowsky moderated a panel of FAA, academia, Airline Pilots Association, and industry panelists. Attendees participated in moderated break-out discussions to identify minimum viable products and steps to make progress towards increasingly autonomous flight and operations.



Jaiwon Shin outlines NASA Aeronautics vision at Autonomy Workshop.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



FAA Administrator Dan Elwell visits the Charlotte air traffic control facility to observe ATD-2 surface departure metering.

NASA ATD-2 and Charlotte Field Demo Partners Host FAA Administrator

POC: [SHAWN ENGELLAND](#)

On April 29, Airspace Technology Demonstration-2 (ATD-2) Field Demo Partners from the FAA's Charlotte, North Carolina air traffic control facility and American Airlines' (AAL) Hub Control Center (ramp control facility) joined with NASA personnel to host the acting FAA Administrator Daniel Elwell. The visit began in the FAA's Charlotte air traffic facility with a briefing and ATD-2 system demo from the former National Air Traffic Controllers Association representative for ATD-2. The administrator then toured the facility interacting with FAA personnel and observing use of ATD-2 equipment in the air traffic control tower and Terminal Radar Approach Control Center. After touring the FAA facility, the administrator met with AAL executives and observed ATD-2 surface departure metering at AAL's Charlotte Hub Control

Center. The administrator was impressed with the collaborative nature of ATD-2 enabled operations in Charlotte and emphasized the importance of technology transfers to both FAA and industry.

UAM-UTM Testbed Integration

POC: [DAVID THIPPHAVONG](#)

In early May, the Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) subproject achieved a significant technical accomplishment in its development of the NASA Aeronautics Research Mission Directorate's UAM Grand Challenge (GC) airspace management backbone. The NASA ATM-X testbed was connected to the UTM Technical Capability Level 4 (TCL 4) system components, and successfully demonstrated the exchange of simulated UTM operational data. The integration of the testbed and the UTM TCL 4 system facilitates a diverse range of GC simulations and enables users to access testbed-connected simulation capabilities and data via TCL 4. This is a crucial step towards preparing for GC flight test activities; industry partners will be able to conduct lab simulations to demonstrate the required information exchange. Follow-up work is underway to connect the components (e.g., UAS Service Supplier) of one or more industry partners with this integrated UTM TCL 4 testbed

system that will be the foundation of the UAM GC airspace management backbone. To reduce risk and pave the way for test simulations with GC partners, a demonstration of information exchange and interoperability between industry and NASA components is expected by the end of fiscal year 2019.

ATD-2 Phase 3 Briefing to FAA Fort Worth District Manager and Staff

POC: [GREG JURO](#)

On May 7, the NASA Airspace Technology Demonstration-2 (ATD-2) team provided a briefing on Phase 3 to the Fort Worth Center district manager and support staff, in Dallas, Texas. The support staff included the air traffic managers from Dallas-Fort Worth International Airport (DFW) tower, DFW Terminal Radar Approach Control Center, Fort Worth Center, and their National Air Traffic Controllers Association representatives. The briefing encompassed a high-level overview of ATD-2 and integrated involvement with several planned future systems that will be utilized in the National Airspace System. A history of FAA and industry involvement was also outlined with particular emphasis on NASA's continuous participation in collaborative decision making groups and forums. The briefing concluded with an operational discussion and overview of the operational concepts

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

planned for Phase 3. The district manager and staff expressed full support of Phase 3 as the project continues to move forward.

ATD-2 Phase 3 Meetings with FAA Field Demo Partners in North Texas

POC: [GREG JURO](#)

In an effort to orient their FAA field demonstration partners, the NASA Airspace Technology Demonstration-2 (ATD-2) team held a series of third quarter meetings. In the first meeting on April 11, the ATD-2 team briefed its North Texas region FAA field demo partners on the proposed operational use of the ATD-2 Phase 3 capability that will be utilized in the field in the summer of 2019. The team

met with local National Air Traffic Controllers Association (NATCA) representatives, traffic managers of Dallas-Fort Worth International Airport (DFW) Air Traffic Control (ATC) Center, DFW Terminal Radar Approach Control Center, and DFW ATC tower. The NASA team demonstrated the ATD-2 metroplex system running with live data and created mock alternatives for rerouting traffic leveraging trajectory options sets for concept walkthrough purposes. The group examined system recommended reroute opportunities and discussed procedural aspects of the FAA traffic management and approval process. A follow-up shadow session took place on May 2, to gather feedback on the system features and discuss needs before

the system is utilized in the field. At the May 2 meeting, the ATD-2 team met again with local NATCA representatives, traffic managers of DFW ATC Center, DFW Terminal Radar Approach Control Center, DFW ATC tower, and Dallas Love tower. The items discussed included using the National Traffic Management Log for integrating restrictions in the metroplex planner, identifying specific coded departure routes that will be utilized, potential feedback venues, training requirements, and appropriate scenarios to test at the initial stages of the project. The discussion was again followed by a hands-on demonstration of the equipment.

At a follow-on meeting on May 9, the ATD-2 team conducted an FAA ATC and Airline Operator shadow session that included all of the field demo partners that will be utilizing the ATD-2 system during the 2019 testing and evaluations. A walkthrough of the concept of use and operational displays was provided, which generated significant productive discussion between all parties. This discussion included evaluation strategy, test process in the initial stages, training, user input, and objective data collection and metrics. The feedback from the shadow session was informative and led to specific actions that were incorporated into the evaluation plans for the summer.



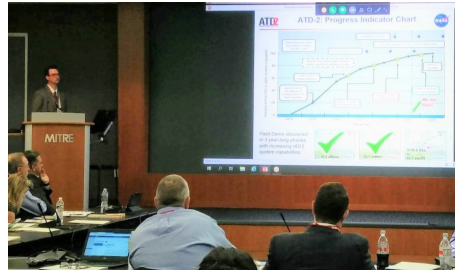
NASA ATD-2 shadow session with FAA field demo partners in North Texas.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

ATD-2 Spring Collaborative Decision Making Engagements

POC: [JEREMY COUPE](#), [ERIC CHEVALLEY](#)
AND [ISAAC ROBESON](#)

From May 13–15, the Airspace Technology Demonstration-2 (ATD-2) team engaged on three separate collaborative decision making (CDM) venues in Washington, DC. On May 13, the team supported the Surface CDM Team (SCT), providing updates on the ongoing field demonstration in Charlotte Douglas International Airport (CLT). On May 14, the team briefed the combined Flow Evaluation Team and SCT, discussing the new tasking that has been created to collaborate with NASA on its Phase 3 work on departure fix load balancing with trajectory option sets. On May 15, the ATD-2 team briefed the main CDM forum, describing the work NASA plans this summer in the North Texas metroplex as well as the ongoing field evaluation in CLT. The main CDM forum briefing also highlighted predictability improvement benefits that have been from automatic scheduling into the overhead stream with the operator provided earliest off block times. CDM engagements are an important venue for NASA research efforts that strive toward aviation system-wide solutions. The CDM participants appreciated the engagement and provided constructive inputs that will



Jeremy Coupe and Al Capps briefing the CDM group.

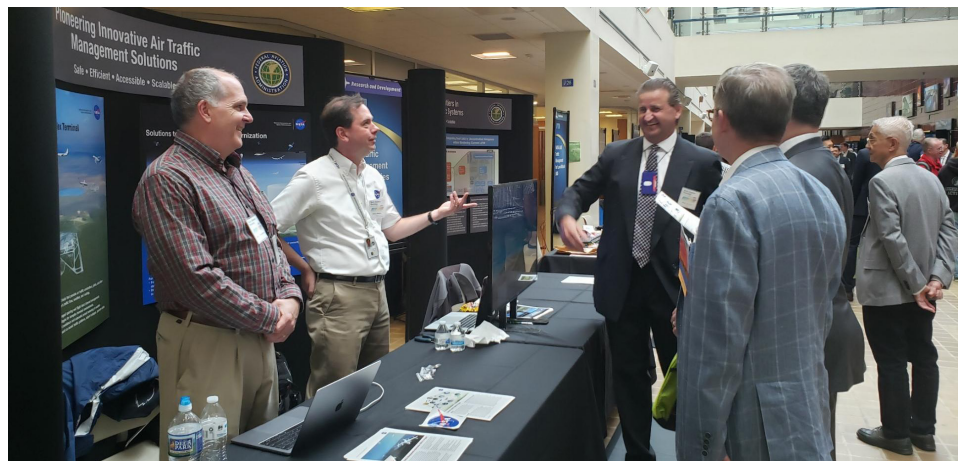
be used to improve the ATD-2 research products.

NASA's ATM Research Featured at ATCA Technical Symposium's Tech Center Tuesday

POC: [BOB STAUDENMEIER](#), [JOEY MERCER](#),
[BRYAN BARMORE](#) AND [ALINA ESKRIDGE](#)

NASA's Air Traffic Management (ATM) research and development was showcased during the annual Air Traffic Controller Association (ATCA) Technical Symposium's Aviation Science, Technology, Engineering, and Math Monday

and Tech Center Tuesday (TCT) events, from May 13-14, at the FAA's William J. Hughes Technical Center in Atlantic City, New Jersey. This year's theme was "Where Innovations Take Flight," and featured technical tours, demonstrations, and exhibits in a variety of aviation fields from over 45 different projects, programs, and organizations. NASA had two booths, which showcased the Airspace Technology Demonstrations (ATDs), ATM-eXploration, System Wide Safety (SWS), and Unmanned Aircraft System (UAS) Traffic Management (UTM) projects. The ATD-1 concept animation and Avionics Phase 2 flight test video were featured. The ATD-2 concept animation was shown in the NASA booth, and the user displays were shown in an adjacent FAA booth highlighting collaboration work with the FAA Tech Center Team. This included the latest



AOSP team members briefing visitors at the NASA booths at ATCA's Tech Center Tuesday Event.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

connection to the electronic flight progress strips in use at Charlotte Douglas International Airport. The ATD booth also showed the ATD-3 concept animation about the integration of ground-based tools and a flight-deck-based tool focusing on improving en route and arrival phases of flight. The UTM booth featured a simulated scenario of UAS operations, showcasing flight test activities that were conducted during the Technical Capability Level (TCL) 2 and TCL 3 events, as well as a demonstration of an upcoming TCL 4 scenario that will take place in Reno, Nevada in June. Visitors viewed visualizations and functions of the UTM research platform, bringing to life the system architecture and data models currently in use. Monday's exhibit visitors included high school students from neighboring New Jersey communities, showing great interest with current and future NASA systems and research. Tuesday's exhibit visitors included government and industry representatives who showed considerable interest throughout the event.

Learning to SWIM with ATD-2

POC: [SHAWN GORMAN](#) AND [JEREMY COUPE](#)

From May 21–23, the Airspace Technology Demonstration-2 (ATD-2) team held meetings with the broader aviation community



ATD-2 team providing SWIM briefing to aviation stakeholders.

to share lessons learned on System Wide Information Management (SWIM) data pre-processing, data mediation, and analysis.

On May 21, at the Southwest Airlines facility in Dallas, Texas, the SWIM Industry/FAA Team (SWIFT) held a quarterly meeting and presented various use cases on SWIM processing. On May 22, the ATD-2 team conducted day-long briefings to approximately 116 members of the aviation community including airline operators, airport operators, industry vendors, the FAA, and the National Business Aviation Association. The ATD-2 presentation covered the lessons learned in SWIM processing over the course of the project, data mappings that have been developed to properly mediate among disparate sources of SWIM flight data, reporting artifacts that have evolved over the life of the project and example analytics work that the ATD-2 team has executed with this

data. The ATD-2 team supported two extra sessions to address specific questions from the community; one after the main briefing, as well as a follow-on session the next morning at the Dallas-Fort Worth Fire Training Research Center. The ATD-2 team received considerable positive feedback on the value of this technical transfer to the aviation community, as well as requests for follow-on transfers. The ATD-2 team is grateful for the collaboration with SWIFT as well as Southwest Airlines and the Dallas-Fort Worth International Airport's hospitality in hosting these important engagements.

ATD-2 Conducts Phase 3 Freeze Meeting with FAA ATC and Operators

POC: [GREG JUR0](#)

On May 23, the Airspace Technology Demonstration-2 (ATD-2) team conducted a Phase 3 requirements freeze meeting with FAA air traffic

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



ATD-2 team briefing field demo partners.

controllers and operators in the North Texas area. ATD-2 field demo partners in attendance included personnel from Southwest Airlines, American Airlines, Dallas-Fort Worth International Airport authority, regional FAA and National Air Traffic Controllers Association (NATCA) personnel, and national FAA and NATCA personnel. In addition to updating the audience on recent activities relating to Phase 3, the meeting obtained concurrence from the group on a roll out strategy for this summer and early fall. The “micro-phased” strategy presented gradual increases in system capability over a three-month period. The group overwhelmingly approved this approach. In the following weeks, the ATD-2 team will focus on the first micro-phase which is scheduled to begin June 10. The first micro-phase encompasses the integration of air traffic restriction SWIM data into a metroplex-wide planning

interface shared by all field demo partners in the North Texas area as well as initial familiarization with system components.

NASA Grand Challenge Airspace Test Infrastructure Kickoff

POC: [JIM MURPHY](#) AND [SHIVANJLI SHARMA](#)

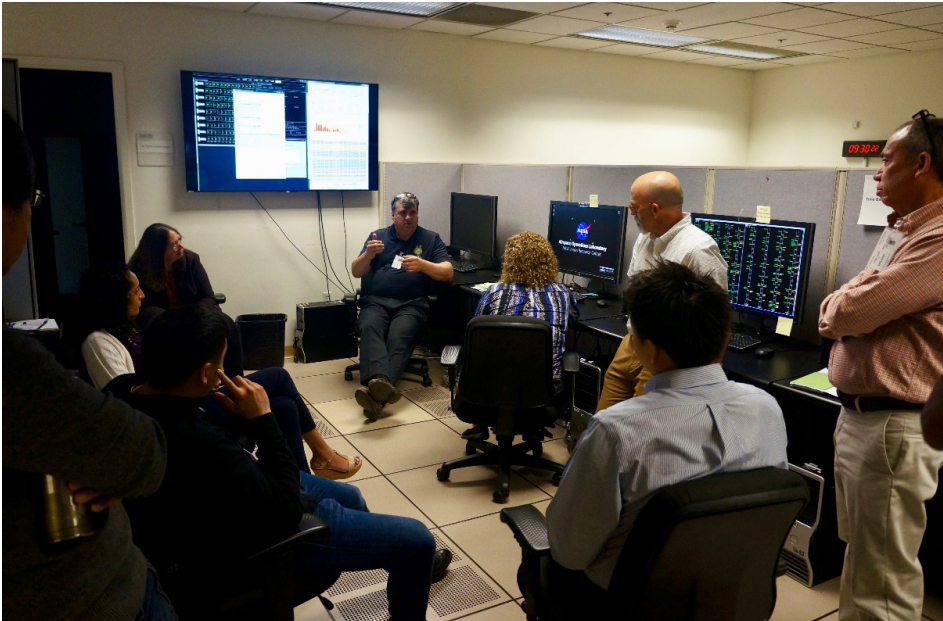
From May 28-29, the NASA Grand Challenge (GC) Airspace Test Infrastructure (ATI) team held a kickoff meeting at the NASA Ames Research Center in California. ATI is preparing for the Urban Air Mobility (UAM) ecosystem-wide challenge for participants to execute system-level safety and integration scenarios within a robust and relevant environment, which NASA will host in 2020. The ATI kickoff meeting included engineers and researchers from Ames and the NASA Langley Research Center in Virginia, who developed a schedule for the initial GC and the associated build-up activities. The ATI team is focused on providing a robust platform for UAM airspace participants to demonstrate their concepts and integrate with UAM vehicle participants. The ATI team is also working closely both with the team at NASA’s Armstrong Flight Research Center in California, which is providing the test range, and with industry partners, to integrate their concepts in order to execute an integrated vehicle and airspace UAM GC.

AOSP Briefs IDM Concept to FAA’s Command Center Staff for iTBO Implementation

POC: [NANCY SMITH](#) AND [PAUL LEE](#)

From May 29-30, Integrated Demand Management (IDM) researchers met with the FAA’s Command Center representatives for Initial Trajectory Based Operations (iTBO) at NASA’s Ames Research Center in California. The purpose of the meeting was to discuss and demonstrate NASA’s IDM concept. FAA Command Center representatives included Pat Somersall, Command Center staff manager, and Jeeja Vengal, Command Center national operations manager. Vengal is the Command Center representative in the FAA’s iTBO implementation effort, and a key stakeholder for facilitating IDM implementation, and Somersall has been an early supporter of the IDM concept. Potential benefits and feasibility of the IDM concept were also demonstrated. The IDM team briefed on the potential benefits of coordinating the strategic traffic flow management system to pre-condition air traffic into the traffic based flow management (TBFM) arrival problem. Initial briefing of the concept, lively discussion about concept and hands-on experience with IDM tools, followed by a four-hour end-to-end simulation run allowed the visitors to ask lots of questions, interact directly with the tools, and see the outcome results of the concept. Overall, the meeting

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



IDM team briefing the FAA's Command Center representatives.

was quite successful. There was a healthy discussion about a potential Philadelphia International Airport (PHL) field trial of the IDM concept as a way of introducing FAA's iTBO concept in the Northeast Corridor airspace. The IDM team showed results of a direct comparison between current PHL operations versus PHL operations with the IDM concept in the human-in-the-loop environment, which was a huge factor in convincing the visitors of the beneficial impact of IDM. They strongly encouraged the IDM team to continue socializing the concept in this way and to continue collecting these types of comparison results and show them to the key operational stakeholders whose participation is critical for implementation of IDM in the field. A second feedback

received was an encouragement for NASA to continue developing modeling and automation/decision support tools that have been built for the IDM concept, which they liked very much. They suggested that the tools could be developed as potential third-party web-based services as a way of providing valuable information to traffic flow managers. Few action items resulted from the meeting. Somersall suggested inviting a PHL operations expert when the Northeast Corridor specialists from the TBFM office are expected to come for a two-day meeting in July so that they could jointly discuss the IDM concept for PHL operations. Secondly, they supported and wanted to participate in a fall 2019 visit to Ames with joint representatives from TBFM, Com-

mand Center, and other relevant parties to examine the IDM concept and their own plans in coordinating strategic and tactical traffic-based flow management systems.

ATM-X UAM Collaboration with Uber

POC: [DAVID THIPPHAVONG](#)

In early May, members of NASA's Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) team met with Uber Elevate engineers and researchers to focus on Uber's involvement to accelerate and enhance NASA's planned fiscal year 2019 ATM-X UAM X2 activity to develop and exercise the UAM airspace system backbone and simulation platform. This backbone leverages Unmanned Aircraft System Traffic Management (UTM) Technical Capability Level 4 (TCL 4) and testbed, which will be used in the NASA UAM Grand Challenge (GC). More specifically, NASA and Uber discussed and decided on technical details for initial connectivity tests scheduled to occur by early June, with engineering evaluations scheduled to occur in August. The actual connectivity test of the UAM airspace management system for the GC with an external partner was successfully conducted on May 30 at the NASA Ames Research Center in California. AOSP's ATM-X UAM team collaborated with the Uber Elevate team to test connectivity

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



NASA team observing exchange of volumes and tracks as expected between NASA and Uber.

between NASA and Uber systems, towards X2 engineering evaluations planned for August that will be used in the GC. The connectivity tests and the X2 engineering evaluations will reduce risk and expedite the future integration of GC partners into the GC airspace system. ATM-X is responsible for developing this system and running scenarios on it with GC partners in lab simulations to demonstrate their capabilities and components prior to GC flight test activities. The team validated the exchange of simulated UAM operational data (e.g., volumes, routes, tracks) between each other's systems. In addition, through these connectivity tests, configuration changes were identified as well as additional necessary features to extend the UTM paradigm and system for UAM operations. Follow-up work is underway to integrate the additional components required to conduct X2 engineering evaluations with UAM airspace management technologies.

EcoDemonstrator Combined Systems Requirements/ Preliminary Design Review

POC: [BARBARA BURIAN](#) AND [JAMES CHARTRES](#)

On May 31, the EcoDemonstrator: Combined System Requirements/ Preliminary Design Review was held at NASA's Ames Research Center in California. The purpose of the meeting was to evaluate the project management, status, and technical work being undertaken at NASA for the 2020 Boeing ecoDemonstrator (ecoD) flight in partnership with Boeing and the FAA. Attendees included the ecoD team, reviewers and stakeholders, technical reviewers, and NASA management. The review covered a variety of topics relating to the formulation and initial development of the activity including scope, goals, objectives, success criteria, system and functional requirements, software development, the testing plan, schedule, resources, and risks.

NASA Grand Challenge Scenarios Technical Working Group Kickoff

POC: [SHIVANJLI SHARMA](#)

The FAA hosted a kickoff meeting for the Grand Challenge (GC) Scenarios Technical Working Group (STWG) at FAA Headquarters on May 31. Meeting participants included representatives from NASA's Advanced Air Mobility project, engineers and researchers

from the GC, and subject matter experts across a wide range of FAA organizations, including Air Traffic, Flight Standards, Aircraft Certification, NextGen, and Unmanned Aircraft Systems. In 2020, NASA will host an Urban Air Mobility (UAM) ecosystem-wide challenge for participants to execute system level safety and integration scenarios within a robust and relevant environment. This STWG kickoff meeting was focused on introducing the team to the development work leading up to the formulation of the GC as well as introducing an initial set of scenarios that will be further refined and amended through iterations in the STWG. The STWG aims to define a set of scenarios that include both NASA and FAA considerations while also maximizing value generated to both industry participants and government organizations. Through the collaboration that will be fostered in this working group, the GC scenarios will serve to provide a robust platform for UAM industry partners to demonstrate their concepts and execute an integrated vehicle and airspace UAM GC.

ATM-X Urban Air Mobility Cognitive Walkthrough

POC: [SAVVY VERMA](#)

A cognitive walkthrough was conducted by Urban Air Mobility (UAM) subproject researchers from June 5–6, at NASA's Ames Research

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Center in California, to evaluate potential UAM operations at a conceptual level. The walkthrough included three FAA subject matter experts (SMEs) sponsored by the FAA's NextGen Office. The SMEs provided input that will be considered in the UAM concept of operations as well as inform the scenarios for upcoming engineering evaluations. The cognitive walkthrough consisted of a table-top exercise with storyboarding for several scenarios focused on: current day procedures and communication protocols for UAM operations; digitizing or automating communications and the challenges involved in the process of automating them; how an Unmanned Aircraft System (UAS) Traffic Management architecture would work for UAM operations; and the processes of authorizing UAS and providing automated clearances for UAS used for cargo delivery.

Testbed Training at Volpe Transportation Center

POC: [KEE PALOPO](#)

NASA's Air Traffic Management-eXploration (ATM-X) testbed team conducted testbed training of its Build 1.5 Software Development Kit, at the Volpe National Transportation Systems Center in Cambridge, Massachusetts, from June 5-6. The training session was conducted to support anticipated future collaborations among



ATM-X team providing training on NASA testbed at Volpe.

government organizations. The following organizations participated in the training (with the number of participants indicated in parentheses): NASA (2), Volpe (14), FAA Tech Center (2), MITRE (2), and MIT Lincoln Lab (4). Build 1.5 Software Development Kit recently added a stand-alone testbed toolset to allow users to test their to-be-connected tools during development. The FAA continues to show a deep interest, in particular to connect NASA and FAA Tech Center facilities beyond their two labs, for supporting the 2020 ecoDemonstrator subproject. Feedback received from participants indicates that the testbed provides a good or even elegant platform for air traffic management simulations and a critical mass of tools would be required to make it useful for research and development collaboration. A critical mass would require stakeholders to provide their capabilities deemed useful by others, by connecting their tools and facilities. Also, MIT Lincoln Lab

indicated an interest to pursue an interagency agreement with NASA. Finally, the participants were asking when documentation supporting the testbed would become available.

ATD-2 Phase 3, Safety Risk Management Meeting

POC: [GREG JURO](#), [AL CAPPAS](#)
AND [SHAWN ENGELLAND](#)

On June 11, the FAA hosted a Safety Risk Management (SRM) meeting to assess the potential risks of utilizing the Airspace Technology Demonstration-2 (ATD-2) metroplex planner, which is scheduled to begin testing in the North Texas area in mid-July 2019. The meeting was facilitated by representatives of the FAA's quality control group located at the Central Service Area in Fort Worth, Texas, and was required by the FAA prior to embarking on ATD-2 Phase 3 activities. The SRM panel members included FAA management and National Air Traffic Controllers

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Association representatives from the Dallas-Fort Worth International Airport (DFW) tower, Dallas Love tower, DFW terminal area, and Fort Worth en route center facilities. NASA and airline representatives provided subject matter expert support for this safety decision. The current use of ATD-2 was outlined and compared with the projected expanded uses, with a new capability being added during ATD-2 Phase 3. No safety hazards were identified by the SRM panel. The next and final step in the SRM process is for the FAA district manager to review the SRM document, which is anticipated to be completed within two weeks, which will allow new ATD-2 Phase 3 trajectory option set capabilities to be used in the field evaluation.

Completed Collaborative Simulation with LSUASC

POC: [RON JOHNSON](#)

On June 14, the Unmanned Aircraft System (UAS) Traffic Management

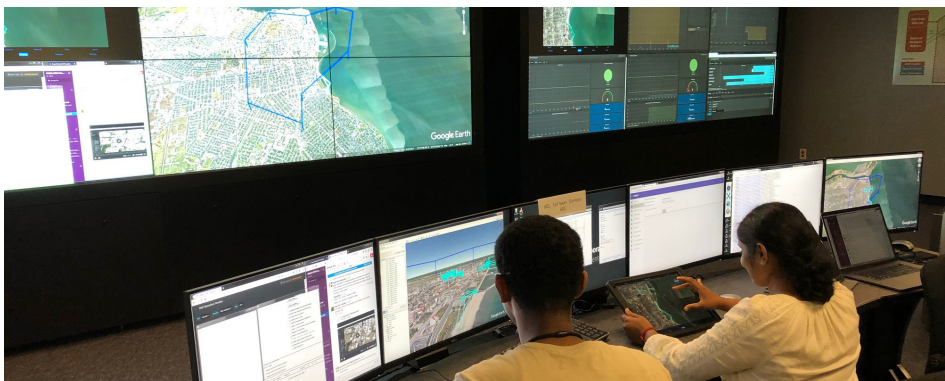
(UTM) project conducted a collaborative simulation with the Lone Star UAS Center (LSUASC) at the NASA Ames Research Center in California, to check preparations for the upcoming Technical Capability Level 4 (TCL 4) testing that is planned for Corpus Christi, Texas, later this summer. The simulation involved multiple industry UAS Service Supplier providers and numerous UAS companies and their partners that executed scenarios of day-in-the-life UAS operations in an urban environment. The scenarios simulated multiple live flights performing missions such as package deliveries, area inspections, traffic monitoring, and building inspections. The UTM system performance was evaluated while several triggering events such as extreme weather restrictions, large scale Global Positioning System outage, and public safety priority flights interrupted normal, high volume UAS traffic. The simulation results will be used to refine the flight plans, ground

instrumentation, and data collection approaches. Actual flight testing of TCL 4 operations will take place in July for shakedowns and August for the full demonstration.

NASA Discussions with American Airlines and Southwest Airlines on Stall Training

POC: [GAUTAM SHAH](#)

From June 18–20, researchers Gautam Shah and Kevin Cunningham from NASA's Langley Research Center in Virginia met with Phil Fuhrer, director of simulator support at American Airlines, and Joe Marott, Southwest Airlines Flight Training Center director, to discuss recent activities regarding stall training. The meetings were held at each of their respective training facilities in Dallas, Texas. The System Wide Safety project conducted extensive modeling and simulation research in support of new FAA stall training requirements that went into effect earlier this year. American Airlines has been an active collaboration partner in NASA research over the past five years through a Space Act Agreement, and Southwest Airlines was one of the industry leaders in implementing the new training. The airline representatives shared their recent experiences in conducting the new training, both in terms of training curriculum development and application



Ames researchers taking part in collaborative simulation with LSUASC.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

(overwhelmingly favorable), as well as impact on simulator hardware (limited effect). They also provided positive comments on the NASA research that enabled the simulator implementation of stall aerodynamics. NASA will continue to follow-up with the airline training community as a whole, to understand the transition of NASA technology into the operational airline environment.

SWS RTT Data Group Meeting

POC: [JESSICA NOWINSKI](#)

On June 27, researchers and leadership from NASA's System Wide Safety (SWS) project, FAA's Aviation Safety and Accident Investigation and Prevention organizations, and MITRE Corporation met at FAA headquarters in Washington, DC, for the SWS Research Technology Transition (RTT) data group. As part of this meeting, the Aviation Safety Information Analysis and Sharing manager praised the FAA/

NASA collaboration, particularly the use of NASA's Multiple Kernel Anomaly Detection (MKAD) tool, as a good example of how NASA and the FAA can work together to improve aviation safety, and also as the only current way forward for using artificial intelligence to examine flight quality data. Leadership and researchers updated each other on tools and processes for automatically understanding data and its safety implications, and agreed on expected progress anticipated during the next quarter.

RECOGNITION

Not Just on the Fly: Drone Strategies for Businesses

POC: [PARIMAL KOPARDEKAR](#)

The Minority Corporate Counsel Corporation presented its Global TEC Forum: Empowering Change in Technology, Education, and Careers to address diversity in the tech industry, the latest disruptions and challenges facing the legal profession, and how emerging technologies are changing the practice of law. The forum was held at the Hilton San Francisco Union Square in San Francisco, California, on April 5. As part of this forum, Parimal Kopardekar from NASA participated as a panelist on the “Not Just on the Fly: Drone Strategies for Businesses” panel, to discuss best practices and review legal issues and compliance requirements when using drones. The website for the forum is listed below.

<https://www.mcca.com/events/global-tec-forum/>

Symposium on Aero-Cybersecurity

POC: [PAUL NELSON](#)

From April 8–9, Paul Nelson, AOSP integration manager for cybersecurity and communications, participated in the Symposium on Aero-Cybersecurity at Embry-Riddle Aeronautical University in Daytona Beach, Florida. This invitation-only event is part of the

larger President’s Forum on Research and Innovation and consisted of approximately 75 participants from government, industry, and academia. Nelson chaired the panel on “Workforce Development Education, Challenges, and Trends.” Nelson was also a speaker on the panels “The Data ‘Sweet Spot’: How to Enrich Collaboration in Aviation” and “Future for End-to-End Aviation Cybersecurity.”

Urban Air Mobility Americas Conference 2019

POC: [PARIMAL KOPARDEKAR](#)

Parimal Kopardekar participated at the Urban Air Mobility (UAM) Americas 2019 Conference, sponsored by Aviation Week Network, at the Georgia World Congress in Atlanta, Georgia, from April 9–10. The conference brought together more than 150 registered attendees including leaders and innovators from the most trusted brands in the industry. UAM drew stakeholders from 10 countries including the United States, Canada, China, Czech Republic, France, Germany, Spain, and the United Kingdom. The conference hosted nearly 40 speakers representing airlines and industry including Bell, Airbus, JetBlue Tech Ventures, Urban Aviation, GoFly, UPS, and Embraer. The intent of the conference was to network, learn, and discuss on-demand aviation in smart cities

and unmanned transportation. Kopardekar participated on the “UAS Traffic Management: Adaption and Integration” panel along with Ben Marcus (AirMap), Isabel del Pozo de Poza (Airbus), and Steve Weidner (National Air Traffic Controllers Association). Kopardekar also presented, “Case Study: Supply Chain 2023.” The website for the conference is listed below.

<https://uam.aviationweek.com/en/home.html>

FAA UAS Symposium

POC: [PARIMAL KOPARDEKAR](#)

On June 5, Parimal Kopardekar was invited to participate as a panelist at the FAA Unmanned Aircraft System (UAS) Symposium, held at the Baltimore Convention Center in Baltimore, Maryland. The panel titled “The Age of Automation—Future of Flight,” included the following industry representatives: Chris Anderson (3DR), Tom Prevot (Uber), Antonio Campello (Embraer X), and Melissa Tye (Skyward). Kopardekar discussed how drones and automation are changing the look and feel of the aviation industry. This meeting was jointly hosted by the FAA and the Association for Unmanned Vehicle Systems International.

RECOGNITION

Third Annual Uber Elevate Summit

POC: [PARIMAL KOPARDEKAR](#) AND [MIN XUE](#)

Uber Elevate hosted its Third Annual Summit in Washington, DC, from June 11–12. This invitation-only summit convened leaders from across academia, industry, government, policy, and technology for a two-day immersive event on the future of on-demand urban aviation. This year, Jaiwon Shin, associate administrator for the NASA Aeronautics Research Mission Directorate, participated on a panel discussing urban aviation in the United States, and Parimal Kopardekar participated on a panel on low-altitude airspace interoperability. In addition, Sandy Lozito (NASA Ames Research Center in California) also participated in a panel on “Urban Airspace Operations, from Concepts to Reality,” to discuss industry and government progress in Urban Air Mobility (UAM) airspace management, and shared NASA’s experience with UAM, Unmanned Aircraft System Traffic Management Technical Capability Level 4 testing, and the UAM Grand Challenge.

More information is available online at: <https://www.uber.com/us/en/elevate/summit/2019/>

ASCE ICTD Panel on Airspace Integration

POC: [PARIMAL KOPARDEKAR](#)

The American Society of Civil Engineers (ASCE) held its annual International Conference on Transportation and Development in Alexandria, Virginia, on June 12. The purpose of the conference was to facilitate the exchange of information, knowledge, and best practices among transportation and development practitioners and researchers, public infrastructure owners, policy makers, government engineers and planners, operations managers, and leading academics from around the world. This year’s conference, themed, “Engineering Smart Mobility for the Smart City,” covered all modes of transportation with heavy focus on the application of technology in transportation and development. Parimal Kopardekar was invited to speak on Unmanned Aircraft System Traffic Management and the future of unmanned systems in urban airspace during a panel moderated by Brent Ingraham, Unmanned Systems, Office of the Undersecretary of Defense.

2019 USA/Europe Air Traffic Management R&D Seminar (ATM 2019)

POC: [SANDY LOZITO](#)



UAM Panelists: Munish Khurana (Eurocontrol), Natesh Manikoth (FAA), Joerg Mueller (Airbus), John Hansman (MIT), Francois Sillion (Uber Elevate), Parimal Kopardekar (NASA), Markus Klopff (Frequentis), Sandy Lozito (NASA).

The 13th USA/Europe Air Traffic Management (ATM) Research and Development (R&D) seminar was held in Vienna, Austria, from June 17–21. There were over 60 technical presentations in several ATM research themes including trajectory management, weather, Unmanned Aerial Systems, and Urban Air Mobility (UAM). Keynote speakers represented government, industry, and academia, and included representatives from Eurocontrol, the FAA, and Uber Elevate. The seminar also hosted a panel focused on the future of UAM, “Where will Urban Air Mobility be in 20 years?” moderated by Sandy Lozito of NASA and Munish Kurana of Eurocontrol. Two papers with NASA

RECOGNITION

authors were selected as “Best Paper in Track” for the seminar: “Accrued Delay Application in Trajectory-Based Operations,” by Husni Idris, Christopher Chin, and Tony Evans; and “Using Wind Observations from Nearby Aircraft to Update the Optimal Descent Trajectory in Real-Time,” by Ramon Dalmau, Xavier Prats, and Brian Baxley.

AOSP Participates in the AIAA Aviation 2019 Conference

POC: [KATHY LEE](#)

The American Institute of Aeronautics and Astronautics (AIAA) held its Aviation 2019 Conference in Dallas, Texas, from June 17–21. The conference included numerous contributions from NASA’s AOSP. Gano Chatterji, from NASA’s Ames Research Center in California, served as one of the forum’s technical chairs. AOSP authors were represented in seven technical papers as principal or co-author, including two papers on the growing topic of Urban Air Mobility (UAM). UAM was a focus of multiple forums and technical paper sessions. AOSP authors also presented papers on airport surface operations, Unmanned Aircraft Systems (UAS) in the National Airspace System, UAS Traffic Management, and cyber-physical security systems.

The Elevated Future of Mobility: What’s Next on the Horizon? — Paris Air Show

POC: [PARIMAL KOPARDEKAR](#)



From left: Ken Stewart (AirXOS), Parimal Kopardekar (NASA), Earl Lawrence (FAA), Antonio Campello (EmbraerX), and Francois Sillion (Uber) are seated on a panel moderated by Robin Lineberger (Deloitte).

On June 18, in the U.S. Pavilion of the Paris Air Show, Parimal Kopardekar was invited to join “The Elevated Future of Mobility: What’s Next on the Horizon?” panel to discuss work being done in the Unmanned Aircraft System and Urban Air Mobility communities. Robin Lineberger (Deloitte) moderated the panel, which included the other following panelists: Antonio Campello (EmbraerX), Francois Sillion (Uber), and Earl Lawrence (FAA). The Paris Air Show is a major international venue with a wide audience of aviation business and government leaders. The panelists specifically discussed the needs and issues to mature the Urban Air Mobility ecosystem. Topics

included eVTOL manufacturing, infrastructure, coordination with regulators, operators and smart city planners, airspace management, and technology related challenges.

Patent Issued for UTM

POC: [PARIMAL KOPARDEKAR](#)

On June 25, U.S. Patent No. 10,332,405 was issued for the Unmanned Aircraft System Traffic Management (UTM) invention. This is a significant milestone achievement for Parimal Kopardekar of NASA’s Ames Research Center in California, and everyone who has contributed to the UTM project since its inception.

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