Research, Engineering, and Development Advisory Committee (REDAC)

National Airspace System (NAS) Operations Subcommittee | MINUTES

Date: *March 16-17, 2021*
Location: *Virtual Meeting*
Purpose: *Review of FY21-23 Proposed Portfolio; Provide Guidance and Recommendations; Program Deep Dives*
Facilitator: *Philip Yeung, Designated Federal Officer (DFO)*
Chairperson: *Jim Kuchar*
Note Takers: *Bruce Holmes, Jim Kuchar*
Upcoming Meetings: *August 31th – September 1st, 2021, Washington, D.C.*

Day 1 – March 16, 2021 (Virtual Meeting)

Welcome / Review of Open Actions

Presenters: *Jim Kuchar/Philip Yeung*

Summary:

Mr. Phil Yeung, the NAS Ops Subcommittee Designated Federal Official (DFO), and Dr. Jim Kuchar, Subcommittee Chair, welcomed the Subcommittee members and the presenters to the meeting.

The Subcommittee reviewed the action items from its last meeting and the upcoming agenda. It was noted that several of the documents that had been requested prior to this spring meeting were still being reviewed internally at the FAA and so were not ready for distribution to the Subcommittee at this time. An earlier proposal to include discussion of Simplified Vehicle Operations as one of the briefing topics was deferred to a later date.

Presentation: Director Remarks

Presenter: *Shelley Yak*

Summary:

Ms. Yak, William J. Hughes Technical Center Director, welcomed the NAS Operations Subcommittee and introduced Mr. Jon Schleifer, head of the Research and Development Management Division. Ms. Yak explained that Mr. Schleifer helps manage the FAA's Research, Engineering, and Development (RE&D) organization and portfolio, supports the development of the FAA National Aviation Research Plan (NARP), and is a key liaison supporting the REDAC and will be sitting in on this and future REDAC Subcommittee meetings.

Ms. Yak provided an update on the impacts that the COVID-19 pandemic has had on FAA Research and Development. Several notable accomplishments include actions the FAA has taken to support fire safety analysis needed to enable rapid dry ice shipments by air for vaccine distribution. Collaborations between the FAA William J. Hughes Technical Center and the Civil Aerospace Medical Institute (CAMI) studying aircraft cabin air quality and ensuring robust NAS operations continue despite the COVID-19

environment. Research has continued by enabling remote work where possible and enabling more efficient remote site adaptation, for example Time Based Flow Management (TBFM) software was integrated remotely without requiring a physical team to deploy to sites.

Ms. Yak also summarized updates to the FAA's Research Landscape Drivers document. This included increased emphasis on an aircraft-centric view of research including what the aircraft of the future will look like. Human Factors has also looked at the research drivers with a view to better understand where Human Factors research needs to focus in the future. She also showed the Subcommittee the latest RE&D strategic diagram which articulates the pathways between research drivers and the research programs.

Dr. Jim Kuchar thanked Ms. Yak for her presentation and noted that the strategic diagram was very helpful toward better understanding the linkages between the research drivers and landscape and the resulting FAA RE&D programs.

Presentation: Budget Briefing
Presenter: *Elizabeth Delarosby*

Summary:

Ms. Delarosby, manager of RED Budget Formulation, presented information on the RE&D budget and Congressional conference language. The President's Budget submission is expected possibly in April. RE&D funding targets for 2023 and beyond have yet to be developed.

Dr. Kuchar noted that there have been significant changes (reductions) in some areas (weather in particular). The forecast cuts to the Weather program come a time when more work will be needed from this FAA program to address the emerging needs of the Unmanned Aircraft Systems (UAS) and Advanced Air Mobility/Urban Air Mobility (AAM/UAM) operations. These operations pose unique requirements for aviation meteorology knowledge in the Earth's boundary layer (below 1,000 feet AGL).

Dr. Holmes (Holmes Consulting), aviation subject matter expert, noted that the technologies to enable options for services are expanding rapidly, including the evolution of the Low Earth Orbit satcom WiFi services from companies OneWeb, Kuiper (Amazon), Starlink (SpaceX), SpaceMobile (AST Science). Given these new drivers of demand and in technology enablers, now does not seem to be the best time to reduce funding for the FAA Weather Program.

Presentation: Possible Changes to Industry Due to COVID-19
Presenter: NAS Ops *Subcommittee*

Summary:

The Subcommittee reviewed its charge to discuss and summarize possible changes to industry due to COVID-19. Dr. Kuchar noted that the Subcommittee brings a breadth of experience and perspectives for this topic.

Ms. Monica Alcabin noted that Boeing has been impacted by reductions in traffic but has been active in developing solutions for cleaning aircraft. Cyber security continues to be a major concern, as are Human Factors issues. Overall, Boeing transitioned to

remote work efficiently and has been maintaining productivity due to people working longer hours.

Dr. Bruce Holmes stated that his company has been pursuing Advanced Air Mobility (AAM) multicopter development. Their flight test facility has been able to continue as before COVID, and they have worked through travel restrictions. He has even seen some productivity increases. Supply chain challenges have emerged; however, some suppliers had to shut down their facilities, leading to delays and challenges for performing on-site inspections at suppliers' facilities. The impact of COVID is being considered in market assessments for AAM services. One aspect is on the shifting in geographics of demand to include growth in exurban (beyond suburban) commuting into and out of metroplexes. A migration out of large cities that has been underway for more than ten years has accelerated, in part driven by COVID effects. Mr. Holmes anticipates a continuing need for AAM travel within cities (UAM), but sees remote and rural use of AAM likely to occur years sooner than urban due to airspace complexity issues, coupled with the limited endurance and range of battery-electric powertrain systems. A small and growing part of the AAM community is focusing on Hydrogen Fuel Cell (HFC) powertrains to provide greater endurance and payload than battery-electric for many the non-AAM ops. COVID may accelerate this reshaping of urban/suburban/exurban/rural demand distributions.

Dr. Emily Stelzer reported that MITRE has been tracking changes in air traffic throughout the COVID-19 pandemic. They are still seeing busy periods, especially with arrival banks and need for air traffic management continues. General aviation also had a drop in traffic but is seeing a more rapid recovery than commercial travel. Cargo air carrier operations have been sustained and more resilient. They have observed an increase in the use of free-flight-like direct-to Atlantic crossings using Space Based Automatic Dependent Surveillance – Broadcast (ADS-B) accommodated by reduced traffic densities in oceanic airspace.

Mr. Akbar Sultan expounded on the NASA perspective. NASA has seen impacts on in-person R&D (such as wind tunnel operations and human-in-the-loop simulations). The Airspace Operations and Safety Program has generally maintained productivity and was able to support a key flight test event remotely. NASA has seen high productivity but also there have been some concerns about burnout due to increased overhead and effort needed to get the same amount of work done, and that the current pace may not be sustainable. Mr. Sultan noted that schedules seem to be packed with back-to-back meetings, but they have been experimenting with different cultural dynamics such as holding no meetings on Fridays. The lack of commute has positively affected work-life balance. NASA has been adjusting milestones and deliverables to accommodate the trends.

Regarding airspace operations, Mr. Sultan noted that demand for purpose-built freighters (perhaps autonomous cargo aircraft) is accelerating. AAM regional/local business cases for the delivery of goods/services is growing. The aerospace community has learned a great deal about the resilience of aviation and how to build systems to be resilient. NASA has observed some operational issues during the pandemic, such as an increased rate of tail strikes as air cargo operations evolved rapidly, and identified some impacts on controllers due to short staffing.

Dr. Kuchar noted that there is an opportunity to capture lessons-learned during the pandemic to build a playbook for future upset events – both for the onset of these events as well as how to efficiently recover afterward.

Dr. Holmes commented that we can anticipate periodic upsets such as COVID: He stated that they will recur. The Santa Fe Institute conducted a workshop in the early 2000's on pandemics; NASA was a member of the institute at the time. The seminar participants included Nobelists involved in complexity science, epidemiology, and related disciplines relevant to modeling and predicting pandemic events. One outcome illustrated that we generally do not prepare as well as we could for such events. Another addressed the differences in the nation's abilities to marshal public behaviors in favor of control of spread, including the differences between Western and Eastern societies. In earlier NextGen strategies development under the JPDO (c2000), "Scenario-Based Planning" was conducted as a tool for producing robust strategies for air transportation, across a range of plausible futures, including such events as pandemics. These tools would serve our transportation system enterprise well as we consider the likelihood of a future disruptive event such as we are experiencing now.

Presentation: Aviation Industry Direction and Challenges
Presenter: NAS Ops *Subcommittee*

Summary:

The NAS Ops Subcommittee reviewed the FAA's current Research Landscape document to identify areas that warranted updates or additions.

Dr. Holmes noted that electrification of aeronautical powertrains is opening an entirely new spectrum of air vehicle and mission concepts. As an industry, aviation will need to consider a collective move toward decarbonization through advancements in vehicle systems and airspace operations. American Institute of Aeronautics and Astronautics (AIAA) Public Policy Committee members (Holmes and others from Airbus, Boeing, and GE Aviation) developed a backgrounder document for Capitol Hill Day: "Sustainability in Flight: Our Journey to Decarbonization." The document emphasized both the challenges to and paths toward decarbonization by the global aviation industry. Emphasis included options for transition to new energy sources, sustainable aviation fuels – available now but require support. Hydrogen and electric vehicles need more attention from Department of Energy, Department of Transportation, and NASA. The FAA in particular could play a role as a leader, since the aviation industry is projected to become the dominant carbon producer by 2050 if nothing changes.

Ms. Alcabin commented that European Union efforts in decarbonization are probably ahead of those in most of the rest of the world. International Civil Aviation Organization (ICAO's) long-term global aspirational goals also call on decarbonization. This extends beyond vehicles, including airports, navigation aids (NAVAIDs), and related airspace systems infrastructures. Cyber and Human Factors continue to be driving factors for research. Mixed-equipage operations and certification of new technologies will be critical going forward.

Dr. Holmes noted that work on Autonomous Ground Service Equipment (GSE) at airports is making vital contributions to sustainability. These activities support transition from battery-electric GSE to hydrogen power and "carbon-aware" GSE. In the U.S., there are more than 40,000 hydrogen-powered forklifts, producing a great impact on improved air quality. 4,000 cellphone towers have shifted from diesel to hydrogen backup power sources. Microsoft and others are using hydrogen for backup power for server centers.

Dr. Kuchar suggested that the Research and Development (R&D) driver related to risk-based decision-making could be expanded to include decision-making under uncertainty in air traffic management, and not just limited to conventional safety-risk decisions.

Dr. Holmes noted that the NAS Operations Subcommittee received a briefing from the Wireless Research Center of North Carolina (Dr. Gerry Hayes) about two years ago on the connectivity implications of the transition from 4G to 5G telecom protocols for wireless systems. He suggested that It would be fruitful for the NAS Ops group to schedule an update as the work of 5G is rapidly maturing in the industry and consumer world, with implications for aviation connectivity solutions. The implications affect UAS initially, but will extend soon into AAM/UAM, as well as general aviation, business aviation, and cargo carriers.

Dr. Stelzer noted that Cyber-Internet of Things (IoT) is included in the Research Landscape and may cover spectrum/communications issues, but perhaps this topic could be expanded

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Presentation: 1A10A0 Enterprise Concept Development
Presenter: *Steve Bradford*

Summary:

Mr. Bradford, FAA Chief Scientist, provided an overview of the Enterprise Concept Development effort. This effort focuses on new ideas requiring development of Concept of Operations (ConOps) and validation of Concepts, to assess their feasibility and budget requirements if they are selected to move forward into an acquisition program.

Mr. Bradford summarized the status of the Urban Air Mobility (UAM) ConOps. This work has been shared with NASA, and an AAM Research Transition Team has been established. A ConOps for Air Traffic Management (ATM) services in 2035 is in development and expected to be released in September 2021.

Mr. Bradford also discussed work on xTM (Extensible Traffic Management), which includes cooperative separation in multiple environments. The program will lead to a unifying framework for cooperative separation in multiple environments, including interactions between xTM and traditional ATM services. Artificial Intelligence (AI) is also a focal point for research. This work has been focused on improved Notice to Airmen (NOTAMs), including digital NOTAMs. A current challenge is how to integrate human-written into digital NOTAM systems.

Mr. Bradford shared that upcoming research in FY 22 will include finalizing functional analysis for AI in the NAS and expanded work with the international community and ICAO.

Mr. Bradford concluded by noting that the NAS 2035 vision document is still being reviewed internally at the FAA and is expected to be released by the end of May 2021.

Presentation: 1A07C0 NextGen – New Air Traffic Management Requirements
Presenter: *Steve Bradford*

Summary:

Mr. Bradford next briefed the Subcommittee on NextGen – New Air Traffic Management Requirements. This Budget Line Item (BLI) is focused on the requirements development preceding NAS deployment and implementation.

Accomplishments included in Mr. Bradford's overview included:

- Ceiling and visibility information services
- Machine Learning (ML) and Artificial Intelligence (AI) in support of controller functions
- Use of IP-based digital communications on flight deck and cybersecurity
- Air-to-ground SWIM for Connected Aircraft
- IP-based Command and Control data links, including Future Air Navigation Systems (FANS) over IPS, to be released as early as 2022

Mr. Bradford noted that there is a Congressional mandate to explore ML/AI, and the focus of this BLI is on ground-based systems that are not necessarily safety-critical. Machine Learning/Artificial Intelligence in the NAS is focused in nearer-term support of controller functions in real-time, with attention to safety considerations and farther-term support for aircraft separation.

Dr. Holmes asked whether there is a standard for trajectory data exchange? Ms. Alcabin responded that the Aeronautical Telecommunication Network (ATN) Baseline 2 standard is mandated starting 2028. FAA message standards are expanded beyond Baseline 2 standards, and can handle advanced trajectories. SC-214 has developed documents. Dr. Holmes followed up asking how scalable is the protocol to support AAM. Mr. Bradford noted that these protocols would not be used for AAM – AAM will need to determine their own message sets. The existing data communication standards are not sufficiently flexible and are based on waypoint-to-waypoint routes. Ms. Alcabin noted that the AAM industry needs standards more rapidly than is possible through conventional techniques.

Presentation: Informational Deep Dive – UTM Roadmap
Presenter: *Peter Sachs*

Summary:

Mr. Peter Sachs provided a briefing summarizing the status of the FAA's Unmanned Aircraft System Traffic Management (UTM) roadmap, including a discussion on methods to ensure equity between different users of a constrained airspace resource. At present, there are diverging priorities between the UAS industry and traditional aviation. UAS is largely a start-up culture with short timelines and limited funding, and the FAA is not accustomed to this way of working, as it doesn't have a way to approve UTM services as an agency, independent of the airframe and operator. Mr. Sachs explained that industry is mostly providing UTM services, and the FAA has a mostly regulatory, oversight, and approval role. In the UTM architecture, the end state is fully developed services with high levels of autonomy and a lighter touch of the FAA. Many informational exchanges will occur among UASs and UAS service suppliers, and there

are many operability requirements yet to be established. Interoperability will be important for data exchange, performance authorization, quality of information, strategic de-confliction in the UTM environment.

Dr. Holmes asked whether there will be a UTM data feed component included in System Wide Information Management (SWIM). Mr. Sachs replied that this is being advocated for, and there are issues to explore with respect to accuracy and security of data. Dr. Holmes asked if there are limitations applying the planned UTM foundation to broader AAM concepts. Mr. Sachs replies that that issue is to be determined, but they are working on determining appropriate conformance thresholds for 4D trajectories.

Dr. Holmes also stated that the UAS needs to model vehicle performance and asked if that would that be part of a message set from the vehicle, or a UAS library. Mr. Sachs replies that this is also to be determined, but it is certainly a requirement. Finally, Dr. Holmes noted that vehicles will have varying levels of autonomy which will also be a challenge to handle in message sets, management techniques, etc.

Dr. Kuchar asked about addressing the implications of a UTM system that reports non-conformance to the FAA – how will the FAA's systems need to change to accommodate these events? Mr. Sachs replied that yes, this needs to be considered from a holistic point of view.

Presentation: 1A01A Runway Incursion Reduction Program (RIRP)
Presenter: *Todd Lewis/Giovanni Dipierro*

Summary:

Mr. Dipierro and Mr. Lewis provided updates on the Runway Incursion Reduction Program (RIRP) efforts. The Small Airport Surveillance Sensor (SASS) proof of concept project is complete and has conducted an industry day to explore transition into operations. Runway Incursion Prevention Surface Awareness (RIPSA) system testing is expected at three airports: Tucson, Daytona Beach, and San Antonio. These system concepts include both towered and non-towered airports and are agnostic on sensors (including cameras).

Presentation: 1A01C Operations Concept Validation & Infrastructure (ATDP)
Presenter: *Guillermo Sotelo*

Summary:

Mr. Sotelo provided an overview of the Operations Concept Validation & Infrastructure (ADTP) program, followed by deeper dives from Sally Stalnaker, Elizabeth Lacher, and Amanda Staley.

Sally Stalnaker (MITRE) summarized work on Preconditioning for Arrival Flows. Future Flow Management (FFM) initial coordination analysis is complete, and will lead to an action plan for the Air Traffic Organization, including space launch and reentry operations.

Philadelphia Airport analysis was conducted in preparation for field trials. Data analysis revealed that Strategic Programs like Ground Delay actually added to NAS arrival delays rather than reduced delays, indicating additional complexities that need to be explored.

Jim Kuchar asked if these were fast-time simulations with variable weather conditions in Monte Carlo runs, or were they Human in the Loops (HITLs). Ms. Stalnaker responded that these were not HITLs, and not Monte Carlo simulations since they required real-time systems, and that the area of research is a candidate for Machine Learning. Dr. Kuchar asked if NASA is still involved with Integrated Demand Management (IDM)? Ms. Stalnaker replied that NASA work has been completed and they are transferring a tech package to FAA later this spring. Finally, Dr. Kuchar asked how weather was included in the analysis? Ms. Stalnaker responded that weather was not directly modeled other than as an abstract reduction in the Airport Arrival Rate.

Dr. Holmes asked if the preconditioning algorithms are candidates for Machine Learning/Artificial Intelligence (ML/AI), and what the timeline is for the remainder of this work. Ms. Stalnaker responded that there is already some AI/ML work underway for departures and many opportunities exist. MITRE has completed its analysis of Newark International Airport and is waiting on NASA's tech transfer package.

Ms. Alcabin thanked the presenters for the work, and noted that it was fascinating to see corner design spaces for more challenging problems that require detailed analysis and identifying where system performance starts to break down.

Elizabeth Lacher (MITRE) provided a presentation on Initial Trajectory Based Operations (iTBO) and Trajectory Based Operations (TBO) implementation in the NAS, as it affects work tasks by air traffic managers. She noted that they are taking a human-centered view of iTBO procedures to articulate who, what, how for key position workflows. She noted that they have developed a white paper with descriptions of workflows and information flows.

Next, Amanda Staley (MITRE) provided a presentation on Future Flow Management and how the FAA will transition organizationally and operationally to TBO through an FFM ATO Corporate Plan. Four key goals include the following:

1. Real-time data for real-time synchronization of strategic and tactical actions in ATM
2. Higher fidelity 4D trajectories to improve predictability in the NAS
3. Collaborative decision-making for more diverse operations
4. Combine enhanced processes with new human capital to accelerate implementation of Traffic Flow Management (TFM) services

Finally, Randy Mauer (FAA) provided a briefing on the Future of the Ocean 2035. This described several oceanic airspace management goals including 4D trajectory operations (gate-to-gate) and oceanic separation standards.

Presentation: A11.k Weather Program
Presenter: *Randy Bass*

Summary:

Randy Bass provided an overview of the Aviation Weather Research Program including its current portfolio, recent accomplishments, and future research plans.

Dr. Kuchar asked whether there was any visibility into why RE&D funding was cut so significantly this year, and whether there is more the FAA or others can do to mitigate this change. Mr. Bass responded that the situation may be partially due to lack of recent weather-related accidents and there is an opportunity to improve awareness of the

importance of weather R&D. Mr. Bass noted that the weather program relies on others to be advocates, and this outreach may have degraded over the years. Dr. Kuchar and Dr. Holmes responded that the forecast cuts to the Weather program come a time when more work will be needed from this FAA program to address the emerging needs of the Unmanned Aircraft Systems (UAS) and Advanced Air Mobility/Urban Air Mobility (AAM/UAM) operations. These operations pose unique requirements for aviation meteorology knowledge in the Earth's boundary layer (below 1,000 feet AGL). Also, the technologies to enable options for services are expanding rapidly, including the evolution of the Low Earth Orbit satcom WiFi services from companies OneWeb, Kuiper (Amazon), Starlink (SpaceX), SpaceMobile (AST Science). Dr. Holmes noted that given these new drivers of demand and in technology enablers, now does not seem to be the best time to reduce funding for the FAA Weather Program.

Presentation: A11.q Weather Technology in the Cockpit (WTIC)
Presenter: *Gary Pokodner*

Summary:

Mr. Pokodner presented an update on research activities within the WTIC program.

Dr. Kuchar noted that the WTIC portfolio has many connections to UAS/UAM/AAM, and that working to connect the WTIC weather R&D with the growing interest in UAS/AAM might help mitigate some of the funding cutbacks. Mr. Pokodner replied that they have been working to heighten awareness of the connections of weather R&D with UAS/AAM, but more progress is warranted.

Presentation: Findings and Recommendations Discussion
Presenter: *Jim Kuchar/Subcommittee*

Summary:

Dr. Kuchar thanked the presenters and reviewed the day's agenda with the rest of the NAS OPS Subcommittee. The Subcommittee members briefly discussed potential Findings and Recommendations to consider on the topics that had been presented, including concerns over the reduction in weather RE&D budget, the impacts of COVID-19, and the need to maintain a rapid pace of standards development to support AAM concepts.

Day 2 – March 17, 2021 (Virtual Meeting)

Presentation: Review Findings and Recommendations
Presenter: *Jim Kuchar/Subcommittee*

Summary:

The NAS Ops Subcommittee Chair, Dr. Jim Kuchar, opened the second day of the NAS Operations REDAC Subcommittee meeting by welcoming all members and thanking the presenters associated with the day's agenda.

Mr. Joe Bertapelle, following up on the previous day's discussion of COVID-19 impacts, noted that there have been some restrictions on the ability to gain access to Air Traffic

Control (ATC) facilities that has in turn impacted the pace of some NextGen Advisory Committee (NAC) initiatives. He proposed that consideration be given to elevating ATC personnel to critical-worker status to enable them to get vaccinated earlier and reduce impacts on facilities. Dr. Kuchar replied that this issue would be added to the Subcommittee's report on COVID-19 impacts.

Presentation: Informational Deep Dive – NAS Integration of Transiting Operations
Presenter: *Guillermo Sotelo*

Summary:

Mr. Guillermo Sotelo began the presentation with an overview of new entrants and an overarching strategy for integrating new operations. Three domains were highlighted under this effort and described in more detail by Bill Lash: Space launch/recovery operations, vertical transiting operations to and from Upper E airspace, and Upper E airspace operations. Objectives and 3, 5, and 7 year outcome goals were summarized for each domain. In Upper E operations, there are challenges due to either very high-speed vehicles or very low speed long-endurance loiter operations. Some changes will be needed: for example, current automation cannot handle flight plans over 24 hours or allow backwards trajectories like from drifting balloons.

Dr. Jim Kuchar asked who is responsible for providing Aircraft Hazard Area (AHA) information. Mr. Bill Lash responded that the space launch operator is responsible for providing AHA data. Re-entries are more strategic than launches since timing of de-orbit burns etc. is planned well in advance. Launches can be more tactical due to short-term changes in timing.

Mr. Joe Bertapelle asked how will space vehicle surveillance be performed, and will they have Automatic Dependent Surveillance Broadcast (ADS-B)? Mr. Lash replied that there are no current requirements, although telemetry will be provided by vehicle operator and integrated into TFM systems. Mr. Bertapelle commented that automation will be required, but surveillance is critical, and there is interest in evaluating space-based surveillance data.

Dr. Jim Kuchar asked how will access equity be mediated (e.g. between a tourist balloon and commercial air traffic) and determining when a given operation should be timed or located? The response was that the upper-E users are likely to be flexible and so could accommodate constraints to operate out of the way of air traffic. Mr. Lash noted that launch users are aware of impacts on other users and may accommodate, but much of their operation is dictated by orbital physics and cannot be adjusted, whereas the length of time for a launch window may be adjusted.

Mr. Joe Bertapelle asked whether the ground-based ADS-B infrastructure is able to pick up high-altitude balloon ADS-B messages. Jennifer Gentry (MITRE) replied that she believes that the ground system does pick up those ADS-B signals but was not certain.

Dr. Jim Kuchar asked whether the FAA will be handling ATC in upper-E airspace or will it be a third-party service provider similar to UTM. The response was that industry will be using a Platform Service Supplier to provide separation services, but the FAA will continue to provide services to those requesting Instrument Flight Rules (IFR) services. It has yet to be determined how those will work together.

Mr. Joe Bertapelle asked how the transition between supersonic and subsonic speeds will be handled. Mr. Akbar Sultan followed-up noting that for NASA's test vehicle, the supersonic/subsonic transition will occur between 20,000-30,000', so it will need to be handled appropriately. How to handle a supersonic aircraft at FL200 is going to be a challenge.

Presentation: A11.r Flight Deck Data Exchange Requirements
Presenter: *Nouri Ghazavi*

Summary:

Mr. Nouri Ghazavi provided an overview and update of the Flight Deck Data Exchange Requirements BLI. This BLI focuses on cybersecurity risk assessment for flight data exchange of flight critical data. The main risks that were cited include Denial of Service and Corruption of Data.

Mr. Joe Bertapelle asked whether the connection between Electronic Flight Bag (EFB) and Aircraft Interface Device (AID) just for power or for exchanging data, and Bruce Holmes followed by asking whether it is a physical connection or wireless? Mr. Ghazavi replied that EFBs can be either physically connected to aircraft data and power sources or connected wirelessly for data sources - for example from AIDs.

Ms. Monica Alcabin asked how the results of this effort will be shared with industry – will they be provided to Radio Technical Commission for Aeronautics (RTCA) and to other security initiatives? Mr. Ghazavi responded that they still have to find appropriate venues for disseminating the results, but Honeywell has been directly involved.

Dr. Jim Kuchar asked if the results are being shared with Aircraft Systems Information Security (ASISP) program - this was one of the Subcommittee's recommendations from the fall 2020 meeting. Mr. Ghazavi responded that such communication has not yet taken place. Dr. Holmes also suggested that it may be appropriate to provide an outbrief of this work to General Aviation Manufacturers Association (GAMA).

Dr. Holmes asked if there was an intersection between this work and other SatComm programs (e.g. Starlink, OneWeb, Kuiper, SpaceMobile) – can these results apply to those systems which haven't been built as flight-critical systems? Mr. Ghazavi replied that yes, it could be applied to those systems, but they have not looked into this yet but will follow up.

Dr. Jim Kuchar asked how the likelihood of attacks was modeled when building a risk matrix. Mr. Ghazavi responded that National Institute of Standards and Technology (NIST) guidelines are used for this purpose.

Dr. Holmes asked whether any issues from high intensity radiated fields have been considered. Mr. Ghazavi responded that this issue has not been investigated to date.

Finally, Mr. Joe Bertapelle asked who will be the recipient of the products of this work - who will pick it up? Mr. Ghazavi stated that this would need to be determined through discussions with Mr. Steve Bradford.

Presentation: A11.o Wake Turbulence

Presenter: *Jillian Cheng*

Summary:

Ms. Jillian Cheng provided a presentation summarizing the Wake Turbulence BLI, which assesses aircraft wake encounter risks at all flight levels, including en route as well as terminal operations. There have been 34 new aircraft entrants into the NAS assessed for separation guidelines in the last year, and typically about 60 to 100 new aircraft enter the NAS annually. The researchers are developing Absolute Wake Encounter Metrics (versus the current relative size-based metrics). Ms. Cheng also noted that wake separation guidelines for large UAS aircraft are being developed. Finally, Ms. Cheng noted that COVID impacts resulted in difficulty in reinstalling wake sensors at ORD (due to interest in avoiding staff travel to ORD). This led to stopping the wake data collection program there.

Mr. Joe Bertapelle asked if Automatic Dependent Surveillance Broadcast (ADS-B) data is being leveraged for some of the wake analysis. Ms. Cheng replied that ADS-B data is not being used in this BLI, but is leveraged under the Facilities & Equipment (F&E) Recategorization (RECAT) program.

Mr. Joe Bertapelle asked what simulator facilities were being used in the program. Ms. Cheng responded that they are using simulators at Oklahoma City and industry. However, simulator use is currently deferred due to COVID impacts and a backlog of other users for those facilities. She added that these delays are not holding up other efforts at this time.

Dr. Bruce Holmes asked whether the subject been raised of exposure and risk for High Altitude Pseudo Satellite (HAPS) aircraft operations both in ascent-descent as well as stratospheric (Upper E Airspace) operations – specifically has there been any effort to explore wake risk on those vehicles? Ms. Cheng replied that no, they have not been approached to explore this issue.

Mr. Akbar Sultan asked whether this effort has been looking at new upper-E aircraft characteristics (high aspect ratio wings etc) and how they would be classified for wake risk. Ms. Cheng noted that the typical approach is to examine the most conservative case for a series of aircraft: analysis is really driven by a new ICAO type indicator, so some are assessments are conducted pre-production.

Jim Kuchar asked for an update on the status on Wake Turbulence Mitigation for Arrivals (WTMA) and paired departures. Ms. Cheng said efforts are not active on WTMA. Paired departures research is mostly complete, so future work there would be handled under n Facilities and Equipment (F&E) program – however, budget limitations have deferred this. At present, dynamic separation is being explored.

Presentation: 1A04B0 Wake Turbulence Re-Categorization
Presenter: *Jillian Cheng*

Summary:

Ms. Cheng followed up with a presentation on the Wake Turbulence Re-Categorization program, where the focus is on increasing runway capacities during instrument flight rules (IFR) operations. Total Wind (TW) Dynamic Pair-Wise Wake Separation Mitigation (DSW-M) is currently a focus on capacity-constrained airports.

Presentation: 1A10B0 Enterprise Human Factors
Presenter: *Tara Holmes*

Summary:

Ms. Tara Holmes reviewed this portfolio focused on NextGen Air Traffic Controller Integration. She noted that there is a new draft report on Human Factors Impacts of Highly Automated Vehicles that is due out shortly. The report includes analysis of air traffic controller interactions with advanced air vehicles. Research into Trajectory Based Operations (TBO) training requirements is still being developed, including the impacts of TBO on Traffic Manager Units.

Dr. Jim Kuchar noted that the Human Factors Impacts of Highly Automated Vehicles report would be of high interest to the Subcommittee and requested a copy of the report be provided when it is released.

Presentation: A11.i Air Traffic Control/Technical Operations Human Factors
Presenter: *Tara Holmes*

Summary:

Ms. Holmes continued by providing an update on ATC Technical Operations Human Factors Program, which is focused on shorter-term needs (1 – 2 years out), related to controller selection and training. She noted that the portfolio is quite broad and include research activities on training needs, controller job analysis, color palette guidelines, Human Machine Learning, Virtual Air Traffic Training environment, NOTAM Specialist job training and certification, controller fatigue, and the effect of automation on de-skilling. She also noted that Remote Tower Controller Human Factors research has been transitioned to an F&E budget line as a program of record.

Presentation: Informational Deep Dive – NASA xTM R&D Update
Presenter: *Akbar Sultan*

Summary:

Mr. Akbar Sultan provided an update on NASA's extensible Traffic Management (xTM) research programs. A series of Epochs have been defined to help focus on the concepts for unified airspace operations for integrating new entrants into the NAS.

Looking forward, Epoch 3 (xTM 3 - Current) includes trajectory management, Epoch 4 (xTM 3 - 2035) is Collaborative, Connected, performance-based, collaborative ATM introducing 3rd party ATM service providers, and Epoch 5 (2045) involves highly automated, Machine Learning/Artificial Intelligence (ML/AI) dynamics, robust performance, and safety with Machine-to-Machine interactions with human collaboration.

The goals of the program include integrated, unified UAS Traffic Management/Advanced Air Mobility/Air Traffic Management (UTM/AAM/ATM) operations, and a capstone demonstration is planned for the 2024 timeframe.

The Subcommittee thanked Mr. Sultan for the presentation and was glad to see "seamless, unified" language framing the program philosophy.

Presentation: Subcommittee Discussion Recap & Closing
Presenter: *Jim Kuchar/Subcommittee*

Summary:

The NAS Operations Subcommittee discussed its Findings and Recommendations and reviewed the input that had been received regarding COVID-19 impacts and updates to the Research Landscape. Recommendations were made for the Subcommittee to receive two documents prior to its fall meeting: the FAA's NAS 2035 vision document, and the Human Factors Impacts of Highly Automated Vehicles Research Plan.

Dr. Kuchar concluded the meeting by summarizing the actions for the Subcommittee members. He mentioned that he will be reaching out to the NAS Ops DFO with action items and recommendations prior to the full REDAC meeting scheduled for 21 April 2021. Dates for next NAS Ops subcommittee meetings were set for Aug 31-Sept 1, 2021 and March 15-16, 2022.

REDAC / NAS Operations Subcommittee Meeting Agenda

Date: March 16-17, 2021
Location: Remote only | See last page for phone and video conferencing details
Purpose: Review the R&D portfolio developed based on the subcommittee's strategic guidance from the Fall Meeting. The FAA briefs the proposed R&D FY+2 years.

Tuesday, March 16th

9:00am	Welcome / Review of Open Actions	Jim Kuchar / Phil Yeung
9:15am	Director Remarks	Shelley Yak
9:20am	Budget Briefing	Beth Delarosby
9:30am	Possible Changes to Industry Due to COVID-19	Subcommittee
10:00am	Aviation Industry Direction and Challenges	Subcommittee
10:30am	Break	
10:45am	1A10A0 Enterprise Concept Development	Steve Bradford
11:15am	1A07C0 NextGen – New Air Traffic Management Requirements	Steve Bradford
11:45am	Lunch	

12:30pm	Informational Deep Dive – UTM Roadmap	Peter Sachs/AUS
1:30pm	1A01A Runway Incursion Reduction (RIRP)	Todd Lewis / Giovanni Dipierro
2:00pm	Break	
2:15pm	1A01C Operations Concept Validation & Infrastructure (ATDP)	Guillermo Sotelo
3:15pm	A11.k Weather Program	Randy Bass
3:45pm	A11.q NextGen – Weather Technology in the Cockpit (WTIC)	Gary Pokodner
4:15pm	Findings and Recommendations Discussion	Subcommittee

Wednesday, March 17th

9:00am	Review Findings and Recommendations	Subcommittee
9:15am	Informational Deep Dive – NAS Integration of Transiting Operations	Guillermo Sotelo
10:15am	A11.r Flight Data Exchange Requirements	Nouri Ghazavi
10:45am	Break	
11:00am	A11.o Wake Turbulence	Jillian Cheng
11:30am	1A04B0 Wake Turbulence Re-Categorization	Jillian Cheng
12:00pm	Lunch	
1:00pm	1A10B0 Enterprise Human Factors	Tara Holmes
1:30pm	A11.i Air Traffic Control/Technical Operations Human Factors	Tara Holmes
2:00pm	Informational Deep Dive – NASA xTM R&D Update	Akbar Sultan/NASA
3:00pm	Recap and Closing	Jim Kuchar / Phil Yeung

Legend Key:

	Informational Deep Dives

REDAC NAS Ops Subcommittee Attendee List:

Day 1:

Chinita Roundtree-Coleman	FAA
Jim Kuchar	MIT Lincoln Laboratory
Philip Yeung	FAA
Host/Co-Host	A3 Technology
Emily Stelzer	MITRE
Jon Schleifer	FAA
Keith Nong	SAIC
Michael Reininger	FAA
Monica Alcabin	Boeing
Philip Hays	FAA
Sadaf Alam	A3 Technology
Shelley Yak	FAA
Guillermo Sotelo	FAA
Karl Kauffman	FAA
Akbar Sultan	NASA
Bruce Holmes	Consultant
Marcus Boukedes	FAA
Steve Bradford	FAA
Todd Lewis	FAA
Peter Sachs	FAA
Elizabeth Delarosby	FAA
Sally Stalnaker	MITRE
Stephanie Beritsky	Tetra Tech
Tara Holmes	FAA
Elizabeth Lacher	MITRE
Randolph Mauer	FAA
Sally Frodge	FAA
Elida Smith	MITRE
Brian Powers	A3 Technology
Gary Pokodner	FAA
Amanda Staley	MITRE
Giovanni Diperro	FAA

Brian Bagstad	FAA
Nattiel Chambers	DIGITALiBiz
Randy Bass	FAA

REDAC NAS Ops Subcommittee Attendee List:

Day 2:

Chinita Roundtree-Coleman	FAA
Host (Brian Powers)	A3 Technology
CoHost (Gwen Mazzotta)	SAIC
Akbar Sultan	NASA
Elizabeth Delarosby	FAA
Tara Holmes	FAA
Bruce Holmes	Consultant
Michelle Blucher	MITRE
Emily K. Stelzer	MITRE
Cheryl Andrews	MITRE
Jim Kuchar	MIT Lincoln Laboratory
Joe Bertapelle	JetBlue
Jennifer Gentry	MITRE
Katie (Catherine Bolczak)	MITRE
Monica Alcabin	Boeing
Nouri Ghazavi	FAA
Phil Yeung	FAA
Philip Hays	FAA
Bill Lash	MITRE
Sadaf Alam	A3 Technology
Sally Frodge	FAA
Guillermo Sotelo	FAA
Maria Geffard	MITRE
Caitlin Matulenas	FAA
Todd Lewis	FAA
Chris Lawler	Cavan Solutions
Michael Reininger	FAA
Michelle Duquette	MITRE
Tom St. Clair	MITRE

Jon Schleifer	FAA
Ben Marple	FAA
Keith Nong	SAIC
Jillian Cheng	FAA