November 21, 2012

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Mr. David Grizzle
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Ms. Margaret Gilligan
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Subject: Automatic Dependent Surveillance–Broadcast In Aviation Rulemaking Committee — Recommendations in Response to Federal Aviation Administration May 30, 2012, Tasking

Dear Ms. Cox, Ms. Gilligan, and Mr. Grizzle:

The Federal Aviation Administration (FAA) chartered the Automatic Dependent Surveillance–Broadcast (ADS–B) In Aviation Rulemaking Committee (ARC) on June 30, 2010, to provide a forum for the U.S. aviation community to define a strategy for incorporating ADS–B In technologies into the National Airspace System (NAS). The ARC was tasked to provide recommendations that clearly define how the community should proceed with ADS–B In while ensuring compatibility with ADS–B Out avionics standards defined in §§ 91.225 and 91.227 of Title 14, Code of Federal Regulations. The ARC submitted its recommendations to this tasking on September 30, 2011.

On May 30, 2012, the FAA extended the ARC's charter to submit additional recommendations on how to frame an ADS–B In equipage mandate such that the benefits exceed costs before 2035. The ARC was tasked to identify (a) in what airspace, and/or (b) at what airports, and/or (c) by what other criteria the FAA could apply to frame an ADS–B In mandate. In addition, the ARC was tasked with providing feedback on a 2020 compliance date for a potential ADS–B In mandate. The ARC provided the FAA its report related to this tasking on October 31, 2012.

The May 30, 2012, ARC charter also included a tasking for the ARC to complete all follow-on work related to the original tasking and prepare a summary report detailing the FAA's recommended next steps.

The ARC has, since submitting its first report on September 30, 2011, continued to provide technical and policy feedback to the FAA with a primary focus on further defining the key applications endorsed in that report. The attachment to this letter acts as an addendum to the ARC's October 31, 2012, report and reflects advancements in technical work that have a direct impact on ADS–B In policy and business case formulation. The ARC specifically is providing the FAA a definition of Cockpit Display of Traffic Information (CDTI)-Assisted Pilot Procedures (CAPP) referenced in the October 31, 2012, report and further feedback and recommendations on Flight-deck-based Interval Management–Spacing (FIM–S) functionality, Airport Traffic Situation Awareness with Indications and Alerts (SURF–IA), ADS–B In cost-benefit analysis as it relates to regional air carriers, and benefits sensitivity analysis to achieve an inter-arrival spacing standard deviation.

The ADS–B In ARC stands ready to help the FAA with any additional tasks as needed.

Sincerely,

Steven J. Brown
ADS–B In ARC Co-Chair
National Business Aviation Association, Inc.

Thomas L. Hendricks
ADS–B In ARC Co-Chair
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Enclosure
Copy to Mr. Doug Arbuckle, ADS–B In ARC Designated Federal Official, and all ARC members.

1.1 Cockpit Display of Traffic Information-Assisted Pilot Procedures

Approach

The Cockpit Display of Traffic Information (CDTI)-Assisted Pilot Procedures (CAPP) approach is designed to be used when the destination airport meets basic visual flight rules (VFR) minimums (1000/3, as measured at the airport), but not the practical minimums for visual approaches. It is used to transition equipped aircraft from instrument meteorological conditions (IMC) to visual meteorological conditions (VMC) where they can complete the approach using CDTI Assisted Visual Separation (CAVS), a sequential visual approach. The maneuver also may be terminated with an instrument approach procedure. Pilots performing CAPP are responsible for spacing from one aircraft, known as the traffic to follow (TTF). Controllers remain responsible for separation between these aircraft and from all other aircraft. It is assumed the aircraft is on or vectoring to a published approach during the CAPP maneuver.

CAPP airborne decision support hardware and software assists the flightcrew to manage the aircraft speed with reference to the TTF. Once the CAPP flightcrew can visually acquire the TTF and maintain visual conditions to the runway, air traffic control (ATC) can approve a CAVS-based visual approach.

CAPP does not present a speed for the pilots to fly. Rather, the avionics continuously displays intuitive graphical trend information on the CDTI in the pilots' forward field of view (see Title 14, Code of Federal Regulations (14 CFR)§§ 23.1321 and 25.1321 of) to assist the pilot with the task of maintaining a distance from TTF no closer than that assigned by the controller.

A selectable range alert will advise the pilot when a specified distance from TTF has been reached.

For early operational use, the minimum no-closer-than distance will be no less than the radar and or wake separation standard, whichever is greater for that facility/runway end. The minimum no-closer-than distance could also be slightly greater than the separation minimums to allow for surveillance latency and controller response time. Upon satisfactory separation standards research, consideration may be given to reducing that distance.

In addition to minimum distance/time alerting, an approved electronic alerting function may add situational awareness to alert the pilot of maximum distance/time. This may help insure situational awareness and provide an additional level of safety.

CAPP can be initiated by ATC with an instrument approach clearance including an instruction to follow [FlightID TTF] no closer than [n] [miles | seconds]. For example, "aircraft X, cleared for the ILS 34, behind aircraft Z no closer than 3 miles." (Note: The phraseology is notional.) CAPP could be enabled by a future potential flight plan code. If the code is not available then the pilot would have to initiate CAPP. CAPP requires only voice communication; a data link is not required.

A clearance to fly no closer than a stated distance to a single TTF does not commit the pilot to maintain precisely that distance. A clearance to fly no-closer-than is strictly a minimum spacing instruction and does not change any other previous clearance. For example, it does not imply a clearance to change altitude, heading, or a navigation clearance.

Once the flightcrew notifies ATC that they have the TTF "in sight" (through the window), they will expect a clearance to conduct a visual approach using a CAVS procedure. Alternatively, a CAVS clearance could be implicit in the CAPP procedure to minimize additional ATC communications. The procedure description could require the flightcrew to report TTF "in sight" to properly continue with CAVS.

Since CAPP will be authorized only when ATC has a reasonable expectation the aircraft will be able to visually acquire TTF, the procedure will terminate in one of three ways:

1. The pilot of the CAPP aircraft visually acquires TTF and is cleared for a CAVS (visual) approach.
2. The pilot of the CAPP aircraft does not visually acquire TTF but has sufficient separation from TTF and terminates with an instrument approach.
3. The pilot of the CAPP aircraft does not visually acquire TTF and does not have sufficient separation from TTF so ATC directs remedial action (for example, directs the CAPP aircraft to discontinue the approach or go around).

Departure

A CAPP departure is designed to be used when the departure airport is under instrument flight rules (IFR) or marginal VFR and the ceiling and/or visibility is not sufficient for visual departures but visibility is good enough for the controller to identify the CAPP aircraft on the runway. Pilots will have direct visual contact with the TTF during the initial takeoff roll until lost from view in the clouds or other restrictions to visibility. No-closer-than spacing is not required to be obtained until the CAPP aircraft becomes airborne because the TTF is pulling away from CAPP aircraft during takeoff and initial climb. If known performance differences exist between the aircraft, such as between a relatively lower performing regional jet leading with a faster mainline airliner following on a CAPP clearance, controllers would adjust the timing of the CAPP aircraft takeoff clearance to account for such differences. Because visual separation is not permitted behind aircraft designated for additional separation due to wake turbulence (for example, a Boeing 757 or Heavy aircraft), CAPP separation on departures would likewise not be permitted with respect to these aircraft. In other words, a CAPP departure, at least initially, is only expected to be implemented behind Large and Small aircraft types.
The separation standard needs to be established through a safety study. The goal is to have a standard less than the current instrument standard.

Pilots performing CAPP are responsible for spacing from one aircraft (the TTF). Controllers remain responsible for separation between these aircraft and from all other aircraft.

CAPP aircraft decision support hardware and software assist the flightcrew to manage the aircraft speed with reference to the TTF. The duration of such responsibility can be variable, but is typically of short duration, only long enough to establish another form of separation after takeoff, such as diverging headings (15° or greater), lateral separation of at least the radar minimum, or altitude separation.

CAPP does not present a speed for the pilots to fly. Rather, the avionics continuously displays intuitive graphical trend information on the CDTI in the pilots' forward field of view to assist the pilot with the task of maintaining a distance from TTF no-closer-than that assigned by the controller.

A selectable range alert will advise the pilot when a specified distance from TTF has been reached.

Separation standards research will determine a satisfactory separation standard for this operation. In addition to minimum distance/time alerting, an approved electronic alerting function may add situational awareness to alert the pilot of maximum distance/time. This may help ensure situational awareness and provide an additional level of safety.

CAPP can be assigned sometime before the takeoff clearance by ATC. The instruction to follow [FlightID TTF] no closer than [n] [miles | seconds] would be issued with the takeoff clearance. For example, "aircraft X, cleared for takeoff behind aircraft Z no closer than 3 miles." (Note: the phraseology is notional.) CAPP could be enabled by a future potential flight plan code. If the code is not available then the pilot would have to initiate CAPP. CAPP requires only voice communication; a data link is not required.

A clearance to fly no closer than a stated distance to a single TTF does not commit the pilot to maintain precisely that distance. A clearance to fly no-closer-than is strictly a minimum spacing instruction and does not change any other previous clearance. For example, it does not imply a clearance to change altitude, heading or navigation clearance.

ATC will advise when CAPP clearances are terminated.

2.0 Feedback on Framing Flight-deck-based Interval Management–Spacing Functionality

The FAA is working with RTCA Special Committee (SC)–186 to refine the functionality of Flight-Deck-Based Interval Management–Spacing (FIM–S). SC–186 identified a divergence between several of its work groups related to the functionality of FIM–S avionics for the integration of named fixes and routes. The FAA asked the ARC to develop a consensus position to help advance the work of SC–186. The ARC–endorsed A4A position paper regarding FIM–S intent information is included in appendix A to the attachment.

3.0 Review of Airport Traffic Situation Awareness with Indications and Alerts Technical Issues

One of the applications the ARC identified as a priority for investigation was Airport Traffic Situation Awareness–Indications and Alerts (SURF–IA), based on the findings of the 2009 operational trials. The FAA's trials, conducted by Honeywell and Aviation Communication and Surveillance Systems (ACSS) respectively, identified technical problems with the use of the application due to multi-path and line-of-sight issues. Additionally, as noted in the September 2011 ARC report, the deployment of SURF–IA is impeded by the reported position accuracy and integrity requirements in 14 CFR § 91.227, Automatic Dependent Surveillance–Broadcast (ADS–B) Out equipment performance requirements (see also Automatic Dependent Surveillance–Broadcast (ADS–B) Out Performance Requirements To Support Air Traffic Control (ATC) Service; Final Rule (74 FR 30194, May 28, 2010). MITRE, as funded by the

FAA's Runway Safety office, completed a report analyzing potential position accuracy mitigations[1]. Additionally, the ARC received three reports addressing these SURF–IA topics[2].

The FAA informed the ARC the agency suspended further work on SURF–IA based on FAA funding and ARC priorities[3].

In light of the potential safety benefits of surface applications using ADS–B In capabilities beyond those in SURF, the ARC recommends a different course of action.

Recommendation 1

> The ARC recommends the FAA specify and implement appropriate mitigations to the technical problems identified by the FAA to enable the definition and implementation of improved surface situational awareness applications using ADS–B In with ADS–B Out rule-compliant avionics.

4.0 Review of FAA ADS–B In Cost-Benefit Analysis

The ARC worked with the FAA to frame how to best undertake the FAA's cost-benefit analysis to better understand National Airspace System (NAS) deployment of ADS–B In.
The September 2011 ADS–B In ARC report endorsed a set of ADS–B In applications viewed as providing opportunity for generating benefits if deployed in the NAS. Since then, the ARC has served as a sounding board to the FAA as it continues to mature its business case including in support of the agency's 2012 ADS–B program Joint Resources Council (JRC) decision.

The ARC also identified that the earlier FAA business case lacked cost data from regional airplane manufacturers. The ARC invited representatives from the two primary regional airplane manufacturers, Bombardier and Embraer, to participate in the ARC as subject matter experts and, in parallel, the FAA worked with the two manufacturers to help advance available cost data for use by the FAA in future analyses of the FAA business case.

[1] Overview of Mitigations Concerning Qualification of ADS–B Out Rule-Compliant (NAC_p 8) Targets for Surface Applications; April 25, 2011; PowerPoint presentation to ADS–B In ARC working group 2 by Peter Moertl

[2] Global Positioning System Accuracy Under Varying Ionospheric Conditions for Surface Automatic Dependent Surveillance–Broadcast Applications, Dr. Brian Bian and Dr. Peter M. Moertl, The MITRE Corporation, Center for Advanced Aviation System Development;

Results of an Analysis to Estimate Safety Benefits of Enhanced Situation Awareness on the Airport Surface with Indications and Alerts (SURF–IA), Dr. Peter M. Moertl, Brock J. Lascara, Mary Kay Higgins, and Jerry K. Baker, June 2012;

Report on the Risk Mitigation Study Related to ADS–B Surface Detection Performance Issues in Support of Future ADS–B Surface Applications, Version 1.1, August 23, 2012

[3] See October 9, 2012, ADS–B In ARC Record of Meeting.

5.0 Benefits Sensitivity to Achieved Inter-Arrival Spacing Standard Deviation

The initial benefits information provided to the ARC was based on an assumed inter-arrival rate standard deviation of 8 seconds. The ARC requested a benefits analysis based on an assumed 5-second standard deviation in inter-arrival time. The additional benefits provided by this lower standard deviation were considered significant.

Recommendation 2

> The ARC recommends the goal for new FIM–S standards and operational approval guidance should be to achieve a standard deviation for the inter-arrival time of 5 seconds. The additional capacity generated by this standard deviation is significant and may improve the operator business case for eventual ADS–B In equipage.

Appendix A—FIM–S Response to SC–186 Question about Intent, June 5, 2012

The subject of this A4A paper is the expression of the desires of the major commercial operators in regard to the functionality of FIM–S avionics.

Named fixes and routes can best be described as "intent". When an aircraft is designated as the lead in a Flight-deck-based Interval Management–Spacing (FIM–S) situation, the lead ship becomes the Traffic To Follow (TTF). The "intent" of the Traffic To Follow (TTF) is an important concept that needs to be incorporated in the FIM–S algorithm for solutions that are meaningful for successful operations in a complex ATC environment. Several operators have considerable experience with Flight-deck-based Interval Management–Spacing (FIM–S).

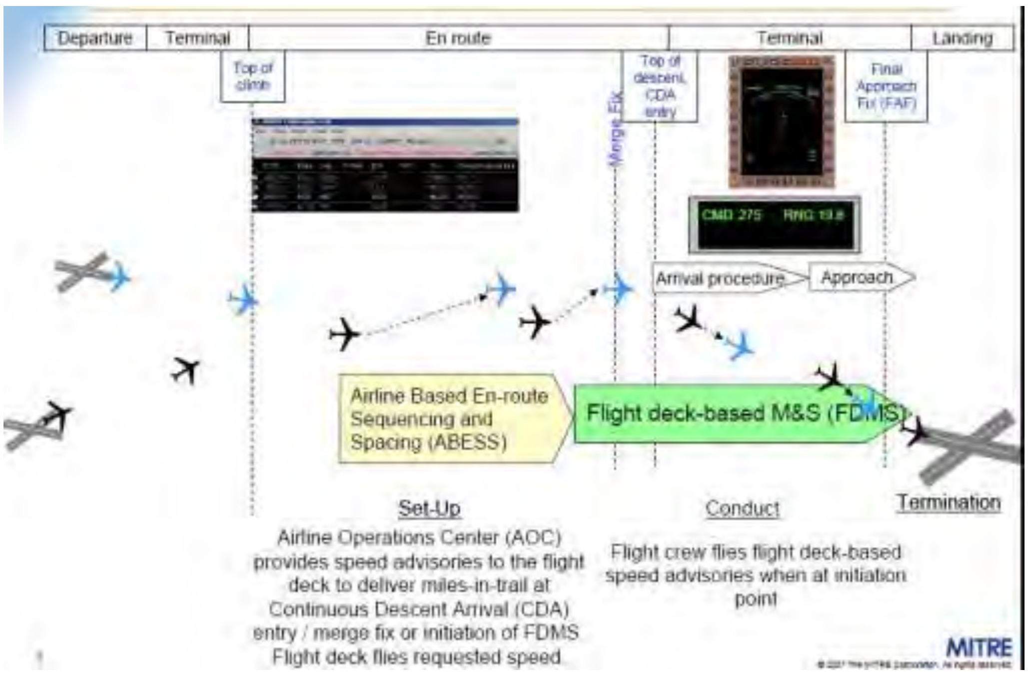

Figure 1—Simple Two-Ship Merge Concept

Their experience has shown that, without the "intent" of the TTF incorporated into the FIM–S algorithm, the maneuver is very elementary and CANNOT withstand the complexity of multiple merges or merges from directions greater than 60 degrees of heading difference. In essence, the FIM–S will be limited to simple merges of two aircraft with less than 90 degrees of track difference as depicted in Figure 1 above.

Operations in the ATC environment include merges with aircraft from many different directions, including on opposing tracks (nose to nose) where "intent" is necessary. Additionally, a string of aircraft proceeding to a common destination will tend to build in number as more aircraft merge into the string along the way (multiple merges). This string of aircraft may have to merge with a different string of aircraft just prior to final approach. In all of these very common scenarios, "intent" is necessary. Any functionality short of this would make the equipment undesirable for operators, due to its limitations.

The database to support intent should not be limited to reside in the CDTI or in the processor which provides the algorithm, but can reside in a number of different locations such as the flight management system (FMS), Traffic Alert and Collision Avoidance System (TCAS), or Enhanced Ground Proximity Warning System (EGPWS) to name a few. The avionics manufacturer should have the liberty to be inventive.

In addition, operators will ultimately want equipment that can function in a Closely Spaced Parallel Operations (CSPO) environment, where an interval has to be maintained in stagger operations on the aircraft directly ahead landing on the same runway and the aircraft ahead landing on a parallel runway. "Intent" is also necessary for these stagger operations.

Airline operators are extremely averse to reequipping several times as a capability or functionality matures. Now would be the best time to incorporate "intent" in the requirements document that defines future FIM–S operations. This will result in acceptable hardware capabilities initially, which will require only software updates for future enhancements.