International Civil Aviation Organization

Eighth Meeting of the Surveillance Implementation Coordination Group (SURICG/8)

Bangkok, Thailand, 6 – 9 June 2023

Agenda Item 8 Update on surveillance activities and explore potential cooperation opportunity
a) States/Administrations

ADS-B IN RETROFIT SPACING (AIRS) EVALUATION PROJECT UPDATE

(Presented by United States/Federal Aviation Administration)

SUMMARY

This paper provides an update on the ADS-B In Retrofit Spacing (AIRS) evaluation project, a large-scale operational evaluation of ADS-B In applications that was the subject of SURICG/6-IP/08. The project engages the FAA with ACSS and American Airlines (AAL) in a public-private partnership to equip 288 AAL A321 aircraft with an ADS-B-In retrofit solution that supports Cockpit Display of Traffic Information (CDTI)-Assisted Visual Separation (CAVS) and Interval Management (IM) capabilities.

1. INTRODUCTION

1.1. The ADS-B In Retrofit Spacing (AIRS) evaluation project was kicked off in September 2017, with the aim of conducting a large-scale operational evaluation of two ADS-B In applications: Cockpit Display of Traffic Information (CDTI)-Assisted Visual Separation (CAVS) and Initial Interval Management (I-IM).

1.2. The project was subsequently expanded in 2020 to include the CDTI-Assisted Separation on Approach (CAS-A) operation. From a pilot's perspective, CAS-A operations are similar to CAVS operations, with the principal difference being that controllers provide the Aircraft ID of the traffic-to-follow directly to the aircraft performing CAS-A via voice communications. Additionally, CAS-A uses the CAVS avionics functionality in ceiling and visibility conditions that would not qualify for "pilot-applied visual separation" in the U.S. under FAA Order 7110.65, "Air Traffic Control." However, CAS-A operations require that the airport of intended landing must be VMC (ceiling at the airport greater than or equal to 1,000 feet AGL and horizontal visibility of 3 miles or greater) – a principal reason for this limitation is to enable tower controllers to apply visual separation on the runway between the CAS-A aircraft and its traffic-to-follow.

1.3. Appendix B of FAA Advisory Circular (AC) 90-114B, Change 1 contains more information on CAVS. Appendix F of this AC contains more information on Interval Management. This AC can be found online in the FAA's dynamic regulatory system (see https://drs.faa.gov/browse/excelExternalWindow/DRSDOCID1293172039202212230006 44.0001).

1.4. The project engages the FAA with ACSS and American Airlines (AAL) in a public-private partnership to equip 288 AAL A321 aircraft with an ADS-B-In retrofit solution supporting CAVS, CAS-A, and I-IM operations. The AAL A321 fleet consists of a mixture of A321ceo and

A321neo aircraft with two different types of ACSS TCAS units – the TCAS-3000SP (installed on A321ceo aircraft) and the T^{3}CAS (installed on A321neo aircraft). The system installed in these aircraft is shown in Figure 1. Figure 2 shows the AGD display for the CAVS function, which is compliant with [E]TSO-C195b. Figure 3 shows the AGD display for various operating modes of the ACSS I-IM implementation.

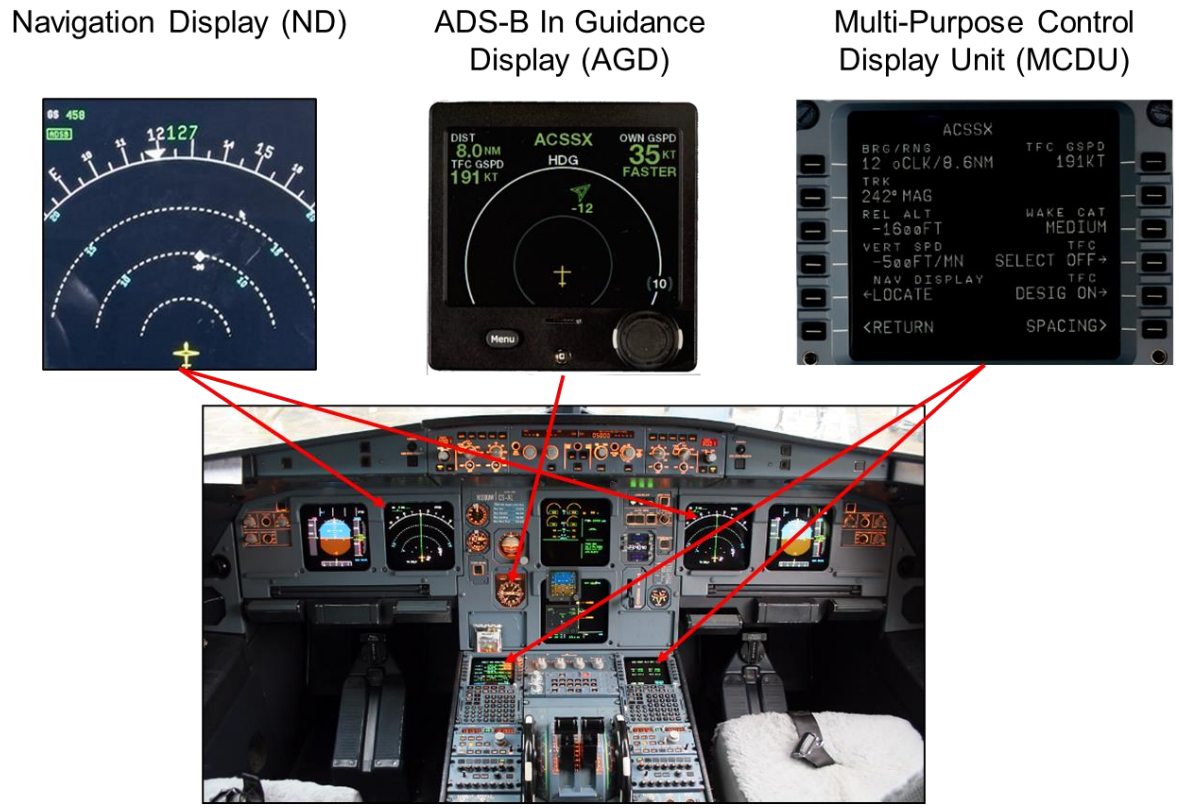

Figure 1 – ACSS avionics being installed in AAL A321s (the only new hardware is the AGD)
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Figure 2 –AGD display details for the [E]TSO-compliant CAVS function as implemented by ACSS
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IM (airspeed command) (time-based ASG)

IM (Mach command) (time-based ASG)

IM (Mach command) (distance-based ASG)

Figure 3 – AGD display for various operating modes of the ACSS I-IM implementation
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1.5. CAVS arrival operations do not require ATC involvement and can be performed at any airport. On the other hand, CAS-A and IM Spacing operations are limited to airspace where controllers have an indication of which aircraft are equipped and have methods to assign proper spacing goals for I-IM.

2. DISCUSSION

2.1. I-IM operations are occurring for westbound arrivals through Albuquerque Air Route Traffic Control Center (ZAB) to Phoenix Terminal Radar Approach Control (P50) airspace. Westbound arrivals through ZAB carry about half of the arrival traffic into P50. I-IM clearances using time-based Assigned Spacing Goals (ASGs) are issued by ZAB controllers prior to the top of descent and terminate at or prior to the P50 boundary. Figure 4 shows an example I-IM operation on the EAGUL arrival to KPHX. Figure 5 shows an example I-IM operation on the PINNG arrival to KPHX. I-IM operations are also occurring for aircraft overflying through ZAB airspace to other locations in the U.S., such as Los Angeles, Dallas, and Las Vegas. For such operations, ZAB controllers are using miles-based ASGs (typically to achieve the Miles-In-Trail restriction at the ZAB boundary with an adjacent Center). Figure 6 shows an example I-IM operation on one of these “overflight” operations. The controllers do not have any special ground automation support for this operational evaluation; alternative methods are provided to inform controllers which aircraft have I-IM capability and what spacing goals should be assigned to the aircraft. Over 210 I-IM operations had been conducted in ZAB’s airspace as of 19-Apr-2023.

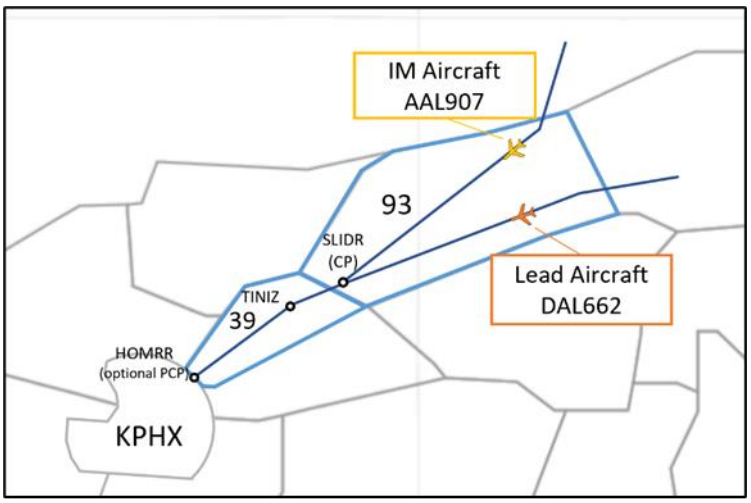


Figure 4 – I-IM operation on the EAGUL arrival to KPHX (terminates at or before HOMRR)

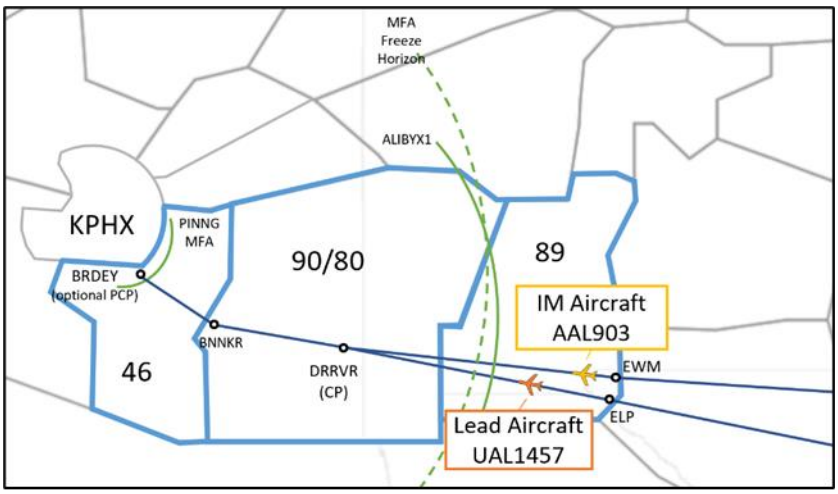


Figure 5 – I-IM operation on the PINNG arrival to KPHX (terminates at or before BRDEY)

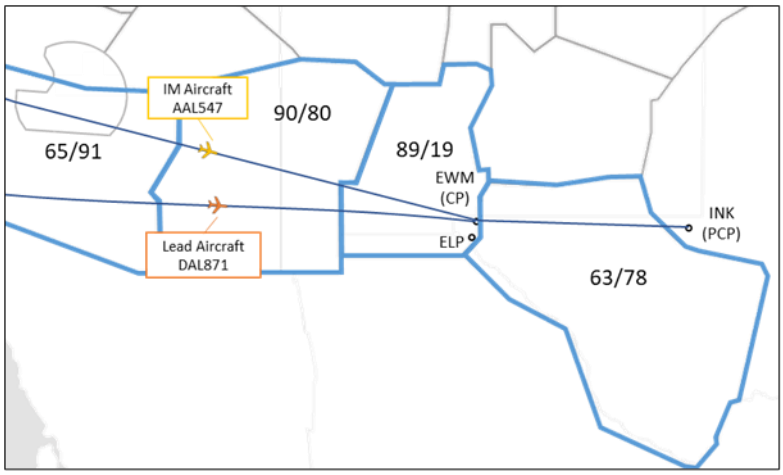


Figure 6 – I-IM operation on an "overflight" operation

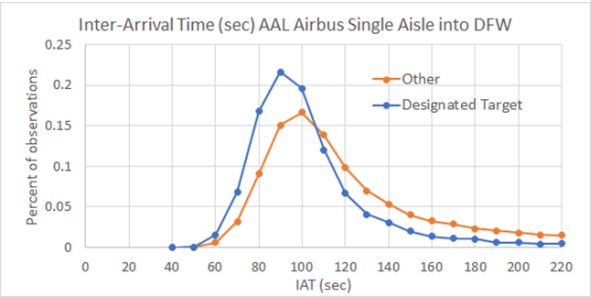
2.2. CAS-A operations are occurring for capable aircraft arriving at KDFW airport. The arrival/approach controllers do not have any special ground automation support for this operational evaluation; alternative methods are provided to inform controllers which aircraft are capable of performing CAS-A and to communicate among the controllers regarding which aircraft are performing CAS-A. Over 450 CAS-A operations have been conducted for KDFW arrivals as of 10-May-2023.

2.3. Avionics certification for SafeRoute on the TCAS-3000SP is complete and installations in AAL A321ceo aircraft are expected to complete in November 2023. Avionics development for SafeRoute functionality hosted on the T^{3}CAS is complete and installations in AAL A321neo aircraft are completed for the operational trials. As of 11-May-2023, 270 AAL A321 aircraft are equipped or in modification to be equipped.

2.4. AAL received FAA operational approval to conduct CAVS operations in May 2021, and initial benefits analyses for KDFW arrivals during 2022 are shown in Figure 7 and for KCLT arrivals during 2022 in Figure 8. In these figures, Inter-arrival Time (IAT) is the time between when the CAVS aircraft crosses the runway threshold time and when the previous arrival crossed the same runway's threshold. Threshold Spacing is the distance between the CAVS aircraft and the previous arrival when the previous arrival crossed the runway threshold. The Designated Target columns and lines show when the flight crew was performing CAVS[1]; the Other columns and lines show when the flight crew was not performing CAVS. This analysis considered only American Airlines single aisle Airbus aircraft (A319, A320, A321, A20N, A21N), as this group of aircraft have the same flight crews flying them. The analysis excludes arrivals with IATs > 220 seconds or < 40 seconds, excludes any arrivals behind a Heavy (as wake vortex rules require a larger following distance), and arrivals during IMC (<1000 feet ceiling OR <3 miles visibility). Both the KDFW and KCLT results indicate that the Mean IAT is smaller by 16 seconds for aircraft performing CAVS compared to Other aircraft, and that the Mean Threshold Spacing is smaller by 0.6 NM for aircraft performing CAVS compared to Other aircraft.

	Designated Target	Other
Mean IAT (sec)	98	114
Observations	4,107	64,092

	Designated Target	Other
Mean Threshold Spacing (NM)	3.9	4.5
Observations	4,105	64,078



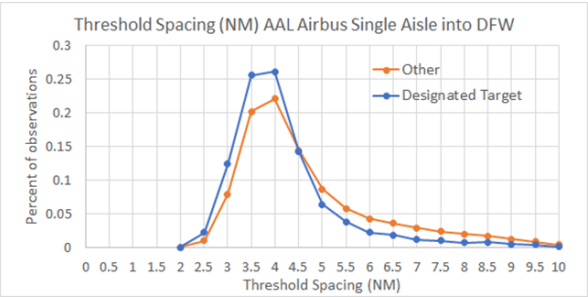
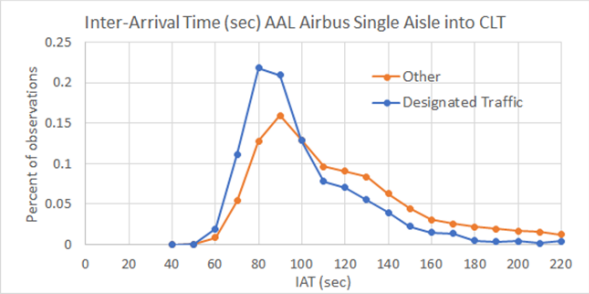


Figure 7 – CAVS results during 2022 for KDFW arrivals

[1] This was defined as aircraft that Designated a Target between 25 NM from the airport and the arrival runway

	Designated Traffic	Other
Mean IAT (sec)	95	111
Observations	2,234	53,631

	Designated Traffic	Other
Mean Threshold Spacing (NM)	3.9	4.5
Observations	2,234	53,623



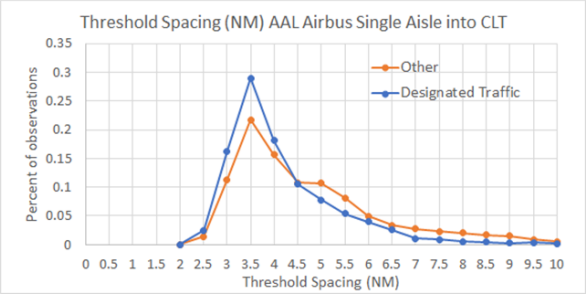


Figure 8 – CAVS results during 2022 for KCLT arrivals

2.5 AAL received FAA operational approval to conduct IM operations in October 2022 and IM Spacing operations began in ZAB airspace on 7-Nov-2022. Benefits data are being gathered for up to one year after IM Spacing operations commenced.

2.6 AAL received FAA operational approval to conduct CAS-A operations in October 2022 and CAS-A operations commenced on 1-Mar-2023 for CAVS-capable AAL A321 aircraft arriving at the KDFW airport. Benefits data are being gathered for up to one year after CAS-A operations commenced.

3. CONCLUSION

The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

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