Aviation Coordination Program (ACP)

ADS-B In Pilot Project Roundtable

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Project Overview

- This ADS-B In Pilot Project is being proposed as a means of demonstrating the operational feasibility and value of ADS-B In technology to the Indian Air Traffic Management system and to the airlines that equip with the capability.

- The benefits are envisioned to help streamline Indian airspace management, in line with the current Indian Single Sky Harmonized (ISHAN) air traffic management initiative ("One Airspace").

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Directorate General of Civil Aviation
(DGCA)

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AIRPORTS AUTHORITY OF INDIA

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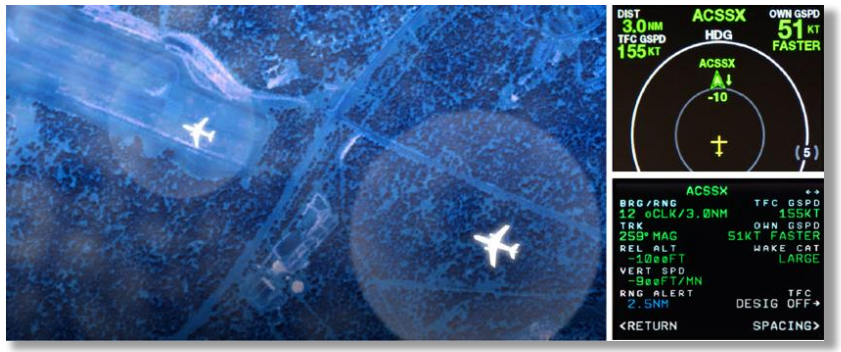
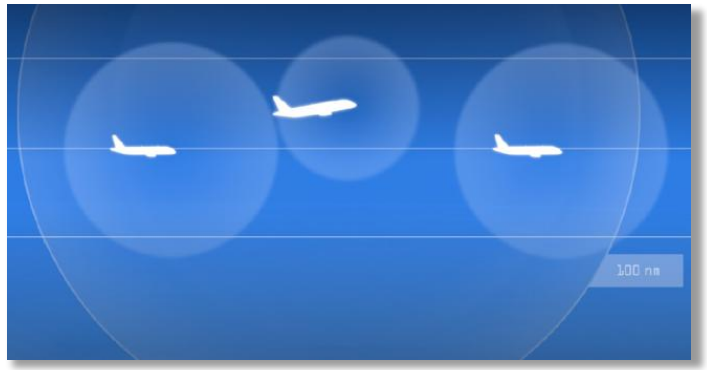
Project Scope

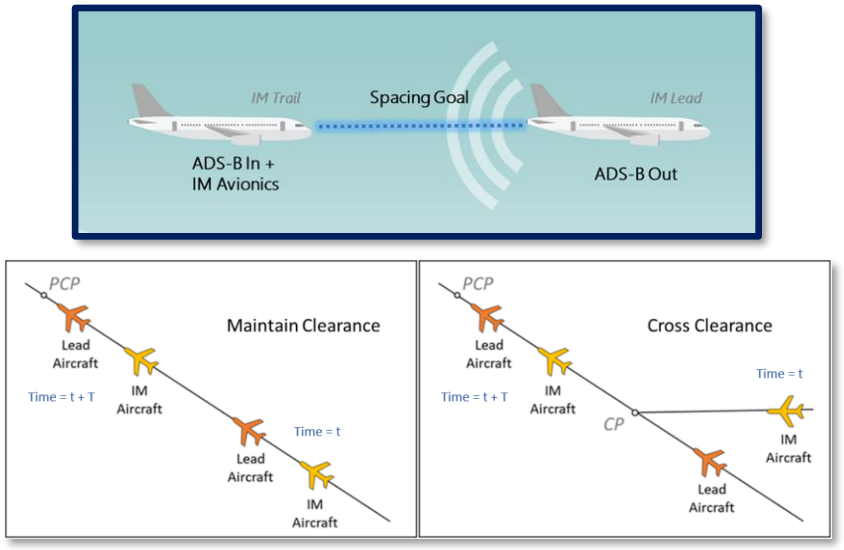
- Under this Project, an agreed-to number of Indian-registered commercial aircraft will be equipped with the certified **ACSS ADS-B In System**.
- **Revenue service operations** will be conducted for a proposed period of **12 Months**, during which time operational data will be gathered and analyzed.
- The program team will generate and release formal **Benefit Report(s)** summarizing the benefits identified during the evaluation.

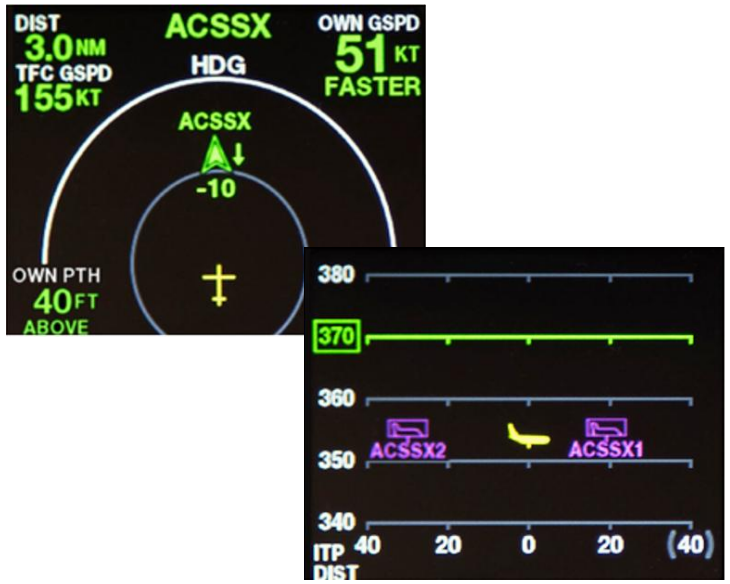


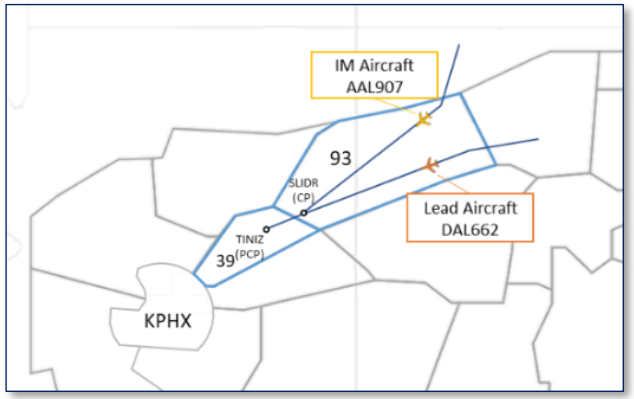


Project Operations

- ADS-B In equipped aircraft (Air India) will operate into Air India hubs, providing opportunities to conduct **CAVS** operations in an effort to obtain benefits that can be measured and quantified
- ADS-B In equipped aircraft will operate in (TBD) airspace, providing opportunities to conduct **Interval Management** operations using the ACSS IM application in an effort to obtain benefits that can be measured and quantified
- Other operations for potential evaluation include **CAS-A** (CAVS during non-visual conditions), **AIRB** (basic airborne situational awareness) and **In-Trail Procedures** (optimization of climb requests)



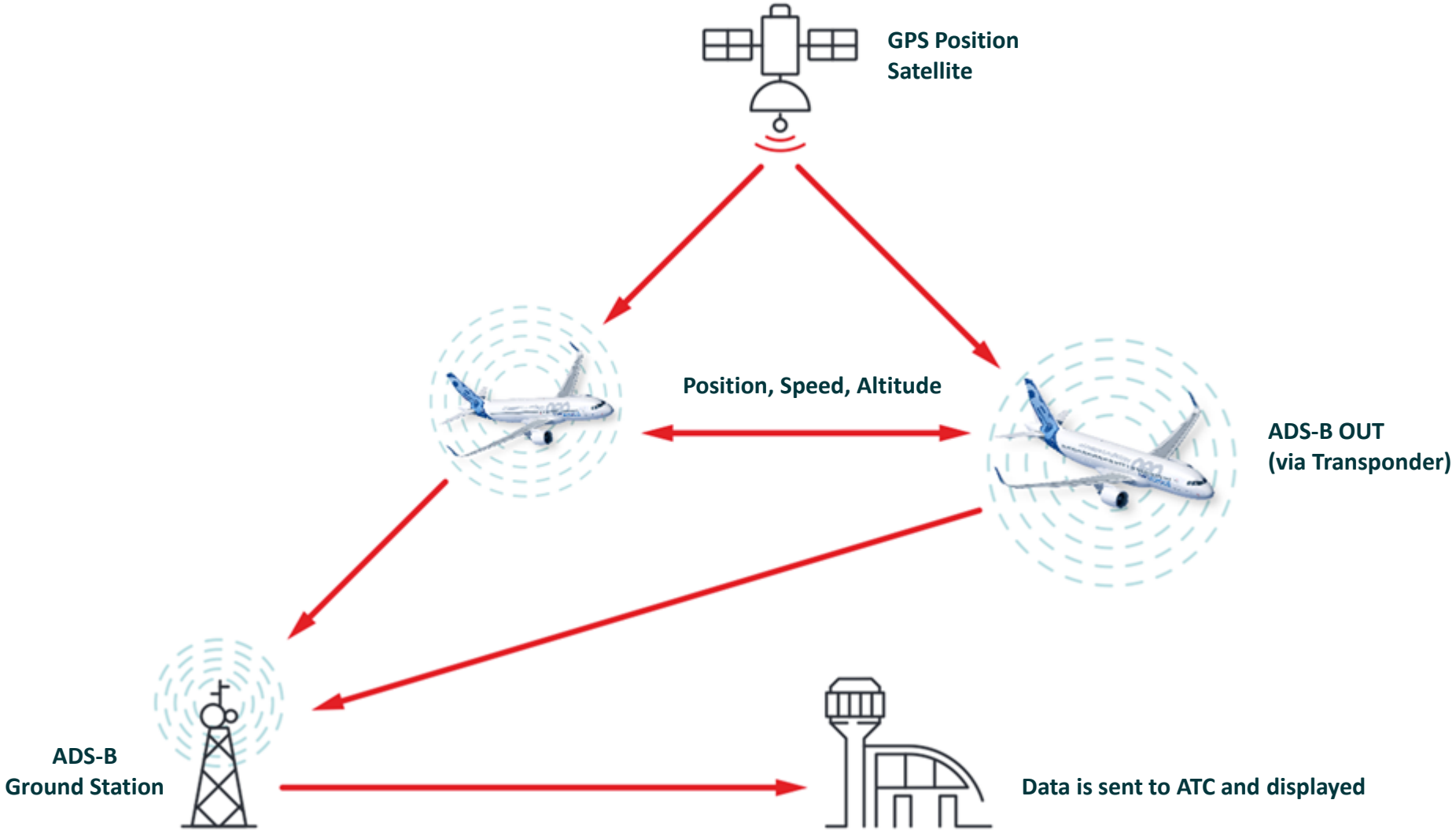




SafeRoute+ ADS-B In

ADS-B IN OVERVIEW

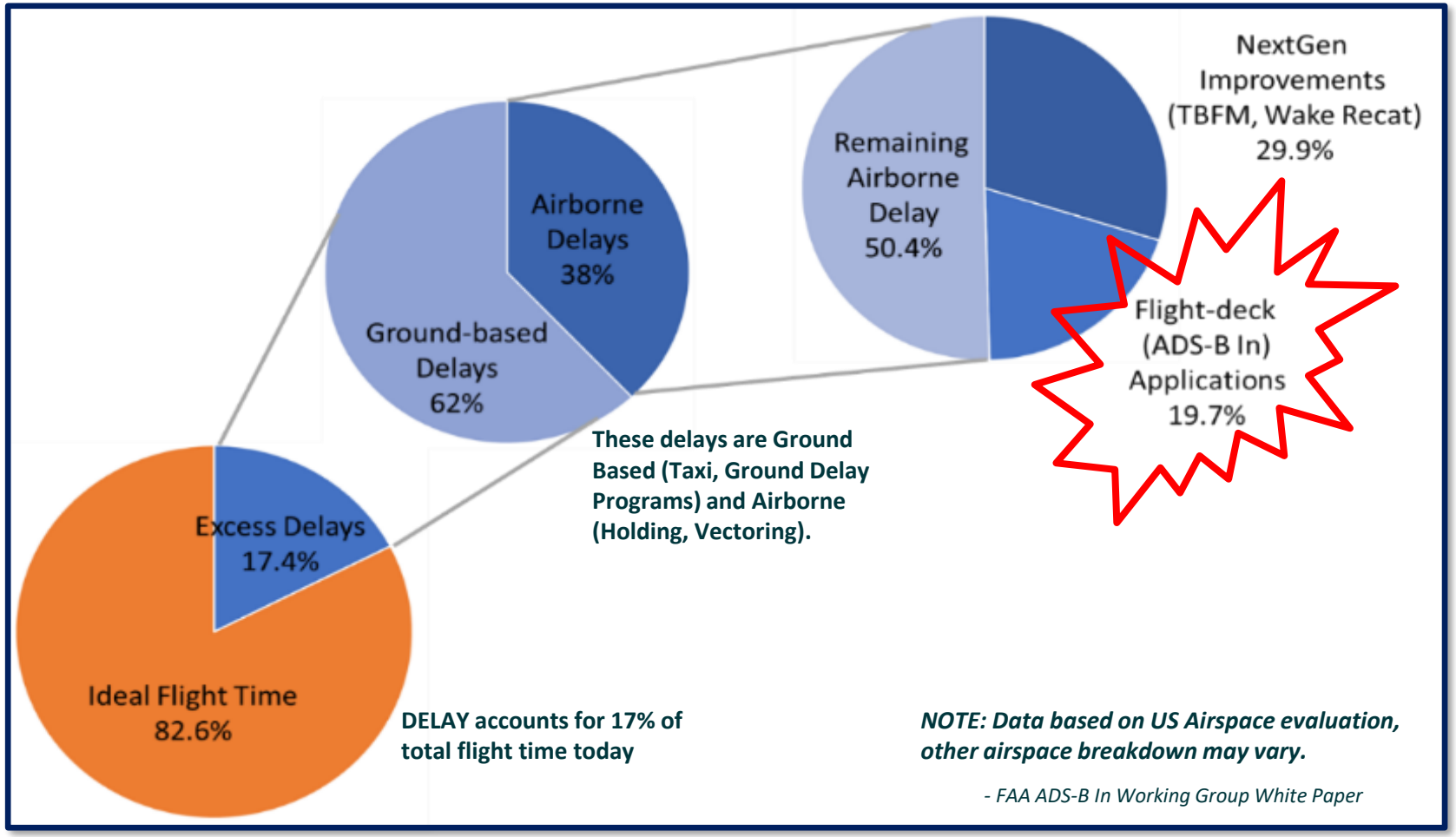
Started with ADS-B OUT…
Automatic Dependent Surveillance Broadcast (ADS-B)



…led to ADS-B In Opportunities
ADS-B IN Benefit Pool

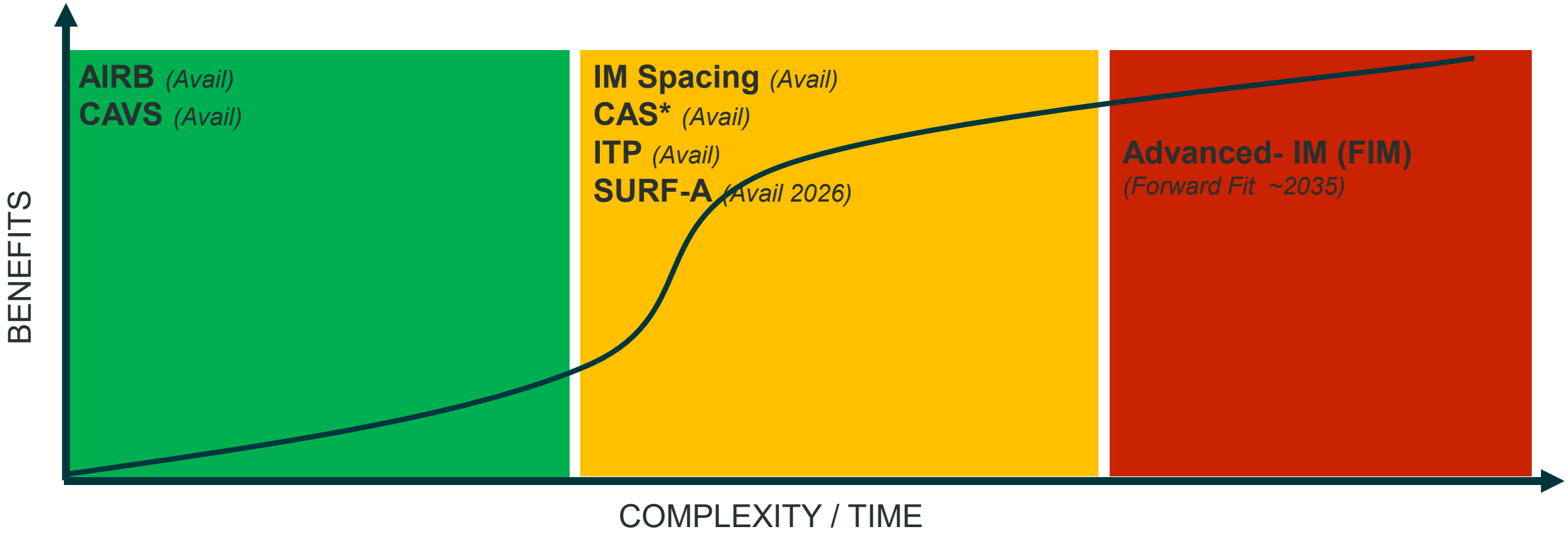
Air transport operators have invested in equipping their fleets with ADS-B Out equipment to meet the ADS-B Out Mandate in 2020.

Operators are now looking forward to the benefits from ADS-B In applications to build on their ADS-B Out investments.



- FLIGHT-DECK ADS-B IN APPLICATIONS COULD ADDRESS **20%** OF THOSE AIRBORNE DELAYS

ADS-B In Ops Benefit / Complexity Map



A: No ground automation required

B: Ground automation required
- Time-Based Management
- Equipage Indicator on Controller display

* CAS is an *operation* using CAVS *application*

C: B + Performance Based Navigation, Trajectory Based Operations
- Datalink Clearances
- Flight Management System Integration
- Autothrottle Integration

SafeRoute – Operationally Proven, Benefits Validated

SafeRoute® ADS-B Solutions

2025: FAA AIRS Benefit Report Release

American Airlines
2019: AIRB, CAVS, AIRS IM, ITP Eval

Alaska **2018:** TASAR

CAAC JUNEYAO AIR 吉祥航空 **2017:** M&S Trial

U·S AIRWAYS
2015: M&S, CAVS, SAMM, ITP

jetBlue AIRWAYS **2014:** M&S, ITP CAVS, SAMM

DELTA
2012 : ITP, SAMM

AIRBUS
2010: ITP, VSA, AIRB

ups **2007:** M&S, CAVS, SAMM, ITP

2020: ADS-B OUT Mandate

2031: *ADS-B IN Mandate (?)*

T3CAS & TCAS 3000SP Platforms, ADS-B Guidance Display

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SafeRoute AIRB

Enhanced Airborne Traffic Situational Awareness (AIRB)

ENABLING PILOTS TO SEE VITAL INFORMATION ABOUT SURROUNDING AIRCRAFT

AIRB is the baseline SafeRoute application, providing flight identification, position, altitude, speed and direction for aircraft up to 180 nautical miles away. This information creates an environment of shared situational awareness and aids the crew in visual acquisition of traffic.

84%

Of pilots surveyed reported **ENHANCED SITUATIONAL AWARENESS** with ADS-B In

AIRBUS OEM Line-Fit Standard and Retrofit option on A320, A330 families *NOW*
BOEING Line-Fit MAX and Retrofit Service Bulletin on B737NG *~2028*
ACSS STC Retrofit Option all Boeing, Airbus models *NOW*

SafeRoute CAVS / CAS

CDTI-Assisted Visual Separation (CAVS)

ENABLING OPTIMUM SPACING AND HIGHER RUNWAY THROUGHPUT

With CAVS, flight crews are able to better manage their visual approach spacing using the SafeRoute display information. CAVS enables continual visual approach in reduced visibility conditions, keeping flights and airports running on time. The CAVS application also supports CDTI-Assisted Separation (CAS) operations, allowing the runway capacity benefits of visual separation operations during weather conditions that do not support visual approaches.

14%

The CAVS application has been shown to **REDUCE AIRCRAFT FINAL APPROACH TIME** by as much as 14%. CAS helps maintain **VISUAL ARRIVAL RATES IN NON-VISUAL CONDITIONS.**

ACSS STC Retrofit Option all Boeing, Airbus models *NOW*

SafeRoute IM

Interval Management (IM)

REDUCING EN ROUTE SPACING VARIATION AND MAXIMIZING AIRSPACE CAPACITY

During the enroute phase of a flight, the Interval Management (IM) application enables aircraft to maintain more consistent and accurate inter-aircraft spacing. More accurate spacing at a delivery point (or a crossing point when merging two traffic streams) results in reduced controller vectoring, allowing flights to remain on their planned routes more frequently. This ultimately enables better block time predictability and helps maximize airspace capacity.

23%

IM can help reduce variance in the delivery of airplanes to metering points, **INCREASE AIRSPACE CAPACITY** up to 23%.

ACSS STC Retrofit Option all Boeing, Airbus models ***NOW***

SafeRoute ITP

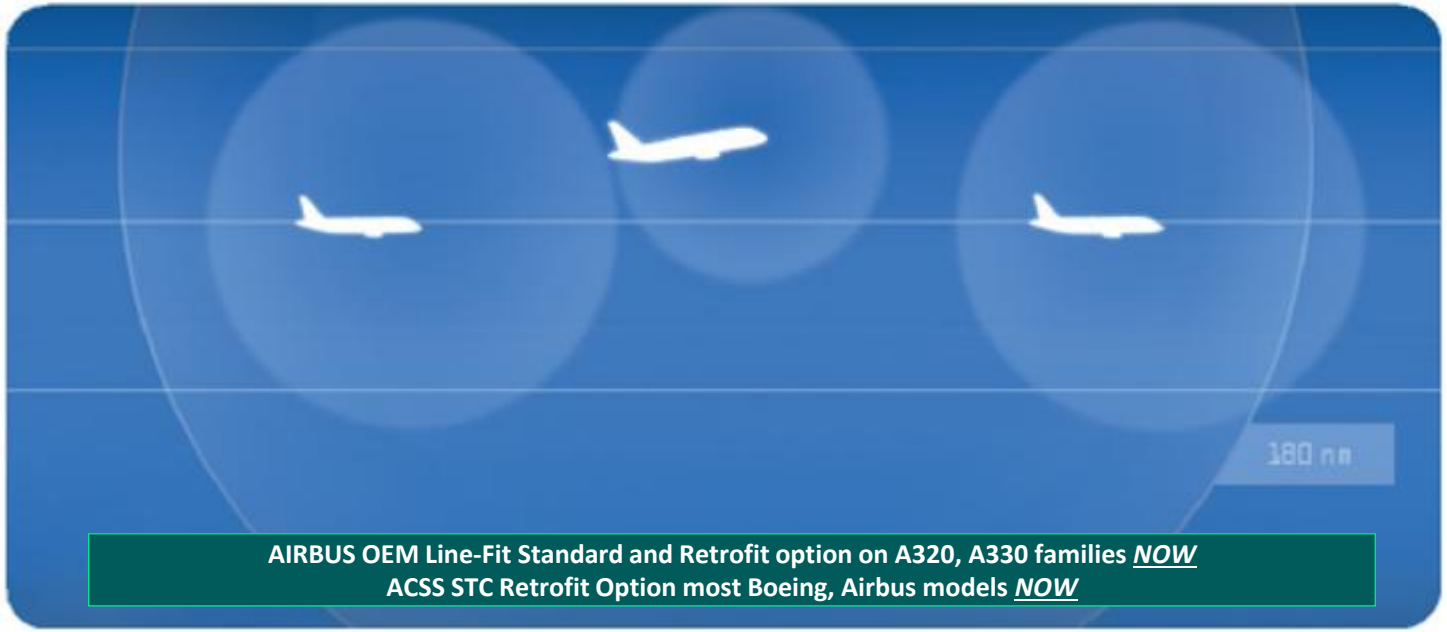
In-Trail Procedures (ITP)

INCREASING FUEL SAVINGS WHILE REDUCING CARBON DIOXIDE EMISSIONS

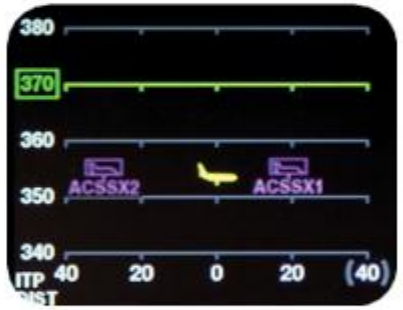
The In-Trail Procedures (ITP) application provides the flight crew with a vertical profile view of surrounding traffic up to 180NM away, which is useful during oceanic routes to determine if an ITP maneuver is possible. The Federal Aviation Administration (FAA) has released studies reporting transatlantic ITP-equipped flights have saved an average of 670 pounds of fuel and likewise, transpacific flights have saved an average 521 pounds per flight. This fuel savings also results in a significant reduction in carbon emissions.

670

Aircraft equipped with ITP have **SAVED AN AVERAGE OF 670 POUNDS OF FUEL** on transatlantic flights.



AIRBUS OEM Line-Fit Standard and Retrofit option on A320, A330 families *NOW*
ACSS STC Retrofit Option most Boeing, Airbus models *NOW*



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SafeRoute SURF-A

Surface Alerting (SURF-A)

ALERTING PILOTS TO POTENTIAL CONFLICT DURING CRITICAL TAKE-OFF AND LANDING OPERATIONS

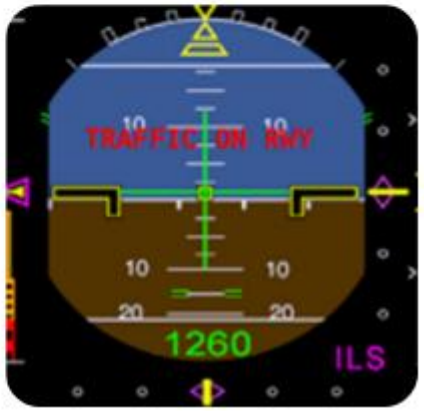
As air traffic continues to grow and airport operations become more and more complex, the risk of runway conflict, particularly during take-off and landing, will only increase. SURF-A puts a prevention tool directly in the flight deck, providing audio and visual warnings when conflict with another aircraft is detected, giving pilots crucial time to react.

62%

NTSB analysis of runway incursion events has determined that **62% WERE DUE TO PILOT DEVIATION**

AIRBUS OEM Line-Fit Standard and Retrofit option on A320, A330 families *2028*
BOEING Line-Fit MAX and Retrofit Service Bulletin on B737NG *2030*
ACSS STC Retrofit Option most Boeing, Airbus models *2028*

"TRAFFIC ON RUNWAY"



ADS-B In Retrofit Spacing (AIRS) Benefit Data

Proving the Benefits of ADS-B IN

2022-2025 Ops Eval

ADS-B In Retrofit Spacing "AIRS" Evaluation

FAA program to demonstrate the operational feasibility and benefit case for ADS-B In capability

- 3-party, large scale operational evaluation: ACSS / AAL / FAA
- American Airlines entire A321 fleet (298 aircraft)

Capabilities demonstrated

- AIRB, CAVS / CAS and limited set of IM capabilities
- CAVS Operational Approval at ALL Airports received 2020
- I-IM Trial (ABQ Center Airspace) Nov 2022 – Nov 2024
- CAS Trial (DFW arrivals) Mar 2023 – Mar 2025

ADS-B In Retrofit System (AIRS) Eval

Objectives

- Evaluate flight crew and controller acceptance of the operations
- Evaluate the use of a retrofit ADS-B Guidance Display for displaying ADS-B In guidance in forward field of view
- Determine better guidance on phraseology and procedures for future NAS-wide implementations
- Gather real-world experience to validate future Air Traffic Control (ATC) automation requirements
- Evaluate and confirm operational benefit assumptions, in real-world conditions
- Accelerate the development and deployment of ADS-B In technology

AIRS DELIVERABLE: FAA-Authored ADS-B In Benefit Reports (I-IM, CAVS/CAS)
>>> https://www.faa.gov/air_traffic/technology/adsb/documents.<<<
TRIAL Reports NOW AVAILABLE on FAA Website above

SafeRoute ADS-B In Retrofit Solution – Airbus A321

ADS-B In Benefits

Benefit Summary

- Aircraft that used this system had **more efficient** arrival and enroute operations, burning **less fuel** and creating **less CO2**.
- Airport ATC facilities that supported these operations were able to **improve runway throughput** (with reduction in go-arounds).
- Enroute ATC facilities that supported these operations realized **increased airspace capacity** with less “managing” of individual aircraft
- Pilots reported clear improvement in **situational awareness** and, therefore, **safety**.

AIRS PROJECT
Benefit Data – CAVS Operations

CAVS Benefits are achievable *anywhere* – NO ATC INVOLVEMENT

Approved for use NAS-wide as of May 2021

Inter Arrival Time (IAT) Reduction Due To Pilot Designation of Preceding Traffic

AIRPORT	AAL IAT	ALL OTHER IAT	IAT Reduction (sec)
DFW	98	118	20
CLT	95	111	16
PHL	99	116	17
PHX	106	120	14
LAX	117	129	12
MIA	110	126	16

Average Reduction in IAT over 12 months : **16 sec**

This equates to ***4-5 aircraft*** increase in throughput…per runway, per hour

"These reductions in time and distance between aircraft can simply be attributed to the fact that when pilots are given better information, they make better decisions" - AAL

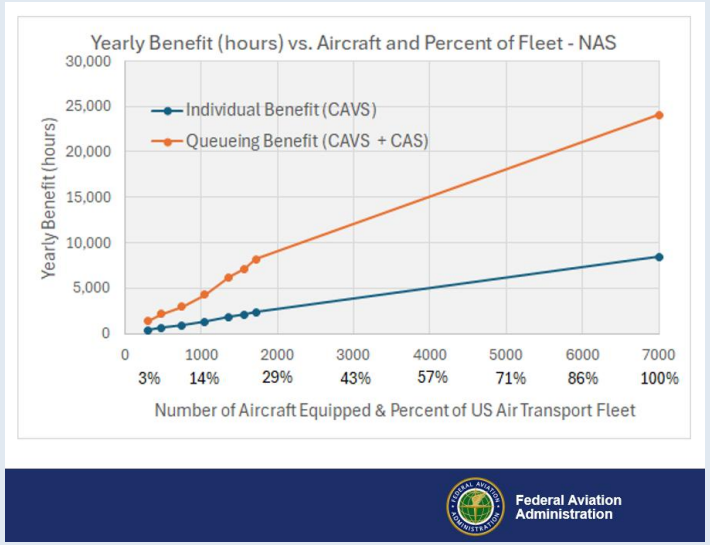
AIRS PROJECT
Benefit Data – CAS-A Operations

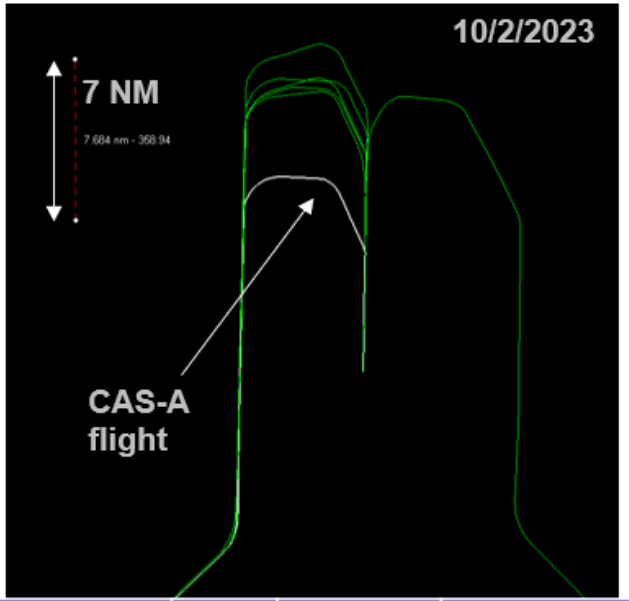
CAS-A Benefits *measured* during AAL Operations at DFW

Savings due to Reduction in Time and Distance flown during trial (2 years, 3,000+ operations, 2.2% of AAL arrivals):

- **659,000 lbs of fuel**
- **944 metric tons of CO_2**

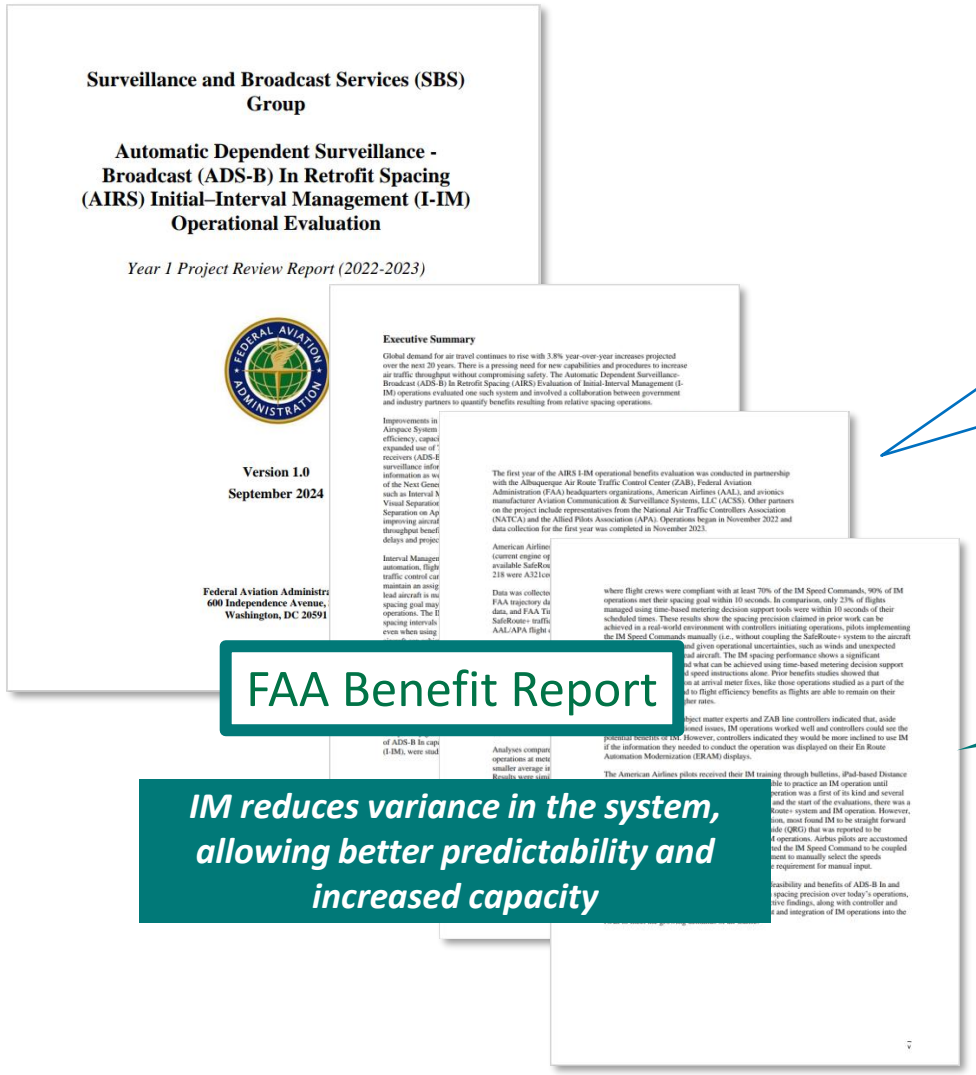
If all equipped American Airlines A321 arrivals into DFW had conducted CAS-A in this period, the total benefit would be approximately ***29 million lbs*** of fuel savings with a value of ***$19.2 million*** and ***42k tons CO_2***…just at DFW.





ACID	Type	Landing	Flight distance (NM)
AAL1288	B738	19:32	57.5
AAL390	B738	19:33	54.8
SKW3285	CRJ7	19:35	53.1
AAL1304	A321	19:37	54.1
AAL1174	B738	19:39	53.6
AAL384	A321	19:41	45.2
AAL1068	A321	19:43	53.2

ADS-B In Retrofit Spacing "AIRS" Evaluation

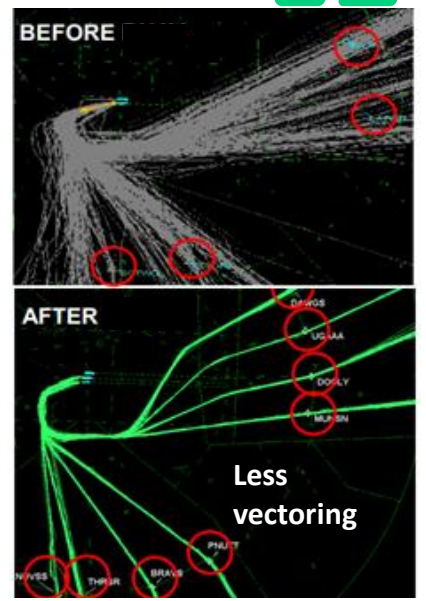


FAA Benefit Report

IM reduces variance in the system, allowing better predictability and increased capacity

Accuracy at Meter Point	TBFM Alone	TBFM + IM
Within 5 seconds	17%	82%
Within 10 seconds	31%	93%
Within 20 seconds	52%	98%
Within 30 seconds	66%	100%
Within 60 seconds	86%	
Within 90 seconds	95%	

Increased Meter Point accuracy



"The AIRS Evaluation demonstrated…significant improvements in spacing precision over today's operations, including time-based metering."
– IM Benefit Report

Increased Accuracy at the Metering Point:

- ***Less Controller Vectoring***
- ***Less fuel burn***
- ***Less CO_2***
- ***More Airspace Capacity***

AIRS PROJECT
Benefit Data – IM Operations

IM *Increases Consistency*

"90% of IM operations met their spacing goal within 10 seconds while only 23% of non-IM flights were within 10 seconds of their scheduled times." **– IM Benefit Report**

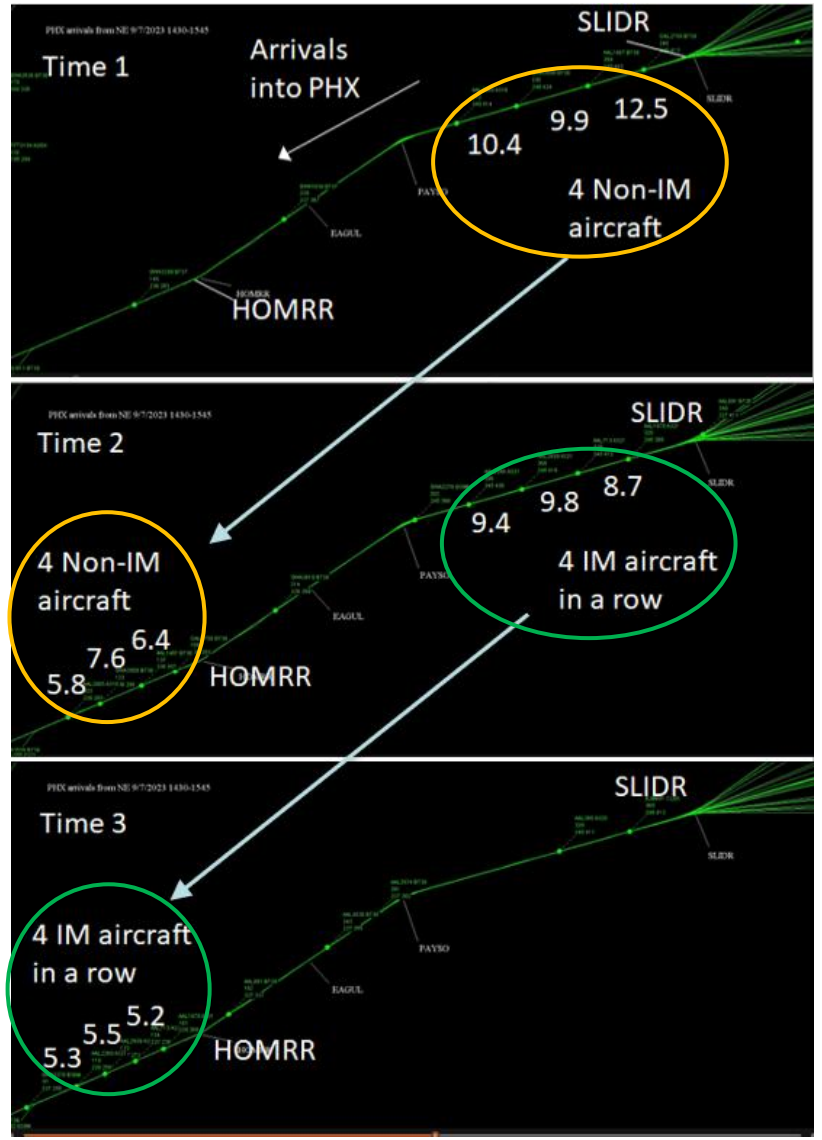
IM *Increases Accuracy*

"The AIRS Evaluation demonstrated…significant improvements in spacing precision over today's operations, including time-based metering." **– IM Benefit Report**

IM *Increases Capacity*

IM provides SIGNIFICANT enhancement to Currently Available System

"IM reduces delay in the NAS…potential for up to 25% airspace capacity increase" **– AIRS WG**



Legislative Activity around ADS-B In

US Mandates In Work (TBC)

- ADS-B In (AIRB)
- SURF-A

Infrastructure Support

- ATC Modernization effort to include ADS-B In
- Leverage existing technologies

FAA Support

- Additional AIRS Funding
- Enable broader airline deployment

ADS-B IN Text

Senator Moran

- **SECTION 1. ADS-B IN AND ADS-B OUT EQUIPMENT RQUIRED FOR AIRCRAFT OPERATING IN CLASS B AIRSPACE IN THE NATIONAL AIRSPACE SYSTEM.**
- (a) REQUIREMENT.—
- (1) IN GENERAL.—Beginning on the date of enactment of this Act, no aircraft, including military aircraft, shall be operated in Class B airspace in the national airspace system unless the aircraft has **ADS-B In and ADS-B Out** equipment that meets such performance requirements as the Administrator shall specify, and is installed, activated, and receiving whenever the aircraft is taxiing or in flight.

Senator Cantwell

- **SEC. 5. ADS-B IN REQUIREMENT TO ENHANCE SAFETY.**
- (a) DEADLINE FOR COMPLIANCE.—Not later than the date that is 4 years after the date of enactment of this section, an air carrier operating under **part 121 of title 14, Code of Federal Regulations or providing service under part 135 of title 14 of such Code pursuant to a schedule or in conjunction with part 380 of title 14 of** such Code may not operate an aircraft unless the aircraft has Automatic Dependent Surveillance-Broadcast In (ADS-B In) equipment installed and operational at all times unless otherwise authorized by air traffic control, regardless of whether the Administrator has issued regulations to implement such requirement.
- (b) PERFORMANCE REQUIREMENTS.—The Administrator shall determine appropriate performance requirements for the ADS-B In equipment referenced in subsection (a) for the purposes of providing safety-enhancing capabilities for flight crews, including but not limited to increasing situational awareness, receiving indications and alerts of air traffic conflicts, and facilitating aircraft collision avoidance. The Administrator shall issue relevant guidance to operators and other appropriate stakeholders on the types of equipment that satisfy the requirements of this section.

Senator Cruz

- The ROTOR Act.
- Details TBD
- "ADS-B IN Required in All Airspace that Require ADS-B OUT."

10

ADS-B In Worldwide

"ADS-B is a foundational technology supporting TBO, which promises benefits in high-density operations," he said. "Accordingly, the FAA will continue implementing proven technologies that support its vision for Trajectory Based Operations."

evaluate, test, and monitor the benefits of ADS-B In technologies to improve traffic flows.

Additionally, ACSS is currently partnering with Thales to participate in a major demonstration of ADS-B In-based surface

> "AIRB and CAVS can yield benefits now, as well as ITP in certain oceanic domains."

ADS-B In will be in-demand around the world.

While the U.S. is the only Air Traffic Control system that currently uses visual approaches, the added situational awareness and safety benefits of technologies like SafeRoute+ may be the motivation for other countries to evaluate the advantages of ADS-B In enabled approaches like CAVS, ITP, and IM.

European ADS-B In implementation.

ACSS is currently working with the FAA, Eurocontrol, ICAO, Airbus, the SESAR Joint Undertaking and NLR, in various studies to

ADS-B applications that are scheduled to run through 2022.

China's move to ADS-B In.

As the Civil Aviation Administration of China (CAAC) begins to prepare for its own ADS-B Out mandate, ACSS, with support of Thales ASW/ATW and other major providers, is socializing the many benefits of ADS-B In at various CAAC events.

ACSS is also working with the CAAC in promoting the use of ADS-B in through an ongoing series of demonstrations and evaluations. For example, ACSS, Airbus, and Thales recently conducted a very successful ADS-B In demonstration with three Juneayo Airlines aircraft in Shanghai.

India's ADS-B In implementation plan.

As one of the largest, and fastest-growing in-country airspace systems, the Indian government has already identified ADS-B In technology for improved throughput through the country. ACSS is working closely with India's aviation leaders to play an active role in ADS-B In technologies at major airports.

Throughout the world, ADS-B In is proving to be a major enabler of not only greatly enhanced situational awareness in the air, but also on the ground. The unparalleled accuracy of the locating capabilities of ADS-B In will provide a major step forward in reducing the number of runway incursions during low-visibility situations.

ACSS SafeRoute+. Using ADS-B In information to streamline ATC operations.

Airlines that retrofit their fleet with ACSS SafeRoute+ will not only take advantage of the flight efficiencies of ADS-B In technology, their flight crews can also make better real-time decisions, which will aid ATC in optimizing traffic flow in all visual conditions. ■

SafeRoute® ADS-B Solutions

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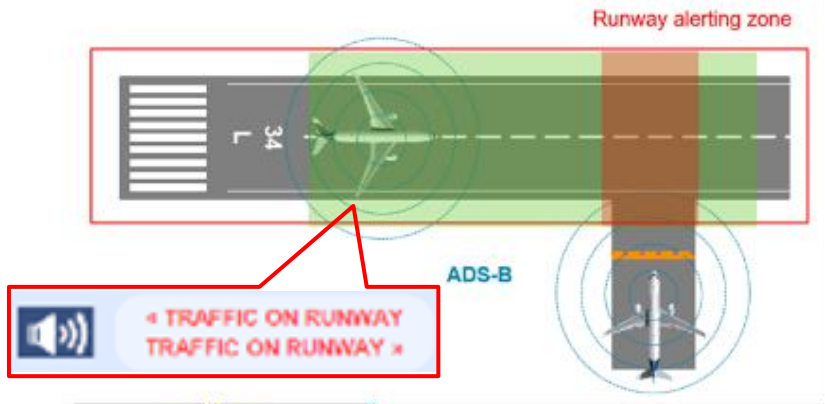
SafeRoute+ ADS-B In

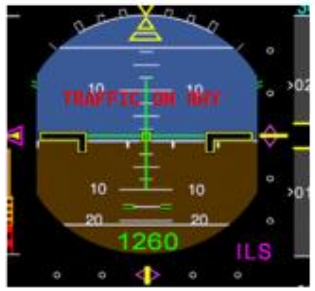
BACK UP SLIDES

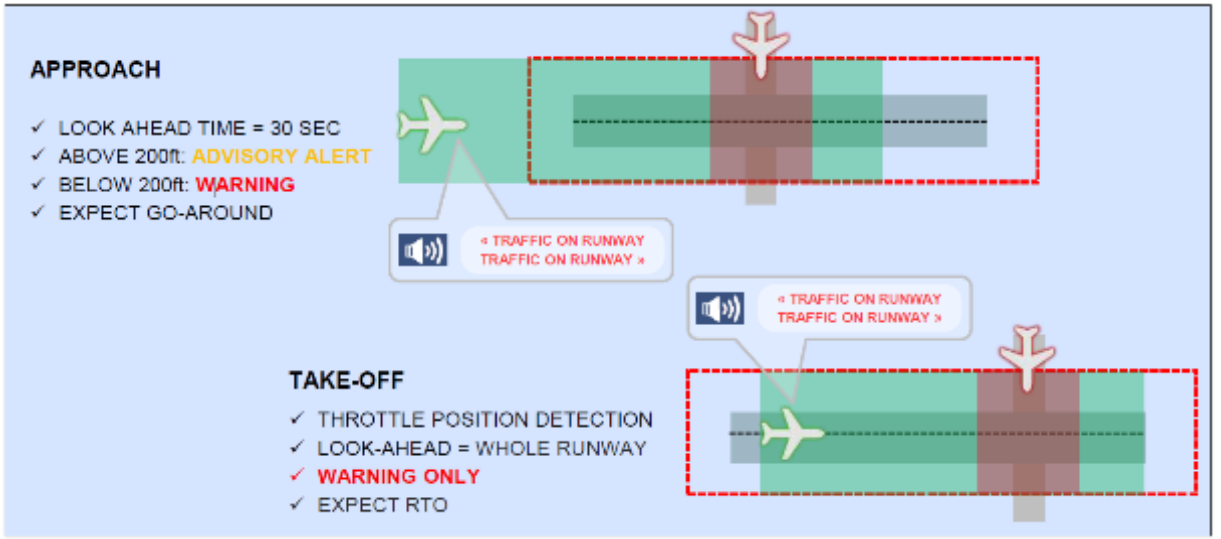
SURF-A (Surface Alerting)

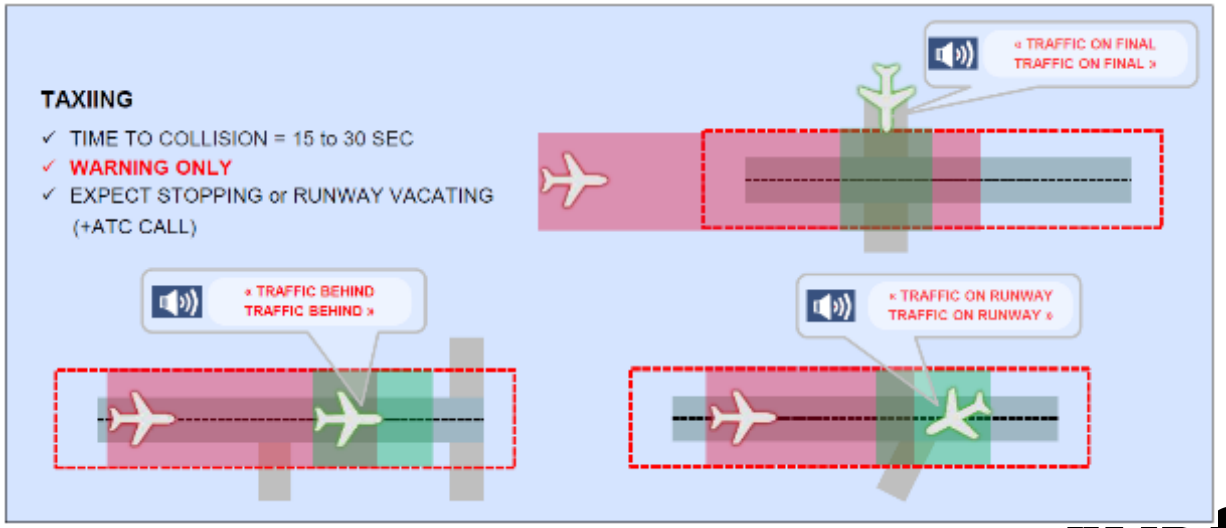
SURF-A (Surface Alerting) – Available Airbus Linefit 2028

- Runway collision avoidance with ADS-B
- Traffic Alerting to include
  - Traffic entering/crossing runway during ownship takeoff
  - Traffic on runway during ownship approach to runway
  - Traffic on approach when ownship occupying runway
- Visual Indications on Primary flight Display







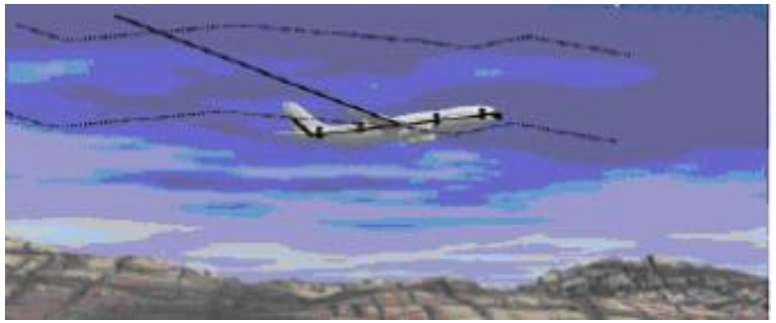


ADS-B In Retrofit Solutions

LDG-SURV (Landing Surveillance) – Available Airbus Linefit 2026

Taxiway Landing Alerting

- This monitor is intended to alert the flight crew if not lined up with a runway at low altitudes.
- Alert when:
  - Alert is issued when the aircraft is in air, close to landing and not aligned with a runway
- Outputs
  - Alert (Aural) - condition trigger) “*Taxiway Taxiway-Taxiway-Taxiway*” (once per alert
  - Visual on Primary Flight Display (PFD)



Altimeter Setting Alerting

- This monitor is intended to detect any altimetry error due to a miss-set baro altimeter during normal operation of the airplane
- Alert (Aural) - “*ALTITUDE*”

Airline & System Benefits of I-IM

IM Adds Accuracy to Existing TBFM (Time-Based Flow Management) System

- TBFM tools have already increased delivery accuracy and reduced vectoring
- IM can further increase delivery accuracy at controlled meter points
- One impact of increased delivery accuracy is increased conformance to RNAV routes
- Increased conformance to RNAV → less vectoring → reduced average flight time and/or variation in flight time
- Reduction in flight time can be directly quantified and monetized
- Reduction in flight time *variation* can be used by airline to evaluate reduction in block time or potential addition of flights

Airline & System Benefits of CAS-A

- Spacing improvements of CAVS extended to more weather conditions, improving airport arrival throughput
  - Higher throughput means less delays and more reliable block times
- Fewer go-arounds
  - No “working” the same aircraft twice
  - Fuel burn avoidance
  - Safety improvement
- Flight crews more aware of their spacing (via AGD info)
  - Less slowing when not needed on short final
  - Better tools…better piloting

Controller Benefits of CAS-A

- No “Deals”: CAS-A = Pilot Applied Separation
  - CAS-A relieves the controller from applying standard separation (3 nm or 2.5 nm)
- Pilot Applied Separation is expanded to instrument approaches and through IMC (e.g., skinny visuals, overcast layer, haze)
- Discontinuation of vertical separation from parallel runway traffic once CAS-A clearance is issued
  - No waiting for the flight crew to see the airport
- Controllers are finding CAS benefits in hazy conditions (very common for DFW) and when the ceiling drops. Examples were given whereby one controller was able to shorten his entire final flow after issuing one CAS clearance. It reportedly shortened the final from 15 miles to 10 miles for several aircraft.

Controller Benefits of CAS-A (cont.)

- Earlier turn-ins during hazy and skinny visuals
- Fewer go-arounds
- Positive ID of TTF
  - Less *"we're looking"*
  - No *"we lost our traffic"* & *"we lost the airport"*
  - No following the wrong lead aircraft
- Tighter spacing on final
- Additionally, when a CAS clearance pulls in the final on one runway and is coordinated with the controller on the parallel runway, that controller can now lower the intercept altitude for the glideslope by 2000' (3000' instead of 5000') which results in a shorter final for the arrival stream. It was stated *"One CAS pulls in the whole operation."*

ADS-B IN Retrofit Architecture – AIRB, CAVS, IM, ITP