The ADS-B Webinar

ICAO
MID & EUR/NAT

ICAO Provisions related to ADS-B

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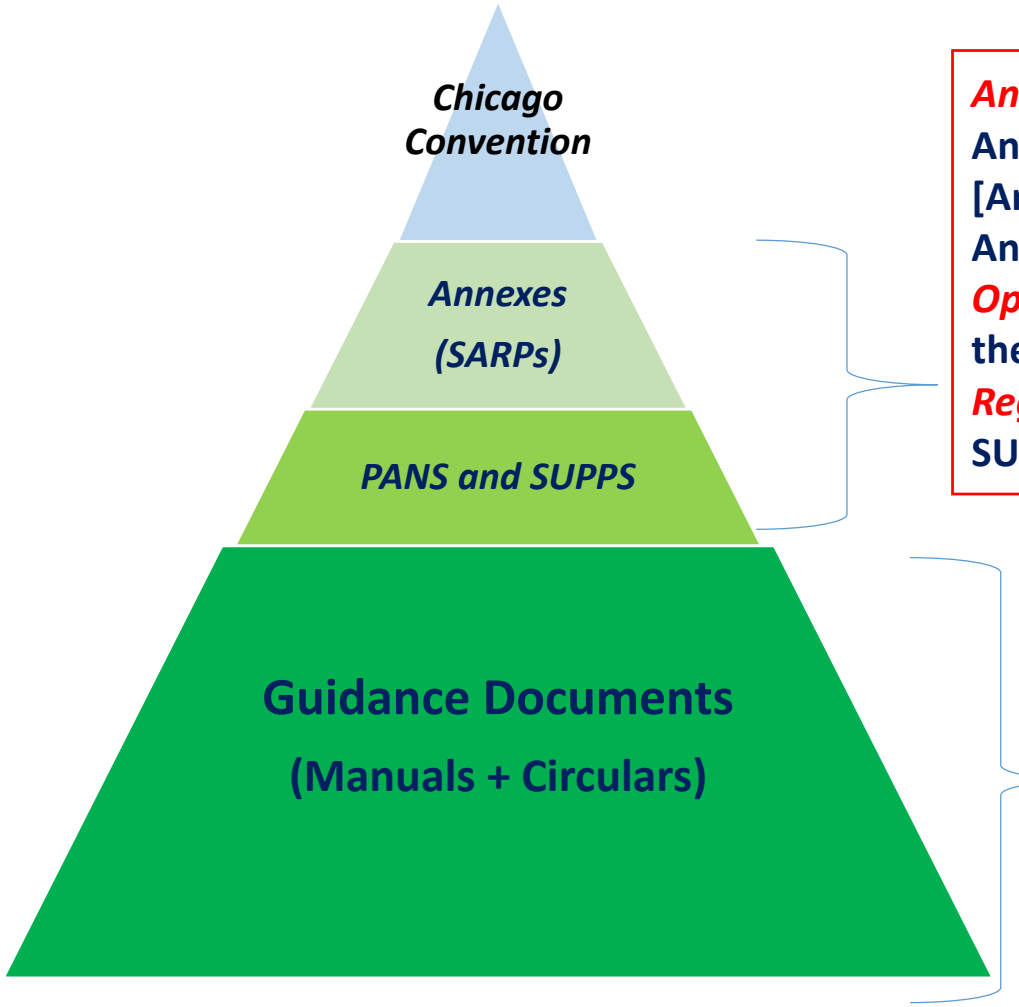
This presentation covers

- ADS-B related ICAO standard framework;
- Global Air Navigation Plan;
  (Aviation System Block Upgrades (ASBUs))
- Surveillance Panel Activities

ICAO Framework …in relation to ADS-B



Annexes (SARPs) :
Annex 10 Vol IV (ADS-B extended squitter)
[Annex 10 Vol I (GNSS) & III (VDL, 24 bit address)]
Annex 2 and Annex 11
Operational procedure:
the PANS-ATM (Doc 4444) and the PANS-OPS (Doc 8168).
Regional requirements/procedure:
SUPPS

Technical Requirements :
Doc 9871, Technical Provisions for Mode S Services and Extended Squitter

Guidance Materials :
Doc 9924 Aeronautical Surveillance Manual
Doc 9994 Manual on Airborne Surveillance Applications
<u>Supporting implementation</u>:
Cir 326 Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation
And other related documents such as GANP/ASBU

Alternate View of ICAO Framework

…in relation to ADS-B

SARPs and PANS :
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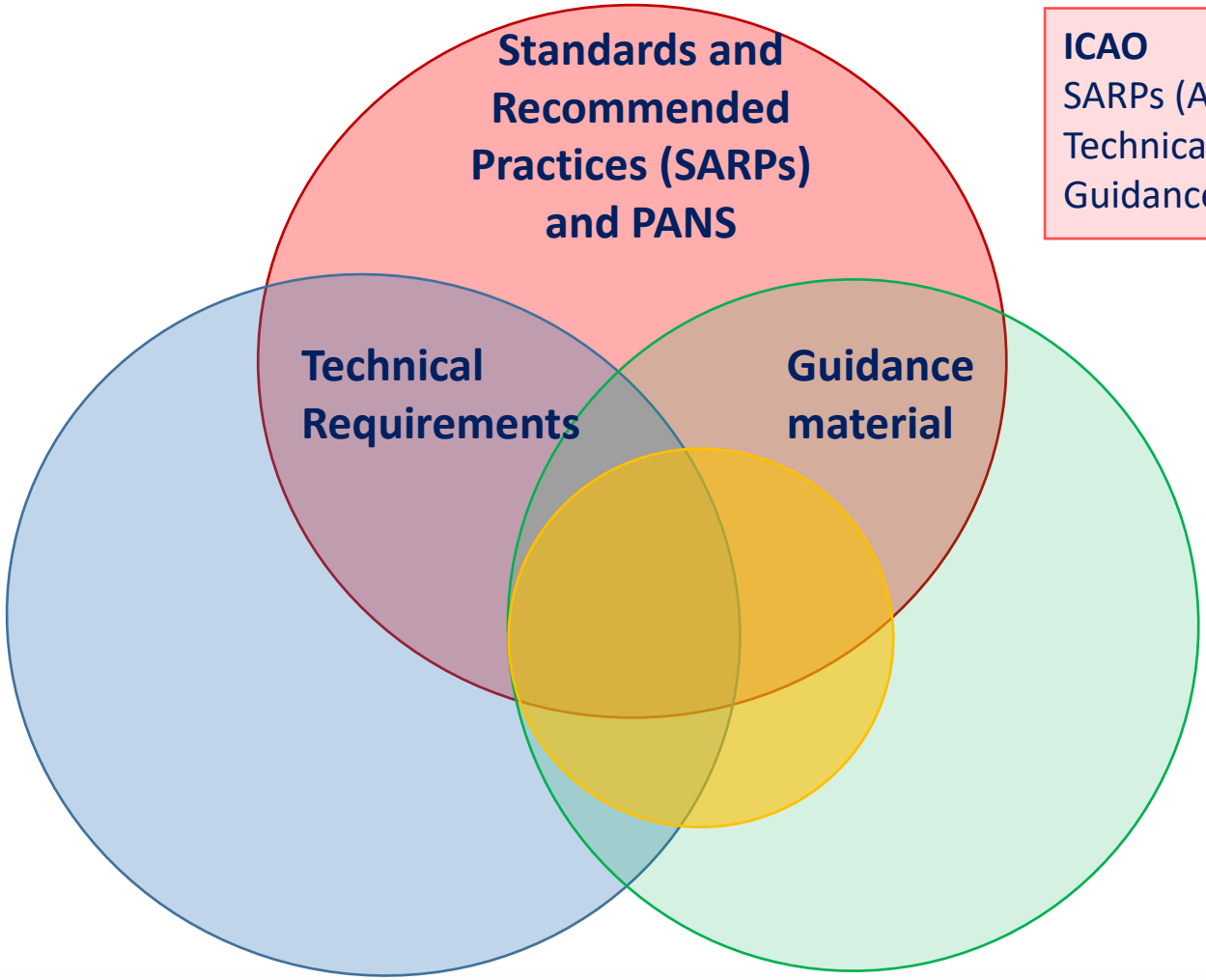
ADS-B Standardisation/Regulatory Activities



ICAO
SARPs (Annex 10 V IV), PANS, etc
Technical Requirements (Doc 9871)
Guidance Material (Doc 9924 & Doc 9994)

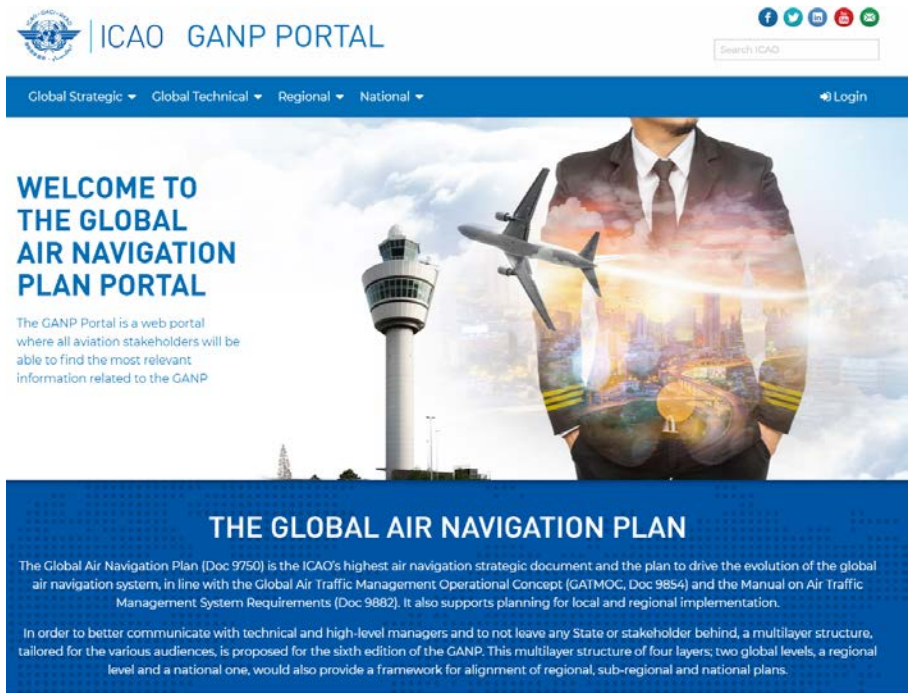
State Regulators
National regulations
Guidance material (Advisory Circulars, etc)

Authorization

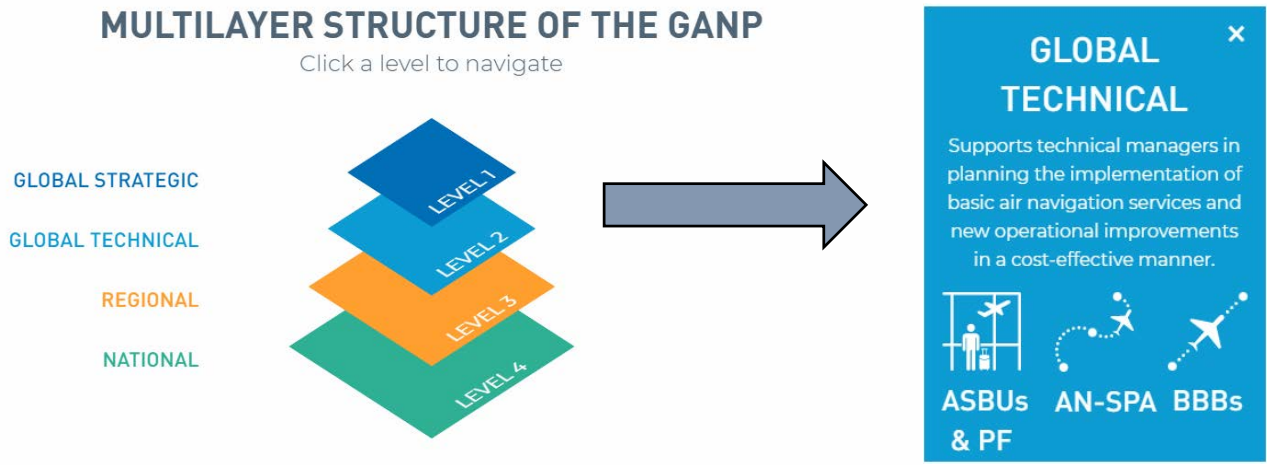
Certification Standards (TSO, eTSO, etc)

Standard-making Orgs (RTCA/EUROCAE)
Minimum Aviation System Performance Standards (MASPS)
Minimum Operational Performance Standards (MOPS)

Global Air Navigation Plan



[Home - ICAO GANP Portal]



Aviation System Block Upgrades (ASBUs)

This includes
- Airborne Collision Avoidance System (ACAS)
- Cooperative Separation (CSEP)
- Ground-based Safety Nets (SNET)
- Surveillance systems (ASUR)

ASBUs

ASUR

ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)	Technology
ASUR-B0/2	Multilateration cooperative surveillance systems (MLAT)	Technology
ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)	Technology
ASUR-B1/1	Reception of aircraft ADS-B signals from space (SB ADS-B)	Technology
ASUR-B2/1	Evolution of ADS-B and Mode S	Technology
ASUR-B2/2	New community based surveillance system for airborne aircraft (low and higher airspace)	Technology
ASUR-B3/1	New non-cooperative surveillance system for airborne aircraft (medium altitudes)	Technology
ASUR-B4/1	Further evolution of ADS-B and MLAT	Technology

Refer to ICAO GANP Portal

ASBUs

CSEP

CSEP-B1/1	Basic airborne situational awareness during flight operations (AIRB)	Operational
CSEP-B1/2	Visual Separation on Approach (VSA)	Operational
CSEP-B1/3	Performance Based Longitudinal Separation Minima	Operational
CSEP-B1/4	Performance Based Lateral Separation Minima	Operational
CSEP-B2/1	Interval Management (IM) Procedure	Operational
CSEP-B2/2	Cooperative separation at low altitudes	Operational
CSEP-B2/3	Cooperative separation at higher airspace	Operational
CSEP-B3/1	Interval Management (IM) Procedure with complex geometries	Operational
CSEP-B3/2	Remain Well Clear (RWC) functionality for UAS/RPAS	Operational
CSEP-B4/1	Airborne separation	Operational

Refer to ICAO GANP Portal

ASBUs

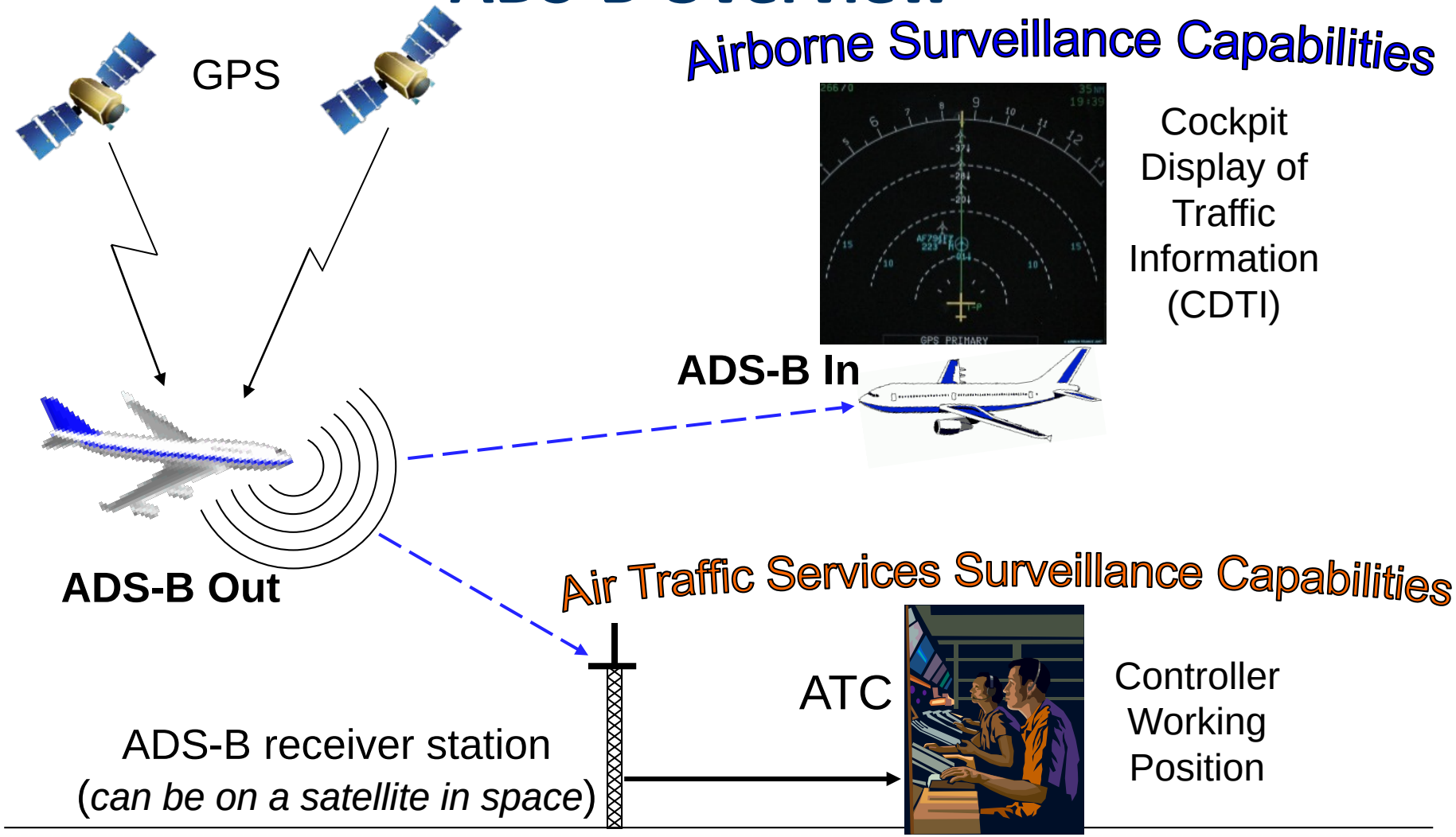
ACAS

ACAS-B1/1	ACAS Improvements	Operational
ACAS-B2/1	New collision avoidance system	Operational
ACAS-B2/2	New collision avoidance capability as part of an overall detect and avoid system for RPAS	Operational

Refer to ICAO GANP Portal

Surveillance Panel Activities - Future ADS-B

ADS-B Overview



Changes Are Coming

- New collision avoidance system **(ACAS X family)**
  GANP ASBU Element ACAS-B2/1

https://www4.icao.int/ganpportal/ASBU/Element/Pdf?IDs=153&ShowPart1=true&ShowPart2=true&ShowPart3=true&ShowPart4=true

- Evolution of ADS-B and Mode S

  New ADS-B Out version (version 3) and associated Mode S transponder changes
  GANP ASBU Element ASUR-B2/1

https://www4.icao.int/ganpportal/ASBU/Element/Pdf?IDs=149&ShowPart1=true&ShowPart2=true&ShowPart3=true&ShowPart4=true

- Interval Management (IM) Procedure

  New ADS-B In capabilities (Airborne Surveillance Applications)
  GANP ASBU Element CSEP-B2/1

https://www4.icao.int/ganpportal/ASBU/Element/Pdf?IDs=82&ShowPart1=true&ShowPart2=true&ShowPart3=true&ShowPart4=true

ACAS X

ACAS X is a family of collision avoidance capabilities being developed to support future airspace requirements & address TCAS II Shortfalls

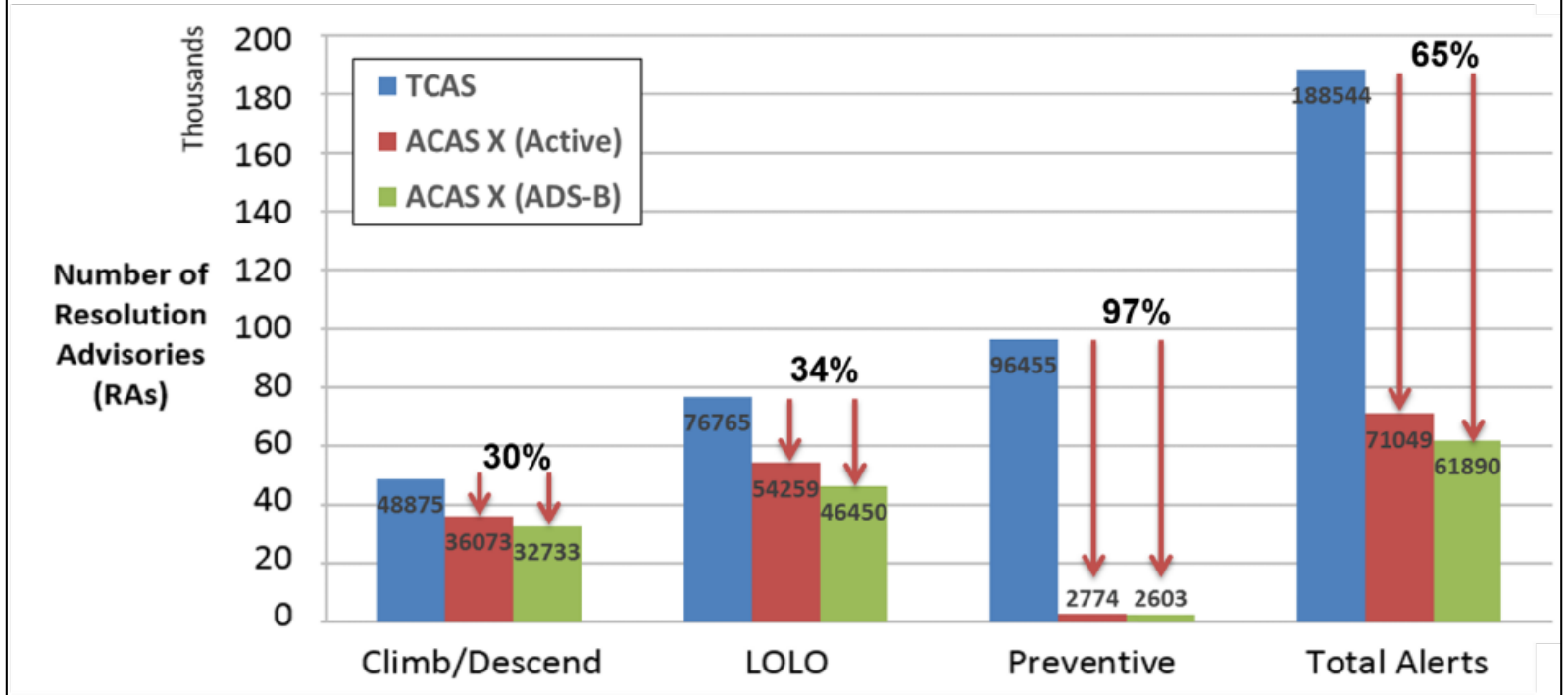
- Transitions from Explicit Programming (TCAS) to Decision Theoretic Planning (ACAS X)
  - Optimal Threat Resolution Logic produced from Probability Models (Logic Tables) vs Deterministic Models (Heuristic Logic)
- Decoupled Surveillance and Threat Resolution Modules

	User Group	Surveillance Technology	Advisories	STDs
 **ACAS X_A** (Active Surveillance)	Current TCAS II users (large manned aircraft)	Active supplemented with ADS-B	Resolution Advisories (RAs): Vertical Same as current TCAS II	RTCA 2018 DO-385
 **ACAS X_O** (Operation Specific)	Users of specific operations (e.g., closely-spaced parallel operations)	Active supplemented with ADS-B	Procedure-specific alerts for selected aircraft, global RAs against all others	
 **ACAS X_U** (Unmanned Aircraft System)	Phase II / Class 3 DAA Harmonizes DRWC and CA Alerting	Active, ADS-B, & Primary Radar EO/IR Augmentable	Vertical and/or Horizontal (DRWC + Blended CA)	RTCA 2020 DO-386
 **ACAS $_SX_U$** (Small UAS)	Part 91, 135, 107 BVLOS / Class E Extendable Class D, G / Part 107 VLOS	ADS-B supplemented with low SWaP & ground sensors	Vertical and/or Horizontal (Scaled DAA Separation Volumes)	ASTM 2019 RTCA 2022
 **ACAS X_R** (Rotorcraft)	Rotorcraft	ADS-B & Reduced Active Reduced Validation / Omni Only	Blended RAs: Vertical, Horizontal, and/or Speed	RTCA 2024

DAA = Detect and Avoid CA = Collision Avoidance DRWC = DAA Remain-Well-Clear BVLOS = Beyond Visual Line of Sight SWaP = Size, Weight, and Power

ACAS X

Xa Operational Benefit: Reduction in RAs

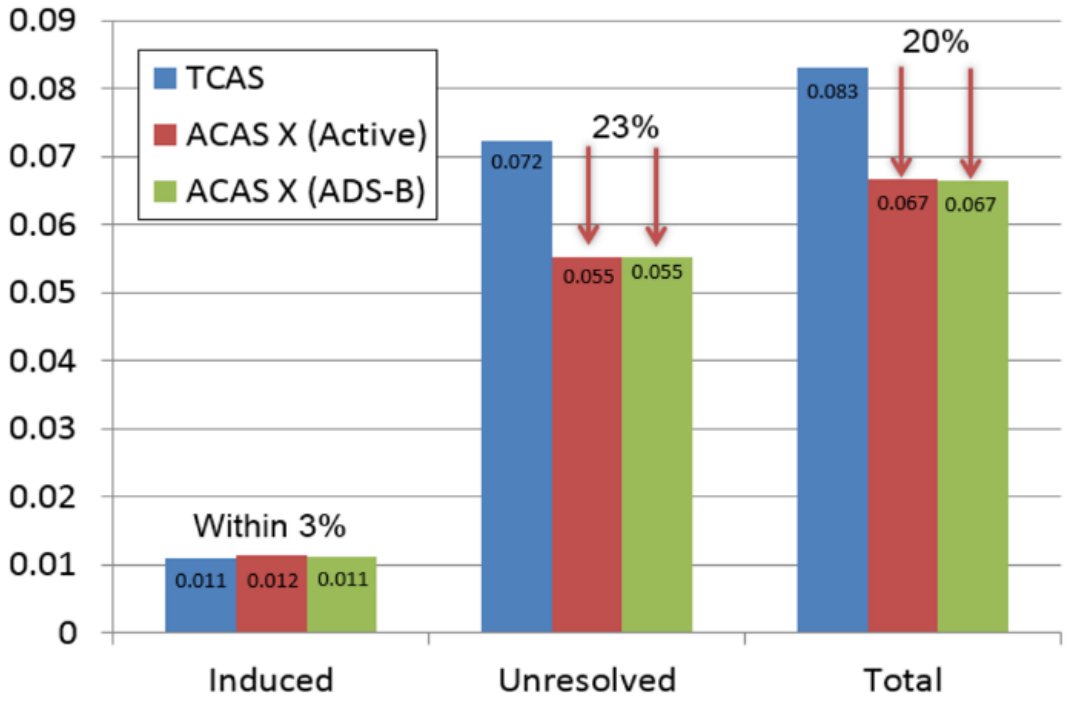


- Alerting comparison between ACASX V1R0 (RTCA DO-385) and TCAS II v7.1 on TRAMS encounter set (~250,000 Observed Encounters between October 2008 and July 2016)

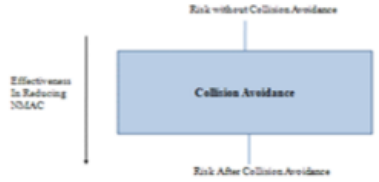
ACAS X

Xa Safety Benefit: Reduction in Collision Risk

- Risk ratio comparison between ACAS X V1R0 (RTCA DO-385) and TCAS II v7.1 on Lincoln Laboratory Correlated Encounter Model
- Notes
  - Induced risk difference due to the prevention of crossing RAs
  - Unresolved risk reduction 23%
  - Total risk reduction of 20% across airspace



$$\text{Risk Ratio} = \frac{P(\text{NMAC with CA})}{P(\text{NMAC without CA})}$$



Goals for ADS-B V3 & Mode S transponder

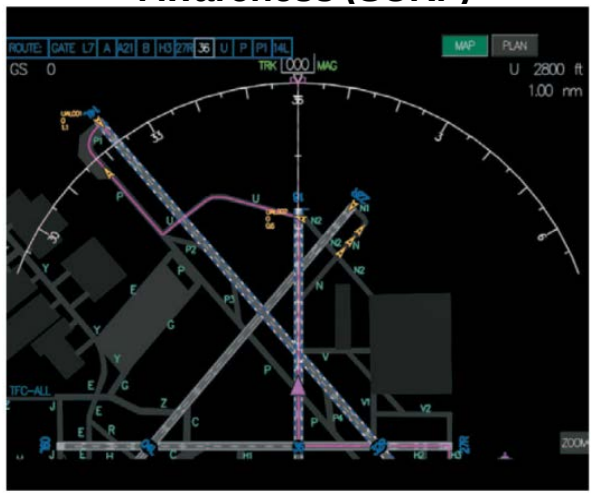
- ❑ Support new applications or new entrants
  - ADS-B In Interval Management
  - Commercial Space and RPAS operations
  - Provide aircraft-reported weather information
- ❑ Fix known deficiencies or ambiguities in current standards
- ❑ Improve/support management of 1030/1090 MHz spectrum

Goals for New ADS-B In capabilities

- Complete development of ADS-B In Interval Management avionics standards
- Fix known deficiencies or ambiguities in current standards

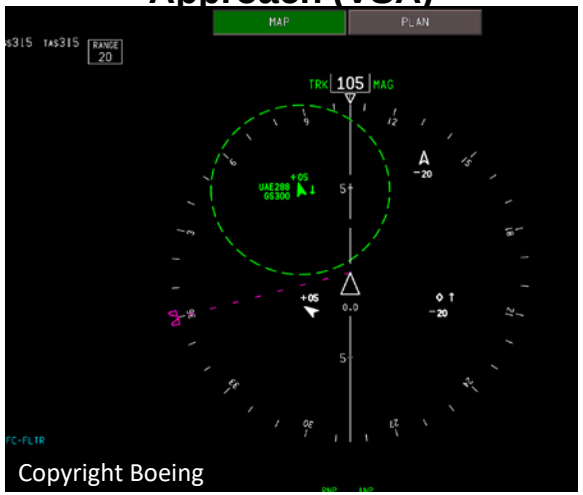
[E]TSO-C195b ADS-B-In Capabilities

Surface Traffic Situational Awareness (SURF)

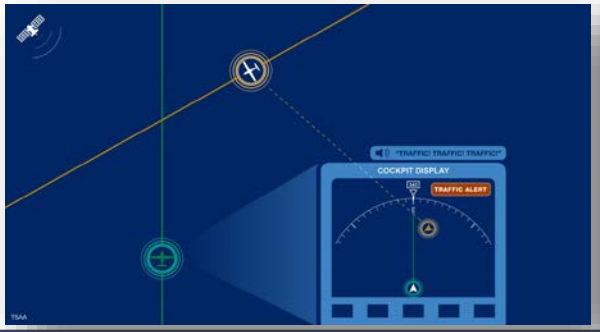


Airborne Traffic Situational Awareness (AIRB)

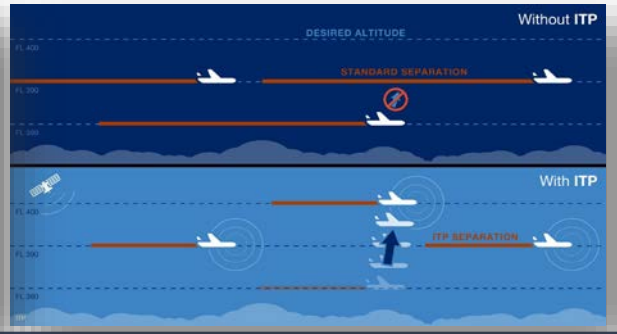
Visual Separation on Approach (VSA)



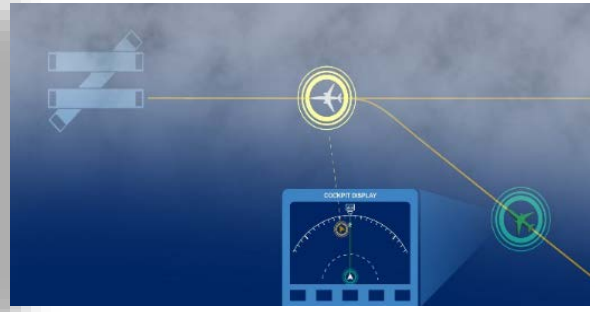
ADS-B Traffic Awareness System (ATAS)



In-Trail Procedure (ITP)



Cockpit Display of Traffic Information- Assisted Visual Separation (CAVS)



Some ADS-B-In Capabilities Require Regulatory Approval

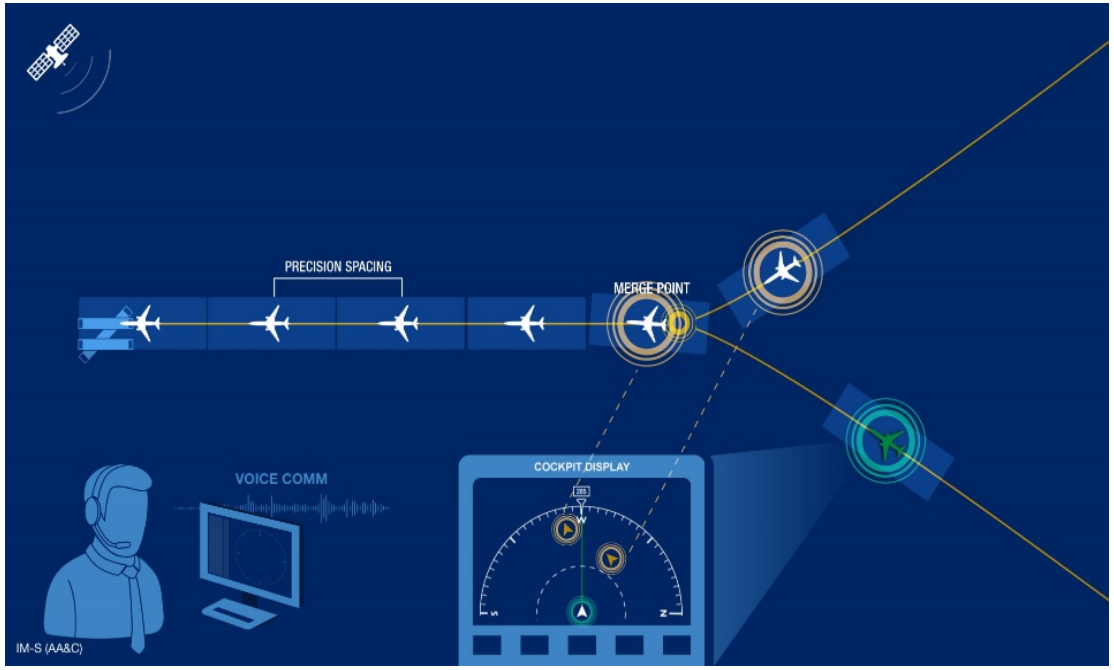
- ❑In-Trail Procedure (ITP)
  - Described in ICAO Circular 325 and PANS-ATM section 5.4.2.7
  - See FAA AC 90-114(), Appendix 2 for typical guidance
- ❑CDTI-Assisted Visual Separation (CAVS)
  - Described in ICAO Doc 9994
  - See FAA AC 90-114(), Appendix 3 for typical guidance

Operations of the following ADS-B-In capabilities are expected to require Regulatory Approval

- *Additional operational uses of [E]TSO-C195 CAVS avionics*
- *Interval Management*

New ADS-B-In Capability: Interval Management (IM)

- IM consists of a set of ground and flight-deck capabilities used in combination by air traffic controllers and flight crews to more efficiently achieve a precise interval between aircraft in a stream of traffic
  - Reducing inter-aircraft spacing variance will yield more efficient use of runway capacity while also enabling aircraft to remain on their Performance-based Navigation (PBN) procedures more frequently
  - IM functionality requires ADS-B Out and ADS-B In equipage



Operational Concept

- Controller instructs flight crew to achieve / maintain an assigned spacing goal (time or distance) relative to another aircraft
- Flight crew uses IM avionics to manage aircraft speed to achieve instructed ATC objective

To see the IM storyboard animation, go to
https://www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/library/Storyboard/detailedwebpages/im.html

Summary

- New Capabilities are coming built on ADS-B technology
  - ACAS X family of Collision Avoidance Systems
  - ADS-B Out version 3 and associated Mode S transponder changes
  - ADS-B In capabilities (Airborne Surveillance Applications)

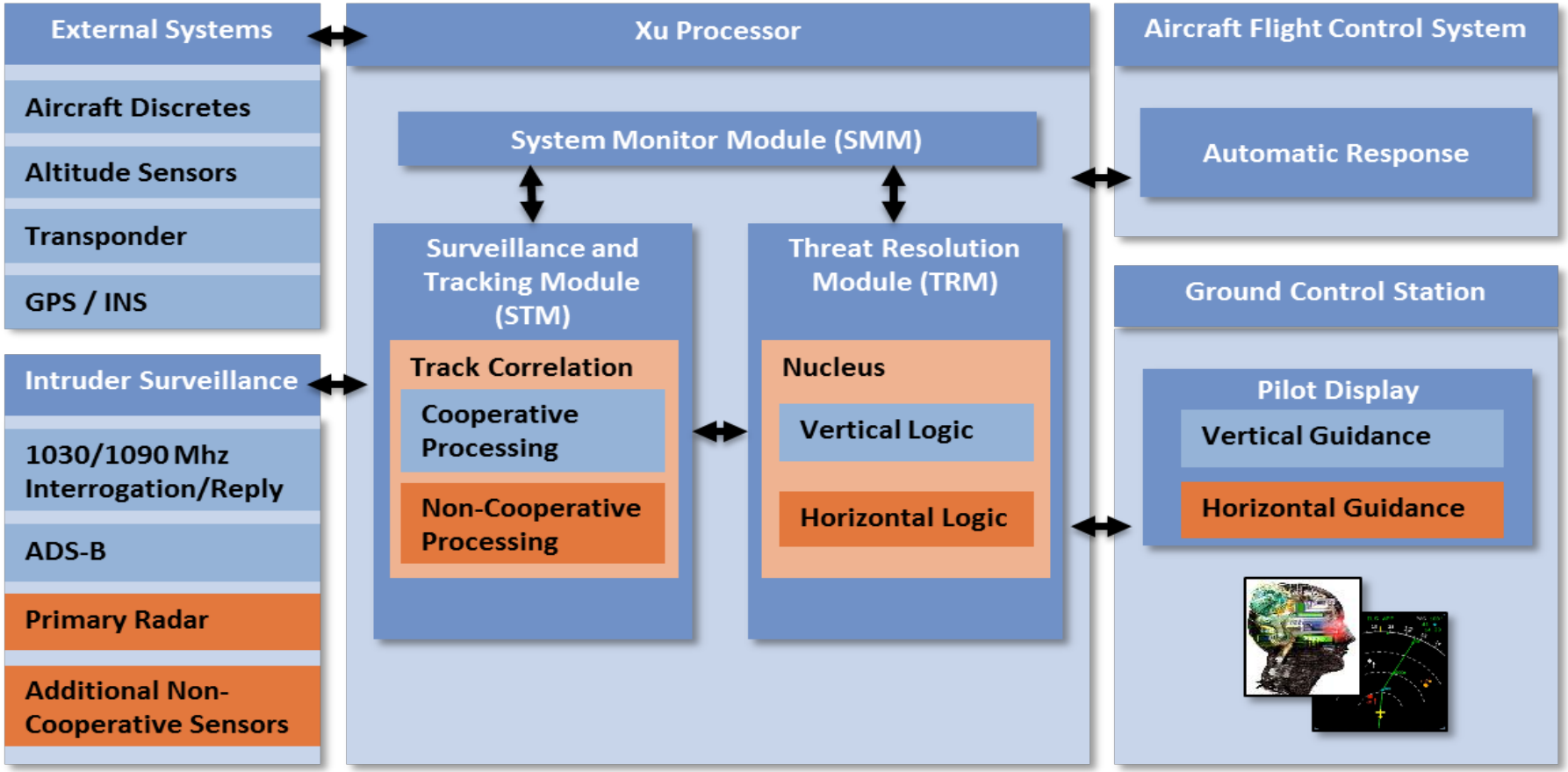
BACKUP SLIDES

Standardisation Activities

- ***2018:*** RTCA and EUROCAE approved ACAS Xa/Xo MOPS (DO-385/ED-256)
- **FAA TSO-C219 issued in Feb 2020**
- Changes to ICAO Annex 10, Volume IV, recognizing ACAS Xa as "equivalent" to TCAS II v7.1 have been approved by Surveillance Panel (appropriate changes to Doc 9863 also approved)
- Other ACAS X variants in development; all variants use ADS-B data in some form

- ***2020:*** RTCA and EUROCAE updated 1090 MHz Extended Squitter (1090ES) MOPS and the Mode S Transponder MOPS
- ***2020:*** RTCA and EUROCAE updated MOPS for Airborne Surveillance Applications (DO-317B/ED-194A) and Interval Management (DO-361A/ED-236A, Change 1)
- **FAA/EU TSOs/ETSOs to be updated in 2022 (?)**
- ICAO SARPs changes planned for Surveillance Panel approval in mid 2023 with effectivity in Nov ***2026*** (or later)
  - Consequential amendments to Doc 9871, Doc 9924

ACAS X Architecture



Variants **share an underlying design** but are tailored (optimized logic tables) for different user groups

ADS-B V3 & Mode S Transponder Changes

Interval Management (IM)

- ❑Add broadcast of additional weather parameters (wind and temperature; see also next slide)
- ❑Receiver Improvements to support IM
  - Advanced range receiver to support longer range performance
  - Track initiation enhancements to improve track acquisition
    - reduced time to initiate tracks for surface traffic by simplifying position decode
    - reduced time to initiate tracks for airborne traffic by use of velocity information
  - Track file maintenance enhancements to prioritize IM traffic as needed
    - reserves 3 track IDs to prevent removal due to automatic range filtering
  - Uniform distribution of (even/odd) squitter formats
- ❑Mode S transponders supporting ADS B version 3 also include IM data registers which can be extracted by Ground SSR interrogations

ADS-B V3 & Mode S Transponder Changes

Aircraft-derived weather data

- ❑ Supports applications such as IM, wake vortex avoidance and surfing, hazardous weather detection and avoidance, and weather forecasting
- ❑ Requirements derived from RTCA DO-364 (Aeronautical Information/Meteorological Data Link Services), which built on previous work from RTCA, World Meteorological Organization, and ICAO Annex 3
  - 2 new optional periodic AIREP Messages (Aircraft State & Weather State)
    - Aircraft State, if provided, includes: aircraft configuration, ICAO Aircraft Type, gross weight, wingspan
    - Weather State, if provided, can include either:
      - icing status; wind quality, wind speed and direction, air temperature, airspeed OR
      - icing status (optional), roll angle, heading, air temperature, airspeed
      - *Units intending to meet European EHS requirements must provide one of these Weather State messages*
  - Additional weather data added to an existing 1090ES Aircraft Status Message
    - Eddy Dissipation Rate (EDR) and Water Vapor
- ❑ Version 3 also supports broadcast of pilot-observed flight weather [Pilot Reports (PIREPs)] with 3 new on-condition messages
  - Flight Weather; Temp, Wind & Turbulence; Hazardous Weather

ADS-B V3 & Mode S Transponder Changes

UAS

- Version 3 includes ability to broadcast a UAS/RPAS lost link condition
- This emergency condition will be reported and made available via ADS-B and Mode S replies and may be used to initiate appropriate contingency procedures
- When in the lost link condition, the UAS/RPAS can broadcast its contingency plan, identifying the course of action the UAS/RPAS is following
- For all aircraft types, ADS B version 3 provides an indication whether the aircraft is conducting manned or unmanned operations

ADS-B V3 & Mode S Transponder Changes

Commercial Space / Hypersonic Vehicles

❑Version 2 and earlier ADS-B cannot reliably support:

- horizontal velocities above 1000 knots
- altitudes above 130,000 feet
- vertical velocities above 32,500 feet per minute

❑Version 3 accommodates higher velocities and altitudes

- Horizontal and vertical velocities consistent with a Space Shuttle launch profile can be reported
- Altitudes up to 1M feet

ADS-B V3 & Mode S Transponder Changes

ACAS support

- ❑ Transponder changes to ensure that RA coordination messages are given priority over other data provided to the ownship ACAS
- ❑ Transponder changes to improve the availability of coordination data received over the RF link and provided to the ownship ACAS
- ❑ RA reporting by the transponder incorporates additional data from collision avoidance systems which provide both vertical and horizontal resolution capability, such as ACAS X for unmanned aircraft
- ❑ Addition of ADS-B subfields to
  - enable Detect & Avoid (DAA) systems to receive ACAS coordination data
  - support future ACAS coordination capabilities

ADS-B V3 & Mode S Transponder Changes

1090 MHz frequency conservation – 1 of 2

- ❑Removal of replies to Mode A/C/S All-Call (as approved by ICAO Surveillance Panel)
- ❑Additionally, transponder reply-rate limiting is improved to minimize loss of surveillance and ACAS functionality in high-density airspace
- ❑New functions to report a transponder in reply-rate limiting and ADS-B Transmit Power indication
- ❑Interrogation/Reply Monitor (IRM) data has been incorporated as an optional reporting feature
  - Will improve 1030/1090 MHz spectrum monitoring and assist in the protection of aeronautical surveillance and collision avoidance system performance
  - IRM data includes measurement of transponder interrogation and reply rate activity from equipped aircraft

ADS-B V3 & Mode S Transponder Changes

1090 MHz frequency conservation – 2 of 2

- Phase Overlay technique, which provides additional data within existing messages, is specified
  - Although Phase Overlay is optional in this MOPS version, it is introduced so that industry can begin producing and testing equipment that can readily incorporate the capability
  - ADS-B Phase Overlay Support
    - Airborne and Surface messages which include full state and status in single squitter
    - IRM messages which provide additional detail on min/max rates
  - Mode S Phase Overlay Support
    - Additional Mode S register data included in Mode S replies to GICB extractions

ADS-B V3 & Mode S Transponder Changes

Air/Ground reporting

- ADS-B version 3 enhances requirements for selection of airborne or surface message formats to transmit
- These improvements are meant for fixed-wing aircraft without an automatic means of determining on the ground status (e.g., a landing gear weight on wheels switch)
- These requirements resulted from FAA monitoring showing that a significant number of aircraft do not reliably report on-the-ground status, which reduces effectiveness and safety associated with ADS-B traffic applications

ADS-B V3 & Mode S Transponder Changes

Surface Reporting Improvements

- ADS-B version 3 supports the ability to report availability of FAA's Same-Link-Rebroadcast service, thereby potentially enabling ADS-B surface alerting applications on-board aircraft
- To enable more accurate position determination on the airport surface by multilateration systems, ADS-B version 3 includes transponder antenna offset information
- To improve tracking of aircraft/vehicles operating on the surface, ADS-B version 3 modifies the surface squitter transmission requirements

ADS-B V3 & Mode S Transponder Changes

Autonomous Distress Tracking (ADT)

- ICAO has released requirements that aircraft delivered after January 1, 2021 automatically transmit aircraft position at least once per minute when the aircraft is in distress
- ADS-B has always provided aircraft position; version 3 provides a means to initiate broadcast of 'aircraft in distress' to satisfy ICAO requirement

ADS-B V3 & Mode S Transponder Changes

Fixes and Miscellaneous Improvements

- ❑Corrected handling of aircraft identification data which can result in a potential difference between aircraft identification data received via ADS-B and ground interrogators (with these MOPS, consistent data will be presented to controllers)

- ❑New ADS-B information to support avionics debugging
  - Active transponder side indication

- ❑Level 2 Transponders redefined to eliminate unused data link functions
  - becomes new ICAO minimum Mode S transponder standard for international civil air traffic
  - data link functions now optional for a Level 2 transponder since currently not utilized and future use is limited due to spectrum concerns

- ❑Revised Emitter Category encodings
  - clarified that intended use is solely as aid to visual acquisition

SURF – Basic Surface Situation Awareness

- SURF provides the flight crew with improved situational awareness of surrounding traffic and ground vehicles
  - Operating on the airport surface
  - During final approach and landing
  - During takeoff
- CDTI display of traffic on an airport moving map
- Supplements out-the-window scans during operations on runways and taxiways
- Benefits:
  - Improved safety (e.g. taxiway intersections)
  - Improved efficiency (e.g., during low-visibility operations)
  - Decreased workload (e.g., reduction in pilot-controller communications)

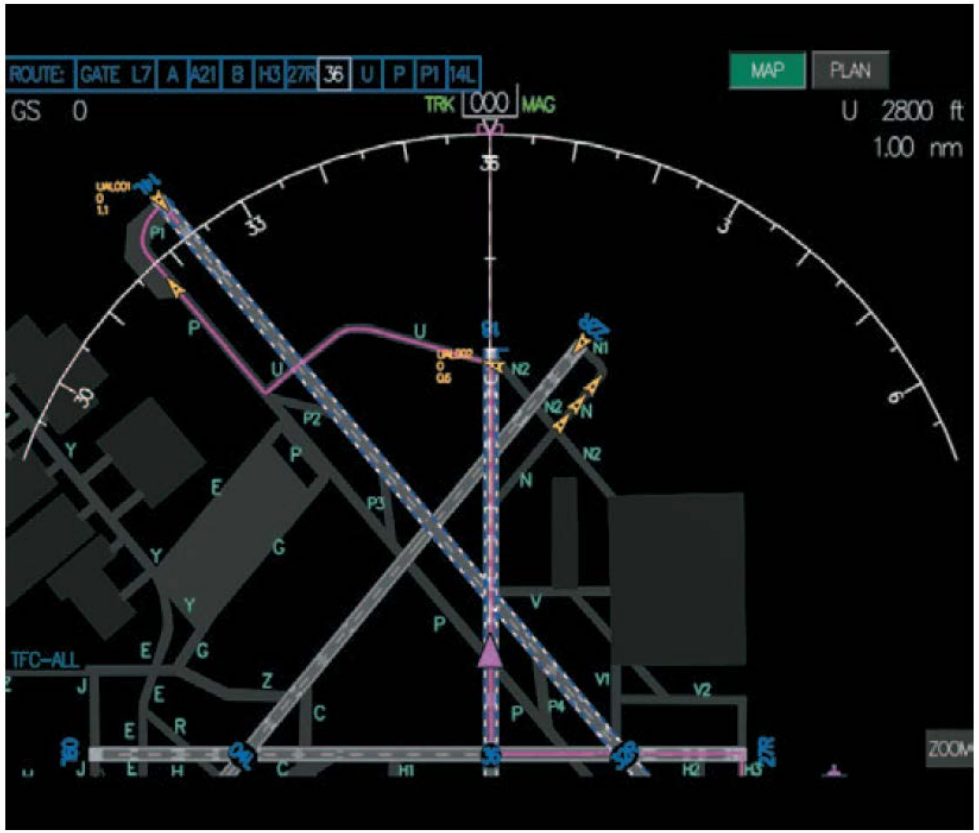


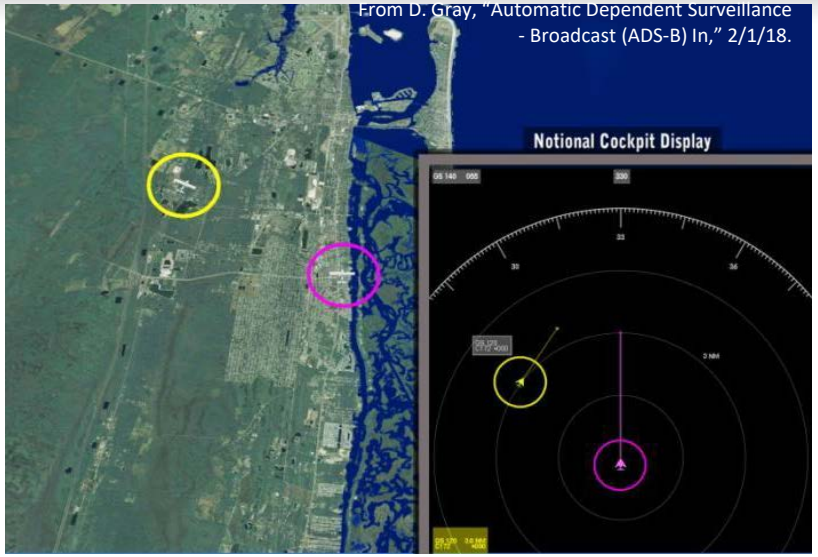
Figure 2: The Boeing Company
http://www.boeing.com/commercial/aeromagazine/articles/qtr_02_10/pdfs/AERO_Q2-10_article02.pdf

AIRB - Basic Airborne Situation Awareness

- AIRB provides the flight crew with a picture of surrounding traffic on a Cockpit Display of Traffic Information (CDTI) during flight operations
- It can be used:
  - Anytime during airborne operations (departure, cruise, and arrival and approach)
  - On board all types of aircraft (large commercial jets to GA aircraft)
  - In all classes of airspace
  - In both IMC and VMC under IFR and VFR
- No new pilot or controller procedures
- Benefits: can improve safety and efficiency of operations (per FAA and Eurocontrol operational trials)

ATAS – ADS-B Traffic Awareness System

- ATAS provides GA pilots with situational awareness and alerts about conflicting traffic
  - Supplements pilot's see-and-avoid responsibility
- Uses ADS-B to provide traffic alerting benefits to GA without TCAS
- Avionics support out-the-window visual acquisition of traffic using a traffic display with:
  - Voice annunciations
  - Visual cues
  - Additional symbols to supplement the plan-view
- Benefits: reduce the number of air-to-air encounters and collisions



http://www.planeandpilotmag.com/article/lynx-ngt-9000-l-3-atp/#.WrptRXnrtol

VSA – Visual Separation on Approach

- VSA is an aid to the flight-crew in maintaining visual contact with a lead aircraft (Traffic) during a visual approach
- Procedure:
  - ATC issues visual approach clearance and advises flight crew to maintain visual separation from Traffic
  - Flight crew visually locates Traffic out-the-window and reports to ATC
  - If Traffic is broadcasting ADS-B Out, flight crew correlates Traffic with its symbol displayed on aircraft's traffic display
  - Flight crew must maintain visual contact with traffic
- VSA procedure is transparent to ATC and to Traffic
  - No special clearance or new phraseology between flight crews and ATC
  - To ATC, procedure is a standard visual approach with visual separation from Traffic
- Benefits: may enable better final approach spacing and reduce go-around rates for equipped aircraft

ITP – Oceanic In-Trail Procedures

- ITP enables a leading or following same-track aircraft to perform a climb or descent to a requested flight level through intermediate flight levels
  - Climb or descent through intermediate flight levels might be disallowed when using current separation minima
- ITP avionics helps the flight crew in determining whether the ITP criteria is met relative to one or two Reference Aircraft at intermediate flight levels
- Benefits: improved fuel efficiency from greater time at optimal altitudes and improved ability to reach less turbulent altitudes when needed
  https://www.faa.gov/nextgen/programs/adsb/media/ADS-BITPOpFlightEvalBenefitsReport.pdf

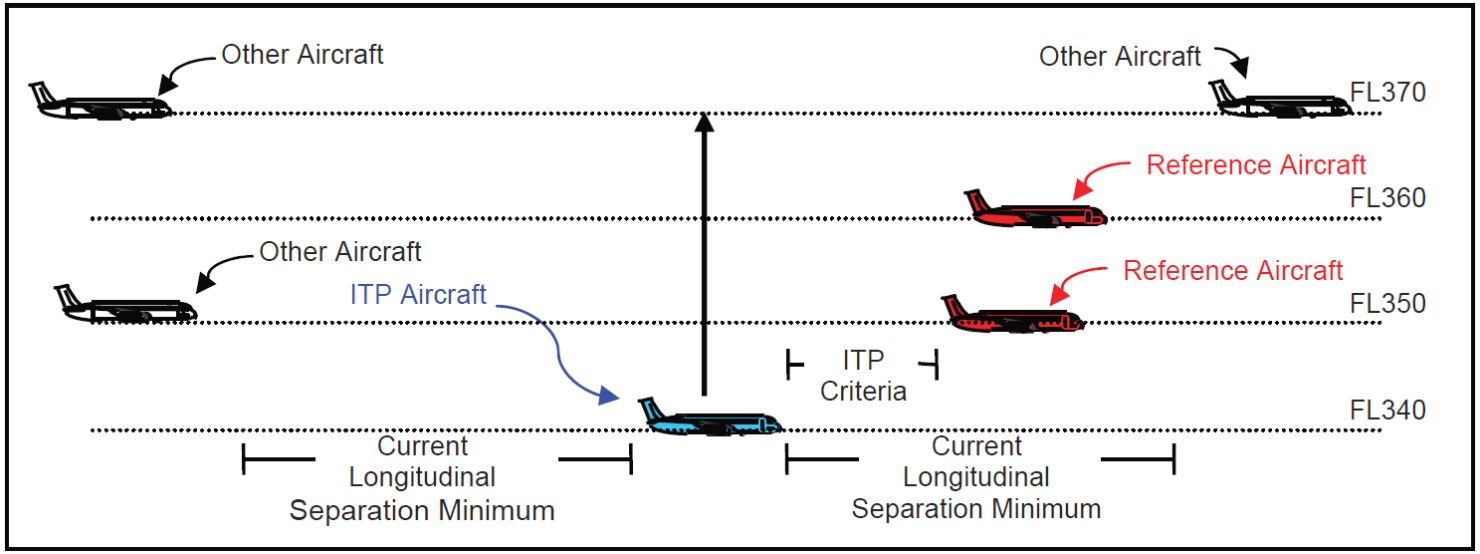


Figure A.2: SPR for In-Trail Procedures in Oceanic Airspace, DO-312.

ADS-B-In Offerings for Part 121 aircraft (Nov 2020)

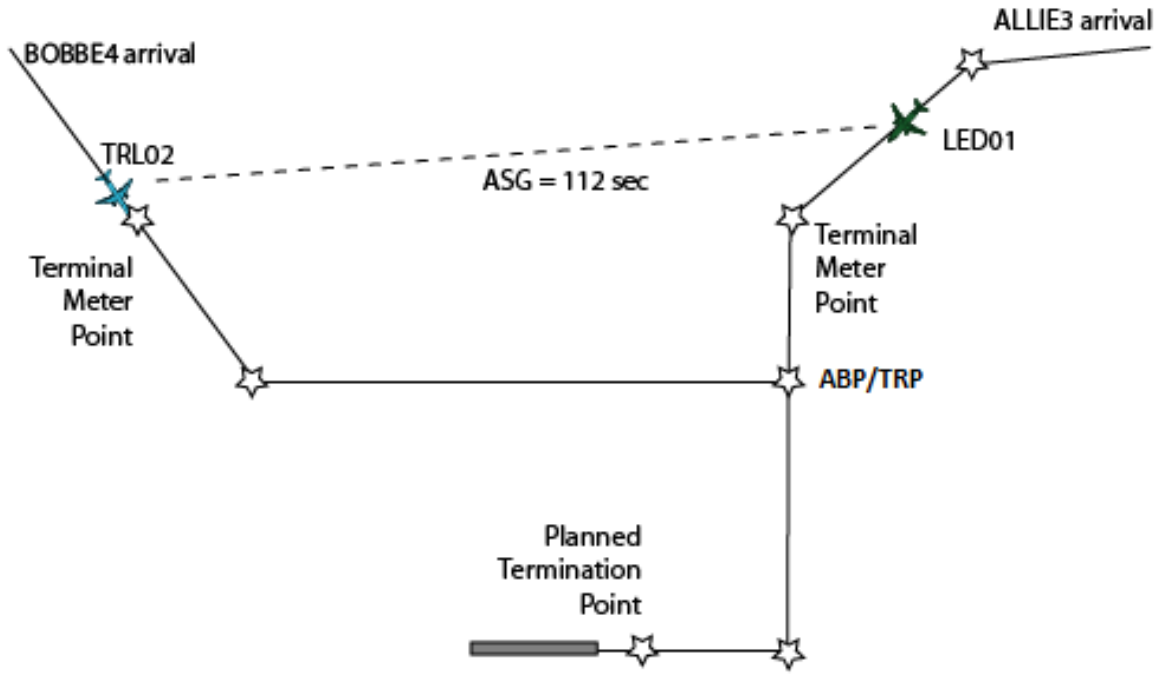
- Airbus
  - New production ADS-B-In solution as a priced option on all but A380
  - Service bulletin to retrofit single aisle and A330/A340 aircraft
  - **Capabilities: AIRB, VSA, and ITP**
- Boeing (built by Collins)
  - New production ADS-B-In solution on 787 as a priced option
  - Service bulletin available to retrofit 787
  - **Capabilities: AIRB, VSA, and ITP**
- ACSS
  - Retrofit ADS-B-In solution, certified on multiple air transport aircraft
  - **Capabilities: AIRB, VSA, CAVS, ITP, iSAMM (SURF-like capability), and 'Merging & Spacing' (initial IM capability)**
- Honeywell
  - Retrofit ADS-B In solution, certified for installation on Boeing 747-400
  - **Capabilities: AIRB, SURF-like capability, and ITP**

CAVS – CDTI-Assisted Visual Separation

- CAVS supports the flight-crew in maintaining visual contact with a lead aircraft (Traffic) during a visual approach
- Procedure:
  - ATC issues visual approach clearance and advises flight crew to maintain visual separation from Traffic
  - Flight crew visually locates Traffic out-the-window and reports to ATC
  - If Traffic is broadcasting ADS-B Out, flight crew correlates Traffic with its symbol displayed on aircraft's CAVS traffic display
  - Once engaged by flight crew, CAVS avionics calculates and displays distance to Traffic and groundspeed differential between CAVS aircraft and Traffic in the primary field of view
- CAVS procedure is transparent to ATC and to Traffic
  - No special clearance or new phraseology between flight crews and ATC
  - To ATC, procedure is a standard visual approach with visual separation from Traffic
- Benefits: maintain visual operations with higher frequency and may reduce go-around rates for equipped aircraft
  https://www.faa.gov/nextgen/programs/adsb/media/CAVS_Benefits_Report.pdf

Interval Management (IM) per DO-361/ED-236

- IM Arrival and Approach (Same Runway)
  - En route through terminal: to a single runway during metering operations
  - Ground automation schedules IM-capable aircraft closer than it would otherwise
  - IM operations can start before aircraft are on common routes, though IM and Target routes must be common after ABP/TRP waypoint
  - Ground automation sets up feasible IM operations
  - Aircraft are on RNAV routes with altitude and speed constraints (4D trajectory)

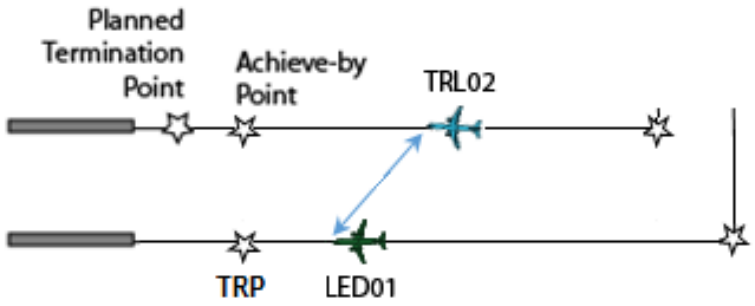


- IM Cruise
  - Used in en route airspace during Miles in Trail (MIT) operations
  - Reduce number of speed or vector instructions controllers need to issue to aircraft to meet MIT restrictions

Additional capabilities per DO-361A/ED-236A (1 of 2)

Dependent Staggered Approaches (DSA) and Dependent Converging/Crossing Runways (DCCR)

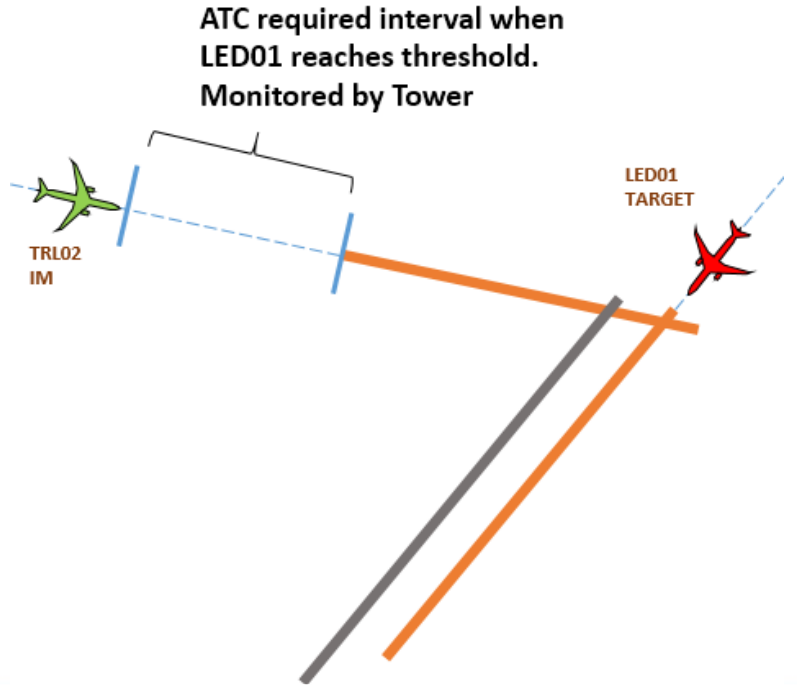
DSA: increase arrival throughput for dependent parallel runway operations by allowing an IM Aircraft to manage its spacing relative to the aircraft landing on the parallel runway



Diagonal Separation Standards
CSPR: FAAO 7110.308C
Non-CSPR: FAAO 7110.65W, §5-9-6

Longitudinal Separation Standard
CSPR: FAAO 7110.65W, §5-5-4

DCCR: potentially enable certain ATC facilities to consider lowering the weather minima (i.e. ceiling and visibility to which the operation can be conducted) and/or increase operations to the secondary runway

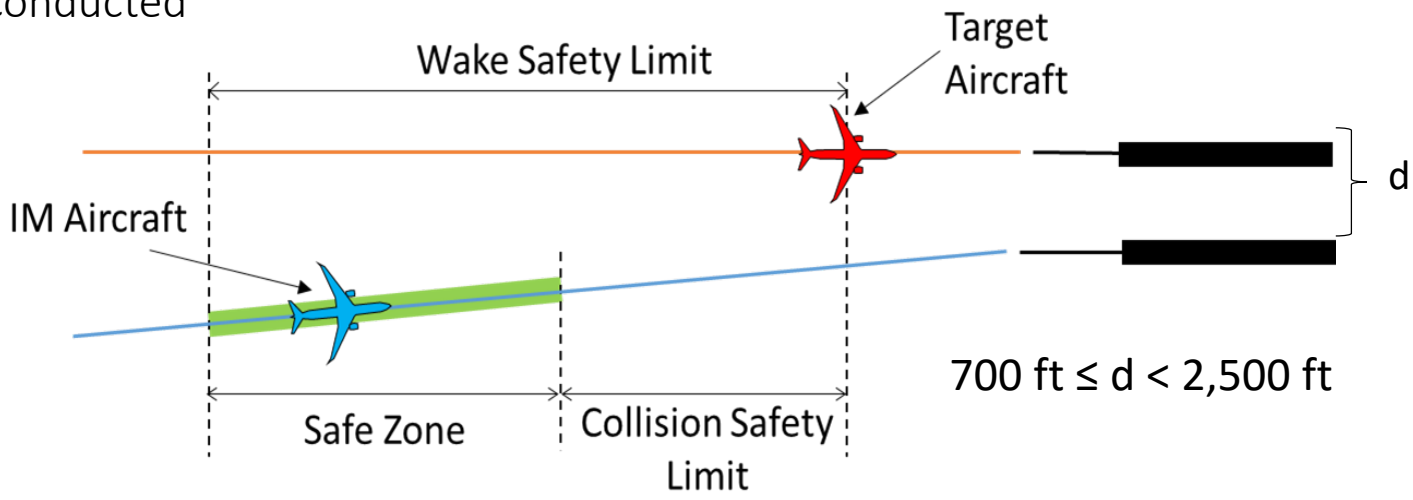


Additional capabilities per DO-361A/ED-236A (2 of 2)

Paired Approach (PA)

Objective: Increase capacity of closely-spaced parallel runways (i.e., runways closer than 2,500 feet and as close as 700 feet) when visual separation cannot be conducted

IM Assigned Spacing Goal calculated to keep the IM Aircraft in Safe Zone



Characteristics

- Requires a new Paired Approach Separation Standard
- Avionics functionality similar to DSA
- Controllers will require additional display/automation features to monitor conformance with the Safety Limits