



# **Towards ADS-B ....and beyond**

## **The Customer Perspective**



# Evolution of Surveillance

- Voice Position Reports
- Primary Surveillance Radar
  - Not Standardized
- Secondary Surveillance Radar
  - Mode A/C, and S
- ADS-C
  - FANS 1 / A (2 / B)
- ADS-B
  - 1090ES – the agreed AIRLINE solution
  - UAT, VDL Mode 4 (not supported)
- Multilateration
  - Being Standardized



# The ADS-B Evolution

*'If I know where I am, I can tell ATC where I am'*

## Step 1. ADS-B Out Non-Radar Airspace – **NRA**

**Investment –ROI**  
what we have **now**



Procedural to  
'radar-like' airspace



Over 3000  
airplanes capable

## Benefits **Airports & Enroute**

Reduces Separation standards from  
60nm to 5nm (12-fold increase)

NavCanada estimates 18m liters  
fuel & 50,000 tons CO2, yearly



### ➤ **Selective implementation**

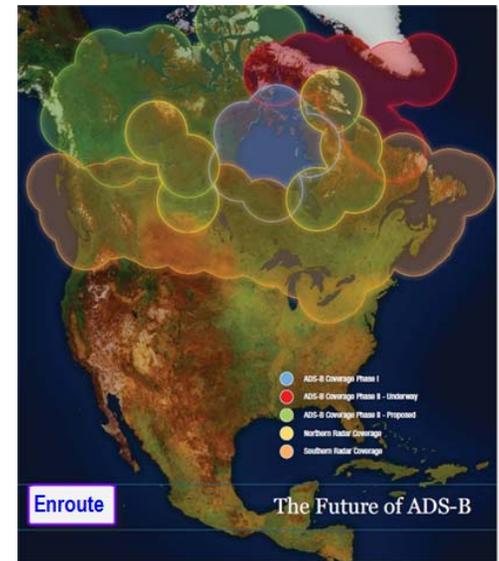
- Identify benefits
- Use technology that delivers

### ➤ **Benefits now**

- Consider existing equipage

### ➤ **Global harmonization**

- Equip once, fly anywhere



# The ADS-B Evolution- 1

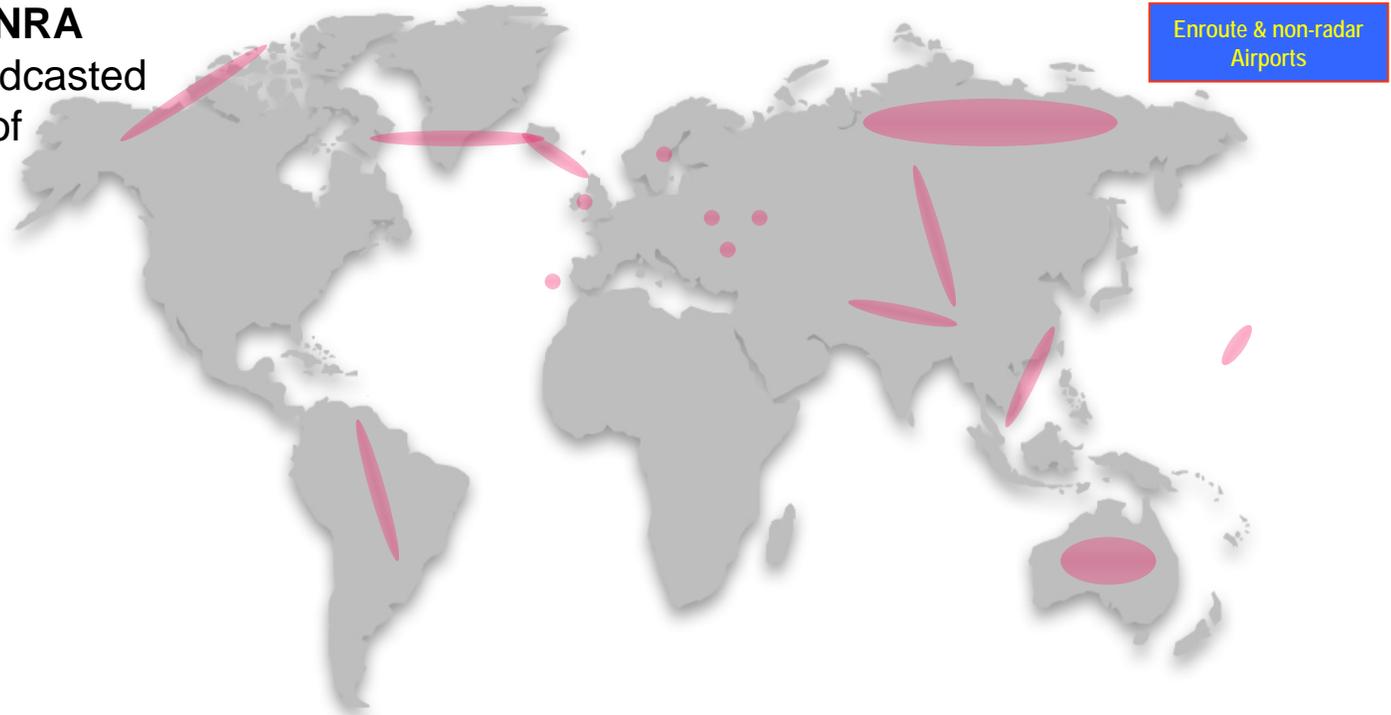
*'If I know where I am, I can tell  
ATC where I am'*

Investment –ROI  
what we have **now**

## Step 1. ADS-B Out NRA

A/C information broadcasted  
to ground – Instead of  
Waypoint Reports

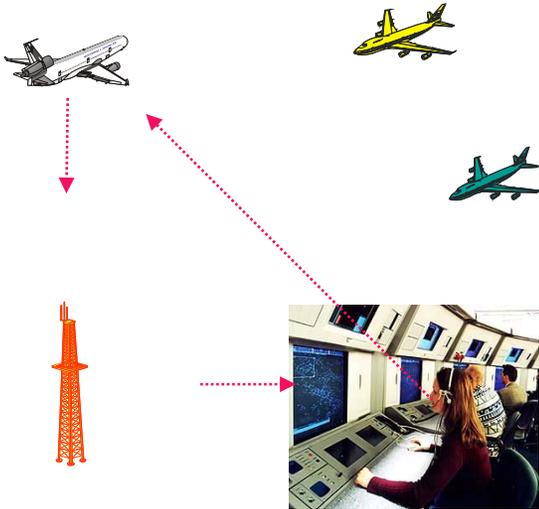
Procedural to  
'radar-like' airspace  
Over 3000  
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# The ADS-B Evolution- 2

*'If we all can tell ATC where we are at 1/2 second updates (and not every 6 seconds), ATC can improve its service to us'*

**Step 2. ADS-B Out RAD**  
 A/C information rapid updates  
 (2 per second)  
 Better performance, lower costs than radar



## Investment –ROI planning for the future



## Benefits

### Example of FAA benefits

- Enhanced Visual Acquisition (e.g. enroute conflict probe)
- Enhanced Visual Approaches
- Final Approach Spacing
- Airport Surface (situational awareness)

ADS-B Out Final Rule

### ➤ System Implementation

- 1<sup>st</sup> step towards ADS-B In
- Plan to a common baseline
  - CDTI & Target Display
  - 1090 Mhz capacity
  - Use sustainable technology for SURF, TMA, Enroute etc.

### ➤ Major Ground Costs

- Ground Stations- ATM target integration & sectorization
- Link decisions (Mode S & UAT)

### ➤ Global harmonization

- Equip once, fly anywhere

# The ADS-B Evolution- 2 contd...

*'If we all can tell ATC where we are at 1/2 second updates (instead of every 6 seconds), ATC can improve its service to us'*

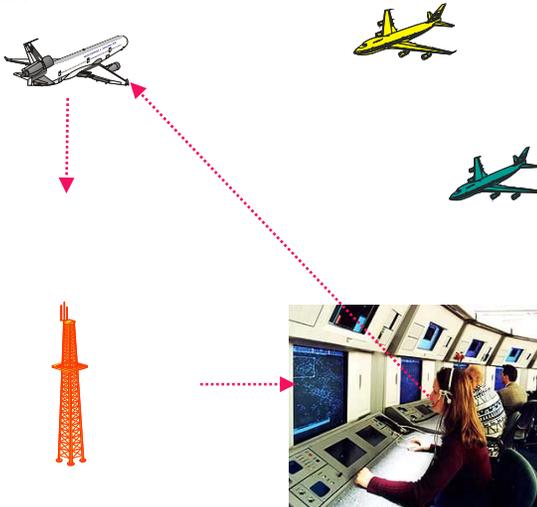
**Investment –ROI  
planning for the future**

## Step 2. ADS-B Out RAD

A/C information rapid updates

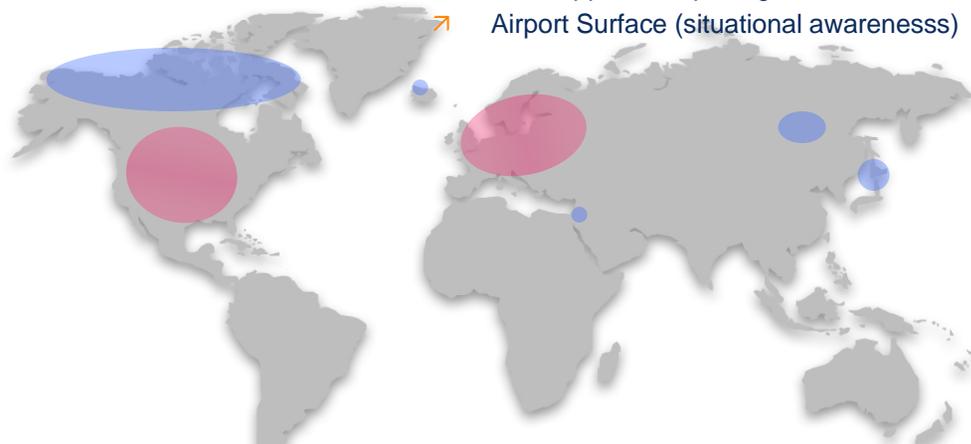
(2 per second)

Better performance, lower costs than radar



## ➤ Example of FAA benefits

- Enhanced Visual Acquisition (e.g.enroute conflict probe)
- Enhanced Visual Approaches
- Final Approach Spacing
- Airport Surface (situational awareness)



- Global Programs with ADS-B as enabler
- Program alignment with NextGen & Sesar

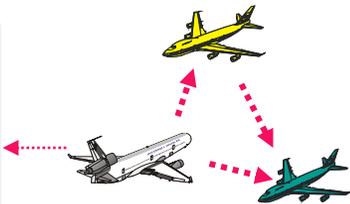
The FAA estimates \$13,8 billion in total benefits (ADS-B Out Final Rule)

# The ADS-B Evolution- 3

*'If we all tell each other where we are, we can separate ourselves while ATC manages'*

## Step 3. ADS-B IN

A/C information rapid updates  
(2 per second) to each other  
AT Control to AT Management



**Investment –ROI  
planning for the future**

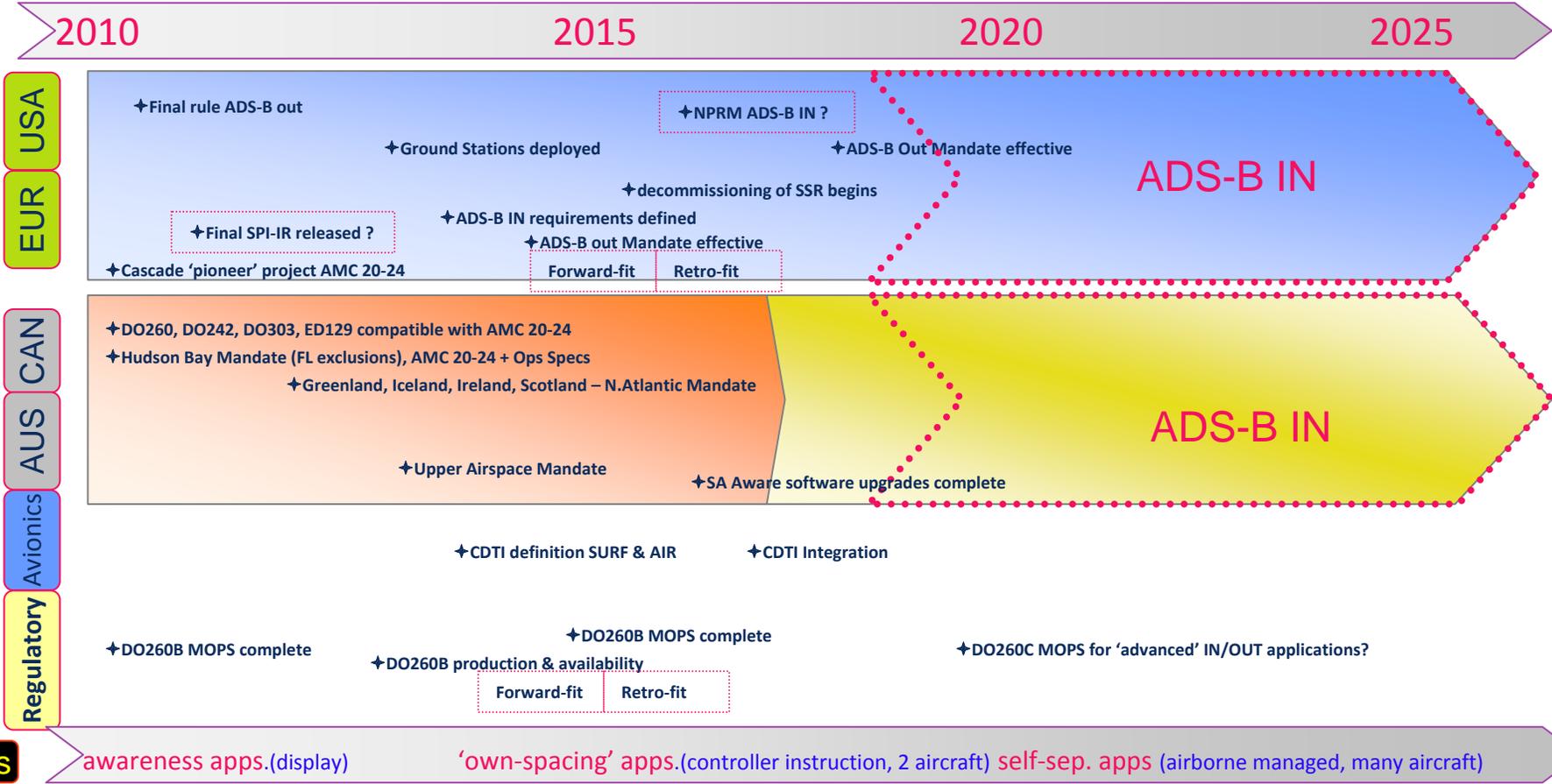
**Many Questions**

- **Globally harmonized**
  - **Airworthiness Standards (Eurocae, RTCA, AEEC)**
  - **Separation Standards (ICAO)**
  - **Avionics (e.g. EFB2 or MFD)**
  - **Datalink (e.g. 1090 'bandwidth')**
  - **Transponder (e.g. DO260B or DO260X?)**
  - **GPS Receiver (full replacement with TSO145/156?)**
  - **Support Surface Applications?**
  - **Sufficient Lead-time from rulemaking to supply**
  - **GNSS as a single nav sensor?**
  - **Institutional Issues (Control or Managed)**
  - **Avionics costs : Incentives and/or Subsidies!**

Q1: What are the Costs?

Q1: What are the Benefits?

# ADS-B Global



apps

awareness apps.(display)

'own-spacing' apps.(controller instruction, 2 aircraft) self-sep. apps (airborne managed, many aircraft)

# Not an eye test!

Mapping of .....

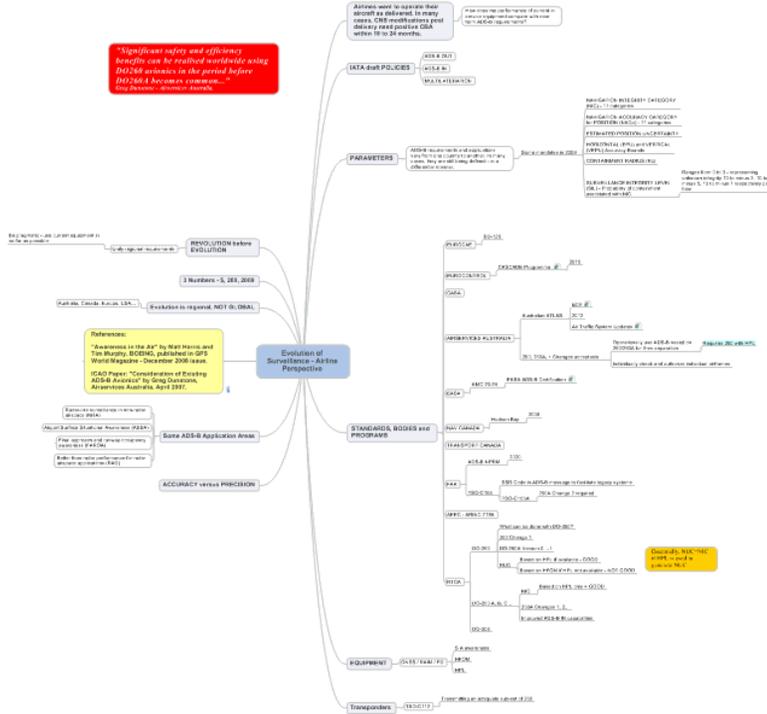
Technical, Operational, Regulatory, Airworthiness requirements

The map tells us...

**SURVEILLANCE** must evolve in a justified and timely manner towards GLOBAL, INTEROPERABLE, ADS-B technology and operational standards, using a cohesive airborne avionics fit

**REGIONAL** differentiation of airborne equipment requirements must be avoided

**REQUIREMENTS** must be **pragmatic**



# Before we talk about surveillance...

## A reminder about the **customer**

- Airborne Costs (retrofit)
  - GNSS
    - About 49% of fleet without GPS today
    - 50-500K USD upgrade per aircraft
  - Mode S Transponders for ADS-B
    - 30-150K per aircraft
  - Forward Field of View Display
    - 400K – 1 MIL USD per aircraft
    - 25% of aircraft today do not have a solution
- Airborne Costs (forward-fit)
  - 'MASPS', 'MOPS', Standards, Planning
    - Too many piece-meal solutions
    - Over-engineered Standards
    - Regional Interpretations of Airworthiness
    - Diverse Application (e.g. Phraseology, Training etc)
    - Displays & Target Definition
  - Getting the 2-big Programs right!
  - Ground Systems, HMI, Automation, Autonomous Operations Planner (AOP)
    - Significant R&D required before costs are understood
    - 1090MhZ sustainability

**Aviation is a Global Industry**

# Before we talk about surveillance...

## A reminder about the **customer**

- **Retrofits** are very expensive!
  - 37% of today's fleet will be operating 20 years from now (29,000 new or replaced + 7,000 retained)
- **Benefits** for equipage today.
  - 99% of long-haul ADS-B capable aircraft are DO260 equipped
  - The A380 & B787 will be DO260A equipped, but of what use!!!
  - 0% are DO260B equipped
- **Planning** a complete solution
  - In & Out
  - All Domains (SURF, TMA, Enroute)
  - Global Specifications, Approvals, Training, Procedures, Certification

**Service – not Technology**

# IATA Surveillance Policies

**SURVEILLANCE**

DOCUMENT CONTROL  
10<sup>th</sup> September 2007  
DRAFT

The following reflects IATA regarding surveillance of category aircraft.

**SITUATION**

Technologies used for the surveillance of category aircraft are various. The systems currently employed are Primary Surveillance Radar (PSR), Secondary Surveillance Radar (SSR), Multi-Mode (MLAT), Precision Approach Radar (PAR), Surface Movement Radar (SMR), Automatic Dependent Surveillance Broadcast (ADS-B).

**IATA POSITION**

In general, IATA views ADS-B in preference to SSR as the most efficient surveillance technology. ADS-B surveillance extends the surveillance envelope and extends the surveillance timeline. In the interim, it is understood that surveillance may vary from another. Where radar needs to be maintained, SSR Mode S is the preferred technology.

**KEY CONSIDERATIONS**

ADS and MLAT build on a common technological framework. Surveillance based on ADS and MLAT is preferred to radar.

**Use of Primary Surveillance Radar for En-Route ATM**

As primary surveillance radar (PSR) installations approach end of operational life, there is no longer an airline requirement for use of PSR in en-route Air Traffic Management (ATM).

**SITUATION**

With many existing PSR networks reaching end of operational life, some ANSPs are concluding that they must substitute new generation PSR in place of old.

**IATA POSITION**

There is no airline requirement or desire for PSR to support en-route ATM. The cost of future upgrades or new installations of PSR should no longer be accepted in the ATC charges cost base.

**KEY CONSIDERATIONS**

While in the past PSR provided useful surveillance for ATC, it has been vastly superseded by Secondary Surveillance Radar (SSR) and Automatic Dependent Surveillance Broadcast (ADS-B).

A supplemental justification for retention of PSR offered by some ANSPs is its ability to detect thunderstorms. PSR designed for ATM does not fully penetrate thunderstorms and in some cases can only display a radar (sometimes false) picture of thunder activity.

In many locations weather information traffic control displays can be provided by other means. Costs associated with such service should not be included in navigation fees.

Airlines have equipped their fleets with radar systems specifically designed to provide accurate weather information to flight operations.

States also use PSR in the identification of unknown or unlawful intrusions into sovereign or territorial airspace. The national security service provided by military, coast guard, drug enforcement agencies and police. Therefore, its infrastructure cost should be borne by services and not included in air navigation charges.

**IATA SUPPORTS**

The elimination of PSR in favour of ADS-B and where operationally justified.

\*\*\*\*\* END \*\*\*\*\*

IATA TOPM/INS-022-00 Edition 1, 17 October 2007 Page 1 of 1

**MULTILATERATION**

DOCUMENT CONTROL  
17<sup>th</sup> October  
DRAFT

**MULTILATERATION (MLAT)** is a ground based surveillance system that uses TRANSPONDER, TCAS, ADS-B or military IFF transmissions to determine position. It is also known as Hyperbolic Positioning and functions by measuring the TIME DIFFERENCE OF ARRIVAL (TDOA) of a signal at a number of dispersed receivers.

**Wide Area Multilateration (WAM)** is the term typically used to describe the surveillance of en-route airspace while the abbreviation MLAT tends to be employed when discussing the monitoring of terminal airspace and airport surface traffic.

**SITUATION**

A limited number of Air Navigation Service Providers (ANSPs) have developed MLAT/WAM systems for ATM surveillance of ground and airborne traffic in combination with ADS-B, PSR or SSR<sup>1</sup> so as to meet specific surveillance requirements. Some ANSPs are also deploying MLAT as a precision runway monitor sensor and for Terrain Surface Detection Equipment (ASDE) applications.

Additional MLAT/WAM applications may include automated airspace flight tracking and billing, and RVSM<sup>2</sup> height monitoring.

**IATA POSITION**

When supported by a clear operational requirement, separation minima and a cost benefit analysis involving all stakeholders, IATA agrees with the application of MLAT/WAM to enhance ATM performance.

**KEY CONSIDERATIONS**

MLAT/WAM systems can be conventional radar to purchase. However, this is not always a substitution of radar with MLAT surveillance costs that benefit. Cost recovery should be sought.

WAM/ATC separation minima better current radar separation.

ICAO guidance materials on MLAT/WAM are being developed.

With the exception of airport surveillance, unless a State promulgated separation minima considered as systems as described benefits for ATC.

**IATA SUPPORTS**

- ADS-B as the future technology for the air traffic control.
- MLAT/WAM deployment cannot meet the operational requirements.
- Maximum use of existing power, land, environmental control planning, a MLAT installation.
- The concept that MLAT is a complementary technology to ADS-B.

1. Some States have implemented WAM with their own ATC separation minima, e.g. 1 nm or more, 1 nm within the TMA and 2 nm in other areas. For example, when ADS-B is used as a precision runway monitor sensor, the minimum separation requirements are 1 nm.

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**Automatic Dependent Surveillance Broadcast (ADS-B) IN**

DOCUMENT CONTROL  
17<sup>th</sup> April 2008  
DRAFT

**Automatic Dependent Surveillance Broadcast (ADS-B) IN** enables various surveillance applications such as situational awareness, spacing and self-separation by suitably equipped aircraft.

ADS-B IN applies to all phases of flight; it supports both airborne and surface operations.

In association with Cockpit Display of Traffic Information (CDTI) and appropriate automation, ADS-B IN facilitates airborne spacing by pilots and possibly in future, self-separation.

ADS-B IN will be a major element of the future surveillance technology mix in accordance with the ICAO Global Air Navigation Plan and in an environment of increased task sharing between pilots and controllers.

**SITUATION**

ADS-B IN development work is in progress with a few airlines conducting operational trials at specific airports.

Integration and certification of initial ADS-B IN / CDTI applications is being undertaken as part of operational trials and technology demonstrations. Widespread implementation of ADS-B IN will incur considerable industry cost.

**IATA POSITION**

Much more human factors applicable.

Regulate defined responses.

Current equipment.

Current cover.

Retrospectively upgrade ten year.

IATA F IATA co enhance technic.

A global.

before provider.

IATA TOPM/INS-022-00 Edition 1, 17 April 2008

**Automatic Dependent Surveillance Broadcast (ADS-B) OUT**

**IATA POSITION**

Where justified by operational and business cases, air traffic control using ground radar surveillance should migrate towards ADS-B (OUT).

New surveillance implementations should consider ADS-B OUT in preference to radar.

In airspace where ADS-B OUT is declared operational, associated radar installations should be decommissioned as soon as operationally feasible.

**SITUATION**

Airlines continue to equip their aircraft with ADS-B (OUT) capability. A return on this investment can only be enhanced as efficient routes lower cost.

**IATA POSITION**

ADS-B

**The Global Evolution of Automatic Dependent Surveillance Broadcast**

Standards, Airworthiness Requirements and State Implementations

1. Automatic Dependent Surveillance Broadcast (ADS-B) OUT is a surveillance technology that enables a cost-effective safety-enhanced surveillance capability.

A complementary ADS-B address for cockpit to ground surveillance that enables a cost-effective safety-enhanced surveillance capability.

IATA TOPM/INS-022-00 Edition 1, 17 April 2008

# IATA Position on ADS-B

- ADS-B **OUT** is not the final solution – rather a **radar replacement or ‘radar-like’ service**
- Where **justified by operational and business cases**, radar based air traffic control should migrate towards **ADS-B (OUT)**
- New surveillance implementations should consider **ADS-B OUT in preference to radar**
- IATA supports Mode S ES with **DO-260 (NRA)** or DO-260X transponders (**RAD**)
- IATA supports **Multilateration** when justified by a clear operational requirement, SARPS and cost/benefit analysis involving all stakeholders
- In airspace where ADS-B OUT is declared operational, associated radar installations should be decommissioned as soon as operationally feasible and the resulting **savings passed to airspace users**
- Implementation should be **incentivized** as possible

## IATA Position on ADS-B (cont.)

- IATA supports early implementation of **ADS-B OUT** services prior to devoting extensive resources to **ADS B IN**
  - **NRA: Non-Radar Airspace**
  - **Current Radar Airspace**
  
- **ADS-B IN** will be a major element of the future surveillance technology mix and of increased task sharing between pilots and controllers
  
- **A global consensus** must be reached on avionics requirements and GNSS receiver specifications (and the benefits to be derived) before **ADS-B IN** can be mandated
  
- Surveillance implementations **worldwide** must be aligned with initiatives like **SESAR** and **NEXTGEN**, which themselves must be harmonized

# Consensus to use 1090ES as initial air transport data link

- End of the air transport link protocol debate is welcome
- Allows industry and ANSPs to invest in surveillance technology to **replace radar** for the air transport industry
- Airlines are enabling ADS-B on the promise of more efficient routing, increase airspace capacity and lower ATM costs
- **IATA recognizes that a link with greater performance will be required in the future – when benefits and performance dictate**

# ADS-B surveillance using existing avionics

- Provided integrity data (HPL) is used - **DO260 ~ DO260A**
- Compliant with ICAO Annex 10 & SASP Doc 4444 amendments
- Compliant with interoperability requirements of RTCA DO-303 & ED126
- **On this basis, thousands of aircraft already equipped for early benefits**
- Unreasonable to deny benefits while waiting for DO-260A, B, C change X

# One 'Solution', many Flavors

## The 'flavor'

- UAT technology
- FIS-B
  
- Gulf of Mexico ADS-B out?
- Capstone, Alaska
- Need for re-broadcast (ADS-B R)
  
- Ground ATM support
  
- Re-broadcast costs on ANSP

## What it means to airlines

- Airlines will not be equipped
- Airlines will not benefit. 1090 does not support
- Helicos only – Upto 3000 feet
- General Aviation only
- Required in a dual link environment
- ATM software integration costs high
- Re-broadcast costs are high on ANSP in a dual-link environment

# Lessons Learned

- Mandates
  - Create Segregated airspace
  - Incentivize 'best-equipped, best-served'
  - Restrict Airspace access (vertical segmentation possible)
- Piece-meal Rulemaking
  - Is DO260B sufficient for ADS-B In or will it be a 260X replacement?
- Timing of Rule
  - Sufficient time for Retrofit (airlines, OEM's)
  - Removal of Legacy Ground systems
  - Aligns with other global mandates (global compliance)
- Operational
  - Service-bulletin Upgrades, Software Upgrades
  - 24-bit addresses
  - Flight plan Completion
  - Phraseology & human-factors
  - Airplane Flight Manual language
- Regulatory
  - Canada instituted its own Part 129 Ops Specs requirement on Foreign Operators, despite accepting AMC 20-24 baseline criteria

# Working towards ADS-B implementation

## In China...

### ADS-B NRA (non-radar airspace)

- Mode S datalink
- DO260 MOPS – 1090 Transponder
- Ann.10 Vol.4 Extended Squitter message-set
- RTCA DO 303 SPI Requirement document
- HPL for auto check & validation of integrity data
- AMC20-24 Certification and Airworthiness

## In priority...

### Phase 1- Implementation

- Procedural to 'radar-like'- Enroute
- TMA's where Radar not available
- Replace Enroute SSR to ADS-B
- Based on trials
- Active involvement from ANSPs
- Cooperation with airlines

### Phase 2- Validation

- ADS-B In

# Conclusion

- A more **pragmatic view** of current airborne equipage is required to **accelerate adoption** of ADS-B surveillance
- When rulemaking, be mindful of the **timeframe** for legacy aircraft upgrades
- Considerable numbers of **aircraft are ready** for ADS-B benefits...today
- A **Planned** and **Evolutionary** approach is critical





**Thank you...**