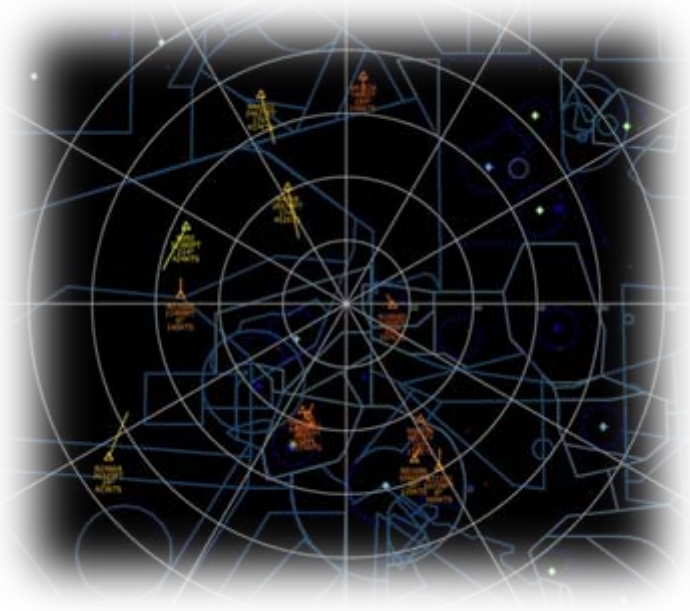
Towards ADS-B
….and beyond

The Customer Perspective



Mr. Li Wenxin

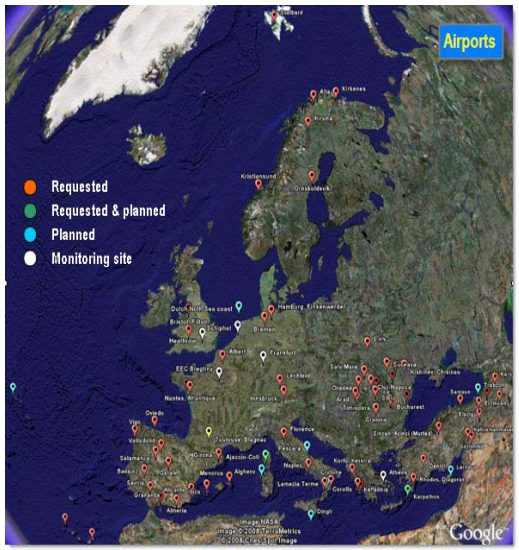
Evolution of Surveillance

- 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

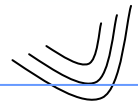
'If I know where I am, I can tell ATC where I am'

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



Investment –ROI
what we have now

Procedural to 'radar-like' airspace



Over 3000 airplanes capable

- **Selective implementation**
  - Identify benefits
  - Use technology that delivers
- **Benefits now**
  - Consider existing equipage
- **Global harmonization**
  - Equip once, fly anywhere

Benefits
Airports & Enroute

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

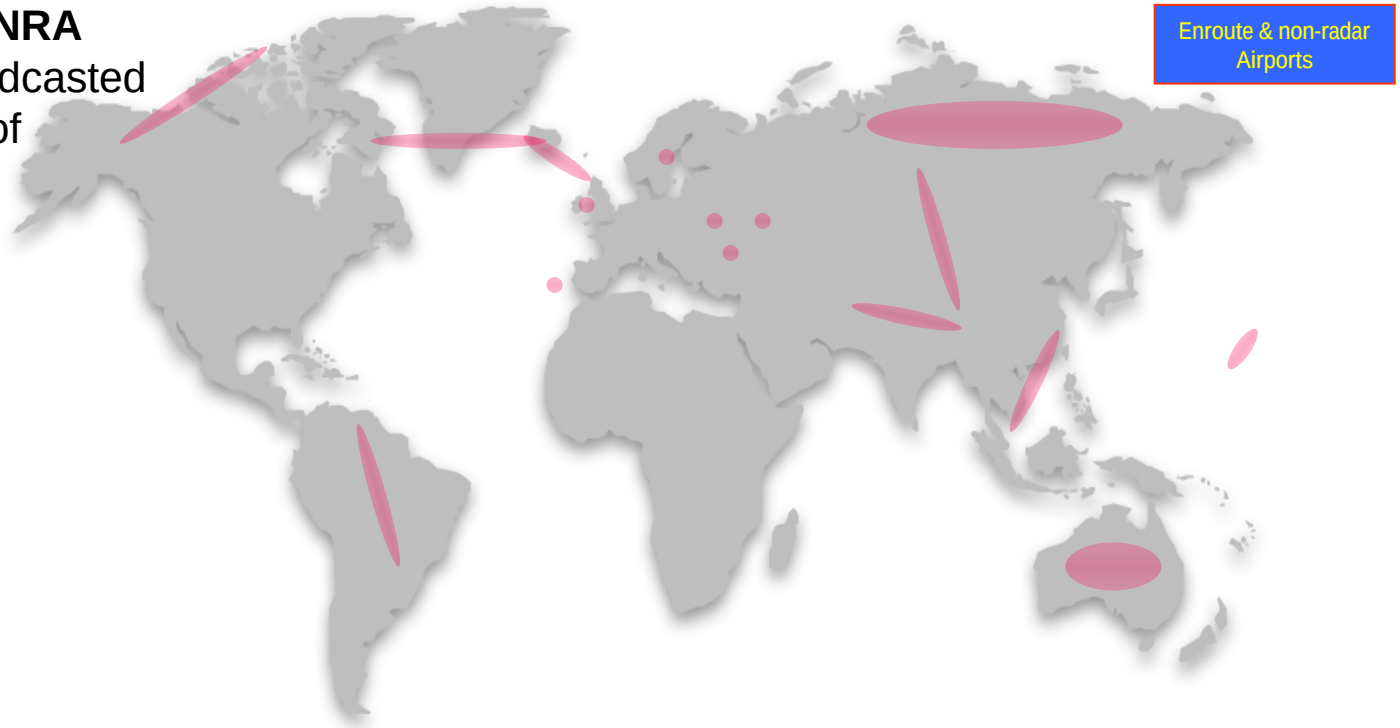
NavCanada estimates 18m liters fuel & 50,000 tons CO2, yearly

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 airplanes capable

The ADS-B Evolution- 2

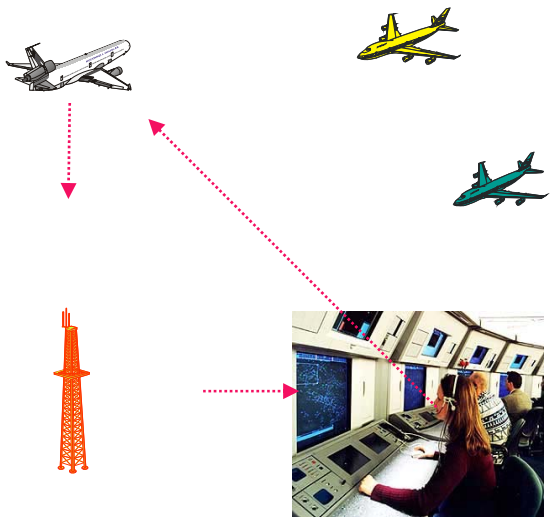
'If we all can tell ATC where we are at ½ second updates (and not every 6 seconds), ATC can improve its service to us'

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

$100k-$400k

Comparisons

$1m - $4 m

- **System Implementation**
  - 1st 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

Benefits

- **Example of FAA benefits**
  - Enhanced Visual Acquistion (e.g. enroute conflict probe)
  - Enhanced Visual Approaches
  - Final Approach Spacing
  - Airport Surface (situational awarenesss)

ADS-B Out Final Rule

The ADS-B Evolution- 2 contd…

'If we all can tell ATC where we are at ½ second updates (instead of every 6 seconds), ATC can improve its service to us'

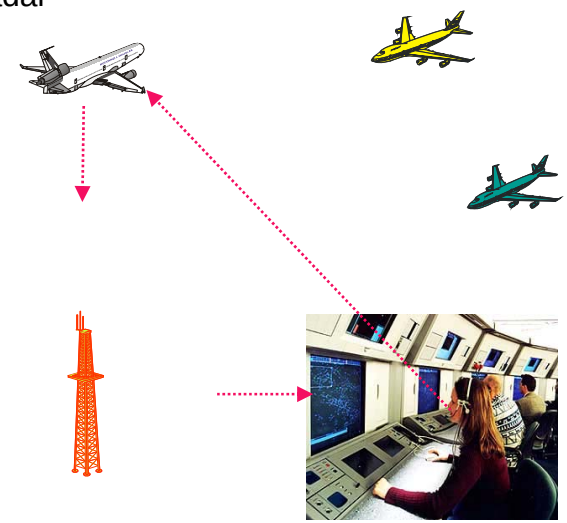
Investment –ROI planning for the future

Step 2. ADS-B Out RAD

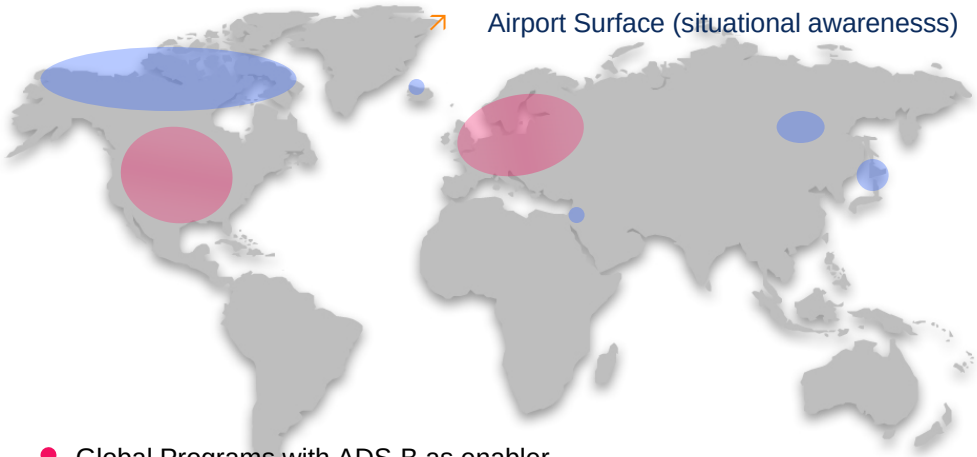
A/C information rapid updates

(2 per second)

Better performance, lower costs than radar



- **Example of FAA benefits**
  - Enhanced Visual Acquistion (e.g.enroute conflict probe)
  - Enhanced Visual Approaches
  - Final Approach Spacing
  - Airport Surface (situational awarenesss)



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

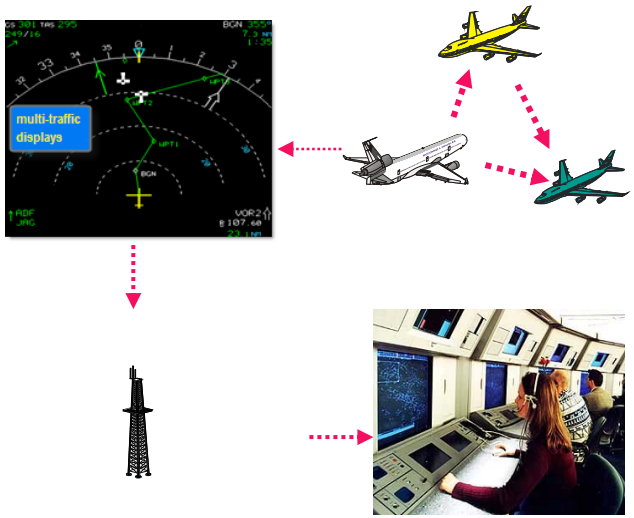
The FAA estimates $13,8 billion in total benefits (ADS-B Out Final Rule)

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

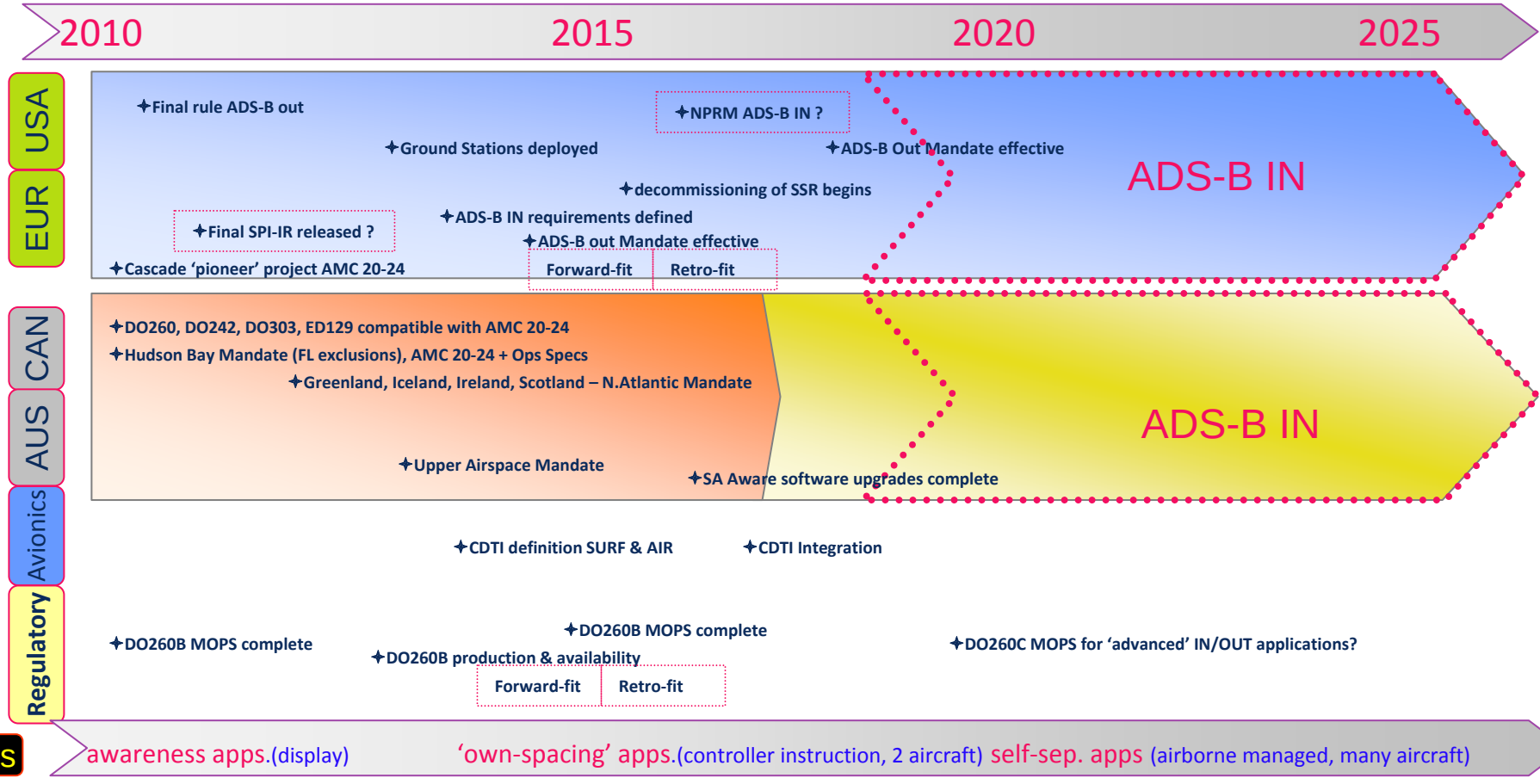
- **Globally harmonized**
  - **Airworthiness Standards (Eurocae, RTCA, AEEC)**
  - **Separation Standards (ICAO)**
  - **Avionics (e.g. EFB2 or MFD)**
  - **Datalink (e.g. 1090 'bandwidth')**
  - **Transponder (e.g. DO260B or DO260X?)**
  - **GPS Receiver (full replacement with TSO145/156?)**
  - **Support 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!**

Many Questions

Q1: What are the Costs?

Q1: What are the Benefits?

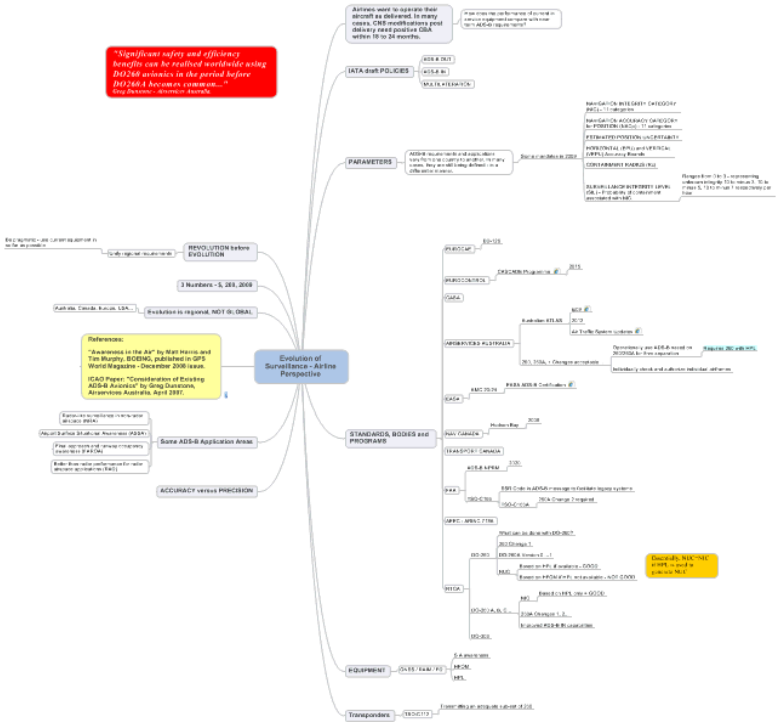
ADS-B Global


2010
2015
2020
2025
USA
EUR
CAN
AUS
Avionics
Regulatory
apps
Final rule ADS-B out
NPRM ADS-B IN ?
Ground Stations deployed
ADS-B Out Mandate effective
ADS-B IN
decommissioning of SSR begins
ADS-B IN requirements defined
Final SPI-IR released ?
ADS-B out Mandate effective
Cascade 'pioneer' project AMC 20-24
Forward-fit
Retro-fit
DO260, DO242, DO303, ED129 compatible with AMC 20-24
Hudson Bay Mandate (FL exclusions), AMC 20-24 + Ops Specs
Greenland, Iceland, Ireland, Scotland – N.Atlantic Mandate
ADS-B IN
Upper Airspace Mandate
SA Aware software upgrades complete
CDTI definition SURF & AIR
CDTI Integration
DO260B MOPS complete
DO260B MOPS complete
DO260B production & availability
DO260C MOPS for 'advanced' IN/OUT applications?
Forward-fit
Retro-fit
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
    - Reqional 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

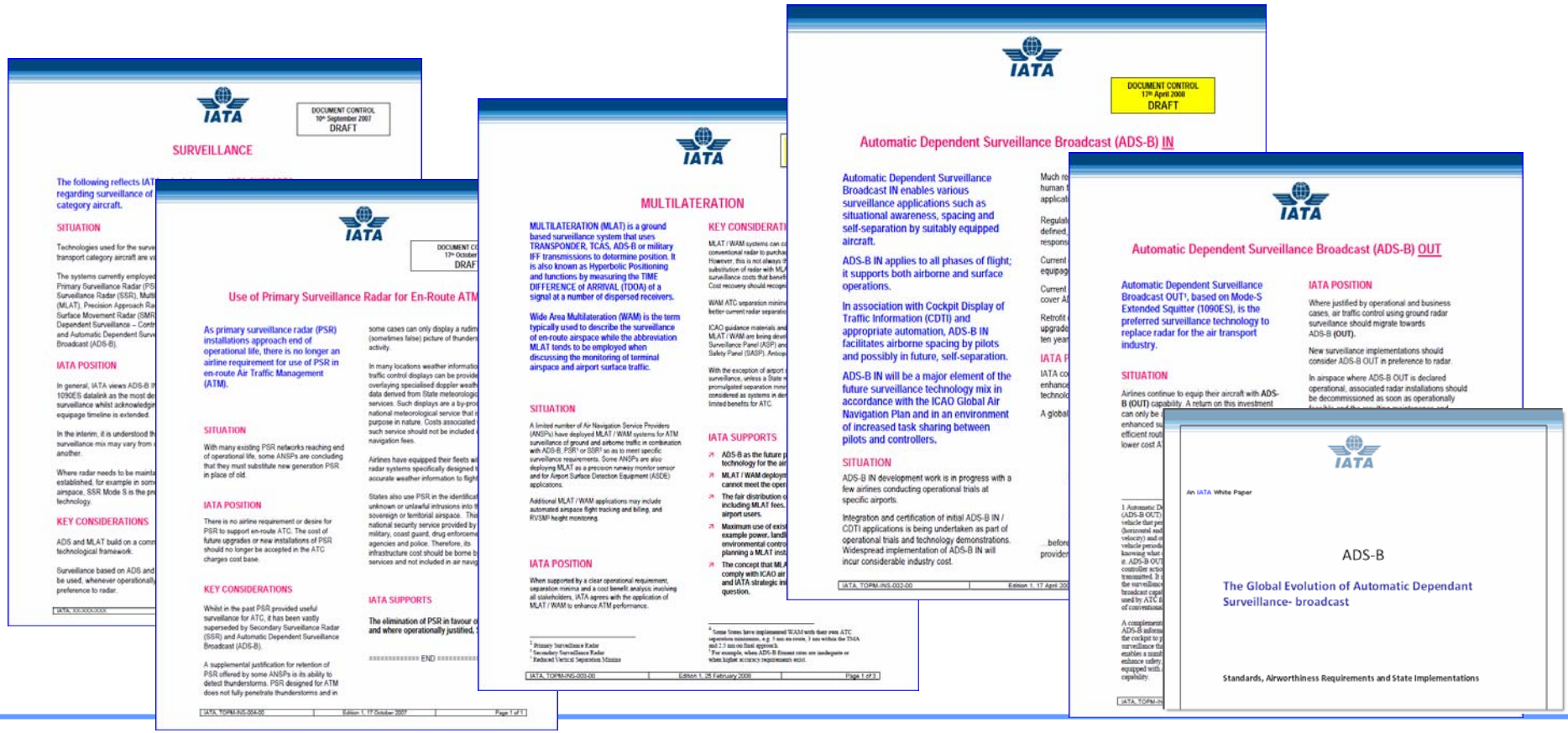
Before we talk about surveillance…

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



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…