ADS-B-NRA : an example of continuum between CND and ANSP

SASI - Support to ANSPs for SMS Implementation

Eurocontrol Brussels June 2009
Gilles Caligaris – Mesut Gurbuz
Overview

Towards ADS-B Implementation

- ADS-B-NRA (European) Activities
- ADS-B-NRA Preliminary Safety Case
- International Co-ordination
- Global Standards
- CASCADE Scope & Scope
- Example at local level: Trabzon
Overview

ADC-B-NRA

Preliminary Safety Case

International Co-ordination

Example at local level:

Global Standards

CASCADE Scope & Status

Towards ADS-B Implementation
ADS-B overview

GPS

Cockpit Display of Traffic Information (CDTI)

ADS-B

Controller Working Position

ADS-B ground stations

ATC
**ADS-B OUT**

Function allowing an aircraft or a surface vehicle to automatically and periodically broadcast information, including Identification, position, etc.

**ADS-B IN**

Function allowing an aircraft or a surface vehicle to receive, process and display ADS-B information to pilots (or vehicle drivers) on a CDTI.
ADS-B in the Surveillance Environment

Europe

Good radar coverage with Mode S radars until ~2025

ADS-B for non-radar areas

ADS-B expected to replace a radar layer

Applications based on ADS-B in the longer term
Surveillance Performance Interoperability - Implementing Rule Draft

1.01.2012 for “new” aircraft
5.02.2015 for retrofit

- **Mode S (Elementary)** all aircraft flying IFR/GAT
- **Mode S (Enhanced and ADS-B Out)** > 5700 kg MTOM OR >250 kts TAS
European Implementing Rule

Pioneer Phase

voluntary implementation in pocket areas
certified existing equipage

Mandate Phase

IR based implementation in wider areas
upgraded equipage

2012
Forward-fit

2015
Retro-fit

2017

SPI IR

Single European Sky
Surveillance Performance & Interoperability
Implementing Rule
ADS-B is Happening
Why ADS-B?

In a non-radar environment

2 mins saved per flight

In a radar environment

Route Charges: - 0.5 %

In Trail Procedure

Fuel: - 0.5 %
Cascade Programme Scope

- Ground Surveillance Applications (ADS-B-out)
  - In a non-radar environment
  - In a radar environment
  - On the airport surface
  - 2008/9

- Airborne Surveillance Applications (ADS-B-in)
  - Situational awareness on the surface
  - Airborne situational awareness
  - Visual separation on approach
  - In Trail Procedure
  - 2011

Traffic Situational Awareness “only”
Overview

Towards ADS-B Implementation

ADS-B-NRA (European) Activities

Preliminary Safety Case

Example at local level: Trabzon International Co-ordination

Global Standards

International Co-ordination

CASCADE Scope & Status
Requirements Focus Group (RFG)
Scope, Objective & Key Stakeholders

Package I
Ground & Airborne Surveillance Applications

- Development of International Industry Standards
- Safety, Performance & Interoperability Requirements

EUROCAE WG51, RTCA SC-186
EUROCONTROL CASCADE, FAA SBS
Requirements Focus Group (RFG)
Requirements Determination Process
High-level RFG Planning

- ADS-B-NRA (ED-126/DO303)
- ATSA-ITP (ED-159, DO-312)
- ATSA-VSA (ED-160, DO-314)
- ADS-B-RAD (ED-161, DO-zzz)
- ATSA-AIRB
- ATSA-SURF
- ADS-B-APT

ADS-B-NRA: Enhanced ATS in Non-Radar Areas
ADS-B-RAD: Enhanced ATS in Radar Areas
ADS-B-APT: Airport Surface Surveillance
ATSA-VSA: Enhanced Visual Separation on Approach
ATSA-ITP: In-trail Procedure in Oceanic Airspace
ATSA-AIRB: Enhanced Traffic Situational Awareness During Flight Operations
ATSA-SURF: Enhanced Traffic Situational Awareness on the Airport Surface
RFG SPR-INTEROP Development Approach

- Key aspects:
  - Top-down & end-to-end
  - Pragmatic: bottom-up constraints
  - Balanced expertise mix
  - Design independence: freedom to aircraft integrators, feeds into system MOPS
  - Harmonised EUROPE/US safety approach
  - Interoperability
  - In coordination with ICAO

- Is there an alternative?
 ADS-B Programmes
International Co-ordination

Air Services Australia
FAA
Nav Canada

EUROCONTROL

Joint ADS-B Harmonisation Statement
- Standards
- Certification
- Implementation
Overview

Towards ADS-B Implementation

- ADS-B-NRA (European) Activities
- ADS-B-NRA Example at local level:
- International Co-ordination
- Global Standards
- CASCADE Scope 

ADS-B-NRA Preliminary Safety Case
Mode S ELS/EHS/ES Equipage Trend
(measured at Charles De Gaulle)
ADS-B-NRA Pioneer Airlines & Trials leading to implementation

“CRISTAL”: Pre-operational Evaluations with ANSPs”

Pioneer airline project
Safety, performance & interoperability requirements (SPR/INTEROP) for the ADS-B-NRA application

Pioneer Airline Certification basis

EASA Airworthiness Approval Acceptable Means of Compliance AMC 20-24
<table>
<thead>
<tr>
<th>“Applicant”</th>
<th>Ac type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbus</td>
<td>A380</td>
</tr>
<tr>
<td></td>
<td>A330/A340</td>
</tr>
<tr>
<td></td>
<td>A320 family</td>
</tr>
<tr>
<td>Boeing</td>
<td>B737-600/700/800/900</td>
</tr>
<tr>
<td></td>
<td>B757, B767</td>
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<td>B747-400</td>
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<tr>
<td></td>
<td>B777</td>
</tr>
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<td>ATR</td>
<td>ATR72</td>
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<td>Dassault</td>
<td>Falcon 2000</td>
</tr>
<tr>
<td>Aeroconseil</td>
<td>A321</td>
</tr>
<tr>
<td>ATI</td>
<td>A3ST</td>
</tr>
<tr>
<td>Air France</td>
<td>B777, B747</td>
</tr>
<tr>
<td>British Airways</td>
<td>A320family, B777, B747</td>
</tr>
</tbody>
</table>
Overview

ADS-B-NRA (European) Activities

CASCADE Scope & Status

Towards ADS-B Implementation

International Co-ordination

Global Standards

ADS-B-NRA Example at local level:

Preliminary Safety Case
Safety case: on the path towards ADS-B-NRA operation

- ADS-B-NRA Standardisation (EUROCAE/RTCA)
- EASA AMC 20-24
- Certified Aircraft
- (Airborne) Operational Approval
- ADS-B-NRA PSC (Preliminary Generic Safety Case)
- Ground infrastructure deployment
- (Local) Safety Case
- Operational Approval
A key input to Local Safety Case and Operation Approval

A reusable structure for Local Safety Case

Document & Support available

PRELIMINARY SAFETY CASE (PSC)

WHICH BENEFITS?
A key input to Local Safety Case and Operation Approval

PRELIMINARY SAFETY CASE (PSC)

A reusable structure for Local Safety Case

Document & Support available
Key input to the local safety case

ADS-B-NRA PSC
(Preliminary Generic Safety Case)

Local Safety Case

Specification  Implementation  Transition to operation  Monitoring

OPERATION
Key input to regulatory bodies

- Preliminary Safety Case
- SRC Safety Regulatory Review
- Local Safety Case
- National Regulatory Approval
A key input to Local Safety Case and Operation Approval

PRELIMINARY SAFETY CASE (PSC)

A reusable structure for Local Safety Case

Document & Support available
Argument/Evidence structure reusable for Local Safety Case
Guidance to Local Safety Case included

- Local safety case can largely refer/re-use the PSC when it is directly applicable

- Guidance material highlights where the development of local argument/evidence is needed
Guidance to Local Safety Case included (example)

Preliminary Safety Case for Enhanced Air Traffic Services in Non-Radar Areas using ADS-B surveillance
25 August 2008

5.5.1 Safety Requirements relating to Operational ADS-B-NRA Procedures

As already mentioned in section 4.3.1 the ATS procedures to be used for ADS-B-NRA are similar to those used in reference radar service. Table 7 below lists the related safety requirements to be applied:

<table>
<thead>
<tr>
<th>Actor</th>
<th>ADS-B-NRA procedural Safety Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATCo</td>
<td>SAF061. Controller shall apply PANS ATM Doc4444 [Ref.2] procedures to perform ADS-B-NRA application.</td>
</tr>
</tbody>
</table>

Table 7: Safety Requirements on ATS Procedures for ADS-B-NRA

GM014: Guidance material to be considered for local implementation. 

GM015: Any divergence in terms of procedures or local implementation that will have to be addressed under agreement (1.3 section 4.4).

Concerning the conditions on which separation minima can be applied by the controller, the related safety requirements are presented hereafter:

SAF003: Separation minima of 5NM shall be only applied by controller to aircraft being eligible for ADS-B-NRA in IFR rules.

Note: see aircraft eligibility conditions in section 5.5.3.3.

SAF094: Separation minima of 3NM shall be only applied by controller to aircraft being eligible for ADS-B-NRA in IMC.

Note: see aircraft eligibility conditions in section 5.5.3.3.

See GM001 for ICAO provision with respect to separation minima applicability.

5.5.2 Safety Requirements relating to Data Items

This section provides safety requirements relating to data items provided and used by the different elements of the ADS-B-NRA system.

5.5.2.1 Safety Requirements on Operational Surveillance Data Items

Concerning the operational surveillance data items required at the ATCo interface (i.e. at point of measurement G2 in Figure 1), the list of related
A key input to Local Safety Case and Operation Approval

PRELIMINARY SAFETY CASE (PSC)

A reusable structure for Local Safety Case

Document & Support available
The CASCADE Programme

The CASCADE programme coordinates the European Implementation of ADS-B (Automatic Dependent Surveillance-Broadcast), a surveillance technology that transmits aircraft identity, position and other air traffic information. This signal can be captured and processed for surveillance purposes (ADS-B-out) or to support other aircraft for air traffic situational awareness (ADS-B-in) and airborne separation assurance. ADS-B-out is intended to reach initial operational capability status in 2008. ADS-B-in for air traffic situational awareness is planned in order to meet the surveillance requirements of different environments. ADS-B-out can be used as a sole means of surveillance or in combination with radar or multi-lateration.

The CASCADE Home page gives you an overview of the CASCADE programme, its applications, validation activities and implementation plans. You can also find dedicated information for Aircraft Operators and ANSPs and documents, FAQs and contacts.

EASA has published the Acceptable Means of Compliance for ADS-B in a non-radar environment

- EASA has published the Acceptable Means of Compliance for ADS-B in a non-radar environment. The document is applicable since 02 May 2009. A number of aircraft have already obtained their airworthiness approval.

Aero Spain has confirmed that it intends to join the CASCADE pre-operational validation work with one or more airports.

- Aero Spain has confirmed that it intends to join the CASCADE pre-operational validation work with one or more airports. The involvement will start with a cost benefit analysis, hopefully leading up to the Installation of one or more ADS-B stations and pre-operational trials.

ADOS-B-NRA Safety Case

- Preliminary Safety Case for Enhanced Air Traffic Services in Non-Radar Areas using ADS-B Surveillance” version 1.0 has now been published to provide the basis for Eurocontrol regulatory approval and to be an input for ANSPs to produce their own Local Safety Case for the ADS-B-NRA application. It includes substantial guidance to local ADS-B-NRA implementers. This PSC is at the moment under Safety Regulation Commission (SRC) review.
to ANSP, in developing their Local Safety Case

Coordination is already taking place with DHMI on the ADS-B-NRA Trabzon Local Safety Case
PRELIMINARY SAFETY CASE (PSC)

A key input to Local Safety Case and Operation Approval

A reusable structure for Local Safety Case

Document & Support available
Overview

ADS-B-NRA (European) Activities

CASCADE Scope & Status

Towards ADS-B Implementation

International Co-ordination

Global Standards

ADS-B-NRA Preliminary Safety Case

Example at local level: Trabzon
Non-radar APP/DEP + Aerodrome Control

Daily traffic average : 40 Flights; Peak traffic 8 Flights/Hr. (2007 figures)
- 90% of traffic delivered by 4 airlines (Turkish, Pegasus, Sunexpress, Onur)
- 30% Traffic increase expected by 2010

Constraints:
- Frequency congestion due to procedural control
- Controller workload due to communication tasks
- Lack of surveillance. Controllers unaware of hazardous situations
- Mountainous terrain.
ADS-B Expected Benefits

- **Safety**
  - Improved Controller Situation Awareness
  - Enabler for safety nets like STCA and MSAW
  - Reduced Controller Workload
  - Improved quality of information for Alerting Services.

- **Capacity and Efficiency**
  - Reduced Communications
  - Increase sector capacity
  - More efficient traffic flow
**European Implementing Rule ADS-B**

**Pioneer Phase**
- voluntary implementation in pocket areas
- certified existing equipage

**Mandate Phase**
- IR based implementation in wider areas
- upgraded equipage

**Timeline**
- 2012: Forward-fit
- 2015: Retro-fit
- 2017

**Partial ADS-B Out equipage**

**Single European Sky Surveillance Performance & Interoperability Implementing Rule**

**CASCADE**

**EUROCONTROL**
ADS-B CERTIFIED

NON ADS-B

Procedural
10 min or 1000 ft

5 NM

10 MINUTES
(procedural)

ADS-B CERTIFIED
Video.......
WORK FLOW

LOCAL OSED → LOCAL SAFETY CASE → REAL TIME SIMULATION
Safety case: on the path towards ADS-B-NRA operation

- ADS-B-NRA Standardisation (EUROCAE/RTCA)
- EASA AMC 20-24
- Certified Aircraft
- (Airborne) Operational Approval
- Ground infrastructure deployment
- ADS-B-NRA PSC (Preliminary Generic Safety Case)
- LOSED & RTS
- (Local) Safety Case
- Operational Approval
WORK FLOW

LOCAL OSED → LOCAL SAFETY CASE → REAL TIME SIMULATION

CASCADE

EUROCONTROL
REAL TIME SIMULATION

- Majority (13) of Trabzon Controllers participated at request of DHMI
  - 2 Simulation Sessions of 2 weeks each
  - 3 Days Training including revision of vectoring
  - 7 Days Measured Runs – R/W 11 & R/W 29
  - 36 “exercises”
    - 6 Baseline (Procedural Service)
    - 6 100% ADS-B Equipped
    - 24 50% ADS-B Equipped
Procedural traffic patterns

ADS-B traffic patterns
ADS-B versus Procedural – Shorter Approach Route PGT2427
- POST EXERCISE QUESTIONNAIRES
- LOSS OF SEPARATION ASSESSMENT
- HAZARD IDENTIFICATION WORKSHOPS
Mountainous terrain in the south can create new hazards when aircraft are vectored perpendicular towards the mountains, waiting for a final turn
  - During frequency occupation by procedurally controlled aircraft
  - During communication loss
  - Not a typical ADS-B issue, but a surveillance issue.

Overall workload with partial equipage still lower than procedural control
  - Some peaks during separation of ADS-B and procedural aircraft.

ATC Procedures and use of controller resources acceptable from controller point of view.

Clear procedures need to be established, especially for R/W 29.

Overall handling partial equipage was acceptable to the controllers.
Overview

ADS-B-NRA (European) Activities

CASCADE Scope & Status

Towards ADS-B Implementation

International Co-ordination

ADS-B-NRA Preliminary Safety Case

Global Standards

Example at local level: Trabzon
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M. Gurbuz: mesut.gurbuz@eurocontrol.int
CASCADE: www.eurocontrol.int/cascade