



Second Iteration - Baseline Report/Matrix

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Abstract

The present document describes the second iteration requirement baseline for the ADS-B GS Prototyping. The baseline report/matrix, which can be found inside, is based on the selection per Prototype Provider of the different requirements derived from Project's 15.4.5a deliverables D19, D09, D10 and D11. This baseline includes the following key information:

- The allocation and compliance of the different requirements of the three ADS-B GS to be provided for project Iteration 2.
- The allocation and compliance of the different requirements of the SDPD to be provided for project Iteration 2.

The document serves as input to the subsequent project tasks which will deal with the development and verification of the prototypes. This specification will be revisited as appropriate in the course of the project work on iteration 3.

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This deliverable consists of SJU foreground.

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Executive summary

The present document describes the baseline for the second iteration of the ADS-B related Prototypes (i.e. ADS-B GS and SDPD). The selection of the requirements upon which these specifications are based are derived from the preceding deliverable D19 Ref [1] coming from Project 15.4.5a as an input. The baseline includes the following key information:

- Mandatory and Optional Requirements classification.
- Compliance of each of the partners' prototypes with Project 15.4.5a D19 [1] requirements.
- Compliance of each of the partners' prototypes with Project 15.4.5a D09 [3], D10 [4] and D11 [5] requirements.

The document serves as input to the subsequent project tasks which will deal with the development and verification of the prototypes. This specification will be revisited as appropriate in the course of the project work on iteration 3.

The Project covers different enhancements of the baseline by a number of drivers (applications and technological enhancements) which can be clustered as follows:

- Initial ADS-B applications
- Applications defined in SESAR projects (including future separation modes such as spacing, separation etc.)
- Integration of ADS-B with WAM
- Security and Civil-Military Interoperability
- 1090 ES MHz data-link technology enhancements
- Other enhancements

More specifically, in accordance with the set of enhancements defined in the Second Iteration in Project 15.4.5a Deliverable D19 Ref [1], high level requirements are described in order to support:

- ADS-B APT Compliance
- Enhanced ADS-B target report validation via WAM integration
- Behavioural Analysis of Targets
- Time Differential of Arrival
- Network Bandwidth Optimisation

Moreover, the ADS-B RAD requirements have been moved to iteration 2 as they haven't been fully implemented and tested.

This baseline will be used as a guideline to identify which of the functionalities (requirements) will be covered by each prototype provider. The requirements have been split into Mandatory or Optional, and allocated to the different elements comprising the system.

Prototype Providers will implement all mandatory requirements affecting their prototype, as well as the selected optional ones.

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1 Introduction

1.1 Purpose of the document

The present document describes the baseline for the second iteration of the ADS-B related Prototypes.

It is to be used as the input document and guideline for the project tasks producing the second prototype of the ADS-B Ground Station and Surveillance Data Processing and Distribution systems as well as for the enhancements to the baseline interfaces.

The baseline matrix is defined at a high level (as provided by document Ref [1]) and shall be allocated to one or more of the above mentioned systems. All mandatory requirements will be covered by all prototypes while optional requirements will be covered by at least one prototype.

1.2 Intended readership

The audience of this document includes

- Projects 15.04.05.a and b,
- any other SJU projects that may require ADS-B Surveillance Systems for their validation activities

1.3 Inputs from other projects

Project 15.4.5b inputs are directly taken from Project 15.4.5a (i.e. 15.4.5a Deliverables).

- SJU 15.04.05a ADS-B Ground Surveillance Specifications for second iteration D19, Ed. 00.03.00, Sep 2011 (Ref [1])
- SJU 15.04.05a Specification Baseline Document, D17, Ed. 00.01.00, Oct 2010 (Ref [2])
- SJU 15.04.05a ADS-B 1090 MHz Ext. Squitter Ground Station Specifications – Iteration 2, D09, Ed. 00.01.02, Sep 2011 (Ref [3])
- SJU 15.04.05a SDPD Specification – Iteration 2, D10, Ed. 00.03.00, Sep 2011 (Ref [4])
- SJU 15.04.05a Interface Specifications for Second Iteration, D11, Ed. 00.01.00, Oct 2011 (Ref [5])
- SJU 15.04.05b First Iteration - Baseline Report/Matrix, D02, Ed. 00.01.02, Nov 2012 (Ref [21])

These Deliverables inter alia address:

- EUROCONTROL CASCADE Program
- Requirements Focus Group (RFG) and associated EUROCAE/RTCA standardisation activities for ADS-B Surveillance Applications (Ref [11], Ref [12])
- ADS-B Avionics equipment standardisation by EUROCAE/RTCA(Ref [8], [9] and [10])

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1.4 Structure of the document

This document is organised as follows:

Chapter 1: Purpose and scope; Requirements definition; Component purpose and high level overview

Chapter 2: General component description;

Chapter 3: ADS-B Ground System Domain Baseline Matrix; Baseline Matrix Overall Overview;

Chapter 4: Assumptions;

Chapter 5: Referenced documents; Use of copyright/classified material;

Appendix A: Traceability

1.5 Requirements Definitions – General Guidance

Requirements were developed according to the SESAR Requirements and V&V Guidelines [6].

They are broken down according to the source of the requirements, derived from the allocation which was done in Ref [1].

The layout follows the description in Ref [7].

In accordance with the guidelines in Ref [7], requirement identifiers follow the scheme:

REQ-15.04.05.a-D19-00xx.yyyy, where

xx	Meaning
10	ADS-B RAD Functional req.
12	ADS-B APT Functional req.
13	ADS-B ADD Functional req.
14	Reserved for SESAR
19	applications Functional req.
20	ADS-B RAD Performance req.
22	ADS-B APT Performance req.
23	ADS-B ADD Performance req.
24	Reserved for SESAR
29	applications Performance req.
30	WAM integration req.
40	Security req.
50	Civil/Military req.
60	1090ES Technology req.
00	Other

Table 1 Requirement Identifier Allocation

1.6 Functional block Purpose

The figure below depicts a functional context diagram of the future Ground Surveillance System, as defined in input Project 15.4.5.a, where the impacted system elements are marked in Blue.

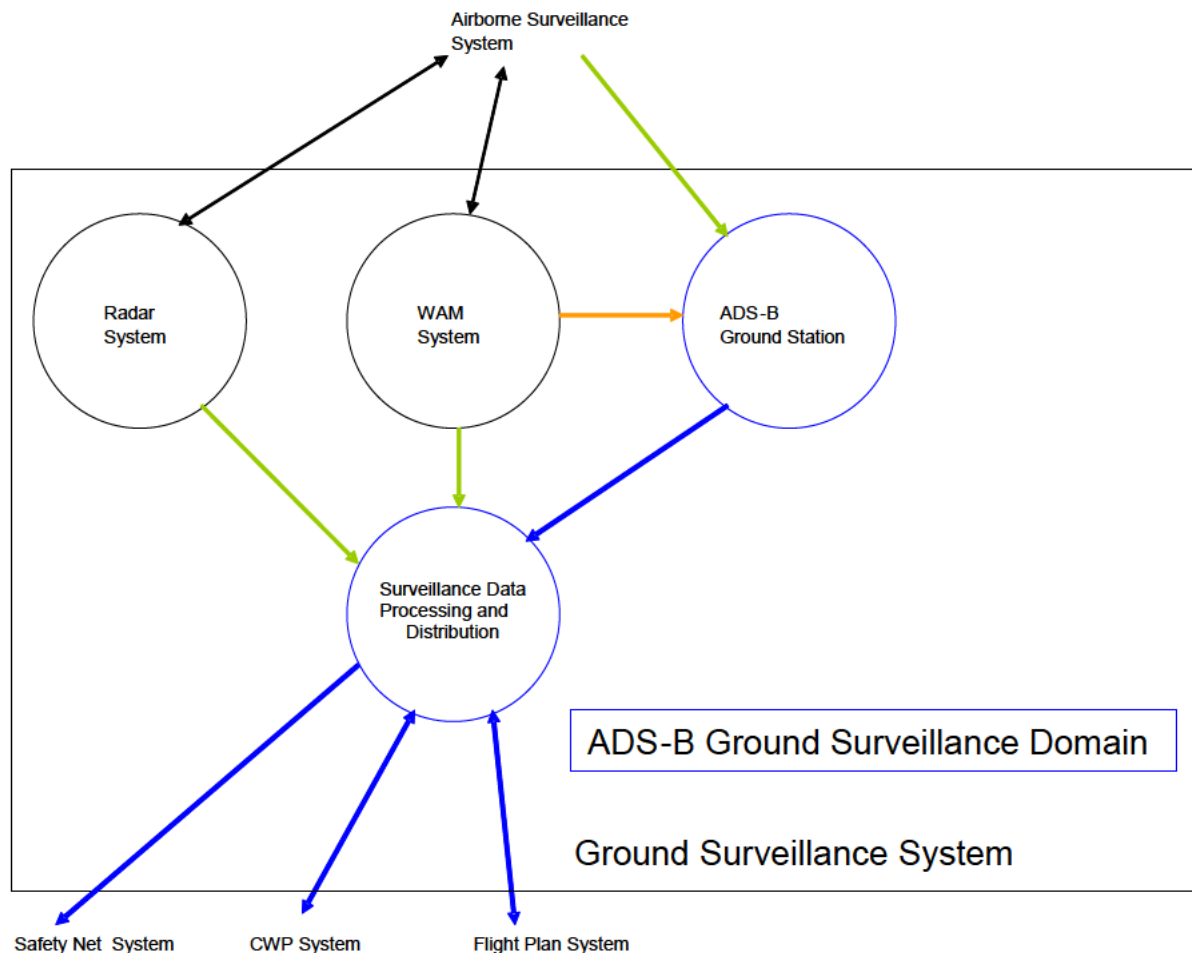


Figure 1 ADS-B Ground Surveillance Domain Context

- = Existing standardised interfaces, **already processed** by Baseline, **not modified** by P15.4.5a
- = Existing standardised interfaces, **not processed** by Baseline, **not modified** by P15.4.5a
- = Existing standardised interfaces, **already processed** by Baseline, **modified** by P15.4.5a
- = Existing standardised interfaces, **out of scope** of P15.4.5a

In the context of this project, the following functional components are addressed:

- ADS-B Ground Station

The term 'ADS-B Ground Station' in this document refers to a 1090ES Ground Station. The primary function of the ADS-B Ground Station is to receive 1090 MHz RF input on the Air Interface, extract data from the 1090 MHz ES messages, assemble the data into ASTERIX Category 21 ADS-B Reports and send these reports over the Ground Interface.

- Surveillance Data Processing and Distribution (SDPD)

The baseline for the SDPD is the ARTAS multi-sensor tracking system enhancement based on the first iteration specifications. This system associates surveillance reports originating from different surveillance technologies (radar, WAM, ADS-B, and ADS-C) and fuses the associated reports into a unique system track. The system tracks are assembled into

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ASTERIX CAT 62 System Track Messages and these messages are sent over the Ground Interface.

- Interfaces

The Interfaces subject to modification by the project refer to:

- ASTERIX CAT21, Ed. 2.80, November 2011 (ref[14])
- ASTERIX CAT 23, Ed 2.72, October 2011 (ref [15])
- ASTERIX CAT 62, Ed 2.74, October 2011 (ref [16])
- ASTERIX CAT 63, Ed 1.3, July 2007 (ref [17])

1.7 Functional block Overview

N/A

1.8 Glossary of terms

N/A

1.9 Acronyms and Terminology

Term	Definition
ACC	Accuracy
ADD	Aircraft Derived Data
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-B ADD	Aircraft Derived Data for ATC tools ("ADS-B out" application)
ADS-B NRA	Enhanced ATS in Non Radar Areas ("ADS-B out" application)
ADS-B RAD	Enhanced ATS in Radar Areas ("ADS-B out" application)
ARTAS	ATM suRveillance Tracker And Server
ASPA-FIM	Flight-deck Interval Management ("ADS-B in" Airborne Spacing Application)
ASSUMP	Assumption
ASTERIX	All-purpose Structured EUROCONTROL Surveillance Information Exchange
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSA-AIRB	Enhanced Traffic Situational Awareness during Flight Operations ("ADS-B in"

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Term	Definition
	ATSAW application)
ATSA-ITP	In-Trail Procedure in procedural airspace ("ADS-B in" ATSAW application)
ATSA-SURF	Enhanced Traffic Situational Awareness on the Airport Surface ("ADS-B in" ATSAW application)
ATSA-VSA	Enhanced Visual Separation on Approach ("ADS-B in" ATSAW application)
ATSAW	Air Traffic Situation Awareness
ATX	ASTERIX
CAT	Data Category
DO	RTCA Document
ED	EUROCAE Document
ES	Extended Squitter
EUROCAE	European Organisation for Civil Aviation Equipment
FIM	Flight-deck Interval Management
GS	Ground Station
INTEROP	Interoperability
IP1	Implementation Package 1
ITP	In-Trail Procedure
Mode S	MODE Select
MOPS	Minimum Operational Performance Standards
NACp	Navigation Accuracy for Position
NM	Nautical Mile
NRA	Non Radar Airspace
OPA	Operational Performance Assessment
OPA-ASSUMP	Assumption made during the OPA
OR	Operational Requirement
OSD	Operational Services and Environment Description
PIR	Project Initiation Report
PR	Performance Requirement

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Term	Definition
REQ	Requirement
RF	Radio Frequency
RFG	Requirement Focus Group
RTCA	Radio Technical Commission for Aeronautics
SDPD	Surveillance Data Processing and Distribution
SESAR	Single European Sky ATM Research (Programme)
SG 4	Sub Group 4
SJU	SESAR Joint Undertaking
SPI IR	Surveillance Performance and Interoperability Implementing Rule
SPR	Safety and Performance Requirements
SPR-INTEROP	Safety, Performance and Interoperability Requirements
SSR	Secondary Surveillance Radar
SWP	Sub Work Package
TMA	Terminal Manoeuvring Area
TOA	Time Of Arrival
Tx	Transmission
VSA	Visual Separation on Approach
WAM	Wide Area Multilateration
WG 51	Working Group 51
WP	Work Package

2 General Functional block Description

2.1 Context

A high level context of the ADS-B Ground Surveillance Domain is shown in Section 1.6. The following Figure gives a more detailed overview of the component boundaries and interfaces.

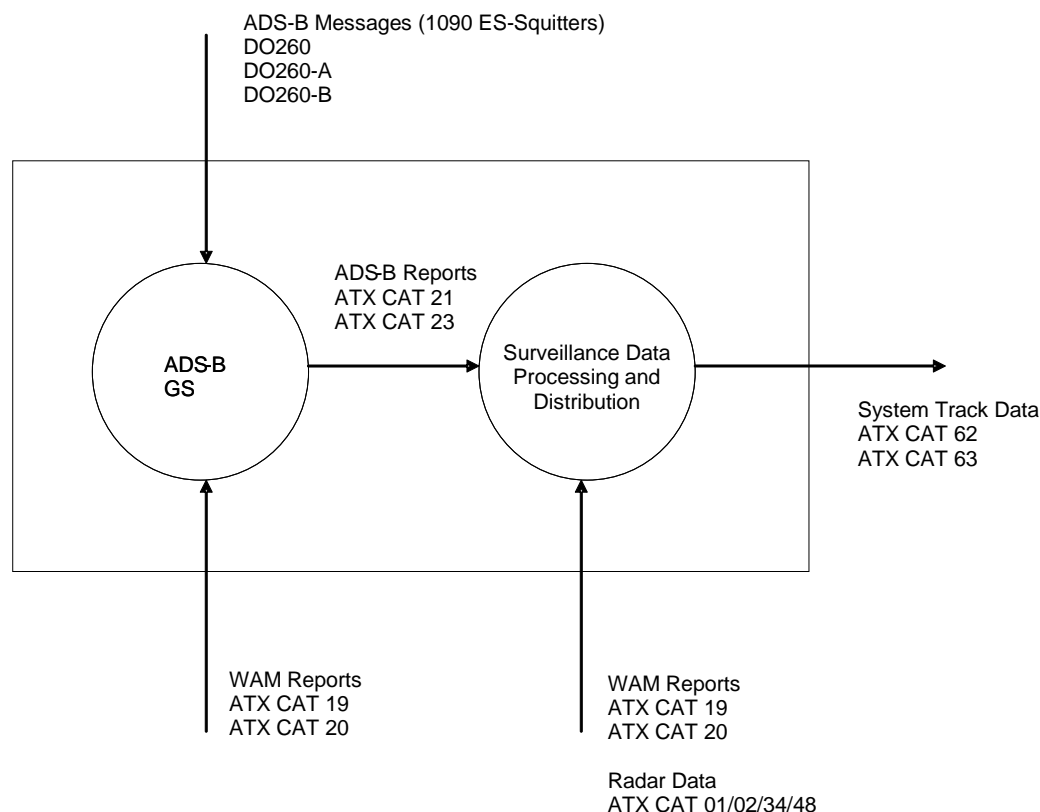


Figure 2 Component Context

2.2 Functional block Modes and States

Detailed Modes and States of the sub-components are described in the baseline documents Ref [13] and [18].

Any change towards these Modes and States has been detailed in Project 15.4.5a deliverables Ref [3], [4] and [5].

2.3 Major Functional block Capabilities

The major components and capabilities are as described in Section 1.6 or in document Ref [1].

2.4 User Characteristics

The ADS-B Ground Surveillance System shall be capable to be integrated into a multi-sensor surveillance environment as an additional means of surveillance. This usage targets the core European airspace.

The ADS-B Ground Surveillance System shall also be able to be deployed in lower density non-core European airspace. This type of airspace could be Non-Radar Airspace (NRA) in which the ADS-B Ground Surveillance System will be the sole means of surveillance.

The ADS-B Ground Surveillance System shall also be able to be deployed at simple to complex airports (as defined in ADS-B APT) with medium traffic complexity where a conventional SMR-only solution would be sufficient for the provision of Aerodrome Control Services supported by Surveillance (SMGCS).

More information on the typical ADS-B APT user characteristics can be found in Ref [20].

The scalability and various potential physical architectures of this system will allow for a surveillance solution adaptable to the local traffic and local ATM system environment.

2.5 Operational Scenarios

Operational scenarios as described in Project 15.4.5.a in document Ref [1] will include:

- High-density traffic environment (en-route and/or TMA) scenarios, including multiple surveillance techniques.
- Nevertheless due to the scalability of the Component (see User Characteristics above), such a system could also be deployed in non-core European airspace.

2.6 Functional

N/A

2.6.1 Functional decomposition

N/A

2.6.2 Functional analysis

N/A

2.7 Service View

N/A

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3 ADS-B Ground System Domain Baseline Matrix

3.1 Baseline Matrix

The Project covers enhancements to the baseline by a number of drivers (applications and technological enhancements) which can be clustered as follows:

- Initial ADS-B applications
- Applications defined in SESAR projects (including future separation modes such as spacing, separation etc.)
- Integration of ADS-B with WAM
- Security and Civil-Military Interoperability
- 1090 ES MHz data-link technology enhancements
- Other enhancements

The Baseline Definition document (Project 15.4.5a deliverable D17) has established the following enhancements to be taken into account for the second iteration:

ADS-B applications	Integration with WAM	Security and civil-military interop	Other enhancements
ADS-B APT ADS-B ADD ATSA SURF	Enhanced target validation Enhancements from CASCADE process	Time Differential of Arrival Behavioural analysis of targets	Automatic network bandwidth optimisation techniques.

Table 2 Enhancements for Iteration 2

The enhancement related to automatic network bandwidth optimisation techniques was classified under 'Integration with WAM' in Ref [2]. However during the work on the Iteration 2 specifications it was felt that this enhancement is a stand-alone enhancement and is as such not linked to WAM integration.

The baselines for the requirements are the enhancements as specified for Iteration 1. This means that the baselines for Iteration 1 are implicitly included in the baseline of Iteration 2.

Iteration 2 will thus build on the results of Iteration 1 and relevant IP1 work (such as EUROCONTROL CASCADE Programme regarding ADS-B & WAM and the Surveillance Products & Services regarding ARTAS and ASTERIX) as well as industry standardisation (such as EUROCAE WG51 SG4).

The baseline matrix including the requirements related with these enhancements per Prototype Provider (GS's and SDPD) is indicated below. The requirements will be as provided by document Ref [1] and shall be allocated to one or more of the above mentioned components. All mandatory requirements will be covered by all prototypes while optional requirements will be covered by at least one prototype.

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This table shows which functionality will be covered per Prototype Implementer. **Note** that Interface Requirements, though addressed to one or more Prototypes, may be used also by other systems out of the Scope of Project 15.4.5b (i.e. Control and Monitoring Systems...).

RAD REQUIREMENTS FROM FIRST ITERATION

				Covered by								
Functionality	REQ-15.04.05.a-D18- Req. ID	GS Requirement for 1 st Iteration (moved to 2 nd it)	Mandatory / Optional	Thales	Selex	Indra	Eurocontrol	Allocation	D05 References (GS)	D06 References (SDPD)	D07 References (INT)	Notes
RAD	0010.0001	The "Ground ADS-B Receive" function shall receive ADS-B messages, decode, package and time-stamp the data, and send ADS-B Surveillance Reports to the ATC Processing System, i.e., the "Ground ADS-B Processing" function.	M	Y	Y	Y	N/A	GS	0010.0010, 0010.0020, 0010.0030, 0010.0040, 0010.0050 and 0010.0060			Moved from 1 st iteration to 2 nd Iteration.

RAD	0010.0002	<p>The “Ground ADS-B Receive” function shall provide the following minimum data set to the ATC Processing system:</p> <ul style="list-style-type: none"> • Aircraft Horizontal Position – Latitude and Longitude; • Pressure altitude ; • Quality Indications of Horizontal Position ; • Aircraft Identity ; Emergency Indicators ; • Special Position Identification ; • Time of Applicability . <p>NOTE: Emergency Indicators and SPI are provided only when selected by the flight crew.</p>	M	Y	Y	Y	Y	GS, INT	0010.0070		see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in Interfaces
RAD	0010.0003	<p>When direct recognition procedures are used by the ATCO for identification, the ADS-B Ground Domain shall contain a function to ensure the aircraft identity data that is broadcast is retained and correctly associated with the position information for display,</p>	M	Y	Y	Y	Y	GS, INT, SDPD	0010.0070	see note	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD and interfaces
RAD	0010.0004	<p>The “Ground ADS-B Receive” function shall provide in each ADS-B surveillance report a time</p>	M	Y	Y	Y	Y	GS, INT	0010.0080		see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in Interfaces

		of applicability (Interface E2) of the position information										
RAD	0010.0005	If the time of applicability within each ADS-B surveillance report is not applicable for all data items of that report (interface E2), the "Ground ADS-B Receive" function shall provide separate times of applicability for the specific data items that differ,	M	Y	Y	Y	Y	GS, INT	0010.0090		see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in Interfaces
RAD	0010.0006	The "Ground ADS-B Surveillance Processing" function shall time-register the asynchronously received ADS-B position updates from ADS-B-equipped aircraft	M	Y	Y	Y	Y	GS, INT, SDPD	0010.0080	see note	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD and interfaces
RAD	0010.0007	The "ADS-B to Radar Association" function shall enable the switching between ADS-B and radar surveillance sources (e.g., as a backup during a failure) without requiring the ATCO to perform a <ul style="list-style-type: none"> • Re-verification of altitude data, and • Re-identification of aircraft identity, 	M	N/A	N/A	N/A	Y	SDPD		see note		Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD

RAD	0020.0001	The likelihood of an ADS-B Ground Domain system integrity failure shall be 2E-05 or less per hour.	M	Y	Y	Y	Y	GS, SDPD	0010.0100	0010.0005		Moved from 1 st iteration to 2 nd Iteration. Requirement applicable for the whole Domain, not for single components
RAD	0020.0002	The likelihood of a "Ground ADS-B Receive" function continuity failure shall be 1E-05 or less per hour.	M	Y	Y	Y	N/A	GS	0010.0110			Moved from 1 st iteration to 2 nd Iteration.
RAD	0020.0003	The 95% latency for ADS-B surveillance reports (measured between points D and E2 – output of the "Ground ADS-B Receive" function) shall be no greater than 0.5 seconds, excluding communication latency to the ATC processing system. Note: It is assumed that all latency on the "Ground ADS-B Receive" function is compensated.	M	Y	Y	Y	N/A	GS	0010.0120			Moved from 1 st iteration to 2 nd Iteration.
RAD	0020.0004	The time of applicability conveyed in the ADS-B surveillance report shall have an absolute accuracy relative to UTC of ± 0.1 seconds or less.	M	Y	Y	Y	Y	GS, INT	0010.0130		see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in Interfaces

RAD	0020.0005	The ADS-B Ground Domain shall not introduce any additional horizontal position error greater than that which might otherwise be introduced by a linear extrapolation using the instantaneous velocity for the target. Note: Linear extrapolation assumes uniform motion is continued along the latest velocity estimate to the time of synchronization. Consequently, additional errors will be introduced into the extrapolated position by uncertainties in the velocity estimate and aircraft accelerations that occur during the extrapolation period.	M	N/A	N/A	N/A	Y	SDPD		see note		Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD
RAD	0020.0006	The ADS-B Ground Domain (including data link) shall not degrade altitude resolution to worse than 100 feet.	M	N/A	N/A	N/A	Y	SDPD		see note		Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD
RAD	0020.0007	The ADS-B Ground Domain shall have capacity to handle the reports from the maximum load of aircraft in the environment as described in the OSED without degradation.	M	Y	Y	Y	Y	GS, SDPD	0010.0140	see note		Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD. Not related with interfaces but with the infrastructure.

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RAD	0020.0008	<p>The probability that the ADS-B Ground Domain detects a loss of ADS-B position, and provides an indication of such to the existing ATC Processing System shall be at least 99.99%.</p> <p>Notes:</p> <p>1. Alternatively, the requirement might be fulfilled by the existing ATC Processing System, i.e., beyond interface F2*.</p> <p>2. This requirement, taken together with ASSUMP 44, will ensure that the appropriate safety objectives are met.</p>	M	N/A	N/A	N/A	Y	SDPD		see note		Moved from 1 st iteration to 2 nd Iteration. Already Implemented in SDPD
RAD	0020.0009	<p>The probability that the ADS-B Ground Domain detects a loss of ADS-B-reported altitude, and provides an indication of such to the existing ATC Processing System shall be at least 99%.</p> <p>Notes:</p> <p>1. Alternatively, the requirement might be fulfilled by the existing ATC Processing System, i.e., beyond interface F2*.</p> <p>2. This requirement, taken together with ASSUMP 46, will ensure that the appropriate safety</p>	M	N/A	N/A	N/A	Y	SDPD		see note		Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD.

		objectives are met.										
RAD	0020.0010	<p>The probability that the “ADS-B to Radar Association” function detects an inconsistency between an ADS-B and radar-reported emergency code, and provides an indication of such to the existing ATC Processing System shall be at least 99%.</p> <p>Note: This requirement, taken together with ASSUMP 37, will ensure that the appropriate safety objectives are met.</p>	M	N/A	N/A	N/A	Y	INT, SDPD		0010.0010	0070.0001	Moved from 1 st iteration to 2 nd Iteration.
RAD	0020.0011	<p>The probability that the “ADS-B to Radar Association” function detects an inconsistency between ADS-B and SSR aircraft identity data (i.e., Mode A or aircraft identification), and provides an indication of</p>	M	N/A	N/A	N/A	N/A	INT, SDPD		<i>see note</i>	<i>see note</i>	<p>Moved from 1st iteration to 2nd Iteration.</p> <p>Requirement not addressed now, because is dependent of the fusion update of ED161.</p>

		such to the existing ATC Processing System shall be at least 99%. Note: This requirement, taken together with ASSUMP 38, will ensure that the appropriate safety objectives are met.										
RAD	0020.0012	The probability that the “ADS-B to Radar Association” function detects an inconsistency between ADS-B and SSR aircraft pressure altitude data, and provides an indication of such to the existing ATC Processing System shall be at least 99%. Note: This requirement, taken together with ASSUMP 48 will ensure that the appropriate safety objectives are met.	M	N/A	N/A	N/A	N/A	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd Iteration. Requirement not addressed now, because is dependent of the fusion update of ED161.

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RAD	0020.0013	The probability that the ADS-B Ground Domain detects duplicate ADS-B Aircraft Identities (i.e., discrete Mode A or aircraft identification) within the same sector), and provides an indication of such to the existing ATC Processing System shall be at least 99%. Notes: 1. Alternatively, the requirement might be fulfilled by the existing ATC Processing System, i.e., beyond interface F2*. 2. This requirement, taken together with ASSUMP 39, will ensure that the appropriate safety objectives are met.	M	Y	Y	Y	Y	GS, INT, SDPD	0010.0150	see note	see note	Moved from 1 st iteration to 2 nd Iteration. SDPD Partial compliance (for mode A. Requirement to be revisited after Fusion PSC is updated
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RAD	0020.0014	<p>The probability that the “ADS-B to Radar Association” function detects a large ADS-B position error, and provides an indication of such to the existing ATC Processing System shall be at least 99%, where a large error is at least 40% of the separation minima for the ADS-B-RAD environment.</p> <p>Notes:</p> <p>1. This requirement, taken together with ASSUMP 43, will ensure that the appropriate safety objectives are met.</p> <p>2. This requirement is conditional on the sustained corruption of the horizontal position information itself or its quality indicators. Very conservative assumptions have been made on the nature of the resulting horizontal position errors (and their probability distribution) as well as the detection capability of the “ADS-B to Radar Association” function (see Appendix C-1.1 for a detailed discussion).</p> <p>Local safety assessments</p>	M	N/A	N/A	N/A	Y	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD.
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RAD	0020.0015	The probability that the “ADS-B to Radar Association” function detects a significant ADS-B horizontal position error, and provides an indication of such to the existing ATC Processing System, shall be at least 90%, where a significant error is at least equal to the NIC boundary but less than 40% of the separation minima for the ADS-B-RAD environment. Note 1: This requirement, taken together with ASSUMP 43, will ensure that the appropriate safety objectives are met. Note 2: This requirement is closely linked to SPR 46 (refer also to Note 2 thereof).	M	N/A	N/A	N/A	Y	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD.
RAD	0020.0016	The probability that the “ADS-B to Radar Association” function detects an error of more than 500 ft between ADS-B and SSR pressure altitudes shall be at least 99%.	M	N/A	N/A	N/A	Y	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD.

RAD	0020.0017	<p>The probability of providing a Surveillance Report containing newly received ADS-B Position data of sufficient quality associated with any aircraft in En Route airspace within 8 seconds shall be 97%.</p> <p>Notes:</p> <p>1. Additional requirements are subject to local implementation. Other considerations may apply (see OSA: §C.5.1.5 - "Loss of track information").</p> <p>2. Data continuity for a single aircraft is inherently encompassed by this requirement for position update, i.e. in terms of the number of consecutive misses of receiving a position update ultimately leading to a track drop. The required position update probability takes account of normal environmental factors that are experienced during this flight phase, such as coverage variations in received signals (including received satellite signals), that</p>	M	Y	Y	Y	Y	GS, SDPD	0010.0160	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD
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		affect the production and receipt of ADS-B positions of sufficient quality on a single aircraft basis. Multiple aircraft data continuity is addressed in ASSUMP 24.										
RAD	0020.0018	The time interval between a change of Mode A code provided by the ADS-B aircraft domain and an ADS-B surveillance report containing the new Mode A code at interface E2 shall be no longer than 8 seconds (95%) En Route.	M	Y	Y	Y	N/A	GS	0010.0170			Moved from 1 st iteration to 2 nd Iteration.

RAD	0020.0019	The time interval between a change of emergency and SPI information provided by the ADS-B aircraft domain and an ADS-B surveillance report containing the new emergency and SPI information at interface E2 shall be no longer than 8 seconds (95%) En Route.	M	Y	Y	Y	N/A	GS	0010.0180			Moved from 1 st iteration to 2 nd iteration.
RAD	0020.0020	For En Route aircraft, if the position accuracy quality indicator (NACp) is not received within 24 seconds of a position message, then the ADS-B Ground Domain shall determine the position accuracy requirement has been met using a NIC encoding that corresponds to 926 meters (or less) as a substitute for the NACp requirement. Note: Alternatively, the requirement might be fulfilled by the existing ATC Processing System, i.e., beyond interface F2*.	M	N/A	N/A	N/A	Y	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd iteration. Already implemented in SDPD and interfaces.

RAD	0020.0021	<p>The probability of providing a Surveillance Report containing newly received ADS-B Position data of sufficient quality associated with any aircraft in TMA airspace within 5 seconds shall be 97%.</p> <p>Notes:</p> <p>1. Additional requirements are subject to local implementation. Other considerations may apply (see OSA: C.5.1.5 - "Loss of track information").</p> <p>2. Data continuity for a single aircraft is inherently encompassed by the requirements for position update, i.e. in terms of the number of consecutive misses of receiving a position update ultimately leading to a track drop. The required position update probability takes account of normal environmental factors that are experienced during this flight phase, such as coverage variations in received signals (including received satellite signals), that affect the production and receipt of ADS-B</p>	M	Y	Y	Y	Y	GS, SDPD	0010.0190	see note	Moved from 1 st iteration to 2 nd Iteration. Already implemented in SDPD.
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		positions of sufficient quality on a single aircraft basis. Multiple aircraft data continuity is addressed in ASSUMP 24.										
RAD	0020.0022	The time interval between a change of Mode A code provided by the ADS-B aircraft domain and an ADS-B surveillance report containing the new Mode A code at point E2 shall be no longer than 5 seconds (95%) TMA.	M	Y	Y	Y	N/A	GS	0010.0200			Moved from 1 st iteration to 2 nd Iteration.
RAD	0020.0023	The time interval between a change of emergency and SPI information provided by the ADS-B aircraft domain and an ADS-B surveillance report	M	Y	Y	Y	N/A	GS	0010.0210			Moved from 1 st iteration to 2 nd Iteration.

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		containing the new emergency and SPI information at point E2 shall be no longer than 5 seconds (95%) TMA.										
RAD	0020.0024	<p>For TMA, if the position accuracy quality indicator (NACp) is not received within 15 seconds of a position message, then the ADS-B Ground Domain shall determine the position accuracy requirement has been met using a NIC encoding that corresponds to 513 meters (or less) as a substitute for the NACp requirement.</p> <p>Note: Alternatively, the requirement might be fulfilled by the existing ATC Processing System, i.e., beyond interface F2*.</p>	M	N/A	N/A	N/A	Y	INT, SDPD		see note	see note	Moved from 1 st iteration to 2 nd iteration. Already implemented in SDPD and interfaces.

Table 3 Baseline Matrix for Iteration 1 requirements moved to Iteration 2

SECOND ITERATION REQUIREMENTS

				Covered by								
Functionality	REQ-15.04.05.a-D19- Req. ID	GS Requirement for 2 nd Iteration	Mandatory / Optional	Thales	Selex	Indra	Eurocontrol	Allocation	D09 References (GS)	D10 References (SDPD)	D11 References (INT)	Notes
APT	0012.0001	If the age of the position information is beyond a time limit, the Target shall be displayed with an indication (e.g. 'coasting' symbol) that the position data is stale and therefore could be unreliable.	M	N/A	N/A	N/A	Y	SDPD		0012.0001		
APT	0012.0002	For all mobiles on the Manoeuvring Area, the Ground Domain should be capable of receiving and processing the following list of ADS-B surveillance parameters: <ul style="list-style-type: none"> ▪ Emitter Category ▪ Geometric Altitude ▪ Velocity Vector (heading/track and ground speed) ▪ Mobile Size (length/width codes) 	M	Y	Y	Y	Y	GS, SDPD	0080.0010, 0080.20, and 0080.30.	0012.0002		

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		GPS antenna offset information										
APT	0012.0003	The Ground Domain shall have the capacity to acquire and maintain all Mobiles in the Manoeuvring Area.	M	Y	Y	Y	N/A	GS	0080.0040			
APT	0012.0004	For all Mobiles on the Manoeuvring Area, the Ground Domain shall be capable of receiving, processing and displaying to the controller the following list of ADS-B surveillance parameters: <ul style="list-style-type: none"> Horizontal Position Identity Information Pressure Altitude (for airborne aircraft) Discrete Emergency Code(s) (not required for vehicles) - as a minimum: general emergency, communications failure, unlawful 	M	Y	Y	Y	N/A	GS	0080.0010			

		interference.										
APT	0022.0001	The update interval for ADS-B position reports for Mobiles on the airport surface Manoeuvring Area shall be 1 second at a probability of at least 90% (at interface E2)	M	Y	Y	Y	N/A	GS	0080.0050			
APT	0022.0002	The update interval for ADS-B emergency mode items for aircraft on the airport surface Manoeuvring Area shall be 2 seconds at a probability of at least 90% (at interface E2)	M	Y	Y	Y	N/A	GS	0080.0060			
APT	0022.0003	The update interval for non-changing ADS-B items for Mobiles on the airport surface Manoeuvring Area shall be 20 seconds at a probability of at least 90% (at interface E2)	M	Y	Y	Y	N/A	GS	0080.0070			
APT	0022.0004	The update interval for changing Identity Information on the airport surface Manoeuvring Area shall be 20 seconds at a probability of at least 90% (at interface E2)	M	Y	Y	Y	N/A	GS	0080.0080			

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APT	0022.0005	The probability of the Ground Domain system integrity failure shall be 1.00E-03 or less per hour	M	Y	Y	Y	Y	GS, SDPD	0080.0090	15.04.05.a-D06-0010.0005		
APT	0022.0006	The probability of the Ground Domain system continuity failure shall be 1.00E-03 or less per hour	M	Y	Y	Y	Y	GS, SDPD	15.04.05.a-D05-0010.0110	0022.0006		
Enhanced ADS-B target report validation via WAM integration	0030.0001	The ADS-B Ground Surveillance Domain processes and decodes received WAM data in ASTERIX CAT020. In addition to data specified in Iteration 1, the following minimum data item should be decoded: <ul style="list-style-type: none"> Measured Height Mode-S MB Data Calculated Track Velocity	O	N	Y	N	N/A	GS	0030.0020, 0030.0205, 0030.0210, and 0030.0215			
Enhanced ADS-B target report validation via WAM integration	0030.0002	The ADS-B Ground Surveillance Domain should be able to manage the case of WAM reports with duplicated Mode S addresses during the phase of correlation of ADS-B reports with WAM reports.	O	N	Y	N	N/A	GS	0030.0220			

Enhanced ADS-B target report validation via WAM integration	0030.0003	The ADS-B Ground Surveillance Domain should be able to check the integrity of the barometric altitude reported in ADS-B reports through the WAM data.	O	N	Y	N	N/A	GS	0030.0225, 0030.0230, 0030.0235, and 0030.0240			
Enhanced ADS-B target report validation via WAM integration	0030.0004	If D19-0030.0003 is implemented, the ADS-B Ground Surveillance Domain shall be able to report the validation result in the ASTERIX CAT021 ADS-B report.	O	N	Y	N	N/A	GS, INT	D09- 0030.0320		0030.0001	
Enhanced ADS-B target report validation via WAM integration	0030.0005	If REQ-15.04.05.a-D19-0030.0004 is implemented, the SDPD shall be able to use the validation result.	O	N/A	N/A	N/A	Y	SDPD		0030.0010		
Enhanced ADS-B target report validation via WAM integration	0030.0006	If REQ-15.04.05.a-D19-0030.0005 is implemented, the validation result shall be reported to the end user of the surveillance data.	O	N	Y	N	Y	SDPD, INT		15.04.05.a- D06- 0030.0020`	0030.0001	

Enhanced ADS-B target report validation via WAM integration	0030.0007	The ADS-B Ground Surveillance Domain should be able to perform a cross check between data in ADS-B report received through 1090 ES and Mode S enhanced data in WAM reports.	O	N	Y	N	N/A	GS	0030.0250, 0030.0255, 0030.0260, 0030.0265, 0030.0270, 0030.0275, 0030.0280, 0030.0285, 0030.0290 and 0030.0295.			
Enhanced ADS-B target report validation via WAM integration	0030.0008	If D19-0030.0007 is implemented, the ADS-B Ground Surveillance Domain shall be able to report the validation result in the ASTERIX CAT021 ADS-B report	O	N	Y	N	N/A	GS	D09-0030.0320			
Enhanced ADS-B target report validation via WAM integration	0030.0009	If REQ-15.04.05.a-D19-0030.0008 is implemented, the SDPD shall be able to use the validation result in order to determine whether the ADS-B report shall be used	O	N/A	N/A	N/A	Y	SDPD		0030.0010, and 15.04.05.a-D06-0030.0015		
Enhanced ADS-B target report validation via WAM integration	0030.0010	If REQ-15.04.05.a-D19-0030.0009 is implemented, the validation result shall be reported to the end user of the surveillance data.	O	N/A	N/A	N/A	Y	SDPD, INT		15.04.05.a-D06-0030.0020	0030.0001	
Enhanced ADS-B target report	0030.0011	The ADS-B Ground Surveillance Domain should be able to check the integrity of the velocity	O	N	Y	N	N/A	GS	0030.0300, 0305, 0310 and 0315.			

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validation via WAM integration		reported in ADS-B reports through the WAM data.										
Enhanced ADS-B target report validation via WAM integration	0030.0012	If D19-0030.0011 is implemented, the ADS-B Ground Surveillance Domain shall be able to report the validation result in the ASTERIX CAT021 ADS-B report.	O	N	Y	N	N/A	GS	0030.0320			
Enhanced ADS-B target report validation via WAM integration	0030.0013	If REQ-15.04.05.a-D19-0030.0012 is implemented, the SDPD shall be able to use the validation result	O	N/A	N/A	N/A	Y	SDPD		0030.0010 and 15.04.05.a-D06-0030.0015		
Enhanced ADS-B target report validation via WAM integration	0030.0014	If REQ-15.04.05.a-D19-0030.0013 is implemented, the validation result shall be reported to the end user of the surveillance data.	O	N/A	N/A	N/A	Y	SDPD, INT		15.04.05.a-D06-0030.0020	0030.0001	
Behavioural Analysis of Targets	0040.0080	The ADS-B Ground Surveillance system should validate the track consistency evaluating track behaviour (values and changes of specific a/c attributes). <i>Note: Those specific attributes are: velocity, acceleration, heading, altitude, and vertical rate.</i>	O	N	N	Y	N/A	GS	0100.0010, 0100.0020, 0100.0030, 0100.0040, 0100.0050, 0100.0060, 0100.0070, 0100.0080, 0100.0090, 0100.0100, 0100.0110, 0100.0120,			

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									0100.0130, 0100.0140, 0100.0150, 0100.0160, 0100.0170, 0100.0180, 0100.0190, 0100.0200, 0100.0210, 0100.0220, 0100.0230, 0100.0240, 0100.0250, 0100.0260 and 0100.0270.			
Behavioural Analysis of Targets	0040.0082	The ADS-B Ground Surveillance system should have a set of configurable ranges for each attribute behaviour to be verified based on "ADS-B Emitter Category SET" Code Definitions. <i>Note: Those specific attributes are: velocity, vertical rate, altitude, acceleration, and heading.</i>	O	N	N	Y	N/A	GS	0100.0280, 0100.0290, 0100.0300, 0100.0310, 0100.0320, 0100.0330, 0100.0340, 0100.0350, and 0100.0360.			
Behavioural Analysis of Targets	0040.0084	Based on received "ADS-B Emitter Category SET" Code Definitions, the ADS-B Ground Surveillance system should verify the track behaviour against predefined valid	O	N	N	Y	N/A	GS	0100.0370, 0100.0380, 0100.0390, 0100.0400, 0100.0410, 0100.0420, 0100.0430, 0100.0440,			

		configurable attribute ranges for each item independently. <i>Note: Those specific attributes are: velocity, vertical rate, altitude, acceleration, and heading.</i>							and 0100.0450,			
Behavioural Analysis of Targets	0040.0086	The ADS-B Ground Surveillance system should issue the corresponding ATX021 report with the PVC bits set to adequate values based on the overall result of Track Consistency verification function. <i>Note: Track Consistency verification includes:</i> <i>1. velocity versus position change (Iteration 1), and</i> <i>2. track consistency evaluating track behaviour (velocity, vertical rate, altitude, acceleration, and heading) (Iteration 2)</i>	O	N	N	Y	N/A	GS, INT	0100.0460, 0100.0470, 0100.0480, 0100.0490, 0100.0500, 0100.0510, 0100.0520, 0100.0530, 0100.0540, 0100.0550, 0100.0560, 0100.0570, 0100.0580, 0100.0590, 0100.0600, 0100.0610, 0100.0620, 0100.0630, 0100.0640, 0100.0650, 0100.0660, 0100.0670, 0100.0680, 0100.0690, 0100.0700, 0100.0710, 0100.0720, and 0100.0730	0040.0002		

Behavioural Analysis of Targets	0040.0088	The SDPD should be able to use the validation result.	O	N/A	N/A	N/A	Y	SDPD		0045.0060, and 0045.0065		
Behavioural Analysis of Targets	0040.0090	The validation result should be reported to the end user of the surveillance data.	O	N/A	N/A	N/A	Y	SDPD, INT		0045.0070	0040.0004	
Time Differential of Arrival	0040.0040	The ADS-B Ground Surveillance Domain should be able to calculate for each received ADS-B position message the relative TDOA.	O	Y	Y	N	N/A	GS	0120.0010, 0120.0030, and 0120.0040			
Time Differential of Arrival	0040.0042	The ADS-B Ground Surveillance Domain should be able to process the TDOA in order to validate the position information extracted from the position message	O	Y	Y	N	N/A	GS	0120.0050, 0120.0060, and 0120.0070			
Time Differential of Arrival	0040.0044	The ADS-B Ground Surveillance Domain should be able to report the validation result in the ASTERIX CAT021 ADS-B report	O	Y	Y	N	N/A	GS, INT	0120.0080, 0120.0090, and 0120.0100		0040.0001	
Time Differential of Arrival	0040.0046	The SDPD shall be able to use the validation result.	O	N/A	N/A	N/A	Y	SDPD		0045.0030, and 0045.0035		

Time Differential of Arrival	0040.0048	The validation result shall be reported to the end user of the surveillance data	O	N/A	N/A	N/A	Y	SDPD, INT		0045.0040	0040.0002 and 0040.0003	
Network Bandwidth Optimisation	0000.0030	The ADS-B Ground Surveillance Domain should have the capability to monitor the load of the network.	O	Y	N	Y	N	GS	0090.0010, and 0090.0020			
Network Bandwidth Optimisation	0000.0032	The ADS-B Ground Surveillance Domain should have the capability to detect the overload of the network.	O	Y	N	Y	N	GS	0090.0110, 0090.0120, 0090.0130, and 0090.0140			
Network Bandwidth Optimisation	0000.0034	The ADS-B Ground Surveillance Domain should have the capability to automatically reduce the load of the network in case of a detected overload, switching to the next level down of degraded data mode.	O	Y	N	Y	N	GS	0090.0210			
Network Bandwidth Optimisation	0000.0036	The ADS-B Ground Surveillance Domain should have the capability to automatically switch back to the next level up of degraded mode or to the normal mode related to the load of the network in the case the detected network load has improved and passed a threshold over a	O	Y	N	Y	N	GS	0090.0310			

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		configurable period of time.										
Network Bandwidth Optimisation	0000.0038	<p>The ADS-B Ground Surveillance Domain should have degraded data mode that could imply:</p> <ul style="list-style-type: none"> omission of optional items (several subsets could be configured); reduced data update rate; geographical filtering 	O	Y	N	Y	N	GS	0090.0410, 0090.0420, 0090.0430, 0090.0435, 0090.0440, 0090.0447, 0090.0450, 0090.0460, 0090.0470, 0090.0480, 0090.0485, 0090.0490, 0090.0495, 0090.0510, 0090.0520, 0090.0540, 0090.0560, and 0090.0580			
Network Bandwidth Optimisation	0000.0040	The ADS-B Ground Surveillance Domain should have a configurable adaptation strategy (including parameters and switching decisions).	O	Y	N	Y	N	GS	0090.0610, 0090.0615, and 0090.0620			
Network Bandwidth Optimisation	0000.0042	The ADS-B Ground Surveillance Domain should have means to indicate to external users the currently used mode level (normal, or level of degradation).	O	Y	N	Y	N	GS	0090.0710, and 0090.0720			

Table 4 Baseline Matrix for Iteration 2

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3.2 Design and Construction Constraints: Baseline Matrix Overall Overview

Due to the different functionalities and enhancements proposed for the Component, an Overall Baseline Matrix addressing the implementation for the different sub-systems as a whole is deemed as necessary.

The following table addresses the different implementations which will be covered per Partner contributor in the Project.

Additionally this table allows to easily check if all the requirements are currently covered by the Project.

		Covered by				Overall fulfillment
Functionality	Mandatory / Optional	Thales	Selex	Indra	Eurocontrol	
ADS-B RAD Compliance	M	Y	Y	Y	Y	Y
ADS-B APT Compliance	M	Y	Y	Y	Y	Y
Enhanced ADS-B target report validation via WAM integration	O	N	Y	N	Y	Y
Behavioural Analysis of Targets	O	N	N	Y	Y	Y
Time Differential of Arrival	O	Y	Y	N	Y	Y
Network Bandwidth Optimisation	O	Y	N	Y	N	Y

Table 5 Baseline Matrix: Overall Overview for Iteration 2

As shown in the table, all requirements are covered by at least one Prototype provider.

4 Assumptions

N/A

5 References

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- [3] SJU 15.04.05a ADS-B 1090 MHz Ext. Squitter Ground Station Specifications – Iteration 2, D09, Ed. 00.01.02, Sep. 2011
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- [8] EUROCAE/RTCA MOPS for 1090 MHz ADS-B, ED-102/DO-260, Sept. 2000
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- [17] EUROCONTROL ASTERIX Standards CAT 63, Ed 1.3, July 2007
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- [20] EUROCAE/RTCA SPIR Document for ADS-B APT Application, ED-163/DO-321, Nov. 2010
- [21] SJU 15.04.05b First Iteration - Baseline Report/Matrix, D02, Ed. 00.01.02, Nov 2012

5.1 Use of copyright / patent material /classified material

No copyright/patent/classified material is included in this report.

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Appendix A Traceability

The objective of this Deliverable is to serve as a quick guideline of the baseline to be taken by the different Prototypes.

Hence, the use of a traceability Matrix is not necessary, as no requirements are defined but options to be implemented.

Traceability will be provided in the following tasks of this Project (i.e. Tailoring of the Test Specifications and Verification activities).

-END OF DOCUMENT-

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