



# ADS-B GS Test Specifications - Iteration I

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## Abstract

This Verification Plan addresses the ADS-B 1090 Ground Station Test Specifications within the functional ADS-B Ground Surveillance Domain as defined in task T005, ADS-B GS Test Specifications for iteration 1. It includes the following key information:

- Scope and context of the ADS-B Ground Station Tests.
- The Test Specifications applying to the Ground Station for Iteration 1 (derived from D18, D05 and D07).

No particular physical implementation or architecture of the prototypes to be tested is assumed for the Ground Station Tests.

This specification will be revisited as appropriate in the course of the project work on iteration 2.

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## Executive summary

This Verification Plan presents the Test Specifications to be performed to the ADS-B 1090 MHz Extended Squitter Ground Station (**1090 GS**) covering the different requirements captured and enhanced as described in the 15.4.5a Deliverables: D18 ADS-B Surveillance System Specifications, Ref [2], D05 ADS-B Ground Station Specifications, Ref. [3] and D07 Interface Specifications, Ref. [4].

This document constitutes the first iteration of the test specifications for the 1090 GS, and it is intended to be used by Project 15.4.5.b in order to develop the first iteration of the 1090 GS prototype compliant with the ADS-B Surveillance Domain enhancements specified in Ref. [2].

The 1090 GS is part of a ground surveillance system that provides airspace and airport surface situational awareness to air traffic controllers and other users. The system provides services that are used by higher-level applications as described in Ref [2]. It makes use of aircraft broadcasted ADS-B data, which include position, velocity, status and other information obtained from onboard systems and sensors.

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter (**1090 ES**) messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports and forward these reports to client systems (typically SDPS) over a Ground Network.

These test specifications are intended to provide the means for verifying the compliance of the equipment to the different requirements not taking into account the physical architecture of the equipment. Hence, allowance is made for different ADS-B Ground Station architectures.

# 1 Introduction

## 1.1 Purpose and scope of the document

This document describes the specifications for the first iteration of tests for the ADS-B Ground Surveillance Station.

It is to be used as input documentation for project 15.4.5b producing the test specifications for an ADS-B Ground Station.

The tests shall be described at a high level and shall be refined and tailored in project 15.4.5b.

This document provides the Verification Plan for an ADS-B Ground Station. It describes how requirements defined in D18 ADS-B Surveillance System Specifications, Ref [2], D05 ADS-B Ground Station Specifications, Ref. [3] and D07 Interface Specifications, Ref. [4]. are intended to be verified.

## 1.2 Intended audience

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 verification activities.

## 1.3 Structure of the document

This section states how the document is organised.

- Chapter 1: Purpose and scope
- Chapter 2: Context of the Verification;
- Chapter 3: Verification Approach;
- Chapter 4: Verification Activities
- Chapter 5: Referenced documents
- Appendices with verification exercises and preliminary coverage matrix.

## 1.4 Acronyms and Terminology

Term	Definition
1090 ES	1090 MHz Mode S Extended Squitter
1090 GS	ADS-B 1090 MHz Extended Squitter Ground Station
A/V	Aircraft/Vehicle
AC	Alternating Current
ACARS	Aircraft Communications, Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ADD	Architecture Definition Document
ADS	Automatic Dependent Surveillance

ADS-B	Automatic Dependent Surveillance - Broadcast
AGL	Above Ground Level
ANSP	Air Navigation Service Provider
ASTERIX	All Purpose Structured EUROCONTROL Surveillance Information Exchange
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
AVOL	Airport Visibility Operational Level
BDS	Comm-B Data Selector
BITE	Built-In Test Equipment
BNR	Binary Numbers
CCW	Counter Clockwise
CDTI	Cockpit Display of Traffic Information
CMS	Control and Monitoring System
Comm -A	Short Uplink Communication Message (Mode S)
Comm-B	Short Downlink Communication Message (Mode S)
Comm-C	Long Uplink Communication Message (Mode S)
Comm-D	Long Downlink Communication Message (Mode S)
Comm-U	ACAS Air 'Uplink' Communication Message (Mode S)
Comm-V	Air 'Downlink' Communication Message (Mode S)
CPR	Compact Position Reporting
CRC	Cyclic Redundancy Check
CW	Clockwise
DC	Direct Current
DF	Downlink Format
DME	Distance Measuring Equipment
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
E-OCVM	European Operational Concept Validation Methodology
EPU	Estimated Position Uncertainty
ERP	Effective Radiated Power
ES	Extended Squitter
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FCU	Flight Control Unit
FDPS	Flight Data Processing System

FIS	Broadcast
FMS	Flight Management System
FOM	Figure of Merit
fpm	Feet Per Minute
FS	Flight Status
FTC	Format Type Code (ADS-B)
GBAS	GPS/Ground-Based Augmentation System
GICB	Ground Initiated Comm-B
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GS	Ground Station
HDOP	Horizontal Dilution of Precision
Hz	Hertz
I/O	Input and/or Output
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation System
INTEROP	Interoperability Requirements
IP	Internet Protocol
IRS	Interface Requirements Specification
LAAS	Local Area Augmentation System
LAN	Local Area Network
lb	Pounds
LNAV	Lateral Navigation
LRU	Line Replaceable Unit
LSB	Least Significant Bit
MA	Message field in Comm-A (Mode S)
MASPS	Minimum Aviation System Performance Standards
MB	Message field in Comm-B (Mode S)
MC	Message field in Comm-C (Mode S)
MCP	Mode Control Panel
MD	Message field in Comm-D (Mode S)
ME	Message Field in Extended Squitter
MHz	Megahertz
MIB	Management Information Base
MLAT	Multilateration

MOPS	Minimum Operational Performance Standards
MSB	Most Significant Bit
MSL	Minimum Signal Level
MTBF	Mean Time Between Failure
MTL	Minimum Trigger Level
MTOW	Maximum Take-Off Weight
MTTR	Mean Time To Repair
MU	U (Mode S)
MV	V (Mode S)
N/A	Not applicable
NACP	Navigation Accuracy Category for Position
NACV	Navigation Accuracy Category for Velocity
NAV	Navigation
NAVAID	Navigation Aid
NIC	Navigation Integrity Category
NICBARO	Navigation Integrity Category for Barometric Altitude
NM	Nautical Mile
NOTAM	Notice to Airmen
NRA	Non Radar Airspace
NUCP	Navigation Uncertainty Category for Position
NUCR	Navigation Uncertainty Category for Velocity
OSD	Operational Service and Environment Definition
Pr	Probability of Receipt
PRF	Pulse Repetition Frequency
PSR	Primary Surveillance Radar
PUT/SUT	Product Under Test. This may be used to refer to both System Under Test and Concept Under Test.
RA	Resolution Advisory
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radio Frequency
RTCA	Radio Technical Commission for Aeronautics
s	Seconds
SAC	System Area Code
SAE	Standard Aerospace Equipment
SAR	Search And Rescue
SARPS	Standards and Recommended Practices
SAT	Site Acceptance Test
SBAS	GPS/Space-Based Augmentation System
SDPD	Surveillance Data Processing and Distribution
SDPS	Surveillance Data Processing System



SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SIC	System Identification Code
SIL	Surveillance Integrity Level
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SMR	Successful Message Reception
SNMP	Simple Network Management Protocol
SPI	Special Position Identification
SPR	Safety and Performance Requirements
SS	Short Squitter
SSR	Secondary Surveillance Radar
TA	Traffic Advisory
TAD	Technical Architecture Description
TAS	True Airspeed
TCAS	Traffic Alert and Collision Avoidance System
TCP	Trajectory Change Point
TDOA	Time Difference of Arrival
TIS-B	Traffic Information System Broadcast
TMA	Terminal Area
TOA	Time of Applicability
TOMR	Time of Message Reception
TS	Technical Specification
TSD	Traffic Situation Display (see also CDTI)
TSO	Technical Standards Order
TTL	Time to Live
U.S.	United States
UAV	Unmanned Air Vehicle
UDP	User Datagram Protocol (an Internet Protocol)
UF	Uplink Format
UPS	Uninterruptible Power System
UTC	Universal Time Coordinated
VDOP	Vertical Dilution of Precision
VFR	Visual Flight Rules
VHF	Very High Frequency
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Radio Range
VP	Validation Plan

VS	Vertical Status
VSWR	Voltage Standing Wave Ratio
WAAS	Wide Area Augmentation System
WAM	Wide Area Multilateration
WAN	Wide Area Network
WGS	World Geodetic System 1984

## 2 Context of the Verification

The scope of this Verification Plan addresses the ADS-B Ground Station to be developed under the requirements defined in D18 ADS-B Surveillance System Specifications, Ref. [2] D05 ADS-B Ground Station Specifications, Ref. [3] and D07 Interface Specifications, Ref.[4] in Project 15.4.5b.

Main addressed stakeholders are Manufacturers of the ADS-B Ground Station prototypes, ANSPs and ATM Organizations, such as EUROCONTROL.

Project 15.4.5a has developed these test specifications in order to provide Project 15.4.5b with a main input to perform the verification of some prototypes: Project 15.4.5b will take this input and will refine and perform a tailoring of it to suit Project 15.4.5b's needs.

Therefore, the Verification activities will be performed in Project 15.4.5b.

## 3 Verification Approach

### 3.1 Verification Overview

Verification activities will be taking place in Project 15.4.5b, using this document as a ramp-up for a refined verification document to be completed in 15.4.5b.

Requirements addressed by D18 ADS-B Surveillance System Specifications, Ref.[2], D05 ADS-B Ground Station Specifications, Ref.[3] and D07 Interface Specifications, Ref. [4] will be verified using different methods (tests, analysis, inspection and design reviews). These will be properly identified in the preliminary Coverage Matrix, which can be found in Appendix BBB.

Objectives and Tests exercises have been developed according to the SESAR Requirements and V&V Guidelines, Ref.[5].

They are broken down into the following categories:

- ☐ Functional Requirements;
- ☐ Performance;
- ☐ Interoperability;
- ☐ Security.

The layout follows the description in Ref. [6].

In accordance with the guidelines in Ref. [6], requirement identifiers follow the scheme:

**ID-15.04.05.a-TS-00xx.yyyy**, where

**ID** is either **OBJ** for Objective or **EXE** for Test exercise.

xx	Meaning
10	ED-161 Identifier
20	DO-260B Identifier
30	WAM integration Id.
40	ToA versus Distance Id.
50	Power versus Distance Id.
60	Angle of Arrival Id.
70	Track Consistency Check (Velocity versus Position Change) Id
00	Other

Table 1: Identifier Allocation

## 3.2 Verification Objectives

Important: Due to be working with different level Specifications, some Requirements on D05 can be traced to more than one D18 Requirements. In these cases, only one Objective will be written in this Iteration, covering all related D18 Requirements.

More precisely:

- REQ-15.04.05.a-D18-0060.0060 is covered by REQ-15.04.05.a-D05-0010.0010, thus covered by D18-0010.0001. So D18-0060.0060 is already covered by OBJ-15.04.05.a-TS.0010.0001.
- REQ-15.04.05.a-D18-0060.0062 is covered by REQ-15.04.05.a-D05-0010.0010, thus covered by D18-0010.0001. So D18-0060.0062 is already covered by OBJ-15.04.05.a-TS.0010.0001.

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0001
Objective	The aim of this objective is to check that the "Ground ADS-B Receive" function receives 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.
Title	ADS-B Receive
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0001	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0002
Objective	The aim of this objective is to check that the "Ground ADS-B Receive" function provides the following minimum data set to the ATC Processing system: <ul style="list-style-type: none"> <li>• Aircraft Horizontal Position – Latitude and Longitude;</li> <li>• Pressure altitude ;</li> <li>• Quality Indications of Horizontal Position ;</li> <li>• Aircraft Identity ; Emergency Indicators ;</li> <li>• Special Position Identification ;</li> <li>• Time of Applicability.</li> </ul> <b>NOTE:</b> <i>Emergency Indicators and SPI are provided only when selected by the flight crew.</i>
Title	ADS-B Data Provision
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0002	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0003
Objective	The aim of this objective is to check that when direct recognition procedures are used by the ATCO for identification, the ADS-B Ground Domain contains a function to ensure the aircraft identity data that is broadcast is retained and correctly associated with the position information for display,
Title	Aircraft Identity Retain
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0003	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0004
Objective	The aim of this objective is to check that the "Ground ADS-B Receive" function provides in each ADS-B surveillance report a time of applicability (Interface E2) of the position information
Title	Time Of Applicability provision
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0004	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0005
Objective	The aim of this objective is to check that 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 provides separate times of applicability for the specific data items that differ,
Title	Separate Times Of Applicability provision
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0005	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0010.0006
Objective	The aim of this objective is to check that the "Ground ADS-B Surveillance



	Processing" function time-registers the asynchronously received ADS-B position updates from ADS-B-equipped aircraft
Title	Position Updates Time registration
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0010.0006	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0001
Objective	The aim of this objective is to check that the likelihood of an ADS-B Ground Domain system integrity failure is 2E-05 or less per hour.
Title	System Integrity
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0001	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0002
Objective	The aim of this objective is to check that the likelihood of a "Ground ADS-B Receive" function continuity failure is 1E-05 or less per hour.
Title	Receive Function Continuity
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0002	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0003
Objective	<p>The aim of this objective is to check that the 95% latency for ADS-B surveillance reports (measured between points D and E2 output of the "Ground ADS-B Receive" function) is not greater than 0.5 seconds, excluding communication latency to the ATC processing system.</p> <p><i>Note: It is assumed that all latency on the "Ground ADS-B Receive" function is compensated.</i></p>

Title	Latency
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0004
Objective	The aim of this objective is to check that the time of applicability conveyed in the ADS-B surveillance report has an absolute accuracy relative to UTC of $\pm 0.1$ seconds or less.
Title	Time Accuracy
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0004	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0007
Objective	The aim of this objective is to check that the ADS-B Ground Domain has capacity to handle the reports from the maximum load of aircraft in the environment as described in the OSED without degradation.
Title	Report Handling Capacity
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0007	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0013
Objective	The aim of this objective is to check that 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 <b>is</b> at least 99%.
Title	Duplicate Aircraft identities Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0013	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0017
Objective	The aim of this objective is to check that 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 <b>is</b> 97%.
Title	Track Update probability en-route
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0017	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0018
Objective	The aim of this objective is to check that 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 <b>is</b> no longer than 8 seconds (95%) En Route.
Title	Mode A Code Change Detection En-route
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0018	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0019
Objective	The aim of this objective is to check that 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 is no longer than 8 seconds (95%) En Route.
Title	Emergency/SPI Change Detection en-Route
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0019	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0021
Objective	The aim of this objective is to check that 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 is 97%.
Title	Track Update probability TMA
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0021	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0022
Objective	The aim of this objective is to check that 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 is no longer than 5 seconds (95%) TMA.
Title	Mode A Code Change Detection TMA
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0022	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0020.0023
Objective	The aim of this objective is to check that 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 point E2 is no longer than 5 seconds (95%) TMA.
Title	Emergency/SPI Change Detection TMA
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0020.0023	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0001
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable to receive output from a WAM system in ASTERIX CAT 020 version 1.7.
Title	WAM Reception
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0001	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0002
Objective	<p>The aim of this objective is to check that the ADS-B Ground Surveillance Domain processes and decodes received WAM data in ASTERIX CAT020 version 1.7. The following minimum set of data item <b>should</b> be decoded:</p> <ul style="list-style-type: none"> <li>• Aircraft Horizontal Position – Latitude and Longitude</li> <li>• Pressure altitude</li> <li>• Aircraft Identity (Mode 3A, Mode-S Address, Aircraft-Id) and Emergency Indicators</li> <li>• Time of Applicability</li> </ul>
Title	WAM Decoding
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0002	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0003
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable of receive WAM system status messages in ASTERIX CAT 019 version 1.2.

Title	WAM Status Reception
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0004
Objective	The aim of this objective is to check that the, ADS-B Ground Surveillance Domain processes and decode received WAM data in ASTERIX CAT019 version 1.2. The following minimum set of data item needs to be decoded:  <ul style="list-style-type: none"> <li>• Time of Applicability</li> <li>• System Status</li> </ul>
Title	WAM Status Decoding
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0004	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0005
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain uses the WAM System Status received by ASTERIX CAT019 as a criterion for the enabling of the ADS-B validity check.
Title	WAM System Status Use
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0005	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0006
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain correlates ADS-B reports received through 1090ES with reports received from a WAM System in ASTERIX CAT020 version 1.7.
Title	ADS-B/WAM Report association



Status	<In Progress>
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[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0006	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0007
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain verifies the validity of ADS-B reports by comparing ADS-B position data with position data of correlated WAM reports.
Title	ADS-B/WAM Position Data Comparison
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0007	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0008
Objective	The aim of this objective is to check that the validation result (positive/negative) <b>shall</b> be reported in the CAT021 ADS-B report
Title	ADS-B/WAM Consistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0030.0005	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0001
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to determine the direction of arrival of the received ES.
Title	Angle of Arrival Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0001	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0002
Objective	The aim of this objective is to check that each time a valid position message is received for a target in "target data maintenance" mode (see ED-129 chapter 3), the ADS-B Ground Surveillance Domain measures the direction of arrival of it
Title	Angle of Arrival Measurement
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0002	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0003
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain registers a real direction of arrival of each of the received ES.
Title	Angle of Arrival Storage
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0004
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain calculates the direction of arrival of each of the received position ES using the reported position and the known GS position.
Title	Reported Angle of Arrival calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0004	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0005
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain compares the real direction of arrival with the calculated direction of arrival using the reported position.
Title	Angle of Arrival Verification
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0005	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0006
Objective	The aim of this objective is to check that if "n" consecutive position updates defined as "not matching" have been received, then the ADS-B Ground Surveillance Domain marks the message as "direction of arrival Failure".
Title	Angle of Arrival Inconsistency Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0006	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0007
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "direction of arrival failures" in ADS-B reports created out of marked messages.
Title	Direction of Arrival Failure Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0007	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0040
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to measure the power of the received ES
Title	ES Reception Power Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0040	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0041
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable to detect the equipment class of the transmitting aircraft.
Title	Equipment Class Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0041	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0042
Objective	The aim of this objective is to check that once a valid position message is received for a target in "target data maintenance" mode (see ED-129 chapter 3), the ADS-B Ground Surveillance Domain estimates the transmission power of it.
Title	ES Reception Power Measurement
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0042	<Full>

[OBJ Suc]

Identifier	Success Criterion

--	--

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0043
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain calculates the distance of the target from the ADS-B receiver using the reported position and altitude
Title	Expected Reception Power Calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0043	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0044
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain determines the approximate distance of each of the received ES using the measured power and equipment class. (see ED129 appendix F)
Title	Reception Power Increment Calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0044	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0045
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain compares the distance obtained from the received position data with the distance calculated using measured power increments.
Title	Reception Power Validation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0045	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0046
Objective	The aim of this objective is to check that "n" consecutive position updates for which the difference between the approximate distance and the reported distance is greater than "x" Nm have been received in "t" seconds, then the ADS-B Ground Surveillance Domain marks the message as "Power/Distance inconsistency".
Title	Reception Power Inconsistency Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0046	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0047
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "Power/Range inconsistency" in ADS-B reports created out of marked messages.
Title	ES Reception Power / Range Inconsistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0047	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0030
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable to determine the distance of a target from an ADS-B receiver by using the received horizontal position data, the received altitude data and the static receiver position.
Title	Target Distance calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0030	<Full>

[OBJ Suc]

Identifier	Success Criterion



[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0031
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has a function elaborating the consistency of TOA versus calculated distance from an ADS-B receiver for multiple ADS-B receivers having received the same position squitter.
Title	Calculated Distance versus TOA validation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0031	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0032
Objective	The aim of this objective is to check that the If "n" consecutive position updates for which the TOA/distance consistency check yields inconsistent, then the ADS-B Ground Surveillance Domain marks the message as "inconsistent TOA/distance".
Title	TOA versus Distance Inconsistency Detection
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0032	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0033
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "inconsistent TOA/distance" in ADS-B reports created out of marked messages.
Title	ES TOA / Distance Inconsistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0033	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0060.0061
Objective	The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
Title	DO-260B Message Decoding
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0060.0061	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0060.0063
Objective	The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
Title	DO-260B encoding into ATX CAT 021
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0060.0063	<Partial>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0070.0064
Objective	The aim of this objective is to check that the ADS-B System validates ADS-B report consistency by evaluating the ADS-B received target velocity against the ADS-B received target position change.
Title	Position versus velocity check
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D18-0040.0050	<Full>

[OBJ Suc]

Identifier	Success Criterion

### 3.3 Verification Assumptions

This verification plan is the first iteration of a set of future incoming versions (Iteration 2 and 3). In this way, this iteration has been written using EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010 [12] and EUROCAE/RTCA MOPS for 1090ES ADS-B and TIS-B, ED-102A/DO-260B, Dec. 2009 as a reference.

Many of the tests are taken from this document and comply with the requirements based on EUROCAE/RTCA SPIR Document for ADS-B NRA Application, ED-126/DO-303, Dec. 2006 [10].

These tests, will be upgraded in future iterations to include full compliance with all requirements contained in related input documents (*D18 ADS-B Surveillance System Specifications, Ref. [2]*, *D05 ADS-B Ground Station Specifications, Ref. [3]* and *D07 Interface Specifications, Ref. [4]*), based on EUROCAE/RTCA SPIR Document for ADS-B RAD Application, ED-161/DO-318, Sept. 2009 [11], as well as to include environment load parameters as described in the OSED, which is to be defined at the time of creation of this first iteration document.

Also it is assumed that in every test of this document, it will be performed the corresponding ASTERIX data field comprobation according to the defined *D07 Interface Specifications, Ref. [4]* and so it will be marked in the Pass/Fail Result.

### 3.4 Verification Requirements on the Concept/System Under Test

Verification requirements on the system under test will be declared for each independent test in its procedure.

### 3.5 Verification Platform Needs

This document contains a set of type approval tests that can be used to demonstrate compliance with the objectives in section 3.2. These type approval tests are intended to be performed once in order to provide evidence that the ground station design complies with these requirements, and therefore is not intended as a production test or factory acceptance test activity. These test procedures may also be used as part of a regression test following a design change. It is up to the manufacturer to determine the scope and suitability of regression test activity.

These test procedures were written with the intention of saving manufacturers the time and expense of developing their own tests while providing equipment buyers with a minimum level of assurance that the equipment is compliant with the objectives in section 3.2. Alternative tests may be substituted if it is more convenient to do so as long as any substituted test procedures fully cover all the mandatory requirements of the relevant part of section 3.2.

Since many test procedures require a similar test equipment setup, a standard setup is defined here and specific test procedures reference this section, specifying exceptions when necessary.

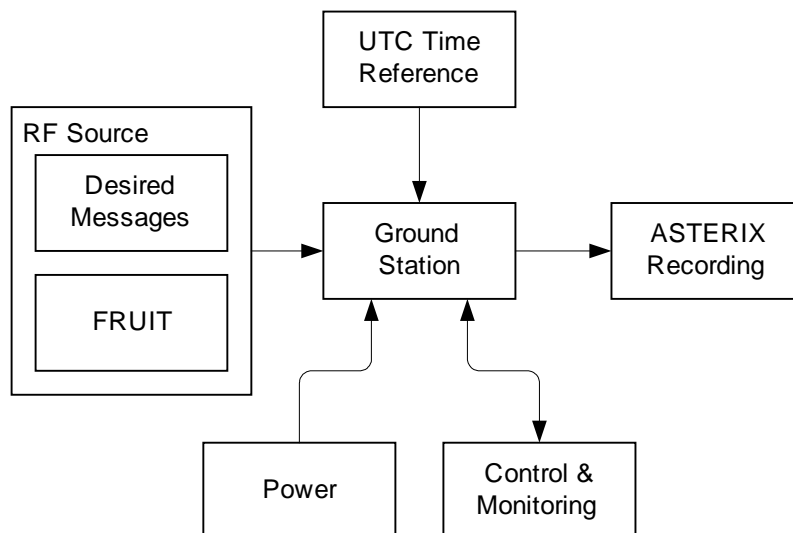
Specific test procedures are defined in this Section starting with section 5.2. Except where otherwise noted, the sub-section number of each test procedure matches the corresponding sub-section number within Section 3.2 containing the requirements being tested.

Only mandatory requirements are covered by these tests.

## Test Equipment Setup

A diagram of the verification platform with standard test equipment setup is shown in Figure 1.

**Figure 1: Standard Test Equipment Setup (Logical Connections)**



*Note: Figure 1 and the remainder of this section describe the test equipment in terms of functions. The functions may be implemented with one or more items of equipment as long as the required capabilities are provided.*

### 3.5.1 RF Source of Desired Messages

Desired messages shall meet the requirements of sections 2.2.2.2.1 and 2.2.3.1 of DO-260A. The source shall be capable of producing messages with an adjustable power level from MTL to -10 dBm at the Ground Station input. The source shall be capable of producing messages simulating 300 targets simultaneously. Desired messages shall not overlap each other. The source shall be capable of producing messages for each simulated target at the rates shown in Table 1.

**Table 1: Message Rates for Desired Messages**

Message Type	Message Rate (per second)	Notes
Airborne Position	2	one even, one odd FTC = 9-18, 20-22
Airborne Velocity	2	FTC = 19, Subtype = 1-4
Aircraft Identification	0.2	FTC = 1-4
Target State and Status	0.8	FTC = 29, Subtype = 0
Aircraft Operational Status	0.4	FTC = 31, Subtype = 0
Aircraft Status	0.4	FTC = 28, Subtype = 1

Dithered transmission intervals, as specified in DO-260A section 2.2.3.3.1, are permissible but not required. Simulated targets may be moving or stationary. Stationary targets must have velocity messages.

### 3.5.2 RF Source of FRUIT

The FRUIT source shall be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time with the power distribution shown in Table 2.

**Table 2: Amplitude and Message Type Distribution of the Injected FRUIT**

Signal Level dB	A/C Squitters	Short Squitters	Extended Squitters	Cumulative A/C	Cumulative SS	Cumulative ES	Cumulative SS+ES
-74	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-75	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-76	11.4	27.6	6.2	11.4	27.6	6.2	33.8
-77	0.0	0.0	0.0	11.4	27.6	6.2	33.8
-78	5.7	24.8	9.3	17.1	52.4	15.5	67.9
-79	4.0	20.4	15.5	21.1	72.7	31.0	103.7
-80	3.5	12.0	6.2	24.5	84.7	37.2	121.9
-81	27.6	85.4	24.8	52.2	170.1	62.0	232.1
-82	19.7	91.3	24.8	71.8	261.4	86.8	348.2
-83	12.3	47.8	21.7	84.2	309.2	108.5	417.7
-84	30.7	95.6	34.1	114.9	404.8	142.6	547.4
-85	45.7	118.3	46.5	160.6	523.1	189.1	712.2
-86	60.4	189.5	55.8	221.0	712.6	244.9	957.5
-87	119.5	299.5	93.0	340.4	1012.1	337.9	1350.0
-88	85.8	218.1	62.0	426.2	1230.1	399.9	1630.0
-89	108.9	271.3	80.6	535.1	1501.5	480.5	1982.0
-90	163.7	405.9	105.4	698.8	1907.4	585.9	2493.3
-91	177.2	443.2	114.7	876.0	2350.6	700.6	3051.2
-92	169.8	502.6	124.0	1045.8	2853.2	824.6	3677.8
-93	100.4	277.9	65.1	1146.2	3131.1	889.7	4020.8
-94	113.7	259.4	55.8	1259.9	3390.5	945.5	4336.0
-95	134.2	313.6	49.6	1394.1	3704.1	995.1	4699.2
-96	48.7	164.2	27.9	1442.8	3868.3	1023.0	4891.3
-97	42.3	84.2	12.4	1485.1	3952.5	1035.4	4987.9
-98	1.2	5.7	3.1	1486.3	3958.1	1038.5	4996.6
-99	2.8	13.2	3.1	1489.1	3971.3	1041.6	5012.9
-100	0.0	0.0	0.0	1489.1	3971.3	1041.6	5012.9
-101	0.0	0.0	0.0	1489.1	3971.3	1041.6	5012.9

The quoted amplitudes assume a zero gain reference antenna. These amplitudes must be adjusted to match the typical gain of the antenna the 1090 ES Ground Station is to be used with.

*Note: The data content of the Mode S FRUIT transmissions is not critical, since one and zero bits have equal energy content. The Mode A/C replies should have half the code bits set (e.g. 0707 or 2525) to reflect the average energy content of all messages. It may be*

*useful to use non-ADS-B DF codes (e.g. 20) for the Mode S ES messages to prevent valid FRUIT ADS-B messages from appearing in the ASTERIX data.*

### 3.5.3 UTC Time Reference

A means of disabling or disconnecting the UTC time reference shall be provided.

### 3.5.4 Control and Monitoring Equipment

Control and monitoring equipment shall be present as to interface with the 1090 ES Ground Station. A means of polling the Ground Station for values of all parameters shall be provided. The control and monitoring equipment shall allow a user to authenticate with and control the Ground Station.

### 3.5.5 ASTERIX Recording Equipment

The ASTERIX recording equipment shall timestamp and record all ASTERIX reports sent from the 1090 ES Ground Station.

The control and monitoring equipment, ASTERIX recording equipment and any other network capable test equipment may be connected through suitable networking equipment.

All test equipment requiring calibration shall have documentation showing that the equipment calibration is valid.

Default Configuration, Mode and State

- a) The 1090 ES Ground Station and all of the test equipment shall be powered on before the beginning of each test.
- b) The 1090 ES Ground Station shall be configured to the default parameter values shown in Appendix A.
- c) The mode shall be Operational.
- d) The state shall be Online.
- e) The time state shall be UTC coupled.
- f) The 1090 ES Ground Station shall have no information on any targets.
- g) Network configuration parameters shall be assigned so that the 1090 ES Ground Station can communicate with the control and management equipment, the ASTERIX recording equipment and any other network connected test equipment.
- h) The MaxBitRate parameter shall be set to the maximum value appropriate for the network.
- i) The 1090 ES Ground Station shall have a suitable configured own position (GSLatitude, GSLongitude) or self-determined (e.g. GPS self-survey) Ground Station location.
- j) The default power level for injected test messages shall be MTL + 3dB.
- k) FRUIT generation shall not be enabled by default.

Message Set Construction

Message sequences for individual targets must be constructed carefully to produce ASTERIX Category 021 output.

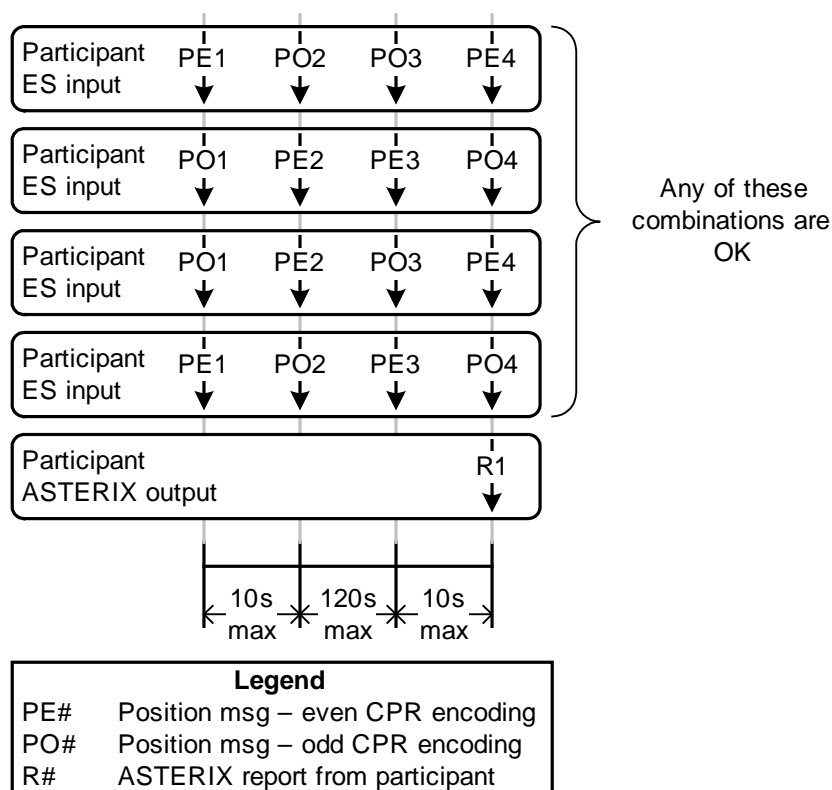
### 3.5.6 Initial Position Messages

Sequences must begin with two even-odd (or odd-even) pairs of messages to allow the Ground Station to acquire the target.

The position messages in each of the first two pairs of messages must be less than 10 seconds apart.



**Figure 2: Initial Position Messages**



The position conveyed in the first pair of messages must be within CPRAirborneMaxRange of the configured (GSLatitude, GSLongitude) or self-determined (e.g. GPS self-survey) Ground Station location.

If moving targets are used, the position change from one message to the next in each of the first two pairs of messages (i.e. from 1 to 2 and from 3 to 4) must be less than 3NM in both latitude and longitude.

If the scenario is correct, the first ASTERIX report will be produced after the 2nd pair of even-odd messages.

Scenario design may be easier to verify in data-driven reporting mode.

### 3.5.7 Field Values

Most tests will use data from just a few 1090 ES message fields. If the number of values that can be conveyed by a field is small, then all the values should be tested. A one bit field has only two possible values, so both should be tested. If the number of values that can be conveyed by a field is large, a subset of the values should be checked. For example, there are thousands of possible altitude values that can be conveyed in position messages. An appropriate subset of these values would include minimum, minimum + 1 LSB, maximum, maximum – 1 LSB and a value in the middle of the altitude range.

Fields that are not relevant for a specific test should be assigned random values. The values may be static throughout a scenario or they may change. Random values in seemingly irrelevant fields will confirm that the outputs are dependent only on the expected fields. The random values must be chosen so they do not stop the output of the Ground Station. For example, if the Flight Level data item is being verified, randomised position values must not change by more than 6NM between successive reports less than 30 seconds apart.

### 3.5.8 Altitude Values

Airborne position messages should contain barometric altitude unless geometric altitude is required for a specific test.

### 3.5.9 Configuration Changes

When a specific test procedure calls for changing a 1090 ES Ground Station configuration parameter value, assume that the user will authenticate with the Ground Station, put the Ground Station in maintenance mode, change the parameter(s), put the Ground Station back into operational mode and then log out of the Ground Station. If the Ground Station was in maintenance mode or the user was already authenticated, then the mode change and authentication steps are not necessary.

### 3.5.10 Checking of Log Files

Ground Station logs shall be checked at the conclusion of each test for unexpected warnings, errors or other anomalies. Any unexpected error or anomaly constitutes a test failure.

## 3.6 Integration and preliminary Verification activities

This section cannot be defined at this stage of the Project (Iteration 1): Project 15.4.5a will refine in forthcoming versions (Iteration 2 and 3) this document.

In any case, preliminary Verification activities will be limited at this stage at visual inspections of the elements that are part of the System Under Test to guarantee that it is ready to undergo the Verification activity.

Manufacturers of the Systems can define additional criteria for both the integration and preliminary activities, being the main stakeholders for the Verification activities.

## 3.7 Acceptance criteria

This section cannot be defined at this stage of the Project (Iteration 1): Project 15.4.5a has got 2 additional Iterations which will be used to refine this document up to a concise final.

## 4 Verification Activities

### 4.1 Verification Exercises List

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0000
Exercise	GS receiving function
Title	GS receiving function
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0010
Exercise	GS decoding function
Title	GS decoding function
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0020
Exercise	GS Association function 1
Title	GS Association function 1
Status	<In Progress>
Responsible Project	N/A

Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0030
Exercise	GS Association function 2
Title	GS Association function 2
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0040
Exercise	GS Validation 1
Title	GS Validation 1
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

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Identifier	EXE-15.04.05.a-TS.0010.0050
Exercise	GS Validation 2
Title	GS Validation 2
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0010.0060
Exercise	GS Data Item Inclusion
Title	GS Data Item Inclusion
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0001	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0002	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0003	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0004	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0005	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0010.0006	<Full>

[EXE]

Identifier	EXE-15.04.05.a- TS.0020.0000
Exercise	GS Integrity
Title	GS Integrity
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0001	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0010
Exercise	GS Continuity
Title	GS Continuity
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.00002	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0020
Exercise	GS Latency
Title	GS Latency
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.00003	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0030
Exercise	TOA accuracy
Title	TOA accuracy
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.00004	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0040
Exercise	GS Capacity
Title	GS Capacity
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0007	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0050
Exercise	Duplicated 24Bit addresses
Title	Duplicated 24Bit addresses
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0013	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0060
Exercise	Probability for Target in En-Route Airspace
Title	Probability for Target in En-Route Airspace
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A



Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0017	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0070
Exercise	Change of mode A code En Route
Title	Change of mode A code En Route
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0018	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0080
Exercise	Emergency SPI information En Route
Title	Emergency SPI information En Route
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0019	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0090
Exercise	Probability for Target in TMA Airspace
Title	Probability for Target in TMA Airspace
Status	<In Progress>

Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0021	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0100
Exercise	Change of Mode A code TMA
Title	Change of Mode A code TMA
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0022	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0020.0110
Exercise	Emergency SPI information TMA
Title	Emergency SPI information TMA
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0020.0023	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0030.0010
Exercise	Integration with WAM
Title	Integration with WAM
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0001	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0002	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0003	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0004	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0005	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0006	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0007	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0030.0008	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0040.0000
Exercise	Angle of Arrival Validation
Title	Angle of Arrival Validation
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0001	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0002	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0003	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0004	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0005	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0006	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0007	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0040.0020
Exercise	Power versus Distance Validation
Title	Power versus Distance Validation
Status	<In Progress>

Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0040	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0041	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0042	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0043	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0044	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0045	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0046	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0047	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0040.0030
Exercise	Time of Arrival versus Distance Validation
Title	Time of Arrival versus Distance Validation
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0030	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0031	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0032	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0033	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0000
Exercise	"Reserved" OM Code Subfield in Aircraft Operational Status Messages
Title	"Reserved" OM Code Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0010
Exercise	Reserved Bit-A" Subfield in Airborne Velocity Messages – Subtype=1
Title	Reserved Bit-A" Subfield in Airborne Velocity Messages – Subtype=1
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0020
Exercise	TCAS Operational" Subfield in Target State and Status Messages
Title	TCAS Operational" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0030
Exercise	"Geometric Vertical Accuracy (GVA)" Subfield in Aircraft Operational Status Messages
Title	"Geometric Vertical Accuracy (GVA)" Subfield in Aircraft Operational Status Messages
Status	<In Progress>

Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0040
Exercise	GPS Antenna Offset" OM Code Subfield in Aircraft Operational Status Messages
Title	GPS Antenna Offset" OM Code Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0050
Exercise	Source Integrity Level (SIL)" Subfield in Aircraft Operational Status Messages
Title	Source Integrity Level (SIL)" Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0060
Exercise	"SIL Supplement" Subfield in Aircraft Operational Status Messages
Title	"SIL Supplement" Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0070
Exercise	"System Design Assurance" OM Code Subfield in Aircraft Operational Status Messages
Title	"System Design Assurance" OM Code Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0080
Exercise	"1090ES IN" CC Code Subfield in Aircraft Operational Status Messages
Title	"1090ES IN" CC Code Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A



Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0090
Exercise	"UAT IN" CC Code Subfield in Aircraft Operational Status Messages
Title	"UAT IN" CC Code Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0100
Exercise	"NIC Supplement-B" Subfield in ADS-B Airborne Position Messages
Title	"NIC Supplement-B" Subfield in ADS-B Airborne Position Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

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Identifier	EXE-15.04.05.a-TS.0060.0110
Exercise	"NIC Supplement-C" Subfield in Aircraft Operational Status Messages
Title	"NIC Supplement-C" Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0120
Exercise	"Aircraft/Vehicle Length and Width Code" Subfield in Aircraft Operational Status Messages
Title	"Aircraft/Vehicle Length and Width Code" Subfield in Aircraft Operational Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0130
Exercise	Navigation Integrity Code (NIC)
Title	Navigation Integrity Code (NIC)
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0140
Exercise	"NAC <sub>P</sub> " Subfield in Target State and Status Messages
Title	"NAC <sub>P</sub> " Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0150
Exercise	"NAC <sub>V</sub> " Subfield in Airborne Velocity Messages - Subtype=1
Title	"NAC <sub>V</sub> " Subfield in Airborne Velocity Messages - Subtype=1
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0160
Exercise	"Selected Heading Status", "Selected Heading Sign", and "Selected Heading"
Title	"Selected Heading Status", "Selected Heading Sign", and "Selected Heading"
Status	<In Progress>

Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0170
Exercise	"MCP/FCU Selected Altitude or FMS Selected Altitude" Subfield in Target State and Status Messages
Title	"MCP/FCU Selected Altitude or FMS Selected Altitude" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0180
Exercise	"Barometric Pressure Setting (Minus 800 millibars)" Subfield in Target State and Status Messages
Title	"Barometric Pressure Setting (Minus 800 millibars)" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0190
Exercise	"Status of MCP/FCU Mode Bits" Subfield in Target State and Status Messages
Title	"Status of MCP/FCU Mode Bits" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0200
Exercise	"Autopilot Engaged" Subfield in Target State and Status Messages
Title	"Autopilot Engaged" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0210
Exercise	"VNAV Mode Engaged" Subfield in Target State and Status Messages
Title	"VNAV Mode Engaged" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A

Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0220
Exercise	"Altitude Hold Mode" Subfield in Target State and Status Messages
Title	"Altitude Hold Mode" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0230
Exercise	"Approach Mode" Subfield in Target State and Status Messages
Title	"Approach Mode" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0240
Exercise	"LNAV Mode Engaged" Subfield in Target State and Status Messages
Title	"LNAV Mode Engaged" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0250
Exercise	"Mode A (4096) Code" Subfield in Aircraft Status Messages
Title	"Mode A (4096) Code" Subfield in Aircraft Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0260
Exercise	"Movement" Subfield in ADS-B Surface Position Messages
Title	"Movement" Subfield in ADS-B Surface Position Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0270
Exercise	"SUBTYPE" Code Subfield in Surface System Status Messages
Title	"SUBTYPE" Code Subfield in Surface System Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0060.0280
Exercise	"Reserved for ADS-R Flag" Subfield in Target State and Status Messages
Title	"Reserved for ADS-R Flag" Subfield in Target State and Status Messages
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0063	<Partial>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0060.0061	<Partial>

[EXE]

Identifier	EXE-15.04.05.a-TS.0070.0000
Exercise	Position versus velocity check
Title	Position versus velocity check
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A

Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0070.0064	<Full>

## 4.2 Verification Exercises Planning

N/A.

## 5 References

- [1] SJU 15.04.05a Specification Baseline Document, D17, Ed. 00.01.00, Oct 2010
- [2] SJU 15.04.05a, *ADS-B Surveillance System Specifications D18*
- [3] SJU 15.04.05a, *ADS-B Ground Station Specifications, D05*
- [4] SJU 15.04.05a, *Interface Specifications, D07*
- [5] SESAR Requirements and V&V Guidelines Latest version
- [6] SESAR Toolbox User Manual Latest version
- [7] EUROCAE/RTCA MOPS for 1090 MHz ADS-B, ED-102/DO-260, Sept. 2000
- [8] RTCA MOPS for 1090ES ADS-B and TIS-B, DO-260A, Dec. 2006 (includes Changes 1 and 2)
- [9] EUROCAE/RTCA MOPS for 1090ES ADS-B and TIS-B, ED-102A/DO-260B, Dec. 2009
- [10] EUROCAE/RTCA SPIR Document for ADS-B NRA Application, ED-126/DO-303, Dec. 2006
- [11] EUROCAE/RTCA SPIR Document for ADS-B RAD Application, ED-161/DO-318, Sept. 2009
- [12] EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010
- [13] EUROCONTROL ASTERIX Standards CAT 21, Ed 1.8, Jan 2011,
- [14] EUROCONTROL ASTERIX Standards CAT 23, Ed 1.2, March 2009
- [15] EUROCONTROL ASTERIX Standards CAT 62, ED 1.10, December 2009
- [16] EUROCONTROL ASTERIX Standards CAT 63, Ed 1.3, July 2007
- [17] EUROCONTROL ARTAS V8, System/Segment Specifications, Doc. 46 127 300 – 305

## Appendix A Verification Exercise EXE-15.04.05.a- TS.0010.0000 GS receiving function

### A.1 Exercise Scope and Justification

#### A.1.1 Exercise Level

The level of the exercise is functional.

#### A.1.2 Exercise Type

The type of this exercise is Test.

#### A.1.3 Description of the system being addressed;

Ground Station ADS-B.

#### A.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### A.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### A.1.6 Verification objectives

OBJ-15.04.05.a-TS.0010.0001
-----------------------------

The aim of this objective is to check that the "Ground ADS-B Receive" function receives 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.
--

#### A.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

- Messages with DF = 17 form an airborne target
- Messages with DF = 18 and CF = 0 or 1 from an airborne target
- Messages with DF = 19 and AF = 0

#### A.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated at input.

#### A.1.9 Entrance criteria

Starting the generation of 1090 MHz Extended Squitter messages set as indicated in the table below.

## A.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in input and once all outputs have been recorded and analyzed.

## A.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010. 0010 / Receiving function

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station receives and processes the following 1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

- Messages with DF = 17 form an airborne target
- Messages with DF = 18 and CF = 0 or 1 from an airborne target
- Messages with DF = 19 and AF = 0

**Exercise Type:** Test

**Precondition(s):**

- The test equipment setup will be in line with that described in Section A.1.13 (see below).
- The scenario consists of generation of the Mode S messages as shown in the next Table by means of Input Source for ADS –B Messages.

INPUTS						OUTPUT	
Msg No	Inject Time (s)	DF	CA/CF/AF	FTC	CPR	ASTERIX Category 021 Report	Notes
1	0.5	17	0	9-18	0	No	
2	1.0	17	4	9-18	1	No	
3	1.1	0	NA			No	
4	1.2	4	NA			No	
5	1.3	5	NA			No	
6	1.4	11	NA			No	
7	1.5	16	NA			No	
8	1.6	20	NA			No	
9	1.7	21	NA			No	
10	2.0	18	2	9-18	0	No	Use position > 4.5 NM from Msg No 2.
11	2.5	18	3	9-18	1	No	Use position > 4.5 NM from Msg No 2.
12	3.0	18	4	9-18	0	No	Use position > 4.5 NM from Msg No 2.
13	3.5	18	5	9-18	1	No	Use position > 4.5 NM from Msg No 2.

14	4.0	18	6	9-18	0	No	Use position > 4.5 NM from Msg No 2.
15	4.5	18	2	5-8	1	No	Use position > 4.5 NM from Msg No 2.
16	5.0	18	3	5-8	0	No	Use position > 4.5 NM from Msg No 2.
17	5.5	18	4	5-8	1	No	Use position > 4.5 NM from Msg No 2.
18	6.0	18	5	5-8	0	No	Use position > 4.5 NM from Msg No 2.
19	6.5	18	6	5-8	1	No	Use position > 4.5 NM from Msg No 2.
20	7.0	17	7	5-8	0	No	Use position < 1 NM from Msg No 2
21	7.5	17	5	9-18	0	No	Use position < 1 NM from Msg No 2
22	8.0	17	6	9-18	1	Yes	Use position < 1 NM from Msg No 2
23	8.5	18	0	9-18	0	Yes	Use position < 4 NM from Msg No 22
24	9.0	18	1	9-18	1	Yes	Use position < 4 NM from Msg No 22
25	9.1	0	NA			No	
26	9.2	4	NA			No	
27	9.3	5	NA			No	
28	9.4	11	NA			No	
29	9.5	16	NA			No	
30	9.6	20	NA			No	
31	9.7	21	NA			No	
32	10.0	18	2	9-18	0	No	Use position < 4NM from Msg No 22
33	10.5	18	3	9-18	1	No	Use position < 4NM from Msg No 22
34	11.0	18	4	9-18	0	No	Use position < 4NM from Msg No 22
35	11.5	18	5	9-18	1	No	Use position < 4NM from Msg No 22
36	12.0	18	6	9-18	0	No	Use position < 4NM from Msg No 22
37	12.5	18	2	5-8	1	No	Use position < 4NM from Msg No 22
38	13.0	18	3	5-8	0	No	Use position < 4NM from Msg No 22
39	13.5	18	4	5-8	1	No	Use position < 4NM from

							Msg No 22
40	14.0	18	5	5-8	0	No	Use position < 4NM from Msg No 22
41	14.5	18	6	5-8	1	No	Use position < 4NM from Msg No 22
42	15.0	17	0	5-8	1	No	Use position < 4NM from Msg No 22
43	15.5	17	4	5-8	0	No	Use position < 4NM from Msg No 22
44	16.0	17	5	5-8	1	No	Use position < 4NM from Msg No 22
45	16,5	17	6	5-8	0	No	Use position < 4NM from Msg No 22
46	17.0	17	7	5-8	1	No	Use position < 4NM from Msg No 22
47	17.5	17	5	9-18	0	Yes	Use position < 4NM from Msg No 22
48	18.0	17	6	9-18	1	Yes	Use position < 4NM from Msg No 22
49	18.5	18	0	9-18	0	Yes	Use position < 4NM from Msg No 22
50	19.0	18	1	9-18	1	Yes	Use position < 4NM from Msg No 22
51	19.5	19	0	9-18	1	Yes	Use position < 4NM from Msg No 22
52	20.0	19	1		NA	No	Randomise bits 9 through 112

Precondition(s):

- The test equipment setup will be in line with that described in Section A.1.13 (see below).
- The scenario consists of generation of the Mode S messages as shown in the next Table by means of Input Source for ADS –B Message

Note(s):

Device(s) in use:

- Ground Station ADS – B
- ADS –B Message Input Source.
- ASTERIX Recording tool
- Power
- UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the			

	default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Activate Emitter category item I021/020 in ASTERIX Category 021 reports			
6	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
7	Prepare the message source to play the scenario			
8	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
9	Play the scenario in the injection tool	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
10	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
11	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 3: Verification Exercise Result

## A.1.12 Verification SUT requirements

N/A

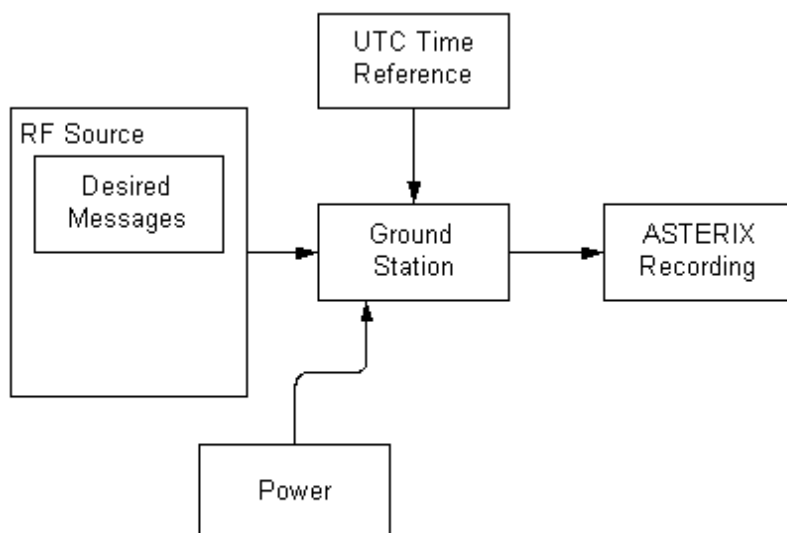
## A.1.13 Exercise Tool, Verification Technique and/or Platform

founding members



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The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Messages
- ASTERIX Recording tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the Analysis of the recorded data verifying that reports produced by the 1090 ADS – B Ground Station are consistent with the input data in the ES messages (e.g. correct lat/lon, altitude etc.).

## A.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## A.1.15 Platform Configuration

N/A

## A.1.16 Configuration(s) Identification of the Verification Platform

N/A

## A.1.17 Links to other Verification Exercises

N/A

## A.1.18 Representatively level/ limitations

N/A

# A.2 Exercises Planning and management

## A.2.1 Activities

### A.2.1.1 Preparatory activities

Set up the tools/equipment listed in 3.5 and A.1.13 in order to meet the Test Preconditions.

### A.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

### A.2.1.3 Post execution activities

Verify that the information reported in the Recorded ASTERIX Reports is consistent with the input messages and expected output.

## A.2.2 Human Resources.

N/A

## A.2.3 Responsibilities in the exercise

N/A

## A.2.4 Training

N/A

## A.2.5 Time planning

N/A

## A.2.6 Risks.

N/A

## A.2.7 Errors and Observation handling

N/A

## A.3 Analysis Specification

### A.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in output are in line with the values generated in input.

### A.3.2 Analysis method

N/A

### A.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix B Verification Exercise EXE-15.04.05.a- TS.0010.0010 GS decoding function

### B.1 Exercise Scope and Justification

#### B.1.1 Exercise Level

The level of the exercise is functional.

#### B.1.2 Exercise Type

The type of this exercise is Test.

#### B.1.3 Description of the system being addressed;

Ground Station ADS – B.

#### B.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### B.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### B.1.6 Verification objectives

The aim of this test procedure is to check that the system detects the version of the 1090 ES MOPS of messages received, decodes the messages according to the detected version, and reports the parameters contained therein accordingly. During the test, all the transitions between version states 0, 1 and unrecognized are tested. In future iterations, the test will be upgraded to include version 2 and decode the information correctly.

OBJ-15.04.05.a-TS.0010.0001
-----------------------------

The aim of this objective is to check that the “Ground ADS-B Receive” function receives 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.
--

#### B.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO206B. Position of the targets shall be inside the maximum range configured in the GS.

#### B.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated in input.

#### B.1.9 Entrance criteria

Starting the generation of 1090 MHz Extended Squitter messages set as indicated in the table below.

## B.1.10 Exit Criteria

The Test will finish after the generation of all the messages foreseen in the input and once all outputs have been recorded and analyzed.

## B.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010. 0010 / decoding function

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station decodes the following 1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

-

**Exercise Type:** Test

**Precondition(s):** The following scenario has been designed to cover all possible version state transitions:

- Step 1: Target acquisition and version 0 assumed. VNS=0, VN=0.
- Step 2: Change from version 0 assumed to version 0 confirmed.
- Step 3: Change from version 0 confirmed to version 1.
- Step 4: Change from version 1 confirmed to version 0 confirmed.
- Step 5: Change from version 0 confirmed to unrecognized version. Note: VNS is 1 for unrecognized version.
- Step 6: Change from unrecognized version to version 0 confirmed.
- Step 7: 92 Seconds of position messages only. Version information should expire, resulting in assumed version 0. VNS=0, VN=0.
- Step 8: Change from version 0 assumed to version 1.
- Step 9: Change from version 1 confirmed to unrecognized version. Note: VNS is 1 for unrecognized version.
- Step 10: Change from unrecognized version to version 1 confirmed.
- Step 11: 92 Seconds of position messages only. Version information should expire, resulting in assumed version 0. VNS=0, VN=0.
- Step 12: Change from version 0 assumed to unrecognized version. Note: VNS is 1 for unrecognized version.
- Step 13: 92 Seconds of position messages only. Version information should expire, resulting in assumed version 0. VNS=0, VN=0.

Once these steps are completed, all possible version state transitions are covered.

Note: The target in this scenario may be stationary. Velocity messages and emitter category / callsign messages may be present but are not required

- The scenario consists of generation of the Mode S messages as shown in the next Table by means of Input Source for ADS –B Message

Step	ES Input					Expected ASTERIX Category 021 Output		
	Msg ID	Inject Time (s)	FTC	CPR	MOPS VN	Rpt	VNS	VN
1	PO1	0.5	18	0				
	PE2	1	18	1				
	PO3	1.5	18	0				
	PE4	2	18	1		R1	0	0 (assumed)
	PO5	2.5	18	0		R2	0	0 (assumed)
2	AOS1	2.6	31		0			
	PE6	3	18	1		R3	0	0 (confirmed)
3	AOS2	3.1	31		1			
	PO7	3.5	18	0		R4	0	1
4	AOS3	3.6	31		0			
	PE8	4	18	1		R5	0	0 (confirmed)
5	PO9	4.5	18	1		R6	0	0 (confirmed)
	AOS4	4.8	31		3			
	PE10	5	18	1		R7	1	3 (unrecognised)
6	AOS5	5.4	31		0			
	PO11	5.5	18	0		R8	0	0 (confirmed)
7	PE12	6	18	1		R9	0	0 (confirmed)
	PO13	6.5	18	0		R10	0	0 (confirmed)
	Position messages (PE14 through PO197) are continued at half-second intervals for the next 92 seconds. No AOS messages are to be injected during this period.							
	PE198	99	18	1		R195		0 (assumed)
	PO199	99.5	18	0		R196	0	0 (assumed)
8	AOS6	99.6	31		1			
	PE200	100	18	1		R197	0	1
9	PO201	100.5	18	0		R198	0	1
	AOS7	138.3	31		3			
	PE202	101	18	1		R199	1	3 (unrecognised)
10	AOS8	138.6	31		1			
	PO203	101.5	18	0		R200	0	1
11	PE204	102	18	1		R201	0	1
	PO205	102.5	18	0		R202	0	1

Step	ES Input					Expected ASTERIX Category 021 Output		
	Msg ID	Inject Time (s)	FTC	CPR	MOPS VN	Rpt	VNS	VN
	Position messages (PE206 through PO389) are continued at half-second intervals for the next 92 seconds. No AOS messages are to be injected during this period.							
	PE390	195	18	1		R387	0	0 (assumed)
	PO391	195.5	18	0		R388	0	0 (assumed)
12	PE392	196	18	1		R389	0	0 (assumed)
	AOS9	196.3	31		3			
	PO393	196.5	18	0		R390	1	3 (unrecognised)
13	PE394	197	18	1		R391	1	3 (unrecognised)
	PO395	197.5	18	0		R392	1	3 (unrecognised)
	Position messages (PE396 through PO580) are continued at half-second intervals for the next 92 seconds. No AOS messages are to be injected during this period.							
	PE581	290	18	1		R578	0	0 (assumed)
	PO582	290.5	18	0		R579	0	0 (assumed)

Note(s):

Device(s) in use: Ground Station ADS – B  
Input Source ADS –B Message.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Activate Emitter category item I021/020 in ASTERIX Category 021 reports			
6	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
7	Prepare the message source to play the scenario			
8	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
9	Play the scenario in the	Recording tool is receiving data from ADS-B GS		

	injection tool	corresponding to test targets.		
10	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
11	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

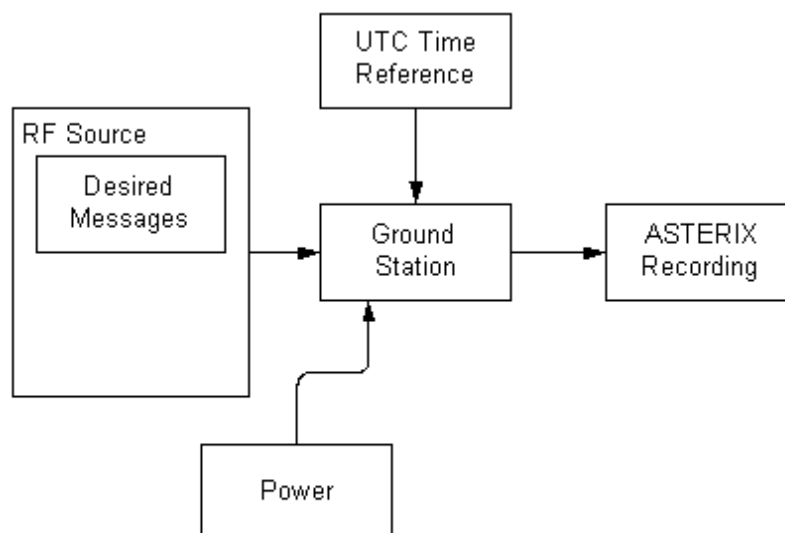
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 4: Verification Exercise Result

## B.1.12 Verification SUT requirements

N/A

## B.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool



- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the Analysis of the recorded data verifying that reports produced by the 1090 ADS – B Ground Station are consistent with the input data in the ES messages (e.g. correct lat/lon, altitude etc.).

## **B.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **B.1.15 Platform Configuration**

N/A

## **B.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **B.1.17 Links to other Verification Exercises**

N/A

## **B.1.18 Representatively level/ limitations**

N/A

## **B.2 Exercises Planning and management**

### **B.2.1 Activities**

#### **B.2.1.1 Preparatory activities**

Set up the tools/equipment listed in 3.5 and B.1.13 in order to meet the Test Preconditions.

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### B.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

### B.2.1.3 Post execution activities

Verify that the information reported in the Recorded ASTERIX Reports is consistent with the input messages and expected output.

## B.2.2 Human Resources.

N/A

## B.2.3 Responsibilities in the exercise

N/A

## B.2.4 Training

N/A

## B.2.5 Time planning

N/A

## B.2.6 Risks.

N/A

## B.2.7 Errors and Observation handling

N/A

## B.3 Analysis Specification

### B.3.1 Data collection methods

The data's collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in output are in line with the values generated in input.

### B.3.2 Analysis method

N/A

### B.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix C Verification Exercise EXE-15.04.05.a- TS.0010.0020 GS Association function 1

### C.1 Exercise Scope and Justification

#### C.1.1 Exercise Level

The level of the exercise is functional.

#### C.1.2 Exercise Type

The type of this exercise is Test.

#### C.1.3 Description of the system being addressed;

ADS-B Ground Station.

#### C.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### C.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### C.1.6 Verification objectives

Verify the following that the 1090 ES Ground Station meets the minimum requirements for Target Data Maintenance. This includes verifying that:

- Local decoding is used
- Positions that fail the Local Decoding Reasonableness Test are not used as a reference position for subsequent local decodes
- The Local Decoding Reasonableness Test works

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The aim of this objective is to check that the "Ground ADS-B Receive" function receives 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.
--

#### C.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A: and DO206B

#### C.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated in input.

#### C.1.9 Entrance criteria

Starting the generation of 1090 MHz Extended Squitter messages set as indicated in the table below.

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## C.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input and once all outputs have been recorded and analyzed.

## C.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010.0020 / Association function 1

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station associates the following 1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B, in particular the target data maintenance function

**Exercise Type:** Test

**Precondition(s):** The position messages used in each scenario must be airborne position messages (FTC = 9-18) located within the configured range of the Ground Station. The positions used in the first two messages must result in a global decode that passes the range check. To maximise test efficiency, the single target scenarios described below may be combined by giving each target a different announced address (AA) and interleaving the messages. The messages for each target in the combined scenario must have the same spacing in time as the corresponding messages in the individual scenarios. The first scenario verifies the use of local decoding during participant data maintenance. Create a scenario with ES messages scheduled as follows:

Scenario 1								
ES Input					Expected ASTERIX Category 021 Output			
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon	CL	RC
PE1	0	0	Y	X	No Output			
PO2	0.5	1	Y	X	No Output			
PE3	1.0	0	Y	X	No Output			
PO4	1.5	1	Y	X	Y	X	0	0
PE5	2.0	0	Y+.075°	X	Y+.075°	X	0	0

The first report from PO4 demonstrates that the GS has completed CPR validation. The fifth message has a latitude change of 4.5NM, If the fifth message were combined with any of the first four in a global decode, the resulting position would not match the expected latitude output for the fifth message The 4.5NM change exceeds the 3NM limit for correct global decoding. The second scenario verifies the local decoding reasonableness test. The scenario should comply with the following table:

Scenario 2						
ES Input					Expected ASTERIX Category 021 Output	
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon
PE1	0	0	Y	X	No Output	
PO2	0.5	1	Y	X	No Output	
PE3	1.0	0	Y	X	No Output	
PO4	1.5	1	Y	X	Y	X
PE5	31.4	0	$Y+a_1^\circ$	$X+b_1^\circ$	$Y+a_1^\circ$	$X+b_1^\circ$
PO6	31.9	1	Y	X	Y	X
PO7	62.0	1	$Y+a_1^\circ$	$X+b_1^\circ$	$Y+a_1^\circ$	$X+b_1^\circ$
PE8	62.5	0	Y	X	Y	X
PE9	92.6	0	$Y+a_2^\circ$	$X+b_2^\circ$	$Y+a_2^\circ$	$X+b_2^\circ$
PO10	93.1	1	Y	X	Y	X
PO11	123.0	1	$Y+a_2^\circ$	$X+b_2^\circ$	No output	
PE12	123.5	0	Y	X	Y	X

Notes:

- $a_1$  and  $b_1$  shall be values that define a point between 5.90 and 5.99 nautical miles from Y, X.
- $a_2$  and  $b_2$  shall be values that define a point between 6.01 and 6.10 nautical miles from Y, X.

The first four messages get the target through the range check and CPR validation. PE5 represents a position jump of less than 6NM in just less than 30 seconds. PO6 and PO7 produce a position jump of less than 6NM in just over 30 seconds. PE8 and PE9 have a position jump of just over 6NM in just over 30 seconds. PO10 and PO11 have a position jump of just over 6NM in just under 30 seconds.

The third scenario verifies that position updates that fail the Local Decoding Reasonableness Test are not used as reference positions for subsequent local decodes. Scenario 3 is described in the table below.

Scenario 3						
ES Input					Expected ASTERIX Category Output 021	
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon
PE1	0	0	Y	X	No Output	
PO2	0.5	1	Y	X	No Output	
PE3	1.0	0	Y	X	No Output	
PO4	1.5	1	Y	X	Y	X
PO5	2.0	1	Y+3.025°	X	No Output	
PE6	2.5	0	Y	X	Y	X

If the position update from PO5 was used as the reference position for PE6, the latitude in PE6 would not decode correctly. Even CPR latitude zones are 6° wide and odd zones are approximately 6.1° wide. Local decoding requires the distance from the reference position to the target to be less than ½ zone, or 3° for even zones and approx 3.05° for odd zones. If the position obtained for PO5 was used as the reference position in the decode of PE6, the distance between the reference point (i.e. PO5) and the reported target position (i.e. PO6) would be 3.025°. A 3.025° change should result in no output because it would exceed the 6NM in 30 seconds criterion for local decoding. If there were an output, the latitude would not match Y because 3.025° exceeds the ½ zone limit (i.e. 3°) for even local decoding.

Note(s):

Device(s) in use: Ground Station ADS – B  
Input Source ADS –B Message.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message			

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	source to play the scenario			
5	<p>For each scenario:</p> <ul style="list-style-type: none"> <li>-Start recording ASTERIX reports.</li> <li>-Play the scenario.</li> <li>-When the scenario is complete, stop recording ASTERIX reports.</li> <li>-Store ASTERIX data in the corresponding files</li> </ul>	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
6	When all the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
7	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

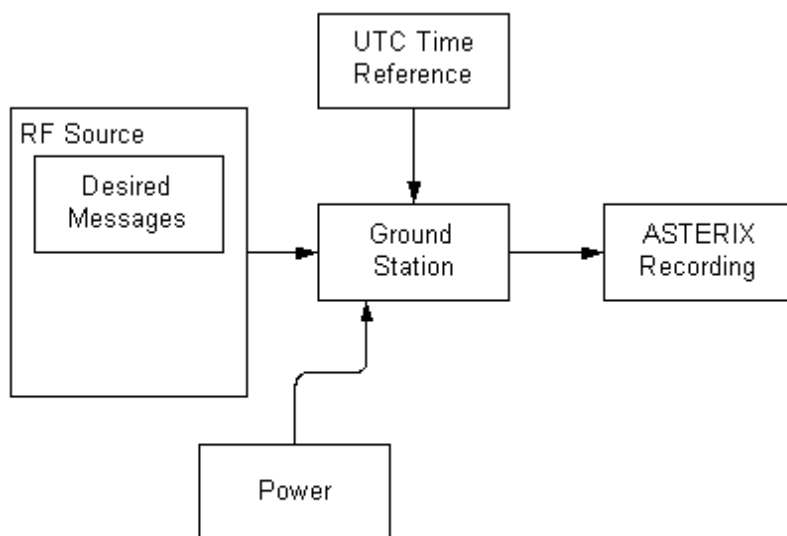
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 5: Verification Exercise Result

## C.1.12 Verification SUT requirements

N/A

### C.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A and DO260B

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the Analysis of the recorded data verifying that reports produced by the 1090 ADS – B Ground Station are consistent with the input data in the ES messages (e.g. correct lat/lon, altitude etc.).



## C.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## C.1.15 Platform Configuration

N/A

## C.1.16 Configuration(s) Identification of the Verification Platform

N/A

## C.1.17 Links to other Verification Exercises

N/A

## C.1.18 Representatively level/ limitations

N/A

## C.2 Exercises Planning and management

### C.2.1 Activities

#### C.2.1.1 Preparatory activities

Set up the tools/equipment listed in 3.5 and C.1.13 in order to meet the Test Preconditions.

#### C.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

#### C.2.1.3 Post execution activities

Verify that the information reported in the Recorded ASTERIX Report is consistent with the input messages and expected output.

### C.2.2 Human Resources.

N/A

### C.2.3 Responsibilities in the exercise

N/A

### C.2.4 Training

N/A

### C.2.5 Time planning

N/A

## C.2.6 Risks.

N/A

## C.2.7 Errors and Observation handling

N/A

## C.3 Analysis Specification

### C.3.1 Data collection methods

The data's collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in output are in line with the values generated in input.

### C.3.2 Analysis method

N/A

### C.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix D Verification Exercise EXE-15.04.05.a- TS.0010.0030 GS Association function 2

### D.1 Exercise Scope and Justification

#### D.1.1 Exercise Level

The level of the exercise is functional.

#### D.1.2 Exercise Type

The type of this exercise is Test.

#### D.1.3 Description of the system being addressed;

Ground Station ADS –B.

#### D.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### D.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### D.1.6 Verification objectives

Verify the following:

Participants shall be reinitialised after no more than 120 seconds without a position update. Messages received after the 120-second timeout shall be treated as messages from a new participant.

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The aim of this objective is to check that the “Ground ADS-B Receive” function receives 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.
--

#### D.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

#### D.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated at input.

#### D.1.9 Entrance criteria

Starting the generation of 1090 MHz Extended Squitter messages set as indicated in the table below.

#### D.1.10 Exit Criteria

The Test will finish after the generation and injection of input data and recording of output data.

## D.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010.0030 / Association function 2

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station associates the following 1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A, DO260B in particular the target data termination function

-

**Exercise Type:** Test

**Precondition(s):** The position messages used in each scenario must be airborne position messages (FTC = 9-18 or FTC = 20-22). The positions used in the first two messages must result in a global decode that passes the range check. To maximise test efficiency, the single target scenarios described below may be combined by giving each target a different announced address (AA) and interleaving the messages. The messages for each target in the combined scenario must have the same spacing in time as the corresponding messages in the individual scenarios.  
The first scenario verifies that the target is not reinitialised before 120 seconds without a position update.

Scenario 1						
ES Input					Expected ASTERIX Category 021 Output	
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon
PE1	0	0	Y	X	No Output	
PO2	0.5	1	Y	X	No Output	
PE3	1.0	0	Y	X	No Output	
PO4	1.5	1	Y	X	Y	X
PO5	121.4	0	Y	X	Y	X
PO6	121.9	1	Y	X	Y	X

The target is shown as stationary in the table above but may be moving as long as the requirements for local decoding, specified in Appendix A of DO-260A, are met.

The second scenario verifies that the target is reinitialised if no updates are received within a 120 second interval.

Scenario 2						
ES Input					Expected Cat21 Output	
Msg	Inject Time	CPR	Lat	Lon	Lat	Lon

ID	(s)					
PE1	0	0	Y	X	No Output	
PO2	0.5	1	Y	X	No Output	
PE3	1.0	0	Y	X	No Output	
PO4	1.5	1	Y	X	Y	X
PO5	121.6	1	Z	T	No Output	
PE6	122.1	0	Z	T	No Output	
PO7	122.6	1	Z	T	No Output	
PE8	123.1	0	Z	T	Z	T

The locations of (Y,X) and (Z,T) must be more than 3NM apart in latitude and must be close enough together to satisfy the requirements for a local decode as specified in DO-260A, Appendix A.

If the GS retains target data longer than 120 seconds, PO5, PE6 and PO7 will trigger ASTERIX reports.

Note(s):

Device(s) in use: Ground Station ADS – B  
Input Source ADS –B Message  
ASTERIX Recording Tool  
Power  
UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	For each scenario: -Start recording ASTERIX reports. -Play the scenario. -When the scenario is complete, stop recording ASTERIX reports. -Store ASTERIX data in the corresponding	Recording tool is receiving data from ADS-B GS corresponding to test targets.		

	files			
6	When all the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
7	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

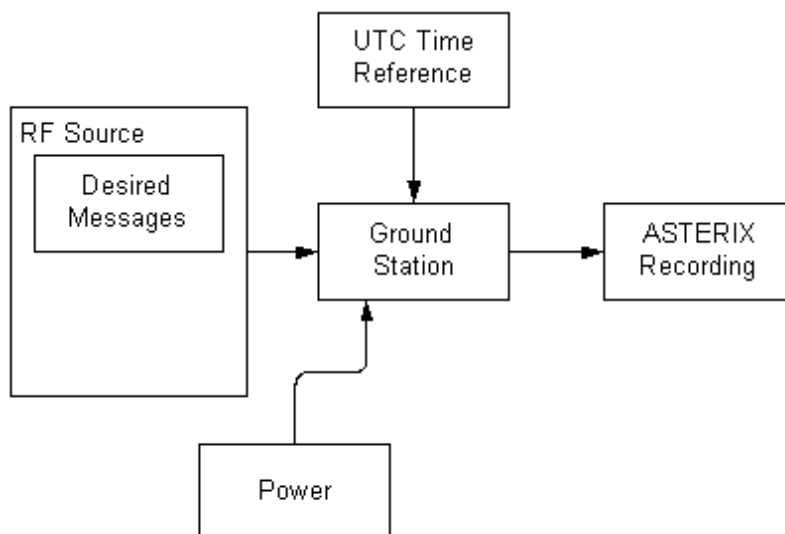
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 6: Verification Exercise Result

## D.1.12 Verification SUT requirements

N/A

## D.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool

- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the Analysis of the recorded data verifying that reports produced by the 1090 ADS – B Ground Station are consistent with the input data in the ES messages (e.g. correct lat/lon, altitude etc.).

## **D.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **D.1.15 Platform Configuration**

N/A

## **D.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **D.1.17 Links to other Verification Exercises**

N/A

## **D.1.18 Representatively level/ limitations**

N/A

## **D.2 Exercises Planning and management**

### **D.2.1 Activities**

#### **D.2.1.1 Preparatory activities**

Set up the tools/equipment listed in 3.5 and D.1.13 in order to meet the Test Preconditions.

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### D.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

### D.2.1.3 Post execution activities

Verify that the information reported in the Recorded ASTERIX Reports is consistent with the input messages and expected output.

## D.2.2 Human Resources.

N/A

## D.2.3 Responsibilities in the exercise

N/A

## D.2.4 Training

N/A

## D.2.5 Time planning

N/A

## D.2.6 Risks.

N/A

## D.2.7 Errors and Observation handling

N/A

## D.3 Analysis Specification

### D.3.1 Data collection methods

The data's collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX data will be performed verifying that the values reported in output are in line with the values generated in input.

### D.3.2 Analysis method

N/A

### D.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.



## Appendix E Verification Exercise EXE-15.04.05.a- TS.0010.0040 GS Validation 1

### E.1 Exercise Scope and Justification

#### E.1.1 Exercise Level

The level of the exercise is functional.

#### E.1.2 Exercise Type

The type of the exercise is Test.

#### E.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### E.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### E.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### E.1.6 Verification objectives

Verify the Requirements related to the validation check.

This test procedure verifies that the 1090 ES Ground Station checks that the position of a newly acquired target lies within a credible area [or volume] relative to the ground station, ensuring that no ASTERIX position report is generated for new targets with unreasonable position values.

A target is considered as new when the 1090ES Ground Station has no previous position information for it.

This procedure does not verify the range check operation under periodic reporting mode operation since the range check function is assumed to be the same as under the data driven mode.

OBJ-15.04.05.a-TS.0010.0001
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The aim of this objective is to check that the “Ground ADS-B Receive” function receives 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.
--

#### E.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

#### E.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated at the input.

## E.1.9 Entrance criteria

Start the generation of input data.

## E.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in input and once all outputs have been recorded and analyzed.

## E.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010.0040 / Validation 1

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station measure the distance of the received 1090 MHz Extended Squitter messages and reports only those who are contained inside a maximum distance configured by the user.

**Exercise Type:** Test  
**Precondition(s):**

The 1090 ES Ground Station will be injected with a sequence of four even/odd pairs of position squitters as shown in the diagram below where the first two pairs refer to airborne target A1 while the last two pairs are for airborne target A2 which must be distinct from A1. The locations of A1 and A2 shall be such that the first is within the acceptance range of the station and the second outside. It has to be shown that position reports are generated only for A1 as shown in the table below.

ES Input						Expected ASTERIX Category 021 Output				
Msg ID	Inject Time (s)	24-bit Address	CPR	Lat	Lon	Rpt	Lat	Lon	CL	RC
PE1	0	A1	0	Y1	X1	No Output				
PO2	0.5	A1	1	Y1	X1	No Output				
PE3	1.0	A1	0	Y1	X1	No Output				
PO4	2.5	A1	1	Y1	X1	R1	Y11	X1	0	0
PE5	3.0	A2	0	Y2	X2	No Output				
PO6	3.5	A2	1	Y2	X2	No Output				
PE7	4.0	A2	0	Y2	X2	No Output				
PO8	4.5	A2	1	Y2	X2	No Output				

<sup>1</sup> The expected latitude and longitude may vary from the input latitude and longitude by the combined quantisation errors of the CPR algorithm and the ASTERIX Category 021 latitude/longitude encoding.

A1 and A2 can be any two distinct legal 24-bit Mode Addresses.

[Y1, X1] can be any lat/long position whose distance from the Ground Station location is less than CPRAirborneMaxRange and greater than CPRAirborneMaxRange – 0.5 nm.

[Y2, X2] can be any lat/long position whose distance from the Ground Station location is greater than CPRAirborneMaxRange but less than CPRAirborneMaxRange + 0.5 nm.

The timing of the messages for A2 (PE5 to PO8) may be shifted with regard to those for A1 (PE1 to PO4).

The above scenario will be repeated for additional targets at same ranges as A1 and A2 but displaced from them to bearings of +12, +22 and +45 degrees to ensure that the area being checked is round. More points may be included in scenario. Messages for each target may be interleaved or separated in time.

Note(s):

Device(s) in use: Ground Station ADS – B  
Message Generator  
ASTERIX Recording Tool  
Power  
UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
6	Play the scenario.	Recording tool is receiving data from ADS-B GS corresponding to test targets.		

7	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
8	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

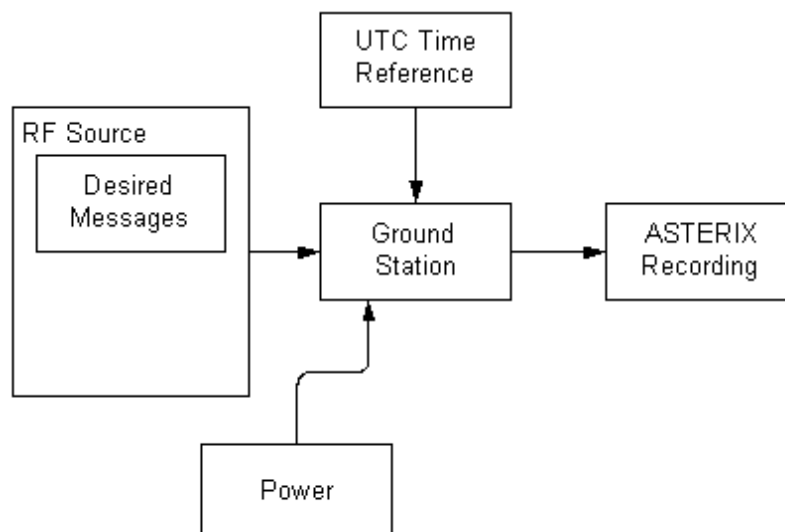
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 7: Verification Exercise Procedure Result

## E.1.12 Verification SUT requirements

N/A

## E.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

For this Exercise, the Ground Station ADS- B has to be provided with a specific functionality in order to perform a Central Processing (Central Processing Server) of Data coming from a lot of Remote Systems (ADS – B Ground Station or 1090 Receiver).

#### Message Generator

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260b.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **E.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **E.1.15 Platform Configuration**

N/A

### **E.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **E.1.17 Links to other Verification Exercises**

N/A

### **E.1.18 Representatively level/ limitations**

N/A

## E.2 Exercises Planning and management

### E.2.1 Activities

N/A

#### E.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and E.1.13 in order to meet the Test Preconditions

#### E.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

#### E.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

### E.2.2 Human Resources.

N/A

### E.2.3 Responsibilities in the exercise

N/A

### E.2.4 Training

N/A

### E.2.5 Time planning

N/A

### E.2.6 Risks.

N/A

### E.2.7 Errors and Observation handling

N/A

## E.3 Analysis Specification

### E.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### E.3.2 Analysis method

N/A

### E.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix F Verification Exercise EXE-15.04.05.a- TS.0010.0050 GS Validation 2

### F.1 Exercise Scope and Justification

#### F.1.1 Exercise Level

The level of the exercise is functional.

#### F.1.2 Exercise Type

The type of the exercise is Test.

#### F.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### F.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### F.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### F.1.6 Verification objectives

Verify the Requirements related to the validation check.

This test needs to verify only those aspects of the CPR validation requirements that are necessary for ED-126 compliance. As a consequence, the test does not verify the processing of surface position messages or the creation of reports prior to the completion of the CPR validation test (e.g. for monitoring applications). This test procedure is applicable to Ground Station implementations that implement CPR decoding in accordance with DO-260A. Alternative CPR decoding implementations may require different procedures and scenarios to ensure compliance with ED129. Alternative tests must exercise the decoding algorithm at vulnerable points and should include two categories of test cases: normal range test cases and robustness (abnormal range) test cases.

OBJ-15.04.05.a-TS.0010.0001
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The aim of this objective is to check that the “Ground ADS-B Receive” function receives 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.
--

#### F.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B:

#### F.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated at input



## F.1.9 Entrance criteria

Start the generation of input data.

## F.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input and once all outputs have been recorded and analyzed.

## F.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010.0050 / Validation 2

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station decodes the received position information encoded using CPR format.

**Note(s):**  
**Exercise Type:** Test

**Precondition(s):**

The position messages used in each scenario must be airborne position messages (FTC = 9-18). The positions used in the first two messages must result in a global decode that passes the range check. To maximize test efficiency, the single target scenarios described below may be combined by giving each target a different announced address (AA) and interleaving the messages. The messages for each target in the combined scenario must have the same spacing in time as the corresponding messages in the individual scenarios.

The following definitions apply to this section

The latitude zone offset (in degrees) is:

$$ZO_{LAT} = \left( \frac{360^\circ}{(59)(60)} \right)$$

The longitude zone offset is:

$$ZO_{LON} = \left( \frac{360^\circ}{(NL)(NL-1)} \right)$$

Where NL is as defined in section A.1.7.2d of DO-260A.

The CPR bin width for latitude is:

$$BW_{LAT} = \frac{360^\circ}{2^{17}(60-i)}$$

Where i=0 for even encoding and i=1 for odd encoding.

The CPR bin width for longitude is:

$$BW_{LON} = \frac{360^\circ}{2^{17}(NL-i)}$$

Where i and NL are as defined above.

Scenario 1								
ES Input					Expected ASTERIX Category 021 Output			
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon	CL	RC
PE1	0	0	Y	X	No Output			
PO2	0.5	1	Y	X	No Output			
PE3	1.0	0	Z	T	No Output			
PO4	10.9	1	Z	T	Z	T	0	0

The change in position between PO2 and PE3 must be less than 6NM to preclude failing the local decoding reasonableness test, if implemented.

Next, create a one target scenario to verify that even and odd messages more than 10 seconds apart are not used for CPR validation. Include an additional message to demonstrate that the system is operational and capable of producing target reports.

Scenario 2								
ES Input					Expected ASTERIX Category 021 Output			
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon	CL	RC
PE1	0	0	Y	X	No Output			
PO2	0.5	1	Y	X	No Output			
PE3	1.0	0	Z	T	No Output			
PO4	11.1	1	Z	T	No Output			
PE5	11.6	0	R	S	R	S	0	0

The difference between latitudes Z and R and between longitudes T and S must

be less than  $\frac{1}{2}$  of the zone offset minus one bin width ( $\frac{1}{2}ZO - BW$ ) for the global decode of PO4 and PE5 to be successful.

Create a one target scenario to verify that all position data used in a failed validation attempt is not used in a subsequent attempt

Scenario 3								
ES Input					Expected ASTERIX Category 021 Output			
Msg ID	Inject Time (s)	CPR	Lat	Lon	Lat	Lon	CL	RC
PE1	0	0	Y	X	No Output			
PO2	0.5	1	Y	X	No Output			
PE3	1.0	0	Y	X	No Output			
PO4	1.5	1	$Y+c_1$	X	No Output			
PE5	2.0	0	Y	X	No Output			
PO6	2.5	1	Y	X	No Output			
PE7	3.0	0	Y	X	No Output			
PO8	3.5	1	Y	X	Y	X	0	0

The latitude differences between Y and Z and between Y and R, and the longitude difference between X and T and between X and S must be greater than 6.2 Nm to ensure that the global decode of PO8 is not using data from any of the first four messages. The change in position between PO6 and PE7 must be less than 6 Nm.  $c_1$  is defined by the following expression

$$c_1 = \frac{1}{2}ZO_{LAT} + BW_{LAT}$$

Device(s) in use:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			

2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool i to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	For each scenario: -Start recording ASTERIX reports -Play the scenario.  -When the scenario is complete, stop recording ASTERIX reports. -Store ASTERIX data in the corresponding files	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
6	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
7	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 8: Verification Exercise Result

## F.1.12 Verification SUT requirements

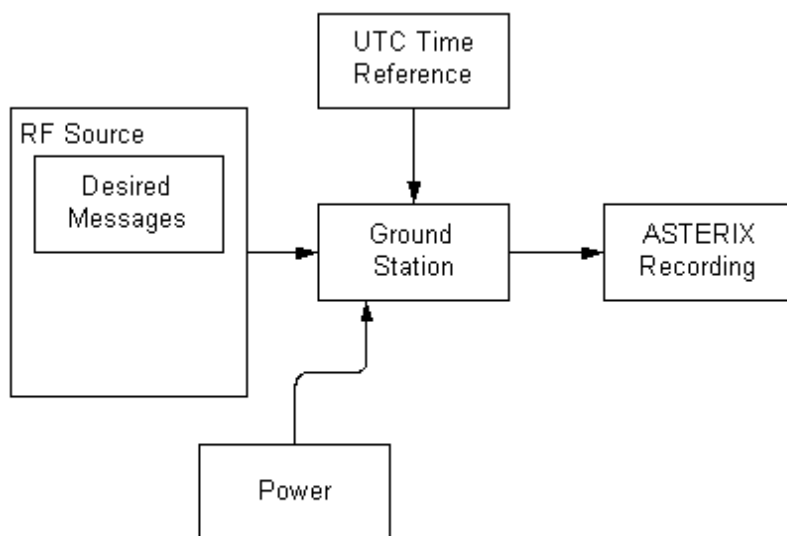
N/A

founding members



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## F.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

For this Exercise, the Ground Station ADS- B has to be provided with a specific functionality in order to perform a Central Processing (Central Processing Server) of Data coming from a lot of Remote Systems (ADS – B Ground Station or 1090 Receiver).

### Message Generator

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and DO260B.

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **F.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **F.1.15 Platform Configuration**

N/A

## **F.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **F.1.17 Links to other Verification Exercises**

N/A

## **F.1.18 Representatively level/ limitations**

N/A

# **F.2 Exercises Planning and management**

## **F.2.1 Activities**

N/A

### **F.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and F.1.13 in order to meet the Test Preconditions

### **F.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

### **F.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

## **F.2.2 Human Resources.**

N/A

## **F.2.3 Responsibilities in the exercise**

N/A

## **F.2.4 Training**

N/A

## **F.2.5 Time planning**

N/A

## **F.2.6 Risks.**

N/A

## **F.2.7 Errors and Observation handling**

N/A

## **F.3 Analysis Specification**

### **F.3.1 Data collection methods**

The data's collection during the test will be Qualitative.

### **F.3.2 Analysis method**

N/A

### **F.3.3 Data logging requirements**

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix G Verification Exercise EXE-15.04.05.a- TS.0010.0060 GS Data Item Inclusion

### G.1 Exercise Scope and Justification

#### G.1.1 Exercise Level

The level of the exercise is functional.

#### G.1.2 Exercise Type

The type of this exercise is Test.

#### G.1.3 Description of the system being addressed;

Ground Station ADS –B.

#### G.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### G.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### G.1.6 Verification objectives

Verify the following:

Verify that if the validation tests are passed, the 1090 GS shall package and timestamp the decoded data into a target report in ATX 21 form.

Verify that the 1090 GS forwards the compiled ATX21 target reports to client systems over a data network

Verify that the 1090 GS reports the following minimum data set per target report to the ATC Processing system:

Aircraft Horizontal Position – Latitude and Longitude);

Pressure altitude

Quality Indications of Horizontal Position

Aircraft Identity (a/c identification and Mode A code)

Emergency Indicators

Special Position Identification (SPI)

Time of Applicability

The 1090 GS provides in each target report a time of applicability of the position information

The 1009 GS **shall** provide separate times of applicability for any specific data items, who's ToA differs from that of the position

OBJ-15.04.05.a-TS.0010.0001
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The aim of this objective is to check that the “Ground ADS-B Receive” function receives 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.
--



OBJ-15.04.05.a-TS.0010.0002

The aim of this objective is to check that the “Ground ADS-B Receive” function provides the following minimum data set to the ATC Processing system:

- Aircraft Horizontal Position – Latitude and Longitude;
- Pressure altitude ;
- Quality Indications of Horizontal Position ;
- Aircraft Identity ; Emergency Indicators ;
- Special Position Identification ;
- Time of Applicability.

**NOTE:**

*Emergency Indicators and SPI are provided only when selected by the flight crew.*

OBJ-15.04.05.a-TS.0010.0003

The aim of this objective is to check that when direct recognition procedures are used by the ATCO for identification, the ADS-B Ground Domain contains a function to ensure the aircraft identity data that is broadcast is retained and correctly associated with the position information for display,

Aircraft Identity Retain

OBJ-15.04.05.a-TS.0010.0004

The aim of this objective is to check that the “Ground ADS-B Receive” function provides in each ADS-B surveillance report a time of applicability (Interface E2) of the position information

Time Of Applicability provision

OBJ-15.04.05.a-TS.0010.0005

The aim of this objective is to check that 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 provides separate times of applicability for the specific data items that differ,

OBJ-15.04.05.a-TS.0010.0006

The aim of this objective is to check that the “Ground ADS-B Surveillance Processing” function time-registers the asynchronously received ADS-B position updates from ADS-B-equipped aircraft

## G.1.7 Inputs

1090 MHz Extended Squitter messages in accordance to the format defined in DO260, DO260A and, DO260B:

## G.1.8 Outputs

ASTERIX reports relevant to 1090 MHz Extended Squitter messages generated in the input.

## G.1.9 Entrance criteria

Start the generation of 1090 MHz Extended Squitter messages set as indicated in the table below.

## G.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input and once all outputs have been recorded and analyzed.

## G.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0010.0060 / Data Item Inclusion

**Pass Criteria:** This test is passed if it is possible to verify that the 1090 ES Ground Station forwards the compiled ATX21 target reports that have passed the validation tests to client systems over a data network including all the items requested in reqs 0010.0070 to 0010.0090.

**Exercise Type:** Test

**Precondition(s):** Due to the number of parameters to test, the scenario will consist of several different targets (different addresses).  
GS coordinates shall be set to 0° latitude, 0 ° longitudes to enable correct CPR decoding to be tested for all possible combinations of positive and negative values for target latitude and longitude.  
To avoid jumps on position, data item "Position WGS-84" will be tested in four different targets. Each target will test one of the North (N), South (S), East (E), West combinations (W).

### Target 1:

This target will provide tests for NIC<sub>BARO</sub>, NAC<sub>V</sub> and position in WGS-84.

Target 1											
Step	ES Input							Expected Category 021 Output			
	Msg ID	FTC	Inject Time (s)	Lat/Lon	NACV	NICbaro	MOPS VN	Rpt	NICbaro	Position in WGS-84	NACV
1	PO1	18	0.5	S/W							
	PE2	18	1	S/W							
	PO3	18	1.5	S/W							
	PE4	18	2	S/W				R1	0	S/W	0
	AOS1	31	2.1				1				
	PO5	18	2.5	S/W				R2	0	S/W	0
2	VEL1	19	2.6		0			R3	0		0
	PE6	18	3	S/W				R4	0		0
	VEL2	19	3.1		1			R5	0		
	PO7	18	3.5	S/W				R6	0		1
	VEL3	19	3.6		2			R7	0		
	PE8	18	4	S/W				R8	0		2
	VEL4	19	4.1		3			R9	0		
	PO9	18	4.5	S/W				R10	0		3

Target 1											
Step	ES Input							Expected Category 021 Output			
	Msg ID	FTC	Inject Time (s)	Lat/Lon	NACV	NICbaro	MOPS VN	Rpt	NICbaro	Position in WGS-84	NACV
	VEL5	19	4.6		4			R11	0		
	PE10	18	5	S/W				R12	0		4
	VEL6	19	5.1		4			R13	0		
	PO11	18	5.5	S/W				R14	0		5
	VEL7	19	5.6		4			R15	0		
	PE12	18	6	S/W				R16	0		6
	VEL8	19	6.1		4			R17	0		
	PO13	18	6.5	S/W				R18	0		7
3	PE14	18	7	S/W				R19	0		
	AOS2	31	7.3			0			0		
	TSS1	29	7.4			0			0		
	PO15	18	7.5	S/W				R20	0		
	AOS3	31	7.8			0					
	TSS2	29	7.9			1					
	PE16	18	8	S/W				R21	1		
	AOS4	31	8.3			1					
	TSS3	29	8.4			0					
	PO17	18	8.5	S/W				R22	0		
	AOS5	31	8.8			1					
	TSS4	29	8.9			1					
	PE18	18	9	S/W				R23	1		
	TSS5	29	9.3			0					
	AOS6	31	9.4			0					
	PO19	18	9.5	S/W				R24	0		
	TSS6	29	9.8			0					
	AOS7	31	9.9			1					
	PE20	18	10	S/W				R25	1		
	TSS7	29	10.3			1					
	AOS8	31	10.4			0					
	PO21	18	10.5	S/W				R26	0		
	TSS8	29	10.8			1					
	AOS9	31	10.9			1					
	PE22	18	11	S/W				R27	1		

Target 1: The evolution of the states of this target is as follows:

Step 1: Target acquisition and version 1 confirmed. S/W position is tested.

Step 2: All possible values for NACV are tested.

Step 3: All possible combinations of values for NICBARO are tested.

## Target 2:

This target will provide tests for SIL.

Target 2							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	SIL	MOPS Version	Rpt	SIL
1	PO1	18	0.5				
	PE2	18	1				
	PO3	18	1.5				
	PE4	18	2			R1	0
	AOS1	31	2.1		1		
	PO5	18	2.5			R2	0
2	AOS2	31	2.8	(random) value 0 to 3			
	TSS1	29	2.9	0			
	PE6	18	3			R3	0
3	AOS3	31	3.3	(random) value 0 to 3			
	TSS2	29	3.4	1			
	PO7	18	3.5			R4	1
4	AOS4	31	3.8	(random) value 0 to 3			
	TSS3	29	3.9	2			
	PE8	18	4			R5	2
5	AOS5	31	4.3	(random) value 0 to 3			
	TSS4	29	4.4	3			
	PO9	18	4.5			R6	3
6	TSS6	29	4.8	(random) value 0 to 3			
	AOS7	31	4.9	0			
	PE10	18	5			R7	0
7	TSS7	29	5.3	(random) value 0 to 3			
	AOS8	31	5.4	1			
	PO11	18	5.5			R8	1
8	TSS8	29	5.8	(random) value 0 to 3			
	AOS9	31	5.9	2			
	PE12	18	6			R9	2
9	TSS9	29	6.3	(random) value 0 to 3			
	AOS10	31	6.4	3			
	PO13	18	6.5			R10	3

Target 2: The evolution of the states of this target is as follows:

Step 1: acquisition and version 1 confirmed.

Steps 2 to 9: all possible values for SIL are tested

### Target 3:

This target will provide tests for NACP.

Target 3							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	NAC <sub>P</sub>	MOPS VN	Rpt	NACP
1	PO1	18	0.5				
	PE2	18	1				
	PO3	18	1.5				
	PE4	18	2			R1	0
	AOS1	31	2.1		1		
	PO5	18	2.5			R2	0
2	AOS2	31	2.8	(random) value 0 to 15			
	TSS1	29	2.9	0			
	PE6	18	3			R3	0
3	AOS3	31	3.3	(random) value 0 to 15			
	TSS2	29	3.4	1			
	PO7	18	3.5			R4	1
4	AOS4	31	3.8	(random) value 0 to 15			
	TSS3	29	3.9	2			
	PE8	18	4			R5	2
5	AOS5	31	4.3	(random) value 0 to 15			
	TSS4	29	4.4	3			
	PO9	18	4.5			R6	3
6	AOS6	31	4.8	(random) value 0 to 15			

Target 3							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	NAC <sub>P</sub>	MOPS VN	Rpt	NACP
	TSS5	29	4.9	4			
	PE10	18	5			R7	4
7	AOS7	31	5.3	(random) value 0 to 15			
	TSS6	29	5.4	5			
	PO11	18	5.5			R8	5
8	AOS8	31	5.8	(random) value 0 to 15			
	TSS7	29	5.9	6			
	PE12	18	6			R9	6
9	AOS9	31	6.3	(random) value 0 to 15			
	TSS8	29	6.4	7			
	PO13	18	6.5			R10	7
10	AOS10	31	6.8	(random) value 0 to 15			
	TSS9	29	6.9	8			
	PE14	18	7			R11	8
11	AOS11	31	7.3	(random) value 0 to 15			
	TSS10	29	7.4	9			
	PO15	18	7.5			R12	9
12	AOS12	31	7.8	(random) value 0 to 15			
	TSS11	29	7.9	10			
	PE16	18	8			R13	10
13	AOS13	31	8.3	(random) value 0 to 15			
	TSS12	29	8.4	11			
	PO17	18	8.5			R14	11
14	AOS14	31	8.8	(random) value 0 to 15			
	TSS13	29	8.9	12			

Target 3							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	NAC <sub>P</sub>	MOPS VN	Rpt	NACP
	PE18	18	9			R15	12
15	AOS15	31	9.3	(random) value 0 to 15			
	TSS14	29	9.4	13			
	PO19	18	9.5			R16	13
16	AOS16	31	9.8	(random) value 0 to 15			
	TSS15	29	9.9	14			
	PE20	18	10			R17	14
17	AOS17	31	10.3	(random) value 0 to 15			
	TSS16	29	10.4	15			
	PO21	18	10.5			R18	15
18	TSS17	29	10.8	(random) value 0 to 15			
	AOS18	31	10.9	0			
	PE22	18	11			R19	0
19	TSS18	29	11.3	(random) value 0 to 15			
	AOS19	31	11.4	1			
	PO23	18	11.5			R20	1
20	TSS19	29	11.8	(random) value 0 to 15			
	AOS20	31	11.9	2			
	PE24	18	12			R21	2
21	TSS20	29	12.3	(random) value 0 to 15			
	AOS21	31	12.4	3			
	PO25	18	12.5			R22	3
22	TSS21	29	12.8	(random) value 0 to 15			
	AOS22	31	12.9	4			
	PE26	18	13			R23	4

Target 3							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	NAC <sub>P</sub>	MOPS VN	Rpt	NACP
23	TSS22	29	13.3	(random) value 0 to 15			
	AOS23	31	13.4	5			
	PO27	18	13.5			R24	5
24	TSS23	29	13.8	(random) value 0 to 15			
	AOS24	31	13.9	6			
	PE28	18	14			R25	6
25	TSS24	29	14.3	(random) value 0 to 15			
	AOS25	31	14.4	7			
	PO29	18	14.5			R26	7
26	TSS25	29	14.8	(random) value 0 to 15			
	AOS26	31	14.9	8			
	PE30	18	15			R27	8
27	TSS26	29	15.3	(random) value 0 to 15			
	AOS27	31	15.4	9			
	PO31	18	15.5			R28	9
28	TSS27	29	15.8	(random) value 0 to 15			
	AOS28	31	15.9	10			
	PE32	18	16			R29	10
29	TSS28	29	16.3	(random) value 0 to 15			
	AOS29	31	16.4	11			
	PO33	18	16.5			R30	11
30	TSS29	29	16.8	(random) value 0 to 15			
	AOS30	31	16.9	12			
	PE34	18	17			R31	12



Target 3							
Step	ES Input					Expected Category 021 Output	
	Msg ID	FTC	Inject Time (s)	NAC <sub>P</sub>	MOPS VN	Rpt	NACP
31	TSS30	29	17.3	(random) value 0 to 15			
	AOS31	31	17.4	13			
	PO35	18	17.5			R32	13
32	TSS31	29	17.8	(random) value 0 to 15			
	AOS32	31	17.9	14			
	PE36	18	18			R33	14
33	TSS32	29	18.3	(random) value 0 to 15			
	AOS33	31	18.4	15			
	PO37	18	18.5			R34	15

Target 3: The evolution of the states of this target is as follows:

Step 1: acquisition and version 1 confirmed.

Steps 2 to 33: all possible values for NACP are tested.

#### Target 4:

This target will provide tests for NIC and position WGS-84.

Target 4									
Step	ES Input						Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	Lat/Lon	MOPS VN	NIC Supplement	Rpt	Position in WGS-84	NIC
1	PO1	0.5	22	N/W					
	PE2	1	22	N/W					
	PO3	1.5	22	N/W					
	PE4	2	22	N/W			R1	N/W	0
	AOS1	2.1	31		1	1			
	PO5	2.5	22	N/W		0	R2	N/W	0

Target 4									
Step	ES Input						Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	Lat/Lon	MOPS VN	NIC Supplement	Rpt	Position in WGS-84	NIC
2	PE6	3	21	N/W		0	R3		10
3	PO7	3.5	20	N/W		0	R4		11
4	PE8	4	18	N/W		0	R5		0
5	PO9	4.5	17	N/W		0	R6		1
6	AOS2	4.8	31			0			
	AOS3	4.9	31			1			
	PE10	5	16	N/W			R7		3
	AOS4	5.3	31			1			
	AOS5	5.4	31			0			
	PO11	5.5	16	N/W			R8		2
7	PE12	6	15	N/W		0	R9		4
8	PO13	6.5	14	N/W		0	R10		5
9	AOS6	6.8	31			0			
	AOS7	6.9	31			1			
	PE14	7	13	N/W			R11		6
	AOS8	7.3	31			1			
	AOS9	7.4	31			0			
	PO15	7.5	13	N/W			R12		6
10	PE16	8	12	N/W		0	R13		7
11	AOS10	8.3	31			0			
	AOS11	8.4	31			1			
	PO17	8.5	11	N/W			R14		9
	AOS12	8.8	31			1			
	AOS13	8.9	31			0			
	PE18	9	11	N/W			R15		8
12	PO19	9.5	10	N/W		0	R16		10
13	PE20	10	9	N/W		0	R17		11
14	PO21	10.5	8	N/W		0	R18		0
15	AOS14	10.8	31			0			
	AOS15	10.9	31			1			
	PE22	11	7	N/W			R19		9
	AOS16	11.3	31			1			

Target 4									
Step	ES Input						Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	Lat/Lon	MOPS VN	NIC Supplement	Rpt	Position in WGS-84	NIC
	AOS17	11.4	31			0			
	PO23	11.5	7	N/W			R20		8
16	PE24	12	6	N/W		0	R21		10
17	PO25	12.5	5	N/W		0	R22		11
18	PE26	13	0	N/W					

The evolution of the states of this target is as follows:

Step 1: acquisition and version 1 confirmed. N/W Position is tested.

Steps 2 to 18: all possible values for NIC are tested.

#### Target 5:

This target provides tests for  $NUC_R$  and  $NUC_P$  for version 0 participants.

Target 5								
Step	ES Input					Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	NUCR	MOPS VN	Rpt	NUCR	NUCP
1	PO1	0.5	18					
	PE2	1	18					
	PO3	1.5	18					
	PE4	2	18			R1	0	0
	AOS1	2.1	31		0			
	PO5	2.5	18			R2	0	0
2	VEL1	2.6	19	0		R3	0	0
	PE6	3	18			R4	0	0
	VEL2	3.1	19	1		R5	1	0
	PO7	3.5	18			R6	1	0
	VEL3	3.6	19	2		R7	2	0
	PE8	4	18			R8	2	0
	VEL4	4.1	19	3		R9	3	0

Target 5								
Step	ES Input					Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	NUCR	MOPS VN	Rpt	NUCR	NUCP
	PO9	4.5	18			R10	3	0
	VEL5	4.6	19	4		R11	4	0
	PE10	5	18			R12	4	0
	VEL6	5.1	19	5		R13	5	0
	PO11	5.5	18			R14	5	0
	VEL7	5.6	19	6		R15	6	0
	PE12	6	18			R16	6	0
	VEL8	6.1	19	7		R17	7	0
	PO13	6.5	18			R18	7	0
3	PE14	7	0					
	PO15	7.5	5			R19		9
	PE16	8	6			R20		8
	PO17	8.5	7			R21		7
	PE18	9	8			R22		6
	PO19	9.5	9			R23		9
	PE20	10	10			R24		8
	PO21	10.5	11			R25		7
	PE22	11	12			R26		6
	PO23	11.5	13			R27		5
	PE24	12	14			R28		4
	PO25	12,5	15			R29		3
	PE26	13	16			R30		2
	PO27	13.5	17			R31		1
	PE28	14	18			R32		0
	PO29	14.5	20			R33		9
	PE30	15	21			R34		8

Target 5: The evolution of the states of this target is as follows:

Step 1: acquisition and version 0 confirmed.

Step 2: all possible values for NUCR are tested

Step 3: all possible values for NUCP are tested

**Target 6**

This target will provide tests for Time of Report Transmission (TORT), DCR, position WGS-84, FL, T.IDENT, PS, SS, VNS, VN, and LTT.

Target 6																				
ES Input										Expected Category 021 Output										
Msg ID	Inject Time (s)	FTC	Lat/Lon	Altitude (feet)	Q	PS	MOPS VN	SS	T. Ident.	Rpt	TORT	DCR	Position in WGS-84	FL	T. Ident.	PS	SS	VNS	VN	LTT
PO1	0.5	20	S/E	30025																
AOS1	0.6	31																		
PE2	1	20	S/E	30025	0															
PO3	1.5	20	S/E	30025	0															
ID1	1.6	2							AAA362											
PE4	2	20	S/E	30025	0					R1	TR1	0	S/E	300.25	AAA362			0	0	2
AOS1	0.6	31					0													
PO5	2.5	18	S/E	30025	0					R2	TR2	0	S/E	300.25	AAA362			0	0	2
AOS2	2.6	31					1													
PE6	3	18	S/E	30025	0			0		R3	TR3	0	S/E	300.25	AAA362		0	0	1	2
AS1	3.1	28				0														
PO7	3.5	18	S/E	25025	0					R4				250.25		0				
PE8	4	18	S/E	25050	0			1		R5				250.50			1			
AS2	4.1	28				1														
PO9	4.5	18	S/E	20075	0					R6				200.75		1				
PE10	5	18	S/E	17525	1			2		R7				175			2			
AS3	5.1	28				2														
PO11	5.5	18	S/E	15025	1					R8				150		2				
PE12	6	18	S/E	12575	1			3		R9				126			3			
AS4	6.1	28				3														
PO13	6.5	18	S/E	10025	1					R10				100		3				
PE14	7	18	S/E	5000	1					R11				50						
AS5	7.1	28				4														
PO15	7.5	18	S/E	2500	1					R12				25		4				
PE16	8	18	S/E	0	1					R13				0						

Target 6																				
ES Input										Expected Category 021 Output										
Msg ID	Inject Time (s)	FTC	Lat/Lon	Altitude (feet)	Q	PS	MOPS VN	SS	T. Ident.	Rpt	TORT	DCR	Position in WGS-84	FL	T. Ident.	PS	SS	VNS	VN	LTT
AS6	8.1	28				5														
PO17	8.5	5	S/E		1					R14						5				
PE18	9	5	S/E		1					R15										
AS7	9.1	28				6														
PO19	9.5	5	S/E		1					R16						6				

TOMT is tested on reports 1, 2 and 3 shall be completed with the time of delivery of the ASTERIX Category 021 reports.

DCR is tested on reports 1, 2 and 3, and shall always be set to zero.

N/E WGS-84 position is tested on reports 1, 2 and 3.

FL is tested on reports 1 to 13. Reports 1 to 6 have 25ft resolution due to Q bit in position message set to zero. Reports 7 to 13 have 100ft resolution due to Q bit in position message set to one.

T.IDENT is tested on reports 1, 2 and 3.

PS is tested on reports 3, 5, 7, 9.

SS is tested on reports 4, 6, 8, 10, 12, 14 and 16.

VNS, VN and LTT are tested on reports 1, 2 and 3.

## Target 7

This target will provide tests for position WGS-84 (N/E), SIC-SAC, GBS, ARC, TARGET ADDRESS.

Target 7													
ES Input							Expected Category 021 Output						
Msg ID	Inject Time (s)	FTC	Lat/Lon	MOPS VN	Target Address	Q	Rpt	Position in WGS-84	SIC	SAC	GBS	ARC	Target Address
PO1	0.5	5	N/E		BBBBBB								
PE2	1	5	N/E		BBBBBB								
PO3	1.5	5	N/E		BBBBBB								
PE4	2	5	N/E		BBBBBB		R1	N/E	A	B	1	2	BBBBBB
AOS1	2.1	31		1									

PO5	2.5	0	N/E		BBBBBB								
PE6	3	5	N/E				R2				1	2	
PO7	3.5	6	N/E				R3				1	2	
PE8	4	7	N/E				R4				1	2	
PO9	4.5	8	N/E				R5				1	2	
PE10	5	9	N/E			1	R6				0	0	
PO11	5.5	10	N/E			1	R7				0	0	
PE12	6	11	N/E			1	R8				0	0	
PO13	6.5	12	N/E			1	R9				0	0	
PE14	7	13	N/E			1	R10				0	0	
PO15	7.5	14	N/E			1	R11				0	0	
PE16	8	15	N/E			0	R12				0	1	
PO17	8.5	16	N/E			0	R13				0	1	
PE18	9	17	N/E			0	R14				0	1	
PO19	9.5	18	N/E			0	R15				0	1	
PE20	10	20	N/E			0	R16				0	1	
PO21	10.5	21	N/E			0	R17				0	1	
PE22	11	22	N/E			0	R18				0	1	

WGS-84 N/E position, SIC, SAC and TARGET ADDRESS are tested on reports 1 and 2.

All possible GBS values are tested on reports 1 to 18. GBS is derived from the FTC of the received position messages.

All possible ARC values are tested on reports 1 to 18. ARC is derived from the Q bit of the position message.

### Target 8

This target will provide tests for TOA for position and TOMR for position.

Target 8								
Step	ES Input					Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	VN	T	Rpt	TOA for Position	TOMR
1	PO1	0.5	5					
	PE2	1	5					
	PO3	1.5	5					
	PE4	2	5		1	R1	2	
	AOS1	2.1	31	1				
2	PO5	2.5	5		1	R2	2.6015625	
	PE6	3	6		1	R3	2.796875	
	PO7	3.5	7		1	R4		3.40625
	PE8	4.01	8		1	R5		4.007813

Target 8								
Step	ES Input					Expected Category 021 Output		
	Msg ID	Inject Time (s)	FTC	VN	T	Rpt	TOA for Position	TOMR
3	PO9	4.51	9		1	R6	4.515625	
	PE10	5	10		1	R7	4.796875	
	PO11	5.53	11		1	R8		5.53125
	PE12	5.99	12		1	R9		5.9921875
	PO13	6.4	13		1	R10		6.3984375
	PE14	6.9	14		1	R11		6.8984375
	PO15	7.45	15		1	R12		7.453125
	PE16	8	16		1	R13		8
	PO17	8.55	17		1	R14		8.546875
	PE18	9.1	18		1	R15		9.1015625
	PO19	9.5	20		1	R16	9.40625	
	PE20	10	21		1	R17	10	
	PO21	10.51	22		1	R18		10.515625
	PE22	10.99	5		0	R19		10.9921875
	PO23	11.47	6		0	R20		11.46875
	PE24	12.03	7		0	R21		12.03125
	PO25	12.52	8		0	R22		12.5234375
	PE26	13	9		0	R23		13
	PO27	13.5	10		0	R24		13.5
	PE28	14	11		0	R25		14
	PO29	14.5	12		0	R26		14.5
	PE30	15	13		0	R27		15
	PO31	15.5	14		0	R28		15.5
	PE32	16	15		0	R29		16
	PO33	16.5	16		0	R30		16.5
	PE34	17	17		0	R31		17
	PO35	17.5	18		0	R32		17.5
	PE36	18	20		0	R33		18
	PO37	18.5	21		0	R34		18.5
	PE38	19	22		0	R35		19

Target 8: The evolution of the states of this target is as follows:

Step 1: acquisition and version 1 confirmed.

Step 2: values for TOA and TOMR are tested with T bit = 1. TOA and TOMR values are calculated according to EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010 [12].

Step 3: values for TOA and TOMR are tested with T bit = 0. TOA and TOMR values are calculated according to EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010 [12].



Note(s):

Device(s) in use: Ground Station ADS – B  
Input Source ADS –B Message.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	For each scenario: -Start recording ASTERIX reports. -Play the scenario. -When the scenario is complete, stop recording ASTERIX reports. -Store ASTERIX data in the corresponding files	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
6	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
7	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

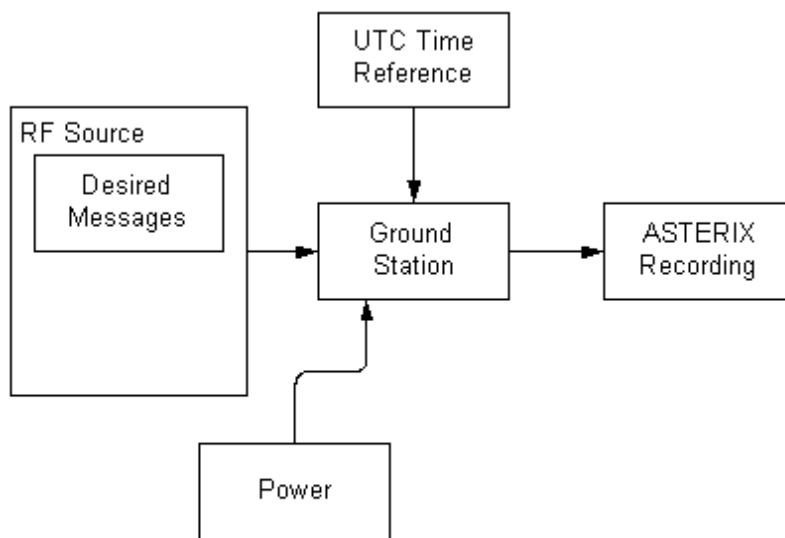
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 9: Verification Exercise Result

## G.1.12 Verification SUT requirements

N/A

## G.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

### UTC Time Reference

founding members



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The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the Analysis of the recorded data verifying that reports produced by the 1090 ADS – B Ground Station are consistent with the input data in the ES messages (e.g. correct lat/lon, altitude etc.).

## G.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## G.1.15 Platform Configuration

N/A

## G.1.16 Configuration(s) Identification of the Verification Platform

N/A

## G.1.17 Links to other Verification Exercises

N/A

## G.1.18 Representatively level/ limitations

N/A

# G.2 Exercises Planning and management

## G.2.1 Activities

### G.2.1.1 Preparatory activities

Set up the tools/equipment listed in 3.5 and G.1.13 in order to meet the Test Preconditions.

### G.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

### G.2.1.3 Post execution activities

Verify that the information reported in the Recorded ASTERIX Reports is consistent with the input messages and expected output

## G.2.2 Human Resources.

N/A

## G.2.3 Responsibilities in the exercise

N/A

## G.2.4 Training

N/A

## G.2.5 Time planning

N/A

## G.2.6 Risks.

N/A

## G.2.7 Errors and Observation handling

N/A

# G.3 Analysis Specification

## G.3.1 Data collection methods

The data's collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX data will be performed verifying that the values reported in output are in line with the values generated in input.

## G.3.2 Analysis method

N/A

## G.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix H Verification Exercise EXE-15.04.05.a- TS.0020.0000-GS Integrity

### H.1 Exercise Scope and Justification

#### H.1.1 Exercise Level

The level of the exercise is functional.

#### H.1.2 Exercise Type

The type of this exercise is Test

#### H.1.3 Description of the system being addressed;

Ground Station ADS – B.

#### H.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### H.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output , containing at least 500,000 ADS – B messages.

#### H.1.6 Verification objectives

Verify that the decoder undetected message error rate is better than 1 in  $10^5$  messages.

OBJ-15.04.05.a-TS.0020.0001
-----------------------------

The aim of this objective is to check that the likelihood of an ADS-B Ground Domain system integrity failure is 2E-05 or less per hour.
---

#### H.1.7 Inputs

At least 500,000 ADS – B messages.

#### H.1.8 Outputs

Recorded Data.

#### H.1.9 Entrance criteria

Start the generation of 500,000 ADS – B messages.

#### H.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input.

#### H.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0020.0000 / Integrity

**Pass Criteria:** The test is passed if it is possible to verify that the 1090 GS integrity match the following condition: the decoder undetected message error rate shall be

better than 1 in  $10^5$  messages.

An undetected message error is assumed for the purposes of this test to be one which results in an error in either a position or a position quality field in an ASTERIX Category 021 position report.

Exercise Type: Test

Precondition(s):

- The test equipment setup will be in line with it described in Section A.1.13 (see below), with FRUIT generator enabled.
- The scenario consists of generating at least 500,000 ADS – B messages in Ground Station's Input.
- Power is on.

Note(s):

- The recorded data may contain data received from real aircraft in the vicinity. This extra data may be ignored.

Device(s) in use:

Ground Station ADS – B  
Input Source for Fruit and ADS –B Messages.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Enable the injection of the valid aircraft			
2	Start the FRUIT generator.			
3	Allow the recording to run for sufficient time to record at least 500,000messages.			
4	Stop the recording.			
5	By comparison of the recorded data against the known aircraft positions, confirm that no more than 1 in 100,000 position reports contain either an incorrect position (I021/130, I021/145) or incorrect position quality values (I021/090).	No more than 1 in 100,000 position reports contain either an incorrect position (I021/130, I021/145) or incorrect position quality values (I021/090).		

Exercise result:

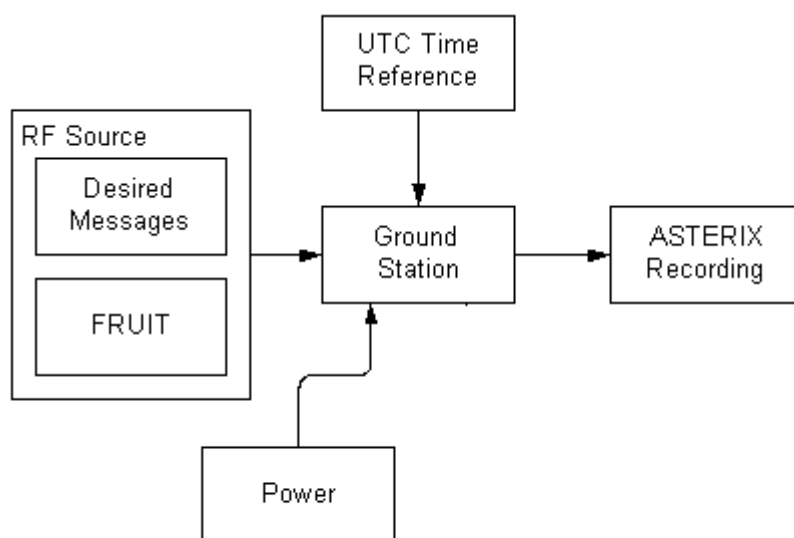
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 10: Verification Exercise Result

### H.1.12 Verification SUT requirements

N/A

### H.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the comparison of the recorded data against the known aircraft positions, confirming that no more than 1 in 100,000 position reports contains either an incorrect position (I021/130, I021/145) or an incorrect position quality values (I021/090).

### **H.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **H.1.15 Platform Configuration**

N/A

### **H.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **H.1.17 Links to other Verification Exercises**

N/A

### **H.1.18 Representatively level/ limitations**

N/A

## **H.2 Exercises Planning and management**

### **H.2.1 Activities**

N/A

#### **H.2.1.1 Preparatory activities**

Set up the tools/equipment listed in 3.5 and H.1.13 in order to meet the Test Preconditions.

#### **H.2.1.2 Execution activities**

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

#### **H.2.1.3 Post execution activities**

Verify that the information reported in the recorded ASTERIX Report is consistent with the input messages. In fact by means of comparison of the recorded data against the known aircraft positions it should be possible to confirm that no more than 1 in 100,000 position reports contain either an incorrect position (I021/130, I021/145) or an incorrect position quality values (I021/090).



## H.2.2 Human Resources.

N/A

## H.2.3 Responsibilities in the exercise

N/A

## H.2.4 Training

N/A

## H.2.5 Time planning

N/A

## H.2.6 Risks.

N/A

## H.2.7 Errors and Observation handling

N/A

## H.3 Analysis Specification

### H.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution, the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in input.

### H.3.2 Analysis method

N/A

### H.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix I Verification Exercise EXE-15.04.05.a- TS.0020.0010-GS Continuity

### I.1 Exercise Scope and Justification

#### I.1.1 Exercise Level

The level of the exercise is functional.

#### I.1.2 Exercise Type

The type of this exercise is Analysis

#### I.1.3 Description of the system being addressed;

ADS-B Ground Station.

#### I.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### I.1.5 Required Datasets

MTBF: Mean Time Between Failure

MTTR: Mean Time To Repair

#### I.1.6 Verification objectives

Demonstrate by analysis that the probability of a 1090 ES Ground Station continuity failure meets the requirements of 1E-05 or less per hour.

OBJ-15.04.05.a-TS.0020.0002
-----------------------------

The aim of this objective is to check that the likelihood of a "Ground ADS-B Receive" function continuity failure is 1E-05 or less per hour.
--

#### I.1.7 Inputs

Design documentation.

#### I.1.8 Outputs

Availability is quantified as the ratio of the time the system is actually available to the time the system is planned to be available.

#### I.1.9 Entrance criteria

N/A

#### I.1.10 Exit Criteria

N/A

## I.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0020.0010 / Continuity

**Pass Criteria:** The test is passed if the manufacturer is able to demonstrate by analysis that the probability of a 1090 ES Ground Station continuity failure meets the requirements of 1E-05 or less per hour.

**Exercise Type:** Analysis

**Note(s):** Availability is quantified as the ratio of the time the system is actually available to the time the system is planned to be available.

$$\text{Availability} = \frac{MTBF}{MTBF + MTTR}$$

Where:

MTBF: Mean Time Between Failure

MTTR: Mean Time To Repair

The 1090 ES Ground Station shall achieve an Availability of 99.99%.

**Assumptions:**

MTTR is based on time to repair assuming all required tools, spares and procedures are available on site and personnel are suitably trained and experienced. Travel time is excluded.

Periods of planned maintenance are discounted from the availability figures.

The Availability requirement applies to the 1090 ES Ground Station as defined in this specification only. External equipment such as antenna, cables and power supplies

are not included.

**Exercise result:**

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 11: Verification Exercise Result

## I.1.12 Verification SUT requirements

N/A

## **I.1.13 Exercise Tool, Verification Technique and/or Platform**

N/A

## **I.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **I.1.15 Platform Configuration**

N/A

## **I.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **I.1.17 Links to other Verification Exercises**

N/A

## **I.1.18 Representatively level/ limitations**

N/A

## **I.2 Exercises Planning and management**

### **I.2.1 Activities**

N/A

#### **I.2.1.1 Preparatory activities**

N/A

#### **I.2.1.2 Execution activities**

N/A

#### **I.2.1.3 Post execution activities**

N/A

### **I.2.2 Human Resources.**

N/A

### **I.2.3 Responsibilities in the exercise**

N/A

### **I.2.4 Training**

N/A

### **I.2.5 Time planning**

N/A

## I.2.6 Risks.

N/A

## I.2.7 Errors and Observation handling

N/A

## I.3 Analysis Specification

### I.3.1 Data collection methods

N/A

### I.3.2 Analysis method

In the 15.4.5b project the Analysis Method will be defined according to the Internal Industry Procedures.

### I.3.3 Data logging requirements

Availability value.

## Appendix J Verification Exercise EXE-15.04.05.a- TS.0020.0020-GS Latency

### J.1 Exercise Scope and Justification

#### J.1.1 Exercise Level

The level of the exercise is functional.

#### J.1.2 Exercise Type

The type of this exercise is Test.

#### J.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### J.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### J.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### J.1.6 Verification objectives

Verify that the 95% Latency is less than 0.5 seconds.

95 % Latency is determined by calculating the delay between the RF reception of the 1090ES and the delivery of each ASTERIX report for all “n” targets verifying that 95% of latency measurements is less than 0.5 seconds.

OBJ-15.04.05.a-TS.0020.0003

The aim of this objective is to check that the 95% latency for ADS-B surveillance reports (measured between points D and E2 output of the “Ground ADS-B Receive” function) is not 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.*

#### J.1.7 Inputs

1090MHz Extended Squitter Messages in input interface relevant to “n” different Targets.

#### J.1.8 Outputs

Latency measurements.

#### J.1.9 Entrance criteria

Start the generation 1090 MHz Extended Squitter messages relevant to “n” targets.

## J.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input.

## J.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0020 / Latency

**Pass Criteria:** The test is passed if it is possible to verify that 95% latency for ADS-B surveillance reports at the output of the 1090 GS is no greater than 0.5 seconds, measured from 1090ES message reception to the transmission of the corresponding target report by the 1090 GS.

**Exercise Type:** Test

**Precondition(s):** The scenario consists of generating in input at RF interface the messages relevant to "n" different Targets.

All UTC synchronised devices are in the UTC synchronised state.

**Note(s):** Since the objective of this test is to measure latency through the Ground Station, a method of determining the difference between the time of arrival of the 1090 ES message at the RF input of the Ground Station and the time of transmission of the corresponding ASTERIX report must be devised. The sum of the measurement uncertainty and the measured latency must be less than the maximum latency specified above.

**Device(s) in use:** Ground Station ADS – B  
Input Source for Fruit and ADS –B Message  
ASTERIX Recording Tool  
Power  
UTC time Reference

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Inject the Target message and FRUIT messages into the 1090 ES Ground Station and record the resulting reports.			
2	95 % Latency is determined by calculating the latency of each ASTERIX report for all n targets and verifying that 95% of measurements is less than 0.5 seconds.	The sum of the calculated latency and the measurement uncertainty for each report must be less than maximum specified.		

The sum of the calculated latency and the measurement uncertainty for each report must be less than the maximum specified.

Exercise result:

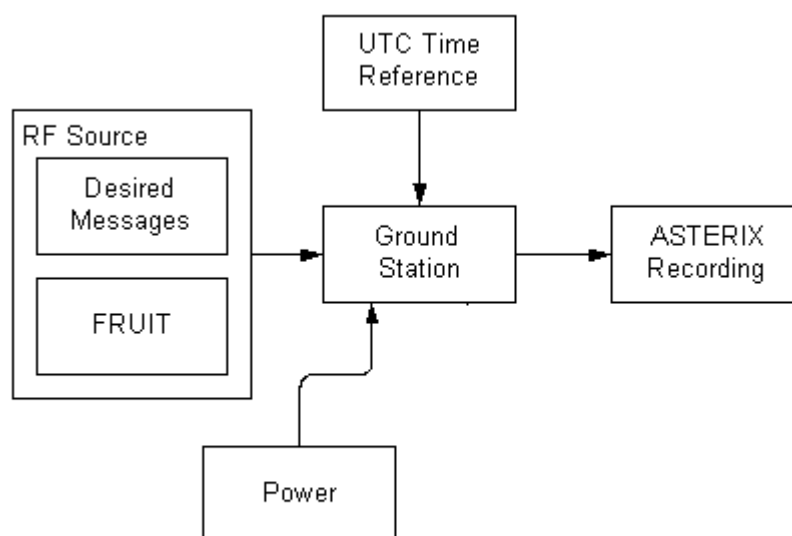
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 12: Verification Exercise Result

## J.1.12 Verification SUT requirements

N/A

## J.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.



#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the verification of 95 % Latency calculating the latency of each ASTERIX report for all n targets generated in the input verifying that 95% of measurements are less than 0.5 seconds.

### **J.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **J.1.15 Platform Configuration**

N/A

### **J.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **J.1.17 Links to other Verification Exercises**

N/A

### **J.1.18 Representatively level/ limitations**

N/A

## **J.2 Exercises Planning and management**

### **J.2.1 Activities**

#### **J.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and J.1.13 in order to meet the Test Preconditions

#### **J.2.1.2 Execution activities**

Play the scenario generating in the input the Desired 1090 MHz messages and record the relevant ASTERIX output.

### J.2.1.3 Post execution activities

The post execution activities in order to verify the 95 % Latency consists in the calculation of the latency for each ASTERIX report for all n targets generated in input verifying that 95% of measurements are less than 0.5 seconds.

### J.2.2 Human Resources.

N/A

### J.2.3 Responsibilities in the exercise

N/A

### J.2.4 Training

N/A

### J.2.5 Time planning

N/A

### J.2.6 Risks.

N/A

### J.2.7 Errors and Observation handling

N/A

## J.3 Analysis Specification

### J.3.1 Data collection methods

The data's collection during the test will be Qualitative. In fact after the test execution the analysis of recorded ASTERIX Data will be performed measuring the ASTERIX report latency for all n targets generated in input and verifying that 95% of measurements are less than 0.5 seconds.

### J.3.2 Analysis method

N/A

### J.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix K Verification Exercise EXE-15.04.05.a- TS.0020.0030-GS TOA Accuracy

### K.1 Exercise Scope and Justification

#### K.1.1 Exercise Level

The level of the exercise is functional.

#### K.1.2 Exercise Type

The type of this exercise is Analysis

#### K.1.3 Description of the system being addressed;

Ground Station ADS-B.

#### K.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### K.1.5 Required Datasets

System Documentation like, for instance, datasheet or system design/choose in order to demonstrate that the Ground Station ADS – B can achieve the Verification objective reported in next section.

#### K.1.6 Verification objectives

Verify by analysis that the time of applicability conveyed in the 1090 GS reports has an absolute accuracy relative to UTC of  $\pm 0.1$  seconds or less.

OBJ-15.04.05.a-TS.0020.0004
-----------------------------

The aim of this objective is to check that the time of applicability conveyed in the ADS-B surveillance report has an absolute accuracy relative to UTC of $\pm 0.1$ seconds or less.
---

#### K.1.7 Inputs

System Documentation like, for instance, datasheet or system design/choose in order to demonstrate that the Ground Station ADS – B can achieve the Verification objective.

#### K.1.8 Outputs

TOA accuracy test documentation

#### K.1.9 Entrance criteria

N/A

#### K.1.10 Exit Criteria

N/A

## K.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS. 0020.0030 / TOA Accuracy

**Pass Criteria:**

The test is passed if the manufacturer is able to demonstrate by analysis that the time of applicability conveyed in the 1090 GS reports has an absolute accuracy relative to UTC of  $\pm 0.1$  seconds or less.

**Exercise Type:**

Analysis

**Exercise result:**

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 13: Verification Exercise Result

## K.1.12 Verification SUT requirements

N/A

## K.1.13 Exercise Tool, Verification Technique and/or Platform

N/A

## K.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## K.1.15 Platform Configuration

N/A

## K.1.16 Configuration(s) Identification of the Verification Platform

N/A

## K.1.17 Links to other Verification Exercises

N/A

## K.1.18 Representatively level/ limitations

N/A

## K.2 Exercises Planning and management

### K.2.1 Activities

#### K.2.1.1 Preparatory activities

N/A

#### K.2.1.2 Execution activities

N/A

#### K.2.1.3 Post execution activities

N/A

### K.2.2 Human Resources.

N/A

### K.2.3 Responsibilities in the exercise

N/A

### K.2.4 Training

N/A

### K.2.5 Time planning

N/A

### K.2.6 Risks.

N/A

### K.2.7 Errors and Observation handling

N/A

## K.3 Analysis Specification

### K.3.1 Data collection methods

N/A

### K.3.2 Analysis method

N/A

### K.3.3 Data logging requirements

N/A

## Appendix L Verification Exercise EXE-15.04.05.a- TS.0020.0040-GS Capacity

### L.1 Exercise Scope and Justification

#### L.1.1 Exercise Level

The level of the exercise is functional.

#### L.1.2 Exercise Type

The type of this exercise is Test

#### L.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### L.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### L.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### L.1.6 Verification objectives

Verify the overall system capacity in a scenario that foresees a maximum Ground Station's load in accordance to RAD Scenario.

OBJ-15.04.05.a-TS.0020.0007
-----------------------------

The aim of this objective is to check that the ADS-B Ground Domain has capacity to handle the reports from the maximum load of aircraft in the environment as described in the OSED without degradation.
--

#### L.1.7 Inputs

A number of targets in order to simulate the maximum Ground Station's load in accordance to RAD Scenario.

#### L.1.8 Outputs

ASTERIX Report Recording.

#### L.1.9 Entrance criteria

Start the generation 1090 MHz Extended Squitter messages relevant to maximum Ground Station's load in accordance to RAD Scenario.

#### L.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in input and once all outputs have been recorded and analyzed.

## L.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0040 / Capacity

**Pass Criteria:** The test is passed if it is possible to verify that the system capacity is equal or greater to maximum Ground Station's load in RAD Scenario.

**Exercise Type:** Test

**Precondition(s):** The test equipment setup will be in line with that described in Section L.1.13 (see below).

The test messages shall be configured in order to simulate n targets, all within the coverage range of the 1090 ES Ground Station

**Note(s):** Since this is a test of the basic system capacity, no FRUIT will be used in the test

If the manufacturer has specified a capacity higher than the maximum Ground Station's load in RAD Scenario for the 1090 ES Ground Station, then this higher number shall be used in the tests above.

**Device(s) in use:** Ground Station ADS – B  
Input Source for ADS –B Message.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Set the Capacity Threshold parameter to n+5.			
2	Enable the injection of the RF test signals.			
3	At least 10 seconds after the target injection is started, start the ASTERIX data recording.  Note: this delay is required to acquire all targets.			

4	Confirm from the SNMP client that no target capacity overload is reported.			
5	Allow the recording to run for at least two minutes, then stop the recording and signal injection.			
6	From the recorded data, confirm that the average number of ASTERIX Category 021 target reports output by the Ground Station for each target is $4 \pm 1\%$ per second for the duration of the recording.			
7	Confirm also that the recorded ASTERIX Category 023 messages do not have the ODP bit set (in item I023/100).			

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

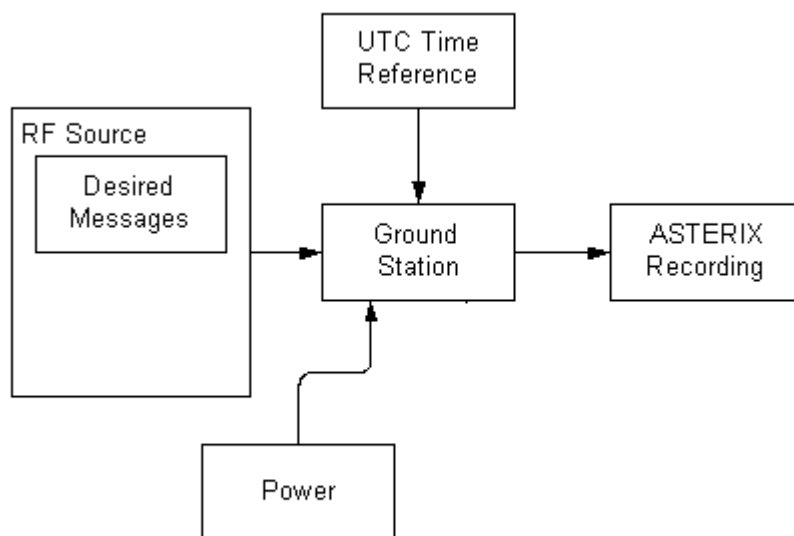
Table 14: Verification Exercise Result

## L.1.12 Verification SUT requirements

N/A



### L.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consist in the verification from the recorded data that the average number of ASTERIX Category 021 target reports output by the Ground Station for each target is  $4 \pm 1\%$  per second for the duration of the recording.

## L.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## L.1.15 Platform Configuration

N/A

## L.1.16 Configuration(s) Identification of the Verification Platform

N/A

## L.1.17 Links to other Verification Exercises

N/A

## L.1.18 Representatively level/ limitations

N/A

# L.2 Exercises Planning and management

## L.2.1 Activities

### L.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and A.1.13 in order to meet the Test Preconditions

### L.2.1.2 Execution activities

Play the scenario generating in the input the Desired 1090 MHz messages and record the relevant ASTERIX output.

### L.2.1.3 Post execution activities

The post execution activities in order to verify the System Capacity consists in the verification from the recorded data that the average number of ASTERIX Category 021 target reports output by the Ground Station for each target is  $4 \pm 1\%$  per second for the duration of the recording.

## L.2.2 Human Resources.

N/A

## L.2.3 Responsibilities in the exercise

N/A

## L.2.4 Training

N/A

## L.2.5 Time planning

N/A

## L.2.6 Risks.

N/A

## L.2.7 Errors and Observation handling

N/A

## L.3 Analysis Specification

### L.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### L.3.2 Analysis method

N/A

### L.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix M Verification Exercise EXE-15.04.05.a- TS.0020.0050-GS Duplicated 24Bit addresses

### M.1 Exercise Scope and Justification

#### M.1.1 Exercise Level

The level of the exercise is functional.

#### M.1.2 Exercise Type

The type of this exercise is Test

#### M.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### M.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### M.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### M.1.6 Verification objectives

Verify that the 1090 ES Ground Station is able to produce separate ASTERIX Category 021 reports for two targets with the same Mode S address in accordance with the requirements specified in EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010 [12] Section 3.10.1.3.

#### OBJ-15.04.05.a-TS.0020.0013

The aim of this objective is to check that 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 **is** 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.1.7 Inputs

1090MHz Extended Squitter Messages in input interface relevant to different Targets (some of them with same 24 Bit Addresses.

#### M.1.8 Outputs

ASTERIX Report Recording.

## M.1.9 Entrance criteria

Start the generation 1090 MHz Extended Squitter messages relevant to duplicated 24 Bit Addresses.

## M.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input and once all outputs have been recorded and analyzed.

## M.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0050 / Duplicated 24Bit addresses

**Pass Criteria:** The test is passed if it is possible to verify that the system is able to produce separate ASTERIX Category 021 reports for two targets with the same Mode S address.

**Exercise Type:** Test

**Preconditions** The test equipment setup will be in line with that described in Section M.1.13 (see below).

In order to test the ability to detect a target with duplicate Mode S address in any point in the lifecycle (i.e. acquisition, maintenance) of the other target three different scenarios are tested. In these scenarios the two targets with the same Mode S address and with 6 - 6.1 NM of horizontal separation are simulated. Altitudes of the targets should be the same. Testing with other altitude combinations is recommended but not required.

### Scenario 1

In this scenario the first target is simulated through the acquisition life cycle. When the target passes the range check and CPR validation and enters the maintenance life cycle, ASTERIX Category 021 Output starts to be issued with CL and RC flags of data item I021/040 set to zero. Two more position messages of this target are injected in order to verify that these positions are reported as new updates of the position of this target.

Injection of the second target is then started. After the second target passes the range check and the CPR validation, both targets shall be flagged as duplicates in ASTERIX Category 021 output (ATP is set to one).

The scenario 1 is listed in Table 15.

*Note: The later target is the first target with ATP flag of data item I021/040 set to one.*

**Table 15: Simulating of Two Duplicate Targets in Scenario 1**

ES Input						Expected ASTERIX Category 021 Output				
Inject Time (s)	Target	CPR	Lat [notes 1,3]	Lon [notes 1,3]	Alt [notes 2,4]	Lat [notes 5,6,7]	Lon [notes 5,6,7]	CL	RC	ATP
0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
0.5		1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
1		0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
1.5		1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	0
2.0		0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>0</sub> <sup>1</sup>	Rlon <sub>0</sub> <sup>1</sup>	0	0	0
2.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
2.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	0
2.75	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
3.0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>0</sub> <sup>1</sup>	Rlon <sub>0</sub> <sup>1</sup>	0	0	0
3.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
3.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	0
3.75	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	Rlat <sub>1</sub> <sup>2</sup>	Rlon <sub>1</sub> <sup>2</sup>	0	0	1
4.0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>0</sub> <sup>1</sup>	Rlon <sub>0</sub> <sup>1</sup>	0	0	1

*Notes:*

1. An arbitrary chosen position of target 1 (Lat<sup>1</sup>, Lon<sup>1</sup>) within the range of the 1090 ES Ground Station is encoded into a pair YZ<sub>0</sub><sup>1</sup>, XZ<sub>0</sub><sup>1</sup> or YZ<sub>1</sub><sup>1</sup>, XZ<sub>1</sub><sup>1</sup> using the CPR Encoding process with even or odd format, respectively.
2. H<sub>1</sub> is an arbitrary chosen altitude of target 1.
3. An arbitrary chosen position of target 2 (Lat<sup>2</sup>, Lon<sup>2</sup>) within the range of the 1090 ES Ground Station is encoded into a pair YZ<sub>0</sub><sup>2</sup>, XZ<sub>0</sub><sup>2</sup> or YZ<sub>1</sub><sup>2</sup>, XZ<sub>1</sub><sup>2</sup> using the CPR Encoding process with even or odd format, respectively. The distance between the positions of target 1 and 2 shall be 6 - 6.1 NM.
4. H<sub>2</sub> is an arbitrary chosen altitude of target 2. The Ground Station must pass the test when H<sub>2</sub> = H<sub>1</sub>. Testing with other altitude combinations is recommended but not required.
5. A pair Rlat<sub>0</sub><sup>1</sup>, Rlon<sub>0</sub><sup>1</sup> or Rlat<sub>1</sub><sup>1</sup>, Rlon<sub>1</sub><sup>1</sup> is a position of target 1 reported in ASTERIX Category 021 reports. The position is a decoded position using Locally Unambiguous CPR Decoding with even or odd format, respectively.
6. A pair Rlat<sub>0</sub><sup>2</sup>, Rlon<sub>0</sub><sup>2</sup> or Rlat<sub>1</sub><sup>2</sup>, Rlon<sub>1</sub><sup>2</sup> is a position of target 2 reported in ASTERIX Category 021 reports. The position is a decoded position using Locally Unambiguous CPR Decoding with even or odd format, respectively.

## Scenario 2

In this scenario the first target is simulated through the range check. When the target passes the range check and is currently in the CPR validation the second target is started to be simulated. The simulation of both the targets continues until both of them enter the maintenance point of their life cycle. Both the targets shall then be flagged as duplicates in ASTERIX Category 021 output (ATP is set to one). The scenario 2 is listed in **Table 16**.

Note: The later target is the first target with ATP flag of data item I021/040 set to one.

**Table 16: Simulating of Two Duplicate Targets in Scenario 2**

ES Input						Expected ASTERIX Category 021 Output				
Inject Time (s)	Target	CPR	Lat [notes 1,3]	Lon [notes 1,3]	Alt [notes 2,4]	Lat [notes 5,6,7]	Lon [notes 5,6,7]	CL	RC	ATP
0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
0.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
0.75	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
1	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
1.25	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
1.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	0
1.75	2	0	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
2.0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>0</sub> <sup>1</sup>	Rlon <sub>0</sub> <sup>1</sup>	0	0	0
2.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	Rlat <sub>0</sub> <sup>2</sup>	Rlon <sub>0</sub> <sup>2</sup>	0	0	1
2.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	1
2.75	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	Rlat <sub>1</sub> <sup>2</sup>	Rlon <sub>1</sub> <sup>2</sup>	0	0	1
3.0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>0</sub> <sup>1</sup>	Rlon <sub>0</sub> <sup>1</sup>	0	0	1

Notes: see Notes of Table 15.

## Scenario 3

In this scenario both the targets are simulated simultaneously through their life cycle until both of them reach the maintenance point of their life cycle. Both the targets shall then be flagged as duplicates in ASTERIX Category 021 output (ATP is set to one). The scenario 3 is listed in Table 17.

Note: The later target is the first target with ATP flag of data item I021/040 set to one.

**Table 17: Simulating of Two Duplicate Targets in Scenario 3**

ES Input						Expected ASTERIX Category 021 Output				
Inject Time (s)	Target	CPR	Lat [notes 1,3]	Lon [notes 1,3]	Alt [notes 2,4]	Lat [notes 5,6,7]	Lon [notes 5,6,7]	CL	RC	ATP
0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
0.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
0.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
0.75	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
1	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	No Output				
1.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	No Output				
1.5	1	1	YZ <sub>1</sub> <sup>1</sup>	XZ <sub>1</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	0
1.75	2	1	YZ <sub>1</sub> <sup>2</sup>	XZ <sub>1</sub> <sup>2</sup>	H <sub>2</sub>	Rlat <sub>1</sub> <sup>2</sup>	Rlon <sub>1</sub> <sup>2</sup>	0	0	1
2.0	1	0	YZ <sub>0</sub> <sup>1</sup>	XZ <sub>0</sub> <sup>1</sup>	H <sub>1</sub>	Rlat <sub>1</sub> <sup>1</sup>	Rlon <sub>1</sub> <sup>1</sup>	0	0	1
2.25	2	0	YZ <sub>0</sub> <sup>2</sup>	XZ <sub>0</sub> <sup>2</sup>	H <sub>2</sub>	Rlat <sub>1</sub> <sup>2</sup>	Rlon <sub>1</sub> <sup>2</sup>	0	0	1

Notes: see Notes of Table 15.

Note(s):

Device(s) in use: Ground Station ADS – B  
Input Source for ADS –B Message.  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

founding members



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Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	For each scenario: -Start recording ASTERIX reports. -Play the scenario. -When the scenario is complete, stop recording ASTERIX reports. -Store ASTERIX data in the corresponding files	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
6	When all the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
7	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

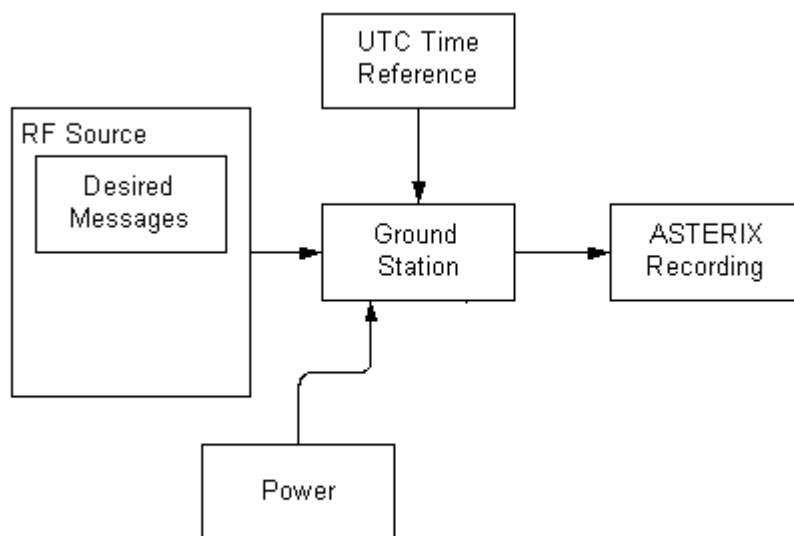
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 18: Verification Exercise Result

## M.1.12 Verification SUT requirements

N/A

## M.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- RF Source for ADS –B Message.
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

### RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## M.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## **M.1.15 Platform Configuration**

N/A

## **M.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **M.1.17 Links to other Verification Exercises**

N/A

## **M.1.18 Representatively level/ limitations**

N/A

## **M.2 Exercises Planning and management**

### **M.2.1 Activities**

#### **M.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and M.1.13 in order to meet the Test Preconditions

#### **M.2.1.2 Execution activities**

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

#### **M.2.1.3 Post execution activities**

The post execution activities in order to verify the System Capacity consists in the verification from the recorded data that ASTERIX Category 021 target reports output by the Ground Station for each of the targets with duplicated 24 bit Address contains the ATP bit set to 1 once they enter in maintenance mode.

### **M.2.2 Human Resources.**

N/A

### **M.2.3 Responsibilities in the exercise**

N/A

### **M.2.4 Training**

N/A

### **M.2.5 Time planning**

N/A

### **M.2.6 Risks.**

N/A

## M.2.7 Errors and Observation handling

N/A

## M.3 Analysis Specification

### M.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### M.3.2 Analysis method

N/A

### M.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix N Verification Exercise EXE-15.04.05.a- TS.0020.0060-GS Report Probability for Target in En- Route Airspace

### N.1 Exercise Scope and Justification

#### N.1.1 Exercise Level

The level of the exercise is functional.

#### N.1.2 Exercise Type

The type of the exercise is Test.

#### N.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### N.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### N.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### N.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0017

The aim of this objective is to check that 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 is 97%.

Notes:

1. Additional requirements are subject to local implementation. Other considerations may apply (see

OSA: §C.5.1.5 - "Loss of track information").

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 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.

#### N.1.7 Inputs

A number of targets in order to simulate the maximum Ground Station's load in accordance to RAD Scenario.

#### N.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

## N.1.9 Entrance criteria

Start the generation of input data.

## N.1.10 Exit Criteria

Finished recording and performed analysis.

## N.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0060 / Report Probability for Target in En-Route Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds with a probability of 97%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output is not greater than 8 seconds in 97% cases.

### Step 2:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route

airspace and received from the a/c within the last 8 seconds in environment with Mode A/C FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output is not greater than 8 seconds in 97% cases.

### Step 3:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment with Mode S FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output is not greater than 8 seconds in 97% cases.

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			

2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

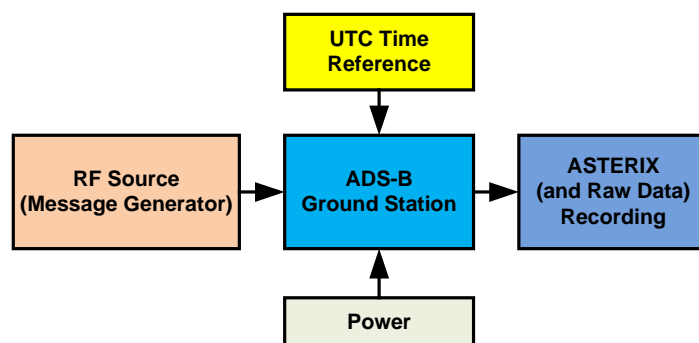
Table 19: Verification Exercise Result

## N.1.12 Verification SUT requirements

N/A



## N.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## N.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## N.1.15 Platform Configuration

N/A

founding members



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## N.1.16 Configuration(s) Identification of the Verification Platform

N/A

## N.1.17 Links to other Verification Exercises

N/A

## N.1.18 Representatively level/ limitations

N/A

## N.2 Exercises Planning and management

### N.2.1 Activities

#### N.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and N.1.13 in order to meet the Test Preconditions.

#### N.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### N.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### N.2.2 Human Resources.

N/A

### N.2.3 Responsibilities in the exercise

N/A

### N.2.4 Training

N/A

### N.2.5 Time planning

N/A

### N.2.6 Risks.

N/A

### N.2.7 Errors and Observation handling

N/A

founding members



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## N.3 Analysis Specification

### N.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### N.3.2 Analysis method

N/A

### N.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix O Verification Exercise EXE-15.04.05.a- TS.0020.0070-GS Change of Mode A code En Route

### O.1 Exercise Scope and Justification

#### O.1.1 Exercise Level

The level of the exercise is functional.

#### O.1.2 Exercise Type

The type of the exercise is Test.

#### O.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### O.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### O.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output

#### O.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0018
The aim of this objective is to check that 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 is no longer than 8 seconds (95%) En Route.

#### O.1.7 Inputs

1090MHz Extended Squitter Messages.

#### O.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

#### O.1.9 Entrance criteria

Start the generation of input data.

#### O.1.10 Exit Criteria

Finished recording and performed analysis.

## O.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0070 / Change of Mode A Code Detection Probability for Target in En-Route Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds with a probability of 95%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 8 seconds in 95% cases.

### Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment with Mode A/C FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 8 seconds in 95% cases.

### Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment with Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 8 seconds in 95% cases.

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			

2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

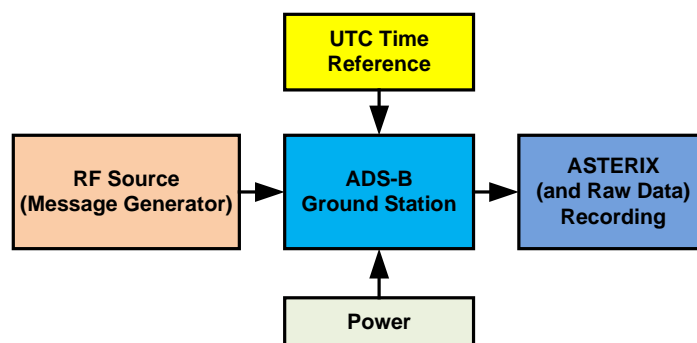
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 20: Verification Exercise Result

## O.1.12 Verification SUT requirements

N/A

## O.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## O.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.



## O.1.15 Platform Configuration

N/A

## O.1.16 Configuration(s) Identification of the Verification Platform

N/A

## O.1.17 Links to other Verification Exercises

N/A

## O.1.18 Representatively level/ limitations

N/A

# O.2 Exercises Planning and management

## O.2.1 Activities

### O.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and O.1.13 in order to meet the Test Preconditions.

### O.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### O.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## O.2.2 Human Resources.

N/A

## O.2.3 Responsibilities in the exercise

N/A

## O.2.4 Training

N/A

## O.2.5 Time planning

N/A

## O.2.6 Risks.

N/A

## O.2.7 Errors and Observation handling

N/A

## O.3 Analysis Specification

### O.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### O.3.2 Analysis method

N/A

### O.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix P Verification Exercise EXE-15.04.05.a- TS.0020.0080-GS Change of Emergency and SPI Information Detection Probability for Target in En-Route Airspace

### P.1 Exercise Scope and Justification

#### P.1.1 Exercise Level

The level of the exercise is functional.

#### P.1.2 Exercise Type

The type of the exercise is Test.

#### P.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### P.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### P.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output

#### P.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0019
-----------------------------

The aim of this objective is to check that 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 is no longer than 8 seconds (95%) En Route.
--

#### P.1.7 Inputs

1090MHz Extended Squitter Messages.

#### P.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

#### P.1.9 Entrance criteria

Start the generation of input data.

## P.1.10 Exit Criteria

Finished recording and performed analysis.

## P.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0080 / Change of Emergency and SPI Information Detection Probability for Target in En-Route Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds with a probability of 95%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output with changed emergency and SPI information is not greater than 8 seconds in 95% cases.

### Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment with Mode A/C FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output with changed emergency and SPI information is not greater than 8 seconds in 95% cases.

### Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in En Route airspace and received from the a/c within the last 8 seconds in environment with Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output with changed emergency and SPI information is not greater than 8 seconds in 95% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	1. Input test scenario versus ASTERIX CAT-21 reports and			
8	2. optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

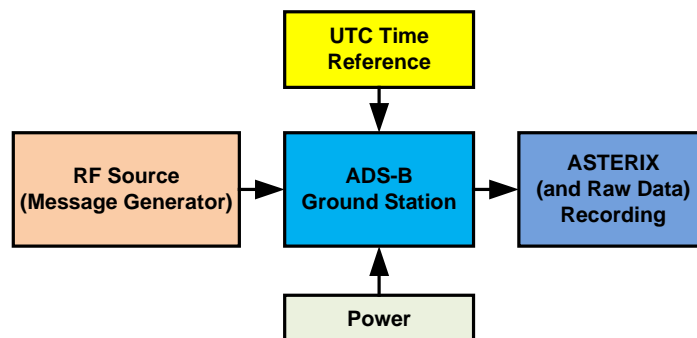
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 21: Verification Exercise Result

## P.1.12 Verification SUT requirements

N/A

## P.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **P.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **P.1.15 Platform Configuration**

N/A

### **P.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **P.1.17 Links to other Verification Exercises**

N/A

### **P.1.18 Representatively level/ limitations**

N/A

## **P.2 Exercises Planning and management**

### **P.2.1 Activities**

#### **P.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and P.1.13 in order to meet the Test Preconditions.

#### **P.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **P.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **P.2.2 Human Resources.**

N/A

### **P.2.3 Responsibilities in the exercise**

N/A

### **P.2.4 Training**

N/A



## P.2.5 Time planning

N/A

## P.2.6 Risks.

N/A

## P.2.7 Errors and Observation handling

N/A

## P.3 Analysis Specification

### P.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### P.3.2 Analysis method

N/A

### P.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix Q Verification Exercise EXE-15.04.05.a- TS.0020.0090-GS Report Probability for Target in TMA Airspace

### Q.1 Exercise Scope and Justification

#### Q.1.1 Exercise Level

The level of the exercise is functional.

#### Q.1.2 Exercise Type

The type of the exercise is Test.

#### Q.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### Q.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### Q.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output

#### Q.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0021

The aim of this objective is to check that 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 is 97%.

Notes:

1. Additional requirements are subject to local implementation. Other considerations may apply (see OSA: C.5.1.5 - "Loss of track information").
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 positions of sufficient quality on a single aircraft basis. Multiple aircraft data continuity is addressed in ASSUMP 24.

#### Q.1.7 Inputs

1090MHz Extended Squitter Messages.

## Q.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

## Q.1.9 Entrance criteria

Start the generation of input data.

## Q.1.10 Exit Criteria

Finished recording and performed analysis.

## Q.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0090 / Report Probability for Target in TMA Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds with a probability of 97%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 5 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output is not greater than 8 seconds in 97% cases.

### Step 2:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 5 seconds in environment with Mode A/C FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output is not greater than 8 seconds in 97% cases.

### Step 3:

This test step verifies that the 1090 ES Ground Station is able to produce a target report containing ADS-B Position data associated with any aircraft in En Route airspace and received from the a/c within the last 5 seconds in environment with Mode S FRUIT with a probability of 97%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of receive and time of output is not greater than 8 seconds in 97% cases.

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test			

	configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

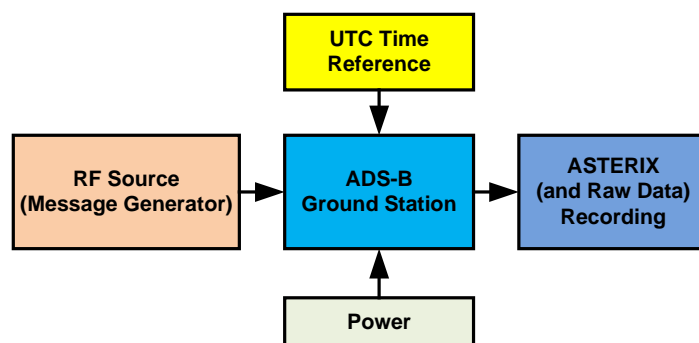
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 22: Verification Exercise Result

## Q.1.12 Verification SUT requirements

N/A

### Q.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

#### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### Q.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## Q.1.15 Platform Configuration

N/A

## Q.1.16 Configuration(s) Identification of the Verification Platform

N/A

## Q.1.17 Links to other Verification Exercises

N/A

## Q.1.18 Representatively level/ limitations

N/A

# Q.2 Exercises Planning and management

## Q.2.1 Activities

### Q.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and Q.1.13 in order to meet the Test Preconditions.

### Q.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### Q.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## Q.2.2 Human Resources.

N/A

## Q.2.3 Responsibilities in the exercise

N/A

## Q.2.4 Training

N/A

## Q.2.5 Time planning

N/A

## Q.2.6 Risks.

N/A

## Q.2.7 Errors and Observation handling

N/A

## Q.3 Analysis Specification

### Q.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### Q.3.2 Analysis method

N/A

### Q.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.



## Appendix R Verification Exercise EXE-15.04.05.a- TS.0020.0100-GS Change of Mode A code TMA

### R.1 Exercise Scope and Justification

#### R.1.1 Exercise Level

The level of the exercise is functional.

#### R.1.2 Exercise Type

The type of the exercise is Test.

#### R.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### R.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### R.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output

#### R.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0022
The aim of this objective is to check that 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 is no longer than 5 seconds (95%) TMA.

#### R.1.7 Inputs

1090MHz Extended Squitter Messages.

#### R.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

#### R.1.9 Entrance criteria

Start the generation of input data.

#### R.1.10 Exit Criteria

Finished recording and performed analysis.

## R.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0100 / Change of Mode A Code  
Detection Probability for Target in TMA Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds with a probability of 95%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 5 seconds in 95% cases.

### Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment with Mode A/C FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 5 seconds in 95% cases.

### Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Mode A code provided by the ADS-B aircraft and to produce a target report containing updated Mode A data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment with Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Mode A addresses, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Mode A code is not greater than 5 seconds in 95% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

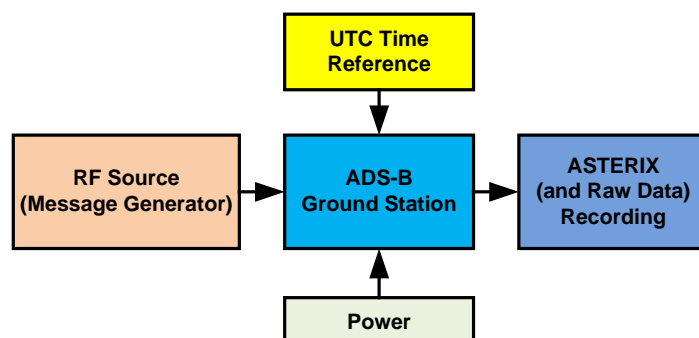
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 23: Verification Exercise Result

## R.1.12 Verification SUT requirements

N/A

## R.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## R.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## R.1.15 Platform Configuration

N/A

## R.1.16 Configuration(s) Identification of the Verification Platform

N/A

## R.1.17 Links to other Verification Exercises

N/A

## R.1.18 Representatively level/ limitations

N/A

# R.2 Exercises Planning and management

## R.2.1 Activities

### R.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and R.1.13 in order to meet the Test Preconditions.

### R.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### R.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## R.2.2 Human Resources.

N/A

## R.2.3 Responsibilities in the exercise

N/A

## R.2.4 Training

N/A

## R.2.5 Time planning

N/A

## R.2.6 Risks.

N/A

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## R.2.7 Errors and Observation handling

N/A

## R.3 Analysis Specification

### R.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### R.3.2 Analysis method

N/A

### R.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix S Verification Exercise EXE-15.04.05.a- TS.0020.0110-GS Change of Emergency SPI information TMA

### S.1 Exercise Scope and Justification

#### S.1.1 Exercise Level

The level of the exercise is functional.

#### S.1.2 Exercise Type

The type of the exercise is Test.

#### S.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### S.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### S.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output

#### S.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0020.0023
-----------------------------

The aim of this objective is to check that 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 point E2 is no longer than 5 seconds (95%) TMA.
---

#### S.1.7 Inputs

1090MHz Extended Squitter Messages.

#### S.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.

#### S.1.9 Entrance criteria

Start the generation of input data.

#### S.1.10 Exit Criteria

Finished recording and performed analysis.



## S.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0020.0110 / Change of Emergency and SPI Information Detection Probability for Target in TMA Airspace

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds with a probability of 95%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

### Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed emergency and SPI information is not greater than 5 seconds in 95% cases.

### Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment with Mode A/C FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed emergency and SPI information is not greater than 5 seconds in 95% cases.

### Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of emergency and SPI information provided by the ADS-B aircraft and to produce a target report containing updated emergency and SPI information data associated with any aircraft in TMA airspace and received from the a/c within the last 5 seconds in environment with Mode S FRUIT with a probability of 95%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have initial emergency and SPI information, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed emergency and SPI information is not greater than 5 seconds in 95% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

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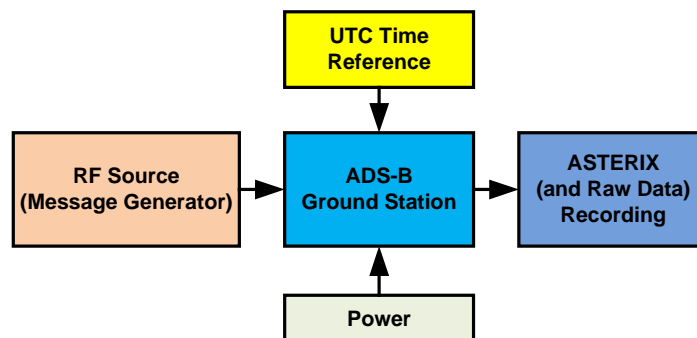
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 24: Verification Exercise Result

## S.1.12 Verification SUT requirements

N/A

## S.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **S.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **S.1.15 Platform Configuration**

N/A

### **S.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **S.1.17 Links to other Verification Exercises**

N/A

### **S.1.18 Representatively level/ limitations**

N/A

## **S.2 Exercises Planning and management**

### **S.2.1 Activities**

#### **S.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and S.1.13 in order to meet the Test Preconditions.

#### **S.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **S.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **S.2.2 Human Resources.**

N/A

### **S.2.3 Responsibilities in the exercise**

N/A

### **S.2.4 Training**

N/A

## S.2.5 Time planning

N/A

## S.2.6 Risks.

N/A

## S.2.7 Errors and Observation handling

N/A

## S.3 Analysis Specification

### S.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### S.3.2 Analysis method

N/A

### S.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix T Verification Exercise EXE-15.04.05.a-TS.0030.0 10-GS Integration with WAM

### T.1 Exercise Scope and Justification

#### T.1.1 Exercise Level

The level of the exercise is functional.

#### T.1.2 Exercise Type

The type of this exercise is Test.

#### T.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### T.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### T.1.5 Required Datasets

The Datasets foreseen for this exercise are:

ADS –B data in the input of the Ground Station.

ASTERIX report CAT20 for the WAM System.

ASTERIX report CAT19 for the WAM System.

#### T.1.6 Verification objectives

Verify the Requirements related to the enhancement of ADS-B/WAM Integration.

OBJ-15.04.05.a-TS.0030.0001
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable to receive output from a WAM system in ASTERIX CAT 020 version 1.7.
---

OBJ-15.04.05.a-TS.0030.0002
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain processes and decodes received WAM data in ASTERIX CAT020 version 1.7. The following minimum set of data item <b>should</b> be decoded:
---

- |   |
|---|
| <ul style="list-style-type: none"><li>• Aircraft Horizontal Position – Latitude and Longitude</li><li>• Pressure altitude</li><li>• Aircraft Identity (Mode 3A, Mode-S Address, Aircraft-Id) and Emergency Indicators</li><li>• Time of Applicability</li></ul> |
|---|

OBJ-15.04.05.a-TS.0030.0003
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable of receive WAM system status messages in ASTERIX CAT 019 version 1.2.
---

OBJ-15.04.05.a-TS.0030.0004

The aim of this objective is to check that the, ADS-B Ground Surveillance Domain processes and decode received WAM data in ASTERIX CAT019 version 1.2. The following minimum set of data item needs to be decoded:

- Time of Applicability
- System Status

OBJ-15.04.05.a-TS.0030.0005

The aim of this objective is to check that the ADS-B Ground Surveillance Domain uses the WAM System Status received by ASTERIX CAT019 as a criterion for the enabling of the ADS-B validity check.

OBJ-15.04.05.a-TS.0030.0006

The aim of this objective is to check that the ADS-B Ground Surveillance Domain correlates ADS-B reports received through 1090ES with reports received from a WAM System in ASTERIX CAT020 version 1.7.

OBJ-15.04.05.a-TS.0030.0007

The aim of this objective is to check that the ADS-B Ground Surveillance Domain verifies the validity of ADS-B reports by comparing ADS-B position data with position data of correlated WAM reports.

OBJ-15.04.05.a-TS.0030.0008

The aim of this objective is to check that the validation result (positive/negative) **shall** be reported in the CAT021 ADS-B report

## T.1.7 Inputs

The foreseen inputs for this exercise are:

Message in the Ground Station Input.

ASTERIX report CAT20 for the WAM System

ASTERIX report CAT19 for the WAM System.

## T.1.8 Outputs

ASTERIX Report Recording

## T.1.9 Entrance criteria

Start the generation of input data.

## T.1.10 Exit Criteria

The Test will finish after the generation and injection of input data and recording of output data.

## T.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0030.0 10 / Integration with WAM

**Pass Criteria:** The test is passed if the conditions described in the different scenarios are

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verified.

Exercise Type: Test

Precondition(s): The test equipment setup will be in line with that described in Section A.1.13 (see below).

The following Scenarios will be simulated:

#### Scenario 1:

It will be simulated that the Time Out for ASTERIX CAT 19 reception expires and as long as this condition persists the relevant information are propagated in the output of the Ground Station by means :

- ASTERIX CAT 23
- ASTERIX CAT 21 with the ADS – B report marked as NOT VALIDATED.

In this Scenario it will be simulated the following input:

- ADS – B input messages in the Ground Station referring to an aircraft with a specific 24 – bit Address.
- ASTERIX CAT20 reports in input of Ground Station referring to an aircraft with the same 24 bits Address used for the ADS – B input messages.
- No ASTERIX CAT19.

The ADS – B messages and ASTERIX CAT20 will be set (e.g. number , Latitude , Longitude, Time of applicability) in order to perform the ADS-B/WAM check.

#### Scenario 2:

In this scenario it will be verified that ADS –B /WAM Validity Check is performed only if the field I019/550 ( NOGO) is set to 00.

In this Scenario it will be simulated the following input:

- ADS – B input messages in the Ground Station referring to an aircraft with a specific 24 – bit Address.
- ASTERIX CAT20 reports in input of Ground Station referring to an aircraft with the same 24 bits Address used for the ADS – B input messages.
- ASTERIX CAT19 with the following set in the item: I019/550 ( NOGO) is set to 00 or 01.

The ADS – B messages and ASTERIX CAT20 will be set (e.g. number , Latitude , Longitude, Time of applicability) in order to verify that the ADS-B/WAM check is passed with the relevant 1090 GS report marked as VALID in ASTERIX CAT 21 as long as the above test condition persists and to verify that ASTERIX CAT 023 is sent showing that WAM integration Validation is Active.

### Scenario 3:

In this scenario it will be simulated that the information coming from ASTERIX CAT19 in the field I019/550 ( NOGO) is set to 11 10 or 01 with the ADS –B /WAM Validity Check not performed.

In this Scenario it will be simulated the following input:

- ADS – B input messages in the Ground Station referring to an aircraft with a specific 24 – bit Address.
- ASTERIX CAT 20 reports in input of Ground Station referring to an aircraft with the same 24 bits Address used for the ADS – B input messages.
- ASTERIX CAT 19 with the item I019/550 ( NOGO) set to 11 10 or 01.

The ADS – B messages and ASTERIX CAT20 will be set (e.g. number , Latitude , Longitude, Time of applicability) in order to perform the ADS-B/WAM check but the ADS – B report is marked as NOT VALIDATED in ASTERIX CAT 21 due to information coming from ASTERIX CAT19.

In this case it will be verified that:

- The test is not performed with the ADS – B report marked as NOT VALIDATED over ASTERIX CAT 21 and WAM integration validation is not active over ASTERIX CAT23

### Scenario 4:

In This Scenario it will be simulated the following input:

- ADS – B input messages in the Ground Station referring to an aircraft with a specific 24 – bit Address.
- ASTERIX CAT 20 reports in input of Ground Station referring to an aircraft with the same 24 bits Address used for the ADS – B input messages.
- ASTERIX CAT 19 with the item I019/550 ( NOGO) set to 00.

The messages ADS – B and ASTERIX CAT 20 will be set (e.g. number , Latitude , Longitude, Time of applicability) in order to verify that the ADS-B/WAM check is NOT passed with the relevant 1090 GS report marked as NOT VALID over ASTERIX CAT 21 and to verify that ASTERIX CAT 023 is sent showing that WAM integration Validation is Active.

Note(s):

Device(s) in use: Ground Station ADS – B

Message Generator  
ASTERIX Recording Tool  
Power  
UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090 GS, activate the ADS-B/WAM check.			
3	Set the parameter Time Out Parameter for ASTERIX 19 reception = XX seconds			
4	Set the parameter ADS-B/WAM Threshold = ZZZ meters.			
5	Prepare the report capture tool to capture ASTERIX reports			
6	Prepare the message source to play the scenario.			
7	For each scenario: Play the scenario. When the scenario is complete, stop recording ASTERIX reports Analyze the recorded data and verify that the conditions described above are met			

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

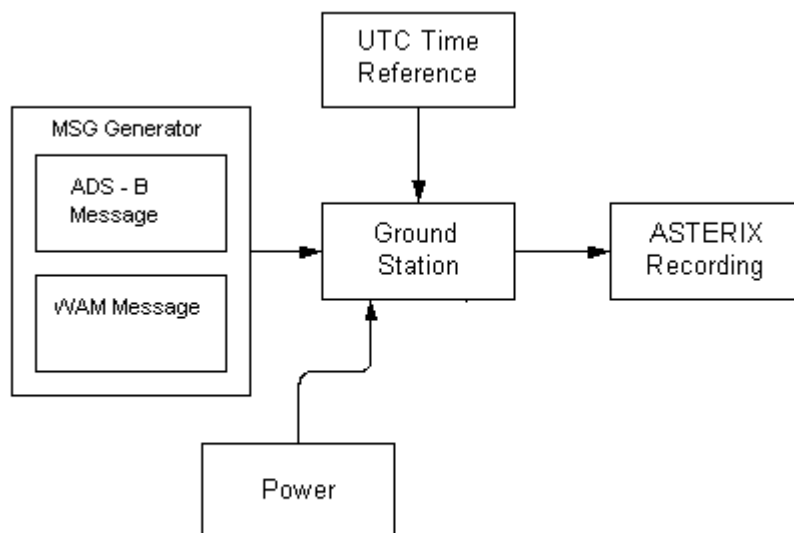
Table 25: Verification Exercise Result

## T.1.12 Verification SUT requirements

N/A

### T.1.13 Exercise Tool, Verification Technique and/or Platform

The Verification Technique consists in the verification from the recorded data that validation information (VALID, NOT VALID, NOT VALIDATED) are correctly propagated over ASTERIX CAT 21 in each scenario reported in the section T.1.11.



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

#### Message Generator

The Messages Generator will be capable to generate the ADS – B message , ASTERIX CAT20 messages and ASTERIX CAT 19 messages.

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **T.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **T.1.15 Platform Configuration**

N/A

## **T.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **T.1.17 Links to other Verification Exercises**

N/A

## **T.1.18 Representatively level/ limitations**

N/A

# **T.2 Exercises Planning and management**

## **T.2.1 Activities**

### **T.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and T.1.13 in order to meet the Test Preconditions

### **T.2.1.2 Execution activities**

Play the scenario generating in the input the Desired messages and record the relevant ASTERIX output.

### **T.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports during the application of each Scenario above. The Recorded ASTERIX reports will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

## **T.2.2 Human Resources.**

N/A

## **T.2.3 Responsibilities in the exercise**

N/A

## **T.2.4 Training**

N/A

## **T.2.5 Time planning**

N/A

## **T.2.6 Risks.**

N/A

## T.2.7 Errors and Observation handling

N/A

## T.3 Analysis Specification

### T.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### T.3.2 Analysis method

N/A

### T.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix U Verification Exercise EXE-15.04.05.a- TS.0040.0000 GS Angle of Arrival Validation

### U.1 Exercise Scope and Justification

#### U.1.1 Exercise Level

The level of the exercise is functional.

#### U.1.2 Exercise Type

The type of the exercise is Test.

#### U.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### U.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### U.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### U.1.6 Verification objectives

Verify the Requirements related to the Angle of arrival enhancement Test.

OBJ-15.04.05.a-TS.0040.0001
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to determine the direction of arrival of the received ES.
--

OBJ-15.04.05.a-TS.0040.0002
-----------------------------

The aim of this objective is to check that each time a valid position message is received for a target in "target data maintenance" mode (see ED-129 chapter 3), the ADS-B Ground Surveillance Domain measures the direction of arrival of it
---

OBJ-15.04.05.a-TS.0040.0003
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain registers a real direction of arrival of each of the received ES.
---

OBJ-15.04.05.a-TS.0040.0004
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain calculates the direction of arrival of each of the received position ES using the reported position and the known GS position.
--

OBJ-15.04.05.a-TS.0040.0005
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain compares the real direction of arrival with the calculated direction of arrival using the reported position.
--

OBJ-15.04.05.a-TS.0040.0006

The aim of this objective is to check that if "n" consecutive position updates defined as "not matching" have been received, then the ADS-B Ground Surveillance Domain marks the message as "direction of arrival Failure".

OBJ-15.04.05.a-TS.0040.0007

The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "direction of arrival failures" in ADS-B reports created out of marked messages.

## U.1.7Inputs

1090MHz Extended Squitter Messages in the input interface relevant to "n" different Targets.

## U.1.8Outputs

ASTERIX Report Recording

## U.1.9 Entrance criteria

Start the generation of input data.

## U.1.10 Exit Criteria

The Test will finish after the generation and injection of the input data and recording of the output data.

## U.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS. 0040.0000 / GS Angle of Arrival Validation

**Pass Criteria:** This test is passed, when it is possible to measure the real direction of arrival of the received ADS-B Extended Squitter and verify that it is coherent with the theoretical angle calculated using the position reported by the target.

**Exercise Type:** Test

**Precondition(s):**

- The minimum resolution of the real direction of arrival **will be set to 180°**.  
Angle of arrival validation is enabled.
- X,Y latitude and longitude reported by target are located in the centre of sector 1 of arrival.
- A,B latitude and longitude reported by target are located in the centre of sector 2 of arrival.

**Step 1:**  
A target will be simulated to transmit ES position messages at standard rates stated in DO260.  
The target will initially transmit a position identical to his real location (both contained in sector 1).



For this period ASTERIX cat 021 reports obtained from the GS will have the DoA bit contained in I021/040 set to 0.

**Step 2:**

In this period, the target will begin to transmit a position contained in a different angle of arrival, while the target has not moved (should be received from a different sector to the reported position).

For a number of ASTERIX reports configured by the user, the GS does not report the DoA bit set to 1.

After a number of "n" ES (configured by the user) is received the GS begins to transmit DoA bit set to 1.

Step	ES Input						Expected ASTERIX Category 021 Output	
	Msg ID	Inject Time (s)	FTC	CPR	LAT-LONG	Receiving SECTOR	Rpt	DoA
1	PO1	0.5	17	0	X,Y	1		
	PE2	1	17	1	X,Y	1		
	PO3	1.5	17	0	X,Y	1		
	PE4	2	17	1	X,Y	1	R1	00
	PO5	2.5	17	0	X,Y	1	R2	00
	PE6	3	17	1	X,Y	1	R3	00
	PO7	3.5	17	0	X,Y	1	R4	00
	PE8	4	17	1	X,Y	1	R5	00
2	PO9	4.5	17	0	A,B	1	R6	00
	PE10	5	17	1	A,B	1	R7	00
	PO11	5.5	17	0	A,B	1	R8	00
	PE12	6	17	1	A,B	1	R9	00
	PO13	6.5	17	0	A,B	1	R10	01
	PE14	7	17	1	A,B	1	R11	01

Note(s): In this test, the direction of arrival measured from the received ES will be compared with the direction of arrival of the received ES, based on the reported position and the known GS position.

Device(s) in use: Ground Station ADS – B  
Message Generator  
ASTERIX Recording Tool  
Power

UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	In the 1090 GS, activate the Angle of arrival validation.			
4	Set the "n" parameter (number of consecutive "not matching" position updates) to a value of = 5.			
5	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
6	Prepare the message source to play the scenario.			
7	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
8	Play the scenario in the injection tool	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
9	Wait for more than 120s			
10	In the 1090 GS, deactivate the Angle of arrival validation.			
11	Prepare the message source to			

	play the scenario																																				
12	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS																																			
13	Play the scenario in the injection tool	Recording tool is receiving data from ADS-B GS corresponding to test targets.																																			
14	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.																																			
15	Analyze the recorded data and verify that the expected outputs are present.																																				
16	Expected ASTERIX CAT 021output with Angle of arrival validation enabled.	<table><tr><th colspan="2">Expected ASTERIX Category 021 Output</th></tr><tr><th>Rpt</th><th>AoA</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>R1</td><td>00</td></tr><tr><td>R2</td><td>00</td></tr><tr><td>R3</td><td>00</td></tr><tr><td>R4</td><td>00</td></tr><tr><td>R5</td><td>00</td></tr><tr><td>R6</td><td>00</td></tr><tr><td>R7</td><td>00</td></tr><tr><td>R8</td><td>00</td></tr><tr><td>R9</td><td>00</td></tr><tr><td>R10</td><td>01</td></tr><tr><td>R11</td><td>01</td></tr></table>		Expected ASTERIX Category 021 Output		Rpt	AoA							R1	00	R2	00	R3	00	R4	00	R5	00	R6	00	R7	00	R8	00	R9	00	R10	01	R11	01		
Expected ASTERIX Category 021 Output																																					
Rpt	AoA																																				
R1	00																																				
R2	00																																				
R3	00																																				
R4	00																																				
R5	00																																				
R6	00																																				
R7	00																																				
R8	00																																				
R9	00																																				
R10	01																																				
R11	01																																				
17	Expected ASTERIX CAT 023output with Angle of arrival validation enabled.	All ASTERIX CAT 023 outputs created with Angle of arrival validation Enabled should have AoA bit set to 1																																			

18	Expected output with Angle of arrival validation disabled.	<b>Expected ASTERIX Category 021 Output</b>			
		<b>Rpt</b>	<b>AoA</b>		
		R1	10		
		R2	10		
		R3	10		
		R4	10		
		R5	10		
		R6	10		
		R7	10		
		R8	10		
		R9	10		
		R10	10		
		R11	10		
19	Expected ASTERIX CAT 023 output with Angle of arrival validation disabled.	<b>All ASTERIX CAT 023 outputs created with Angle of arrival validation disabled should have AoA bit set to 0</b>			

Exercise result:

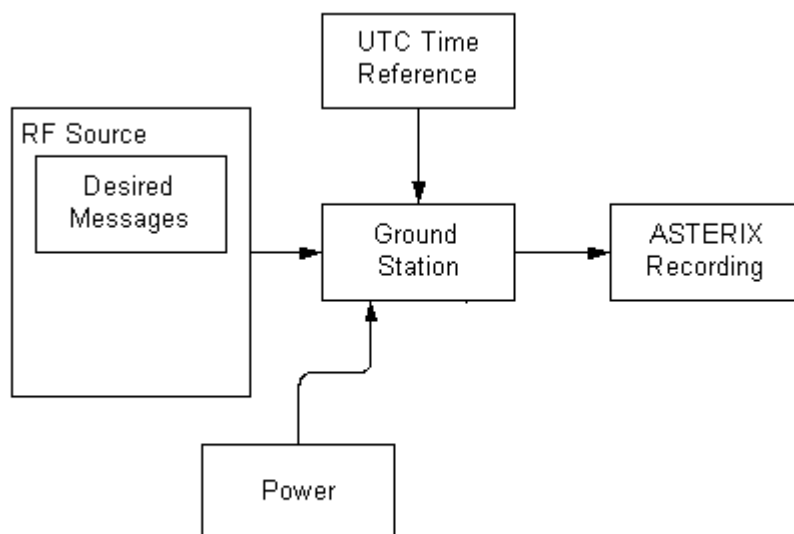
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 26: Verification Exercise Result

## U.1.12 Verification SUT requirements

N/A

## U.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

### RF source message Generator

The source Generator will be capable to generate RF data and send it to the 1090GS through the transmission of 1090MHz ES (a site monitor with configurable position could be used).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## U.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## U.1.15 Platform Configuration

N/A

## U.1.16 Configuration(s) Identification of the Verification Platform

N/A

## U.1.17 Links to other Verification Exercises

N/A

## U.1.18 Representatively level/ limitations

N/A

# U.2 Exercises Planning and management

## U.2.1 Activities

N/A

### U.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and U.1.13 in order to meet the Test Preconditions

### U.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

### U.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

## U.2.2 Human Resources.

N/A

## U.2.3 Responsibilities in the exercise

N/A

## U.2.4 Training

N/A

## U.2.5 Time planning

N/A

## U.2.6 Risks

N/A

## U.2.7 Errors and Observation handling

N/A

## U.3 Analysis Specification

### U.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### U.3.2 Analysis method

N/A

### U.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix V Verification Exercises EXE-15.04.05.a- TS.0040.0020 GS Power Versus Distance Validation

### V.1 Exercise Scope and Justification

#### V.1.1 Exercise Level

The level of the exercise is functional.

#### V.1.2 Exercise Type

The type of the exercise is Test.

#### V.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### V.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### V.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### V.1.6 Verification objectives

Verify the Requirements related to the Power versus range enhancement Test.

This test is designed to comply with the verification of the following objectives:

OBJ-15.04.05.a-TS.0040.0040
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to measure the power of the received ES
--

OBJ-15.04.05.a-TS.0040.0041
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain is capable to detect the equipment class of the transmitting aircraft.
--

OBJ-15.04.05.a-TS.0040.0042
-----------------------------

The aim of this objective is to check that once a valid position message is received for a target in "target data maintenance" mode (see ED-129 chapter 3), the ADS-B Ground Surveillance Domain estimates the transmission power of it.
--

OBJ-15.04.05.a-TS.0040.0043
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain calculates the distance of the target from the ADS-B receiver using the reported position and altitude
--

OBJ-15.04.05.a-TS.0040.0044
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain determines the
--



approximate distance of each of the received ES using the measured power and equipment class. (see ED129 appendix F)
---

OBJ-15.04.05.a-TS.0040.0045
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain compares the distance obtained from the received position data with the distance calculated using measured power increments.
--

OBJ-15.04.05.a-TS.0040.0046
-----------------------------

The aim of this objective is to check that "n" consecutive position updates for which the difference between the approximate distance and the reported distance is greater than "x" Nm have been received in "t" seconds, then the ADS-B Ground Surveillance Domain marks the message as "Power/Distance inconsistency".
--

OBJ-15.04.05.a-TS.0040.0047
-----------------------------

The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "Power/Range inconsistency" in ADS-B reports created out of marked messages.
--

## V.1.7Inputs

1090MHz Extended Squitter Messages in the input interface relevant to "n" different Targets.

## V.1.8 Outputs

Identify the deliverable generated to test compliance.

ASTERIX Report Recording.

## V.1.9 Entrance criteria

Start the generation of input data.

## V.1.10 Exit Criteria

The Test will finish after the generation and injection of the input data and recording of the output data.

## V.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0040.0020 / GS Power Versus Distance Validation

Pass Criteria:

This test is passed, when it is possible to measure the power of the received ADS-B Extended Squitter and verify that it is coherent with the theoretical power calculated using the position reported by the target.

Exercise Type: Test

Precondition(s): The scenario will include the next test targets:

**Correct target1:**

Target 1 "A1" moves respect to sensor (approach or away) and transmits power related with the position reported.

The injected power will be according to the distance between the target and the GS.

**Incorrect target2:**

Target 2 "A2" moves respect to sensor (approach or away) and with transmitting power related with the position reported up to time "t<sub>1</sub>".

After a later instant "t<sub>2</sub>", the target will maintain transmitting power at the value corresponding to "t<sub>2</sub>" until the end of the test.

In the period of time between "t<sub>2</sub>" and the end of the test, in a certain moment, "t<sub>3</sub>" the target will be transmitting a constant power which should be marked as power-range failure.

**Incorrect target3:**

Target 3 "A3" moves respect to sensor (approach or away) and transmits power related with the position reported.

The injected power will be at any moment outside the maximum and minimum values allowed for the different equipment classes according to the distance between the target and the GS.

Note(s):

Device(s) in use: ADSB GS

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			

4	Prepare the message source to play the scenario			
5	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
6	In the 1090 GS, activate the power versus range validation.			
7	Play the scenario in the injection tool	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
8	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
9	Analyze the recorded data and verify that the expected outputs are present.	AST reports for target 1 should have PrV bit set to 00 at any time.		
10	Analyze the recorded data and verify that the expected outputs are present.	AST reports for target 2 created before $t_3$ should have PrV bit set to 00.		
11	Analyze the recorded data and verify that the expected outputs are present.	AST reports for target 2 created after $t_3$ should have PrV bit set to 01.		
12	Analyze the recorded data and verify that the expected outputs are present.	AST reports for target 3 created before $t_4$ should have PrV bit set to 00.		
13	Analyze the recorded data and verify that the expected outputs are present.	AST reports for target 3 created after $t_4$ should have PrV bit set to 01.		
14	Analyze the recorded data and verify that the expected outputs are present.	All ASTERIX CAT 023 outputs created with Power & range enabled should have PRV bit set to 1		
15	Wait for at least 120s.			
16	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS			
17	In the 1090 GS, deactivate the power versus range			

	validation.			
18	Prepare the message source to play the scenario			
19	Start recording ASTERIX reports.	Recording tool is receiving data from ADS-B GS		
20	Play the scenario in the injection tool	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
21	When the scenario replay is completed stop recording ASTERIX reports.	Recording tool is not receiving data from ADS-B GS corresponding to test targets.		
22	Analyze the recorded data and verify that the expected outputs are present.	AST reports for all targets should have PrV bit set to 10 at any time.		
23	Analyze the recorded data and verify that the expected outputs are present.	All ASTERIX CAT 023 outputs created with Power & range disabled should have PRV bit set to 1		

Exercise result:

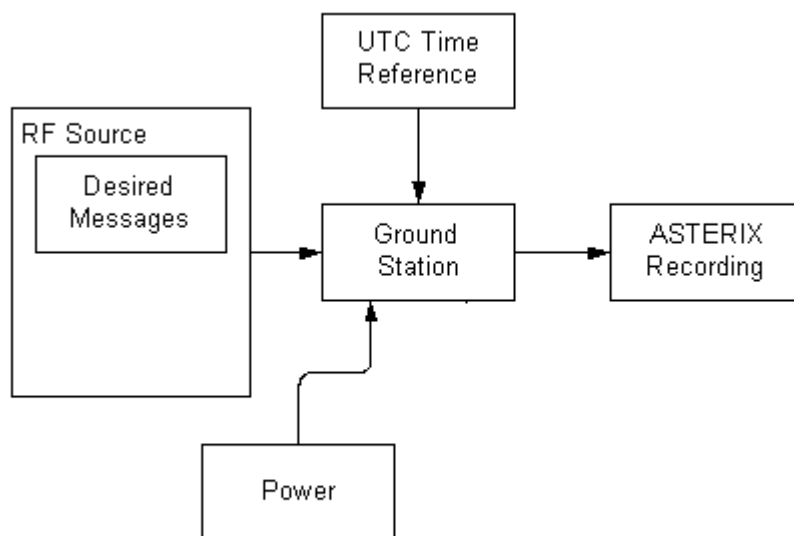
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 27: Verification Exercise Result

## V.1.12 Verification SUT requirements

N/A

## V.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS – B Ground Station or 1090 Receiver) like:

**Target data stream** with inside the information extracted by the ADS – B message (ASTERIX CAT 21 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

**Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## V.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## V.1.15 Platform Configuration

N/A

## V.1.16 Configuration(s) Identification of the Verification Platform

N/A

## V.1.17 Links to other Verification Exercises

N/A

## V.1.18 Representatively level/ limitations

N/A

# V.2 Exercises Planning and management

## V.2.1 Activities

N/A

### V.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and V.1.13 in order to meet the Test Preconditions

### V.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

### V.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

## V.2.2 Human Resources

N/A

## V.2.3 Responsibilities in the exercise

N/A

## V.2.4 Training

N/A

## V.2.5 Time planning

N/A

## V.2.6 Risks

N/A

## V.2.7 Errors and Observation handling

N/A

## V.3 Analysis Specification

### V.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### V.3.2 Analysis method

N/A

### V.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

## Appendix W Verification Exercise EXE-15.04.05.a- TS.0040.0030 GS Time of Arrival versus Distance Validation

### W.1 Exercise Scope and Justification

#### W.1.1 Exercise Level

The level of the exercise is functional.

#### W.1.2 Exercise Type

The type of the exercise is Test.

#### W.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### W.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

#### W.1.5 Required Datasets

The Datasets foreseen for this exercise are:

N Target data stream coming from Remote System.

N Operational Status Data Stream coming from Remote System.

#### W.1.6 Verification objectives

Verify the Requirements related to the TOA versus Distance enhancement Test.

<b>OBJ-15.04.05.a-TS.0040.0030</b>
The aim of this objective is to check that the ADS-B Ground Surveillance Domain <b>is</b> capable to determine the distance of a target from an ADS-B receiver by using the received horizontal position data, the received altitude data provided by several ADS-B receivers and the static receiver positions.

<b>OBJ-15.04.05.a-TS.0040.0031</b>
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has a function elaborating the consistency of TOA versus calculated distance from an ADS-B receiver for multiple ADS-B receivers having received the same position squitter.

<b>OBJ-15.04.05.a-TS.0040.0032</b>
The aim of this objective is to check that the If "n" consecutive position updates for which the TOA/distance consistency check yields inconsistent, then the ADS-B Ground Surveillance Domain marks the message as "inconsistent TOA/distance".



OBJ-15.04.05.a-TS.0040.0033

The aim of this objective is to check that the ADS-B Ground Surveillance Domain reports "inconsistent TOA/distance" in ADS-B reports created out of marked messages.

## W.1.7 Inputs

The Dataset foreseen for this exercise are:

N Target data stream coming from Remote System.

N Operational Status Data Stream coming from Remote System.

## W.1.8 Outputs

ASTERIX Report Recording

## W.1.9 Entrance criteria

Start the generation of input data.

## W.1.10 Exit Criteria

The Test will finish after the generation and injection of the input data and recording of the output data.

## W.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0040.0030-GS / Time of Arrival versus Distance Validation

**Pass Criteria:** The test is passed if the conditions described in the different scenarios, reported below, are verified.

**Exercise Type:** Test

**Precondition(s):** **The following Scenarios will be simulated:**

### Scenario 1:

It will be simulated that the Time Out for Target Data Streams coming from one Remote System expires.

The following inputs will be simulated:

N -1 Target Data Streams coming from Remote Systems

N Operational Status Data Streams coming from Remote Systems

In this case, after time out expiring, it will verify that the relevant information is propagated over ASTERIX CAT 23.

## Scenario 2

It will be simulated that the Time Out for System Operational Status Data Streams for one Remote System expires, with the corresponding Target Data Stream excluded by the Validity Check.

The following input will be simulated:

- 2 Target Data Streams coming from different Remote Systems
- 1 Operational Status Data Streams coming from one Remote Systems

In this case, it will be verified that:

After Time out expiration the relevant information is propagated over ASTERIX CAT 23.

Until the condition above persists, it is NOT possible to perform the TOA/DISTANCE Check with the 1090 GS report marked as NOT VALIDATED over ATX21. The test above isn't performed because the scenario foresees only 2 (two) remote system Target Data Streams and one will be excluded in the computation because the relevant Operational Status Data Stream is not available.

## Scenario 3

In this Scenario it will be simulated that the operational status of one Remote System become not healthy and the relevant Target Data Stream will not be used in the TOA/DISTANCE Check.

The following input will be simulated:

- 2 Target Data Streams coming from remote systems
- 2 Operational Status Data Streams coming from remote systems with one Operational Data Streams set in order to simulate the transition between Healthy status to Not Healthy status in the Remote System.

Taking into account that we have in configuration only 2 (two) remote system it will be verified that:

Until the Status of both remote system are declared as healthy the TOA/DISTANCE Check will be performed and the 1090 GS report will be marked as in accordance with the setting of Target Data Streams in input.

After that Operational Status of one Remote System become NOT healthy the 1090 GS report is marked as NOT VALIDATED over ATX21. In fact the TOA/Distance Check isn't performed because the scenario foresees only 2 (two) remote system Target Data Streams and one it will be excluded in the computation because the relevant Operational Status of the relevant Remote Systems become NOT healthily.

#### Scenario 4

In this scenario it will be simulated the reception in the central Server function of N separate Target Data Streams and N Operational Status Data Streams with the Target Data Streams set in order to verify that the TOA/Distance Check conditions are passed.

The following inputs will be simulated:

N Target Data Streams coming from remote systems

N Operational Data Streams coming from remote systems

In this case, the check will be performed and the 1090 GS report will be marked as VALID over ASTERIX 21.

#### Scenario 5

In this scenario it will be simulated the reception in the central Server function of N separate Target Data Streams and N Operational Status Data Streams with the Target Data Streams set in order to verify that the TOA/Distance Check conditions are passed. In this case the Target Data Stream coming from Remote System it will be set in order to simulate a Target equidistant by two or more remote System.

The following inputs will be simulated:

N Target Data Streams coming from remote systems

N Operational Data Streams coming from remote systems

In this case, the check will be performed and the 1090 GS report will be marked as VALID over ASTERIX 21.

#### Scenario 6

In this scenario it will be simulated the reception in the central Server function of N separate Target Data Streams and N Operational Status Data Streams with the Target Data Streams set in order to verify that the TOA/Distance Check conditions are NOT passed.

The following inputs will be simulated:

N Target Data Streams coming from remote systems  
N Operational Data Streams coming from remote systems

In this case, the check will be performed and the 1090 GS report will be marked as NOT VALID over ASTERIX 21.

Note(s):

In order to Perform the Exercise related to TOA versus Distance Validation are requested the following item in the System:

Central Server Function

n (with  $n \geq 2$ ) Remote Systems.

Each Remote System will be able to generate two different data stream:

Target data stream with inside the information extracted by the ADS – B message (ASTERIX CAT 21 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

Operational Data Stream (ASTERIX CAT 23 in case of Ground Station or Raw Data referring to operational Status in case the remote System is a 1090 MHz Receiver).

Device(s) in use:

Ground Station ADS – B  
Message Generator  
ASTERIX Recording Tool  
Power  
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090GS in the default configuration.			
2	In the 1090 GS, activate the TOA versus distance validation.			
3	Set the parameter Time Out Parameter for Target Data Stream = XX seconds			
4	Set the parameter Time Out			

	Parameter for Operational Status Data Stream = YY seconds			
5	Prepare the report capture tool to capture ASTERIX reports.			
6	Prepare the message source to play the scenario			
7	For each scenario: -Play the scenario. -When the scenario is complete, stop recording ASTERIX reports. -Analyze the recorded data and verify that the conditions described above are met			

Exercise result:

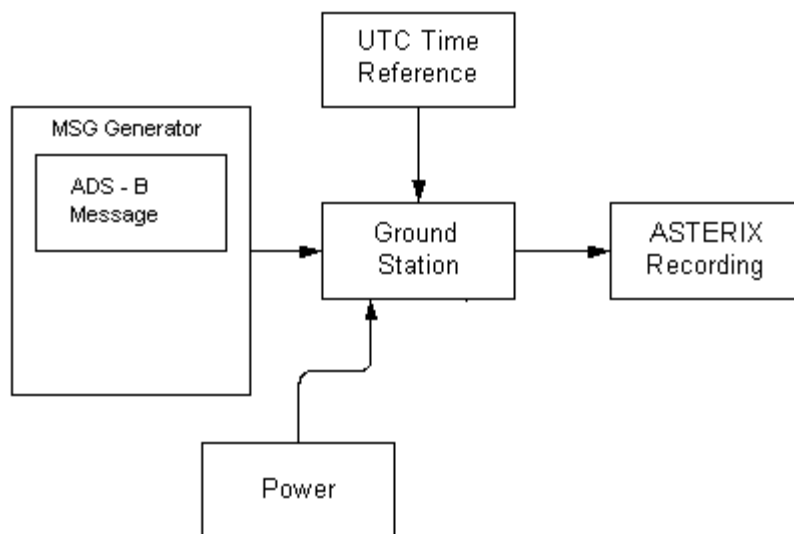
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 28: Verification Exercise Result

## W.1.12 Verification SUT requirements

N/A

## W.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS – B
- Message Generator
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS - B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

For this Exercise, the Ground Station ADS- B has to be provided with a specific functionality in order to perform a Central Processing (Central Processing Server) of Data coming from a lot of Remote Systems (ADS – B Ground Station or 1090 Receiver).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS – B Ground Station or 1090 Receiver) like:

**Target data stream** with inside the information extracted by the ADS – B message (ASTERIX CAT 21 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

**Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## W.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## W.1.15 Platform Configuration

N/A

## W.1.16 Configuration(s) Identification of the Verification Platform

N/A

## W.1.17 Links to other Verification Exercises

N/A

## W.1.18 Representatively level/ limitations

N/A

## W.2 Exercises Planning and management

### W.2.1 Activities

N/A

#### W.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and W.1.13 in order to meet the Test Preconditions

#### W.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

#### W.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

### W.2.2 Human Resources

N/A

### W.2.3 Responsibilities in the exercise

N/A

### W.2.4 Training

N/A

## W.2.5 Time planning

N/A

## W.2.6 Risks

N/A

## W.2.7 Errors and Observation handling

N/A

## W.3 Analysis Specification

### W.3.1 Data collection methods

The data's collection during the test will be Qualitative.

### W.3.2 Analysis method

N/A

### W.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.



## Appendix X Verification Exercise EXE-15.04.05.a- TS.0060.0000 GS “Reserved” OM Code Subfield in Aircraft Operational Status Messages

### X.1 Exercise Scope and Justification

#### X.1.1 Exercise Level

The level of the exercise is functional.

#### X.1.2 Exercise Type

The type of the exercise is Test.

#### X.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### X.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### X.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### X.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
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The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### X.1.7 Inputs

1090MHz Extended Squitter Messages.

#### X.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## X.1.9 Entrance criteria

Start the generation of input data.

## X.1.10 Exit Criteria

Finished recording and performed analysis.

## X.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0000 / “Reserved” OM Code Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

“Reserved” bits, (“ME” bits 33 – 40, Message bits 65 – 72) in the OM Code Subfield of surface format Aircraft Operational Status Messages are reserved for future assignment. Until such future assignment, these bits shall be set to “ZERO” (0).

### Step 1:

#### Aircraft Operational Status Message Initialization

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with appropriate operational status data in order to initialize transmission of Aircraft Operational Status Messages.

### Step 2:

#### Verification of “Reserved” Bits

Verify that Aircraft Operational Status Messages are broadcast with “ME” bits 33 – 40 (Message bits 65 – 72) set to ZERO (0).

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			

2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

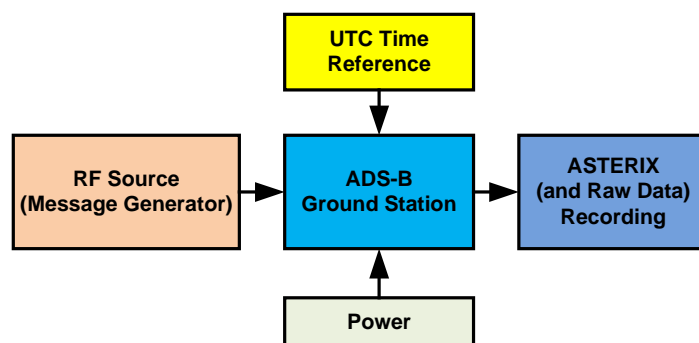
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 29: Verification Exercise Result

## X.1.12 Verification SUT requirements

N/A

## X.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## X.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## **X.1.15 Platform Configuration**

N/A

## **X.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **X.1.17 Links to other Verification Exercises**

N/A

## **X.1.18 Representatively level/ limitations**

N/A

## **X.2 Exercises Planning and management**

### **X.2.1 Activities**

N/A

#### **X.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and X.1.13 in order to meet the Test Preconditions.

#### **X.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **X.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **X.2.2 Human Resources.**

N/A

### **X.2.3Responsibilities in the exercise**

N/A

### **X.2.4 Training**

N/A

### **X.2.5 Time planning**

N/A

### **X.2.6 Risks**

N/A

## X.2.7 Errors and Observation handling

N/A

## X.3 Analysis Specification

### X.3.1 Data collection methods

N/A

### X.3.2 Analysis method

N/A

### X.3.3 Data logging requirements

N/A

## Appendix Y Verification Exercise EXE-15.04.05.a- TS.0060.0010 GS: “Reserved Bit-A” Subfield in Airborne Velocity Messages – Subtype=1

Note: This “Reserved Bit-A” subfield was identified in RTCA DO-260A as the “IFR Capability Flag” subfield, and was required to be set to ONE only for transmitting aircraft that had the capability for applications requiring ADS-B equipage Class “A1” or above. The “IFR Capability Flag” has been eliminated from the ADS-B MASPS (RTCA DO-242B), and so has been removed from these requirements for the 1090ES MOPS.

### Y.1 Exercise Scope and Justification

#### Y.1.1 Exercise Level

The level of the exercise is functional.

#### Y.1.2 Exercise Type

The type of the exercise is Test.

#### Y.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### Y.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### Y.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### Y.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### Y.1.7 Inputs

1090MHz Extended Squitter Messages.

founding members



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## Y.1.8Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

## Y.1.9 Entrance criteria

Start the generation of the input data.

## Y.1.10 Exit Criteria

Finished recording and performed analysis.

## Y.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0010 / "Reserved Bit-A" Subfield in Airborne Velocity Messages – Subtype=1.

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):** Test equipment is setup as described above  
GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The "Reserved Bits-A" subfield is a 1-bit ("ME" bit 10, Message bit 42) field that shall be set to ZERO (0) in all ADS-B Transmitting Subsystems that comply with DO-260B.

### Measurement Procedure:

Configure the ADS-B Transmitting Subsystem to broadcast Airborne Velocity Messages – Subtype=1 at the nominal rate. Verify that the "Reserved Bits-A" subfield is set to ZERO (0) in all transmitted messages.

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and,			



	optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

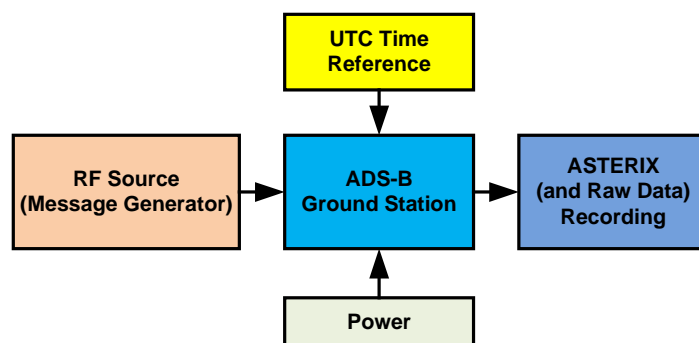
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 30: Verification Exercise Result

## Y.1.12 Verification SUT requirements

N/A

## Y.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference
- 

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## Y.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## Y.1.15 Platform Configuration

N/A

## Y.1.16 Configuration(s) Identification of the Verification Platform

N/A

## Y.1.17 Links to other Verification Exercises

N/A

## Y.1.18 Representatively level/ limitations

N/A

## Y.2 Exercises Planning and management

### Y.2.1 Activities

#### Y.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and Y.1.13 in order to meet the Test Preconditions.

#### Y.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### Y.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### Y.2.2 Human Resources

N/A

### Y.2.3 Responsibilities in the exercise

N/A

### Y.2.4 Training

N/A

### Y.2.5 Time planning

N/A

### Y.2.6 Risks

N/A

### Y.2.7 Errors and Observation handling

N/A

## Y.3 Analysis Specification

### Y.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### Y.3.2 Analysis method

N/A

### Y.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix Z Verification Exercise EXE-15.04.05.a- TS.0060.0020-GS “TCAS Operational” Subfield in Target State and Status Messages

### Z.1 Exercise Scope and Justification

#### Z.1.1 Exercise Level

The level of the exercise is functional.

#### Z.1.2 Exercise Type

The type of the exercise is Test.

#### Z.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### Z.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### Z.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### Z.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### Z.1.7 Inputs

1090MHz Extended Squitter Messages.

#### Z.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optional, GS system ‘Raw data output’ reports.

## Z.1.9 Entrance criteria

Start the generation of input data.

## Z.1.10 Exit Criteria

Finished recording and performed analysis.

## Z.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0020 / "TCAS Operational" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "TCAS Operational" information is properly reported in accordance with DO260B, §2.2.3.2.7.1.3.17.

### Step 1:

#### Initialization with TCAS Not Operational

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that TCAS is Not Operational.

### Step 2:

#### Verification of TCAS Not Operational

Verify that Target State and Status Messages are properly transmitted having the "TCAS Operational" subfield ("ME" bit 55, Message bit 85) set to ZERO (0).

### Step 3:

#### Initialization with TCAS Operational

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that TCAS is Operational.

### Step 4:

#### Verification of TCAS Operational

Verify that Target State and Status Messages are properly transmitted having the "TCAS Operational" subfield ("ME" bit 53, Message bit 85) set to ONE (1).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

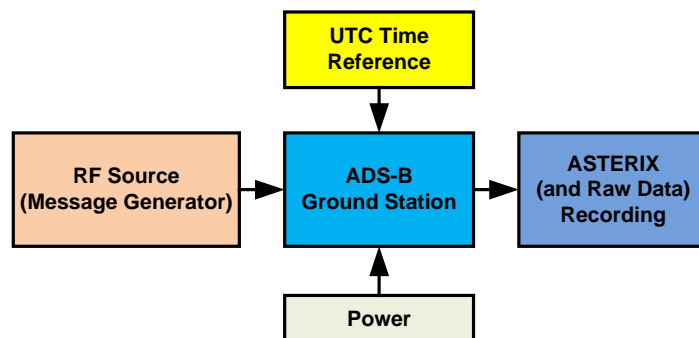
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 31: Verification Exercise Result

## Z.1.12 Verification SUT requirements

N/A

## Z.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.



## Z.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs

## Z.1.15 Platform Configuration

N/A

## Z.1.16 Configuration(s) Identification of the Verification Platform

N/A

## Z.1.17 Links to other Verification Exercises

N/A

## Z.1.18 Representatively level/ limitations

N/A

## Z.2 Exercises Planning and management

### Z.2.1 Activities

N/A

#### Z.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and Z.1.13 in order to meet the Test Preconditions.

#### Z.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### Z.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### Z.2.2 Human Resources

N/A

### Z.2.3 Responsibilities in the exercise

N/A

### Z.2.4 Training

N/A

### Z.2.5 Time planning

N/A

## Z.2.6 Risks

N/A

## Z.2.7 Errors and Observation handling

N/A

## Z.3 Analysis Specification

### Z.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### Z.3.2 Analysis method

N/A

### Z.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix AA Verification Exercise EXE-15.04.05.a- TS.0060.0030 GS “Geometric Vertical Accuracy (GVA)” Subfield in Aircraft Operational Status Messages

### AA.1 Exercise Scope and Justification

#### AA.1.1 Exercise Level

The level of the exercise is functional.

#### AA.1.2 Exercise Type

The type of the exercise is Test.

#### AA.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### AA.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### AA.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### AA.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### AA.1.7 Inputs

1090MHz Extended Squitter Messages.

#### AA.1.8 Outputs

Recordings of ASTERIX CAT 21 and, optionally, GS system ‘Raw data output’ reports.

## AA.1.9 Entrance criteria

Start the generation of the input data.

## AA.1.10 Exit Criteria

Finished recording and performed analysis.

## AA.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0030 / “Geometric Vertical Accuracy (GVA)” Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The “Geometric Vertical Accuracy (GVA)” subfield of Subtype=0 Aircraft Operational Status Message is a 2-bit field (“ME” bits 49-50, Message bits 81-82) defined in *Table 32*. The GVA field is set by using the Vertical Figure of Merit (VFOM) (95%) from the GNSS position source used to encode the geometric altitude field in the Airborne Position Message.

### Step 1:

#### Verification of GVA Transmission

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Set the Vertical Figure of Merit (VFOM) field to each of the following values in *Table 32* and verify that the corresponding encoding is set in the GVA field of the Aircraft Operational Status Message.

Table 32: Geometric Vertical Accuracy Validation Values

Row	VFOM (meters)	GVA Encoding
1	Invalid	0
2	30.0	1
3	44.5	1
4	45.5	0
5	327.1	0

### Step 2:

#### Verification of GVA – Data Lifetime

Rerun *Table 32*, Row 2 from Step 1. Remove the data source input for GVA for a period of at least 2 seconds. Verify that the GVA subfield of the Aircraft Operational Status Message is set to ZERO (binary 00).

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

#### Exercise result:

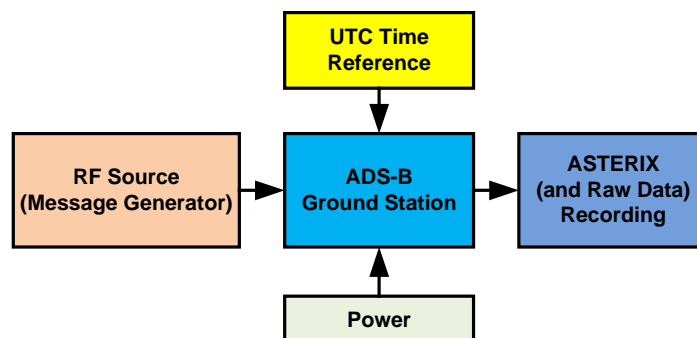
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 33: Verification Exercise Result

## AA.1.12 Verification SUT requirements

N/A

## AA.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **AA.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **AA.1.15 Platform Configuration**

N/A

### **AA.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **AA.1.17 Links to other Verification Exercises**

N/A

### **AA.1.18 Representatively level/ limitations**

N/A

## **AA.2 Exercises Planning and management**

### **AA.2.1 Activities**

N/A

#### **AA.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and AA.1.13 in order to meet the Test Preconditions.

#### **AA.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **AA.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **AA.2.2 Human Resources**

N/A

### **AA.2.3 Responsibilities in the exercise**

N/A

### **AA.2.4 Training**

N/A

## AA.2.5 Time planning

N/A

## AA.2.6 Risks

N/A

## AA.2.7 Errors and Observation handling

N/A

## AA.3 Analysis Specification

### AA.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### AA.3.2 Analysis method

N/A

### AA.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.



## Appendix BB Verification Exercise EXE-15.04.05.a-TS.0060.0040-GS “GPS Antenna Offset” OM Code Subfield in Aircraft Operational Status Messages

### BB.1 Exercise Scope and Justification

#### BB.1.1 Exercise Level

The level of the exercise is functional.

#### BB.1.2 Exercise Type

The type of the exercise is Test.

#### BB.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### BB.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### BB.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### BB.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### BB.1.7 Inputs

1090MHz Extended Squitter Messages.

#### BB.1.8 Outputs

Recordings of ASTERIX CAT 21 and, optionally, GS system ‘Raw data output’ reports.

## BB.1.9 Entrance criteria

Start the generation of the input data.

## BB.1.10 Exit Criteria

Finished recording and performed analysis.

## BB.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0040 / “GPS Antenna Offset” OM Code Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The “GPS Antenna Offset” subfield is an 8-bit (“ME” bits 33 – 40, Message bits 65 – 72) field in the OM Code Subfield of surface format Aircraft Operational Status Messages that defines the position of the GPS antenna.

Table 34: Lateral Axis GPS Antenna Offset Encoding

“ME” Bit (Message Bit)			Upper Bound of the GPS Antenna Offset Along Lateral (Pitch) Axis Left or Right of Longitudinal (Roll) Axis	
33 (65)	34 (66)	35 (67)		
0 = left 1 = right	Encoding		Direction	Meters
	Bit 1	Bit 0		
0	0	0	LEFT	No data
	0	1		2
	1	0		4
	1	1		6
1	0	0	RIGHT	0
	0	1		2
	1	0		4

	1	1		6
--	---	---	--	---

**Step 1:**

**Verification of Lateral Axis GPS Antenna Offset**

- Configure the ADS-B Transmitting Subsystem to transmit Surface Aircraft Operational Status Messages by providing valid operational status information at the nominal rate.
- Via an appropriate data interface provide the ADS-B Transmitting Subsystem with data necessary to establish each of the Lateral Axis GPS Antenna Offset Encodings indicated in Table 34.

**Step 2:**

**Verification of Longitudinal Axis GPS Antenna Offset**

- Configure the ADS-B Transmitting Subsystem to transmit Surface Aircraft Operational Status Messages by providing valid operational status information at the nominal rate.
- Via an appropriate data interface provide the ADS-B Transmitting Subsystem with data necessary to establish each of the Longitudinal Axis GPS Antenna Offset Encodings indicated in Table 35, for encodings of binary 00010 through 11111.
- Remove the data from the interface that is providing the Longitudinal Axis GPS Antenna Offset encodings and verify that "ME" bits 36 – 40 (Message bits 68 – 72) are set to binary 0000.
- For ADS-B Transmitting Subsystems that HAVE established that the Position Offset Adjustment has been applied by the Sensor via the "Position Offset Applied by Sensor" input, verify that the "ME" bits 36 – 40 (Message bits 68 – 72) of the Surface Format Aircraft Operational Status Message are encoded as binary 00001.

Longitudinal Axis GPS Antenna Offset Encoding					
“ME” Bit (Message Bit)					Upper Bound of the GPS Antenna Offset Along Longitudinal (Roll) Axis Aft From Aircraft Nose
36 (68)	37 (69)	38 (70)	39 (71)	40 (72)	
Encoding					
Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
0	0	0	0	0	(meters) 0 or NO DATA
0	0	0	0	1	2
0	0	0	1	0	4
0	0	0	1	1	6
0	0	1	0	0	8
*	*	*	*	*	***
*	*	*	*	*	***
*	*	*	*	*	***
1	1	1	1	1	62

Table 35: Longitudinal Axis GPS Antenna Offset Encoding

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

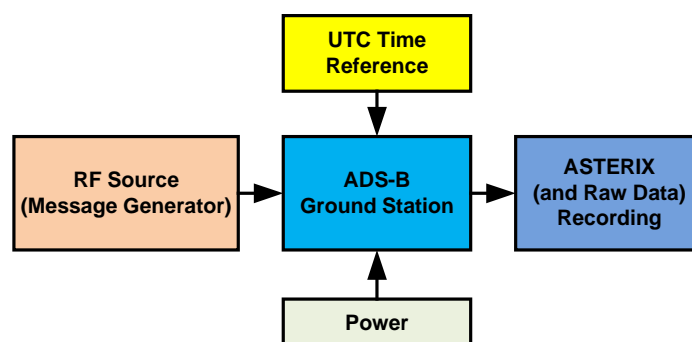
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 36: Verification Exercise Result

## BB.1.12 Verification SUT requirements

N/A

## BB.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

founding members



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The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **BB.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **BB.1.15 Platform Configuration**

N/A

## **BB.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **BB.1.17 Links to other Verification Exercises**

N/A

## **BB.1.18 Representatively level/ limitations**

N/A

## **BB.2 Exercises Planning and management**

### **BB.2.1 Activities**

N/A

#### **BB.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and BB.1.13 in order to meet the Test Preconditions.

#### **BB.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **BB.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **BB.2.2 Human Resources**

N/A

### **BB.2.3 Responsibilities in the exercise**

N/A

## BB.2.4 Training

N/A

## BB.2.5 Time planning

N/A

## BB.2.6 Risks

N/A

## BB.2.7 Errors and Observation handling

N/A

## BB.3 Analysis Specification

### BB.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### BB.3.2 Analysis method

N/A

### BB.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix CC Verification Exercise EXE-15.04.05.a- TS.0060.0050 GS: “Source Integrity Level (SIL)” Subfield in Aircraft Operational Status Messages

### CC.1 Exercise Scope and Justification

#### CC.1.1 Exercise Level

The level of the exercise is functional.

#### CC.1.2 Exercise Type

The type of the exercise is Test.

#### CC.1.3 Description of the system being addressed;

ADS – B Ground Station.

#### CC.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### CC.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### CC.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### CC.1.7 Inputs

1090MHz Extended Squitter Messages.

#### CC.1.8 Outputs

Recordings of ASTERIX CAT 21 and, optionally, GS system ‘Raw data output’ reports.



## CC.1.9 Entrance criteria

Start the generation of the input data.

## CC.1.10 Exit Criteria

Finished recording and performed analysis.

## CC.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0050 / "Source Integrity Level (SIL)" Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The Source Integrity Level (SIL) is a 2-bit subfield of "Subtype=0" ADS-B Aircraft Operational Status Messages ("ME" bits 51 and 52, Message bits 83 and 84) that defines the probability of the reported horizontal position exceeding the radius of containment defined by the NIC, without alerting, assuming no avionics faults. Although the SIL assumes there are no unannounced faults in the avionics system, the SIL must consider the effects of a faulted Signal-in-Space, if a Signal-in-Space is used by the position source. *Table 37* defines the meaning of each SIL value. For installations where the SIL value is being dynamically updated, if an update has not been received from an on-board data source for SIL within the past 2 seconds, then the SIL subfield is set to a value of ZERO (0), indicating "Unknown."

### Step 1:

#### Verification of SIL Transmission

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Provide the data externally at the interface to the ADS-B system.

Verify that for each "SIL" parameter input condition that is specified by the probability of exceeding the RC Integrity Containment Radius without detection (i.e., the values in *Table 37*), that the system generates ADS-B Messages with the "SIL" subfield set equal to the corresponding binary coding value shown in *Table 37*.

Table 37: "SIL" Subfield Encoding

SIL Coding		Probability of Exceeding the NIC Containment Radius ( $R_C$ )
(Binary)	(Decimal)	
00	0	Unknown or $> 1 \times 10^{-3}$ per flight hour or per sample
01	1	$\leq 1 \times 10^{-3}$ per flight hour or per sample
10	2	$\leq 1 \times 10^{-5}$ per flight hour or per sample
11	3	$\leq 1 \times 10^{-7}$ per flight hour or per sample

## Step 2:

### Verification of SIL – Data Lifetime

Rerun the Test Procedure in Step 1. Remove the data source input for SIL for a period of at least 2 seconds. Verify that “ME” bits 51 and 52 in the Aircraft Operational Status Message are set to a value of ZERO (binary 00).

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system ‘Raw Data Output’ reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system ‘Raw data output’ reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			

8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

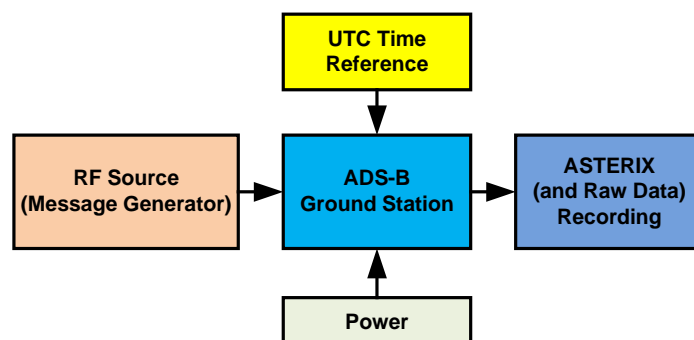
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 38: Verification Exercise Result

## CC.1.12 Verification SUT requirements

N/A

## CC.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

#### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### CC.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

### CC.1.15 Platform Configuration

N/A

### CC.1.16 Configuration(s) Identification of the Verification Platform

N/A

### CC.1.17 Links to other Verification Exercises

N/A

### CC.1.18 Representatively level/ limitations

N/A

## CC.2 Exercises Planning and management

### CC.2.1 Activities

N/A

#### CC.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and CC.1.13 in order to meet the Test Preconditions.

#### CC.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### CC.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## CC.2.2 Human Resources

N/A

## CC.2.3 Responsibilities in the exercise

N/A

## CC.2.4 Training

N/A

## CC.2.5 Time planning

N/A

## CC.2.6 Risks

N/A

## CC.2.7 Errors and Observation handling

N/A

## CC.3 Analysis Specification

### CC.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### CC.3.2 Analysis method

N/A

### CC.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix DD Verification Exercise EXE-15.04.05.a- TS.0060.0060 GS: “SIL Supplement” Subfield in Aircraft Operational Status Messages

### DD.1 Exercise Scope and Justification

#### DD.1.1 Exercise Level

The level of the exercise is functional.

#### DD.1.2 Exercise Type

The type of the exercise is Test.

#### DD.1.3 Description of the system being addressed

ADS – B Ground Station.

#### DD.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### DD.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### DD.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### DD.1.7 Inputs

1090MHz Extended Squitter Messages.

#### DD.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## DD.1.9 Entrance criteria

Start the generation of the input data.

## DD.1.10 Exit Criteria

Finished recording and performed analysis.

## DD.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0060 / “SIL Supplement” Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The “SIL Supplement” (Source Integrity Level Supplement) subfield is a 1-bit (“ME” bit 55, Message bit 87) field that defines whether the reported SIL probability is based on a “per hour” probability or a “per sample” probability as defined in *Table 39*. The purpose of the following procedure is to verify that the “SIL Supplement” subfield is being set appropriately.

Table 39: “SIL Supplement” Subfield Encoding

Coding	Meaning
0	Probability of exceeding NIC radius of containment is based on “per hour”
1	Probability of exceeding NIC radius of containment is based on “per sample”

### Step 1:

#### Aircraft Operation Status Message Initialization

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with valid operational status data in order to initialize transmission of Aircraft Operational Status Messages.

### Step 2:

#### Verification of SIL Supplement for “Per Hour” Probability

Via the appropriate data input interface, provide the ADS-B Transmitting Subsystem with valid data indicating that the integrity of the geometric position source is being established on a “Per Hour” basis.

*Note: If an actual interface is not used to provide "SIL Supplement" information, then ensure that a GNSS position source is being used to provide geometric position data for the purpose of establishing position in the Airborne and Surface Position messages.*

Verify that the "SIL Supplement" subfield ("ME" bit 55, Message bit 87) in the Aircraft Operational Status Messages is set to "ZERO" (0).

### Step 3:

#### Verification of SIL Supplement for "Per Sample" Probability

Via the appropriate data input interface, provide the ADS-B Transmitting Subsystem with valid data indicating that the integrity of the geometric position source is being established on a "Per Sample" basis.

*Note: If an actual interface is not used to provide "SIL Supplement" information, then ensure that a Non-GNSS position source is being used to provide geometric position data for the purpose of establishing position in the Airborne and Surface Position messages.*

Verify that the "SIL Supplement" subfield ("ME" bit 55, Message bit 87) in the Aircraft Operational Status Messages is set to "ONE" (1).

### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			



8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

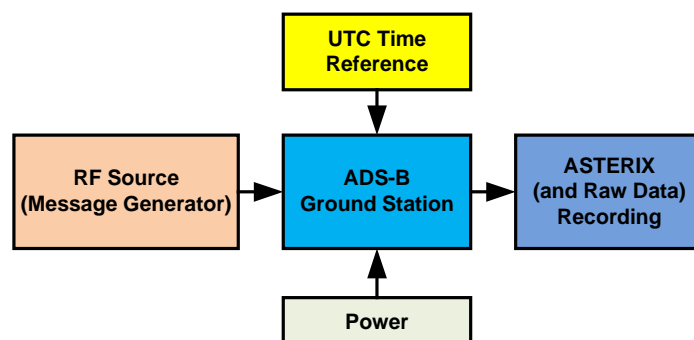
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 40: Verification Exercise Result

## DD.1.12 Verification SUT requirements

N/A

## DD.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

#### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### DD.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

### DD.1.15 Platform Configuration

N/A

### DD.1.16 Configuration(s) Identification of the Verification Platform

N/A

### DD.1.17 Links to other Verification Exercises

N/A

### DD.1.18 Representatively level/ limitations

N/A

## DD.2 Exercises Planning and management

### DD.2.1 Activities

N/A

#### DD.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and DD.1.13 in order to meet the Test Preconditions.

#### DD.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### DD.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## DD.2.2 Human Resources

N/A

## DD.2.3 Responsibilities in the exercise

N/A

## DD.2.4 Training

N/A

## DD.2.5 Time planning

N/A

## DD.2.6 Risks

N/A

## DD.2.7 Errors and Observation handling

N/A

## DD.3 Analysis Specification

### DD.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### DD.3.2 Analysis method

N/A

### DD.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix EE Verification Exercise EXE-15.04.05.a- TS.0060.0070 GS: “System Design Assurance” OM Code Subfield in Aircraft Operational Status Messages

### EE.1 Exercise Scope and Justification

#### EE.1.1 Exercise Level

The level of the exercise is functional.

#### EE.1.2 Exercise Type

The type of the exercise is Test.

#### EE.1.3 Description of the system being addressed

ADS – B Ground Station.

#### EE.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### EE.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### EE.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### EE.1.7 Inputs

1090MHz Extended Squitter Messages.

#### EE.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## EE.1.9 Entrance criteria

Start the generation of the input data.

## EE.1.10 Exit Criteria

Finished recording and performed analysis.

## EE.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0070 / “System Design Assurance” OM Code Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The “System Design Assurance” (SDA) subfield is a 2-bit (“ME” bits 31 – 32, Message bits 63 – 64) field that defines the failure condition that the ADS-B system is designed to support as defined in Table 41.

Table 41: “System Design Assurance” OM Subfield in Aircraft Operational Status Messages

SDA Value		Supported Failure Condition <small>Note 2</small>	Probability of Undetected Fault causing transmission of False or Misleading Information <small>Note 3,4</small>	Software & Hardware Design Assurance Level <small>Note 1,3</small>
(decimal)	(binary)			
0	00	Unknown/ No safety effect	$> 1 \times 10^{-3}$ per flight hour or Unknown	N/A
1	01	Minor	$\leq 1 \times 10^{-3}$ per flight hour	D
2	10	Major	$\leq 1 \times 10^{-5}$ per flight hour	C
3	11	Hazardous	$\leq 1 \times 10^{-7}$ per flight hour	B

### Step 1:

#### Verification of “System Design Assurance” (SDA) OM Code Subfield

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Provide data externally at the interface to the ADS-B Transmit subsystem to establish each of the “System Design Assurance” (SDA) encoding defined in Table 41.

Verify that each "System Design Assurance" (SDA) parameter input condition that is identified in Table 41 that the system generates ADS-B Aircraft Operational Status Messages with the "System Design Assurance" (SDA) subfield set equal to the corresponding binary coding value indicated in Table 41.

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

#### Exercise result:

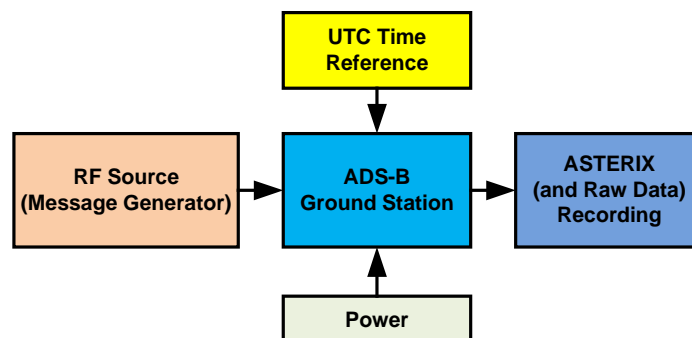
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 42: Verification Exercise Result

## EE.1.12 Verification SUT requirements

N/A

## EE.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **EE.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **EE.1.15 Platform Configuration**

N/A

### **EE.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **EE.1.17 Links to other Verification Exercise**

N/A

### **EE.1.18 Representatively level/ limitations**

N/A

## **EE.2 Exercises Planning and management**

### **EE.2.1 Activities**

N/A

#### **EE.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and EE.1.13 in order to meet the Test Preconditions.

#### **EE.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **EE.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **EE.2.2 Human Resources**

N/A

### **EE.2.3 Responsibilities in the exercise**

N/A

### **EE.2.4 Training**

N/A



## EE.2.5 Time planning

N/A

## EE.2.6 Risks

N/A

## EE.2.7 Errors and Observation handling

N/A

## EE.3 Analysis Specification

### EE.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### EE.3.2 Analysis method

N/A

### EE.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix FF Verification Exercise EXE-15.04.05.a- TS.0060.0080 GS: “1090ES IN” CC Code Subfield in Aircraft Operational Status Messages

### FF.1 Exercise Scope and Justification

#### FF.1.1 Exercise Level

The level of the exercise is functional.

#### FF.1.2 Exercise Type

The type of the exercise is Test.

#### FF.1.3 Description of the system being addressed

ADS – B Ground Station.

#### FF.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### FF.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### FF.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### FF.1.7 Inputs

1090MHz Extended Squitter Messages.

#### FF.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## FF.1.9 Entrance criteria

Start the generation of the input data.

## FF.1.10 Exit Criteria

Finished recording and performed analysis.

## FF.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.04.05.a-TS.0060.0080 / “1090ES IN” CC Code Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The CC Code for “1090ES IN” in Aircraft Operational Status Messages (TYPE=31, Subtype=0 or 1) is a 1-bit field (“ME” bit 12, Message bit 44) that will be set to ONE (1) as specified in *Table 43* if the transmitting aircraft has the capability to receive ADS-B 1090ES Messages. Otherwise, this CC code will be ZERO (0).

Table 43: Encoding of “1090ES IN” CC Subfield in Aircraft Operational Status Messages

“1090ES IN” CC Code Encoding	Meaning
0	No Capability to Receive ADS-B 1090ES Messages
1	Aircraft has the Capability to Receive ADS-B 1090ES Messages

*Note: If the aircraft is fitted with ADS-B 1090ES receive equipment but such equipment is not functional, then the encoding should be set to “ZERO” (0), e.g., the same as if the aircraft were NOT fitted with the receive capability.*

### Step 1:

#### Verification of the “1090ES IN” CC Code Transmission

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages (TYPE=31, Subtype=0, indicating airborne participants) by providing valid operational status information at the nominal update rate. Set the ADS-B Transmitting Subsystem to Airborne status. Provide appropriate data externally at the interface to the ADS-B Transmitting Subsystem to indicate that the installation IS NOT fitted with a properly functioning ADS-B 1090ES Message Receiving Subsystem. Verify that “ME” bit 12 is set to ZERO (0). Repeat this step while indicating that the installation IS fitted with the capability to receive ADS-B 1090ES Messages and verify that “ME” bit 12 is set to ONE (1).

Set the ADS-B Transmitting Subsystem to Surface status. Repeat the above procedure while transmitting Aircraft Operational Status Messages with TYPE=31 and Subtype=1, indicating surface participants.

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

#### Exercise result:

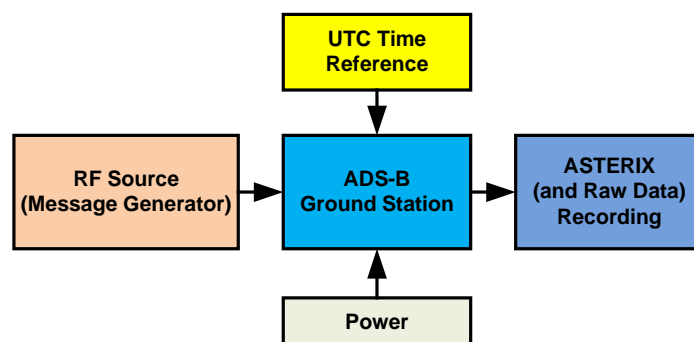
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 44: Verification Exercise Result

## FF.1.12 Verification SUT requirements

N/A

## FF.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **FF.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **FF.1.15 Platform Configuration**

N/A

## **FF.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **FF.1.17 Links to other Verification Exercises**

N/A

## **FF.1.18 Representatively level/ limitations**

N/A

## **FF.2 Exercises Planning and management**

### **FF.2.1 Activities**

N/A

#### **FF.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and FF.1.13 in order to meet the Test Preconditions.

#### **FF.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **FF.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **FF.2.2 Human Resources**

N/A

### **FF.2.3 Responsibilities in the exercise**

N/A

## FF.2.4 Training

N/A

## FF.2.5 Time planning

N/A

## FF.2.6 Risks

N/A

## FF.2.7 Errors and Observation handling

N/A

## FF.3 Analysis Specification

### FF.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### FF.3.2 Analysis method

N/A

### FF.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix GG Verification Exercise EXE-15.04.05.a- TS.0060.0090 GS: “UAT IN” CC Code Subfield in Aircraft Operational Status Messages

### GG.1 Exercise Scope and Justification

#### GG.1.1 Exercise Level

The level of the exercise is functional.

#### GG.1.2 Exercise Type

The type of the exercise is Test.

#### GG.1.3 Description of the system being addressed

ADS – B Ground Station.

#### GG.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### GG.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### GG.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### GG.1.7 Inputs

1090MHz Extended Squitter Messages.

#### GG.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.



## GG.1.9 Entrance criteria

Start the generation of the input data.

## GG.1.10 Exit Criteria

Finished recording and performed analysis.

## GG.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0090 /"UAT IN" CC Code Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The "UAT IN" CC Code subfield ("ME" bit 19, Message bit 51, TYPE=31, Subtype=0, for airborne participants AND "ME" Bit 16, Message bit 48, TYPE=31, Subtype=1 for surface participants) in ADS-B Aircraft Operational Status Messages denotes whether the aircraft is equipped with the capability to receive ADS-B UAT Messages. The coding of "UAT IN" CC Code subfield is specified in Table 45.

Table 45: Encoding of "UAT IN" CC Subfield in Aircraft Operational Status Messages.

"UAT IN" CC Code Encoding	Meaning
0	No Capability to Receive ADS-B UAT Messages
1	Aircraft has the Capability to Receive ADS-B UAT Messages

### Step 1:

#### Verification of "UAT IN" CC Code Transmission

- Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Provide appropriate data externally at the interface to the ADS-B Transmitting Subsystem to indicate that the installation IS fitted with a properly functioning ADS-B UAT Receiving Subsystem. Set the ADS-B Transmitting Subsystem to Airborne status. Verify that "ME" bit 19 (Message bit 51) is set to ONE (1).
- Repeat Step 1.a while indicating that the aircraft has NO UAT IN Receive capability, and verify that "ME" bit 19 (Message bit 51) is set to ZERO (0).

- c. Repeat Step 1.a after setting the ADS-B Transmitting Subsystem to Surface status, and verify that “ME” bit 16 (Message bit 48) is set to ONE (1).
- d. Repeat Step 1.b after setting the ADS-B Transmitting Subsystem to Surface status and verify the “ME” bit 16 (Message bit 48) is set to ZERO (0).

## Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

## Exercise result:

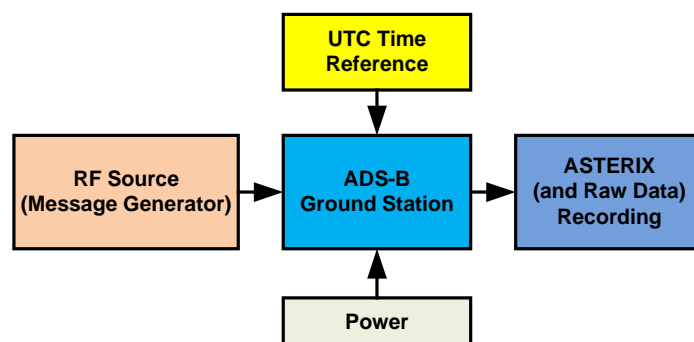
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 46: Verification Exercise Result

## GG.1.12 Verification SUT requirements

N/A

## GG.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **GG.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **GG.1.15 Platform Configuration**

N/A

## **GG.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **GG.1.17 Links to other Verification Exercise**

N/A

## **GG.1.18 Representatively level/ limitations**

N/A

## **GG.2 Exercises Planning and management**

### **GG.2.1 Activities**

N/A

#### **GG.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and GG.1.13 in order to meet the Test Preconditions.

#### **GG.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **GG.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **GG.2.2 Human Resources**

N/A

### **GG.2.3 Responsibilities in the exercise**

N/A

## GG.2.4 Training

N/A

## GG.2.5 Time planning

N/A

## GG.2.6 Risks

N/A

## GG.2.7 Errors and Observation handling

N/A

## GG.3 Analysis Specification

### GG.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### GG.3.2 Analysis method

N/A

### GG.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix HH Verification Exercise EXE-15.04.05.a- TS.0060.0100 GS: “NIC Supplement-B” Subfield in ADS- B Airborne Position Messages

### HH.1 Exercise Scope and Justification

#### HH.1.1 Exercise Level

The level of the exercise is functional.

#### HH.1.2 Exercise Type

The type of the exercise is Test.

#### HH.1.3 Description of the system being addressed

ADS – B Ground Station.

#### HH.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### HH.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### HH.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### HH.1.7 Inputs

1090MHz Extended Squitter Messages.

#### HH.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## HH.1.9 Entrance criteria

Start the generation of the input data.

## HH.1.10 Exit Criteria

Finished recording and performed analysis.

## HH.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0100 / “NIC Supplement-B” Subfield in ADS-B Airborne Position Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

Table 47: Navigation Integrity Category (NIC) Encoding.

NIC Value	Radius of Containment (R <sub>C</sub> )	Airborne			Surface		
		Airborne Position TYPE Code	NIC Supplement Codes		Surface Position TYPE Code	NIC Supplement Codes	
			A	B		A	C
0	R <sub>C</sub> unknown	0, 18 or 22	0	0	0, 8	0	0
1	R <sub>C</sub> < 20 NM (37.04 km)	17	0	0	N/A	N/A	N/A
2	R <sub>C</sub> < 8 NM (14.816 km)	16	0	0	N/A	N/A	N/A
3	R <sub>C</sub> < 4 NM (7.408 km)	16	1	1	N/A	N/A	N/A
4	R <sub>C</sub> < 2 NM (3.704 km)	15	0	0	N/A	N/A	N/A
5	R <sub>C</sub> < 1 NM (1852 m)	14	0	0	N/A	N/A	N/A
6	R <sub>C</sub> < 0.6 NM (1111.2 m)	13	1	1	8	0	1
	R <sub>C</sub> < 0.5 NM (926 m)	13	0	0	N/A	N/A	N/A
	R <sub>C</sub> < 0.3 NM (555.6 m)	13	0	1	8	1	0
7	R <sub>C</sub> < 0.2 NM (370.4 m)	12	0	0	8	1	1
8	R <sub>C</sub> < 0.1 NM (185.2 m)	11	0	0	7	0	0
9	R <sub>C</sub> < 75m	11	1	1	7	1	0
10	R <sub>C</sub> < 25m	10 or 21	0	0	6	0	0
11	R <sub>C</sub> < 7.5m	9 or 20	0	0	5	0	0
12	Reserved						
13	Reserved						
14	Reserved						
15	Reserved						

**Step 1:**

**Verification of NIC Supplement-B Transmission**

Configure the ADS-B Transmitting Subsystem to transmit Airborne Position Messages by providing valid trajectory information at the nominal update rate. Provide the data externally at the interface to the ADS-B system.

Verify that for each input NIC parameter that is specified by the RC value in Table 47, that the system generates ADS-B Airborne Position Messages with the NIC Supplement-B subfield ("ME" bit 8) set equal to the corresponding binary coding value shown in Table 47. Do this for all TYPE Codes in Table 47 for Airborne Position Messages.

**Step 2:**

**Verification of NIC Supplement-B – Data Lifetime**

Rerun the Test Procedure in Step 1. Remove the data source input for NIC Supplement-B for a period of at least 2 seconds. Verify that "ME" bit 8 in the Airborne Position Message is set to a value of ZERO (0).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw			



	data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

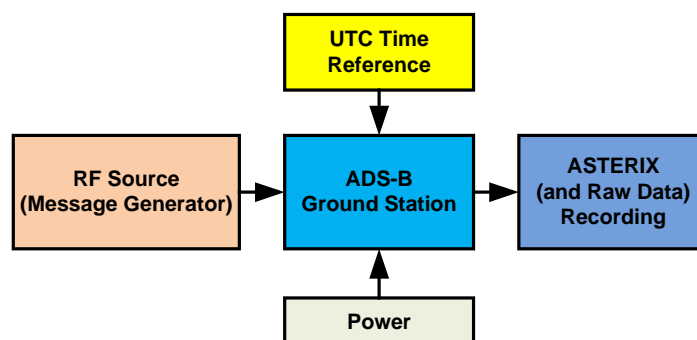
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 48: Verification Exercise Result

## HH.1.12 Verification SUT requirements

N/A

## HH.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

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- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## HH.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## HH.1.15 Platform Configuration

N/A

## HH.1.16 Configuration(s) Identification of the Verification Platform

N/A

## HH.1.17 Links to other Verification Exercises

N/A

## HH.1.18 Representatively level/ limitations

N/A

## HH.2 Exercises Planning and management

### HH.2.1 Activities

N/A

#### HH.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and HH.1.13 in order to meet the Test Preconditions.

#### HH.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### HH.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## HH.2.2 Human Resources

N/A

## HH.2.3 Responsibilities in the exercise

N/A

## HH.2.4 Training

N/A

## HH.2.5 Time planning

N/A

## HH.2.6 Risks

N/A

## HH.2.7 Errors and Observation handling

N/A

## HH.3 Analysis Specification

### HH.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### HH.3.2 Analysis method

N/A

### HH.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix II Verification Exercise EXE-15.04.05.a- TS.0060.0110 GS: “NIC Supplement-C” Subfield in Aircraft Operational Status Messages

**Note:** Appropriate test procedures required to validate the “NIC Supplement-C” are included in Verification of “NIC Supplement-A”. Therefore it is applied here also Verification of “NIC Supplement-A”.

### II.1 Exercise Scope and Justification

#### II.1.1 Exercise Level

The level of the exercise is functional.

#### II.1.2 Exercise Type

The type of the exercise is Test.

#### II.1.3 Description of the system being addressed

ADS – B Ground Station.

#### II.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### II.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### II.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### II.1.7 Inputs

1090MHz Extended Squitter Messages.

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## II.1.8Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

## II.1.9 Entrance criteria

Start the generation of the input data.

## II.1.10 Exit Criteria

Finished recording and performed analysis.

## II.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0150 / "NIC Supplement-C" Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The NIC Supplement-A subfield in the Aircraft Operational Status Message is a 1-bit subfield ("ME" bit 44, Message bit 76) that, together with the TYPE subfield in Airborne Position and Surface Position Messages, is used to encode the Navigation Integrity Category (NIC) of the transmitting ADS-B participant.

Table 49 lists the possible NIC codes and the values of the TYPE Code subfield of the Airborne and Surface Position Messages, and the NIC Supplement-A, NIC Supplement-B and NIC Supplement-C subfield values that are used to encode those NIC codes in messages on the 1090 MHz ADS-B data link.

Table 49: Navigation Integrity Category (NIC) Encoding.

NIC Value	Radius of Containment ( $R_C$ )	Airborne			Surface		
		Airborne Position TYPE Code	NIC Supplement Codes		Surface Position TYPE Code	NIC Supplement Codes	
			A	B		A	C
0	$R_C$ unknown	0, 18 or 22	0	0	0, 8	0	0
1	$R_C < 20$ NM (37.04 km)	17	0	0	N/A	N/A	N/A
2	$R_C < 8$ NM (14.816 km)	16	0	0	N/A	N/A	N/A
3	$R_C < 4$ NM (7.408 km)	16	1	1	N/A	N/A	N/A
4	$R_C < 2$ NM (3.704 km)	15	0	0	N/A	N/A	N/A
5	$R_C < 1$ NM (1852 m)	14	0	0	N/A	N/A	N/A
6	$R_C < 0.6$ NM (1111.2 m)	13	1	1	8	0	1
	$R_C < 0.5$ NM (926 m)	13	0	0	N/A	N/A	N/A
	$R_C < 0.3$ NM (555.6 m)	13	0	1	8	1	0
7	$R_C < 0.2$ NM (370.4 m)	12	0	0	8	1	1
8	$R_C < 0.1$ NM (185.2 m)	11	0	0	7	0	0
9	$R_C < 75$ m	11	1	1	7	1	0
10	$R_C < 25$ m	10 or 21	0	0	6	0	0
11	$R_C < 7.5$ m	9 or 20	0	0	5	0	0
12	Reserved						
13	Reserved						
14	Reserved						
15	Reserved						

#### Step 1:

##### Verification of NIC Supplement-A, NIC Supplement-B and NIC Supplement-C Transmission

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Provide the data externally at the interface to the ADS-B system.

Verify that for each input NIC parameter that is specified by the  $R_C$  value in Table 49, that the system generates ADS-B Messages with the NIC Supplement-A, NIC Supplement-B and NIC Supplement-C subfields set equal to the corresponding binary coding values shown in Table 49. Do this for all TYPE Codes in Table 49 for both Airborne and Surface Position Messages.

#### Step 2:

##### Verification of NIC Supplement – Data Lifetime

Rerun the Test Procedure in Step 1. Remove the data source input for NIC Supplement-A and NIC Supplement-C for a period of at least 2 seconds. Verify that

the NIC-Supplement-A in the Aircraft Operational Status Message, and the NIC Supplement-B in the Airborne Position Message are set to a value of ZERO (0). Set the system to On-the-Ground condition and repeat this Test Procedure and verify that both the NIC Supplement-A and NIC Supplement-C are set to ZERO (0).

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

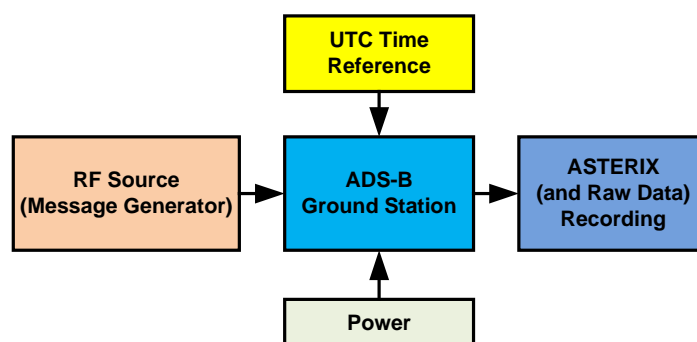
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 50: Verification Exercise Result

## II.1.12 Verification SUT requirements

N/A

## II.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).



#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## **II.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

## **II.1.15 Platform Configuration**

N/A

## **II.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **II.1.17 Links to other Verification Exercise**

N/A

## **II.1.18 Representatively level/ limitations**

N/A

## **II.2 Exercises Planning and management**

### **II.2.1 Activities**

N/A

#### **II.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and II.1.13 in order to meet the Test Preconditions.

#### **II.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **II.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **II.2.2 Human Resources**

N/A

### **II.2.3 Responsibilities in the exercise**

N/A

## II.2.4 Training

N/A

## II.2.5 Time planning

N/A

## II.2.6 Risks

N/A

## II.2.7 Errors and Observation handling

N/A

## II.3 Analysis Specification

### II.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### II.3.2 Analysis method

N/A

### II.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix JJ Verification Exercise EXE-15.04.05.a- TS.0060.0120 GS: “Aircraft/Vehicle Length and Width Code” Subfield in Aircraft Operational Status Messages

### JJ.1 Exercise Scope and Justification

#### JJ.1.1 Exercise Level

The level of the exercise is functional.

#### JJ.1.2 Exercise Type

The type of the exercise is Test.

#### JJ.1.3 Description of the system being addressed

ADS – B Ground Station.

#### JJ.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### JJ.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### JJ.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### JJ.1.7 Inputs

1090MHz Extended Squitter Messages.

#### JJ.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## JJ.1.9 Entrance criteria

Start the generation of the input data.

## JJ.1.10 Exit Criteria

Finished recording and performed analysis.

## JJ.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0120 / "Aircraft/Vehicle Length and Width Code" Subfield in Aircraft Operational Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The Aircraft/Vehicle (A/V) Length and Width Code Subfield is a 4-bit field ("ME" bits 21 – 24, Message bits 53 – 56) of the Aircraft Operational Status Messages (Subtype=1, for Surface Participants). This field describes the amount of space that an aircraft or ground vehicle occupies. The A/V Length and Width Code is based on the actual dimensions of the transmitting aircraft or surface vehicle as specified in Table 51. Once the actual Length and Width of the A/V has been determined, each A/V is assigned the smallest A/V Length and Width Code from Table 51 for which the actual length is less than or equal to the upper bound length for that Length/Width Code, and for which the actual width is less than or equal to the upper bound width for that Length/Width Code.

If the Aircraft or Vehicle is longer than 85 meters, or wider than 90 meters, then decimal Aircraft/Vehicle Length/Width Code 15 shall be used.

Table 51: "Aircraft/Vehicle Length and Width Code" Encoding

A/V - L/W Code (Decimal)	Length Code			Width Code	Upper-Bound Length and Width for Each Length/Width Code	
	"ME" Bit 21	"ME" Bit 22	"ME" Bit 23	"ME" Bit 24	Length (meters)	Width (meters)
0	0	0	0	0	No Data or Unknown	
1	0	0	0	1	15	23
2	0	0	1	0	25	28.5
3				1		34
4	0	1	0	0	35	33
5				1		38
6	0	1	1	0	45	39.5
7				1		45
8	1	0	0	0	55	45
9				1		52
10	1	0	1	0	65	59.5
11				1		67
12	1	1	0	0	75	72.5
13				1		80
14	1	1	1	0	85	80
15				1		90

#### Step 1:

##### Establish Initial Conditions

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing valid operational status information at the nominal update rate. Provide the A/V Length and Width Code data externally at the interface to the ADS-B system for an aircraft or vehicle greater than 25 meters in length and greater than 25 meters in width.

Set up the system to enable broadcast of ADS-B Aircraft Operational Status Messages with the air/ground status set to "On-Ground" according to the conditions defined in RTCA DO260B §2.2.3.2.1.2.

#### Step 2:

##### Verification of Transmission of "A/V Length and Width Code" – ON GROUND

Verify that each of the A/V Length and Width Code values being transmitted by the ADS-B Transmitting Subsystem, are encoded according to Table 51 in "ME" bits 21 – 24 of the "A/V Length and Width Code" subfield. Verify that the A/V Length and Width Code is accurately reflected in the next broadcast of the Aircraft Operational Status Message.

#### Step 3:

#### Verification of No Data Available

Set up the ADS-B Transmitting Subsystem as in Step 1 above, and then remove the data input for the A/V Length and Width Codes. Verify that the value being transmitted for the A/V Length and Width Code is set to ALL ZERO (binary 0000) in the next broadcast of the Aircraft Operational Status Message.

#### Step 4:

#### Verification of Transmission of “A/V Length and Width Code” – AIRBORNE

Set up the system to enable broadcast of ADS-B Messages with the the air/ground status set to “Airborne” according to the conditions defined in RTCA DO260B §2.2.3.2.1.2. Verify that the Aircraft Operational Status Message is being broadcast with Subtype=0, and that the A/V Length and Width Code is not reflected in the next broadcast of the Aircraft Operational Status Message.

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system ‘Raw Data Output’ reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system ‘Raw data output’ reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system ‘Raw data output reports			
9	Verify that the GS system			

under test has generated the expected outputs, and has fulfilled the test objective.

Exercise result:

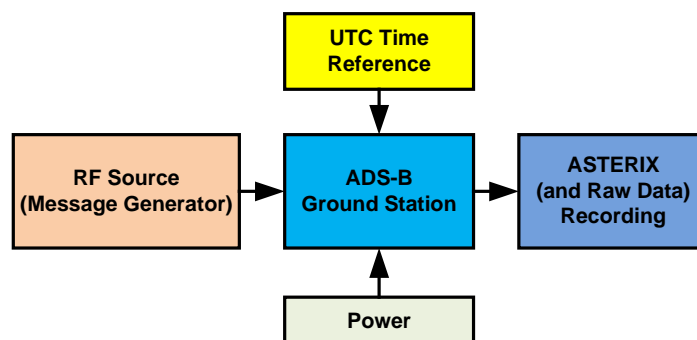
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 52: Verification Exercise Result

## JJ.1.12 Verification SUT requirements

N/A

## JJ.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## JJ.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## JJ.1.15 Platform Configuration

N/A

## JJ.1.16 Configuration(s) Identification of the Verification Platform

N/A

## JJ.1.17 Links to other Verification Exercises

N/A

## JJ.1.18 Representatively level/ limitations

N/A

## JJ.2 Exercises Planning and management

### JJ.2.1 Activities

N/A

#### JJ.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and JJ.1.13 in order to meet the Test Preconditions.

#### JJ.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### JJ.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.



## JJ.2.2 Human Resources

N/A

## JJ.2.3 Responsibilities in the exercise

N/A

## JJ.2.4 Training

N/A

## JJ.2.5 Time planning

N/A

## JJ.2.6 Risks

N/A

## JJ.2.7 Errors and Observation handling

N/A

## JJ.3 Analysis Specification

### JJ.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### JJ.3.2 Analysis method

N/A

### JJ.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix KK Verification Exercise EXE-15.04.05.a- TS.0060.0130 GS: Navigation Integrity Code (NIC)

### KK.1 Exercise Scope and Justification

#### KK.1.1 Exercise Level

The level of the exercise is functional.

#### KK.1.2 Exercise Type

The type of the exercise is Test.

#### KK.1.3 Description of the system being addressed

ADS – B Ground Station.

#### KK.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### KK.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### KK.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### KK.1.7 Inputs

1090MHz Extended Squitter Messages.

#### KK.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

## KK.1.9 Entrance criteria

Start the generation of the input data.

## KK.1.10 Exit Criteria

Finished recording and performed analysis.

## KK.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0130 / Navigation Integrity Code (NIC)

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

These test procedures verify that the ADS-B Report Assembly Function extracts "TYPE" Code data (RTCA DO260B §2.2.3.2.3.1) and the NIC Supplement-B value (RTCA DO260B §2.2.3.2.3.3) from the ADS-B Airborne Position Message, or the "TYPE" Code data (RTCA DO260B §2.2.3.2.4.1) from the ADS-B Surface Position Message, and the NIC Supplement-A (RTCA DO260B §2.2.3.2.7.2.6) and NIC Supplement-C (RTCA DO260B §2.2.3.2.7.2.3.10) values from the ADS-B Aircraft Operational Status Message, and provides Navigation Integrity Category (NIC) information to the user application in the State Vector Report as specified in Table 53.

Table 53: Navigation Integrity Category (NIC) Encoding.

NIC Value	Radius of Containment (R <sub>C</sub> )	Airborne			Surface		
		Airborne Position TYPE Code	NIC Supplement Codes		Surface Position TYPE Code	NIC Supplement Codes	
			A	B		A	C
0	R <sub>C</sub> unknown	0, 18 or 22	0	0	0, 8	0	0
1	R <sub>C</sub> < 20 NM (37.04 km)	17	0	0	N/A	N/A	N/A
2	R <sub>C</sub> < 8 NM (14.816 km)	16	0	0	N/A	N/A	N/A
3	R <sub>C</sub> < 4 NM (7.408 km)	16	1	1	N/A	N/A	N/A
4	R <sub>C</sub> < 2 NM (3.704 km)	15	0	0	N/A	N/A	N/A
5	R <sub>C</sub> < 1 NM (1852 m)	14	0	0	N/A	N/A	N/A
6	R <sub>C</sub> < 0.6 NM (1111.2 m)	13	1	1	8	0	1
	R <sub>C</sub> < 0.5 NM (926 m)	13	0	0	N/A	N/A	N/A
	R <sub>C</sub> < 0.3 NM (555.6 m)	13	0	1	8	1	0
7	R <sub>C</sub> < 0.2 NM (370.4 m)	12	0	0	8	1	1
8	R <sub>C</sub> < 0.1 NM (185.2 m)	11	0	0	7	0	0
9	R <sub>C</sub> < 75m	11	1	1	7	1	0
10	R <sub>C</sub> < 25m	10 or 21	0	0	6	0	0
11	R <sub>C</sub> < 7.5m	9 or 20	0	0	5	0	0
12	Reserved						
13	Reserved						
14	Reserved						
15	Reserved						

**Step 1:****Verification****Step 1:****Verification of (NIC) on Receipt of ADS-B Messages – Version Zero (0)**

Set up to simulate reception of Version Zero (0) ADS-B Messages by inputting data directly to the ADS-B Receiving Subsystem. Table 54 shows how a Version One or above ADS-B Receiving Subsystem shall interpret the NUCP Codes that it receives from a Version Zero ADS-B Transmitting Subsystem. Using Table 54 input the TYPE Code values found in each row of the table and verify that the corresponding NIC value in that row is reflected in the next output State Vector Report. Repeat this procedure for each row in the table.

Table 54: Interpretation of NUCP Codes from Version Zero Transmitting Subsystems When Received by Version One or above ADS-B Receiving Subsystems

Values Sent By Version Zero Transmitting Subsystem		Values Inferred by Version One or Above Receiving Subsystem			Notes
Message TYPE Codes	NUC <sub>P</sub>	NAC	NIC	SIL	
0	0	0 (HFOM $\geq$ 10 NM)	0 (R <sub>C</sub> $\geq$ 20 NM)	0 (No Integrity)	
5	9	11 (HFOM < 3 m)	11 (R <sub>C</sub> < 7.5 m)	2 ("5 nines")	
6	8	10 (HFOM < 10 m)	10 (R <sub>C</sub> < 25 m)	2 ("5 nines")	
7	7	8 (HFOM < 0.05 NM)	8 (R <sub>C</sub> < 0.1 NM)	2 ("5 nines")	
8	6	0 (HFOM $\geq$ 0.05 NM)	0 (R <sub>C</sub> $\geq$ 0.1 NM)	0 (No Integrity)	[1]
9	9	11 (HFOM < 3 m)	11 (R <sub>C</sub> < 7.5 m)	2 ("5 nines")	
10	8	10 (HFOM < 10 m)	10 (R <sub>C</sub> < 25 m)	2 ("5 nines")	
11	7	8 (HFOM < 0.05 NM)	8 (R <sub>C</sub> < 0.1 NM)	2 ("5 nines")	
12	6	7 (HFOM < 0.1 NM)	7 (R <sub>C</sub> < 0.2 NM)	2 ("5 nines")	
13	5	6 (HFOM < 0.3 NM)	6 (R <sub>C</sub> < 0.5 NM)	2 ("5 nines")	
14	4	5 (HFOM < 0.5 NM)	5 (R <sub>C</sub> < 1.0 NM)	2 ("5 nines")	
15	3	4 (HFOM < 1.0 NM)	4 (R <sub>C</sub> < 2.0 NM)	2 ("5 nines")	
16	2	1 (HFOM < 10.0 NM)	1 (R <sub>C</sub> < 8 NM)	2 ("5 nines")	
17	1	1 (HFOM < 10 NM)	1 (R <sub>C</sub> < 20 NM)	2 ("5 nines")	
18	0	0 (HFOM $\geq$ 10 NM)	0 (R <sub>C</sub> $\geq$ 20 NM)	0 (No Integrity)	
20	9	11 (HFOM < 3 m, VFOM < 4 m)	11 (R <sub>C</sub> < 7.5 m)	2 ("5 nines")	[2]
21	8	10 (HFOM < 10 m, VFOM < 15 m)	10 (R <sub>C</sub> < 25 m)	2 ("5 nines")	[2]
22	N/A	0 (HFOM $\geq$ 10 NM or unknown)	0 (R <sub>C</sub> $\geq$ 25 m or unknown)	0 (No Integrity)	[2]

Note: Table 54 specifies that Surface Position Messages with a TYPE Code of 8 should be interpreted by Version Two (i.e., RTCA DO-260B compliant) Receiving Subsystems as specifying that NIC, NACP and SIL should all be ZERO (0). This is because the information in the message is insufficient to indicate the value of either the RC Integrity Containment Radius, or the HFOM 95% Horizontal Accuracy Bound.

## Step 2:

### Verification of (NIC) on Receipt of ADS-B Messages – Version One (1)

Set up to simulate Version One (1) ADS-B Messages by inputting data directly to the ADS-B Receiving Subsystem being sure to first input an Aircraft Operational Status Message indicating Version One. Using Table 55 input the TYPE Code and NIC Supplement-A values found in each row of the table and verify that the corresponding NIC value is reflected in the next output State Vector Report. Repeat this procedure for each row in Table 55 for both Airborne and Surface Position Messages.

Table 55: Version One (1) Format Type Code Mapping to Navigation Source Characteristics

TYPE Code	Subtype Code	NIC Supplement			Format (Message Type)	Horizontal Containment Radius Limit (R <sub>C</sub> )	Navigation Integrity Category Category (NIC)	Altitude Type			
		A	B	C							
0	Not Present	Not Applicable			No Position Information (Airborne or Surface Position Messages)	R <sub>C</sub> unknown	NIC = 0	Baro Altitude or No Altitude Information			
1	Not Present	Not Applicable			Aircraft Identification and Category Message (§2.2.3.2.5)	Not Applicable	Not Applicable	Not Applicable			
2											
3											
4											
5	Not Present	0	--	0	Surface Position Message (§2.2.3.2.4)	R <sub>C</sub> < 7.5 m	NIC = 11	No Altitude Information			
6		0	--	0		R <sub>C</sub> < 25 m	NIC = 10				
7		1	--	0		R <sub>C</sub> < 75 m	NIC = 9				
		0	--	0		R <sub>C</sub> < 0.1 NM (185.2 m)	NIC = 8				
8		1	--	1		R <sub>C</sub> < 0.2 NM (370.4 m)	NIC = 7				
		1	--	0		R <sub>C</sub> < 0.3 NM (555.6 m)	NIC = 6				
		0	--	1		R <sub>C</sub> < 0.6 NM (1111.2 m)					
		0	--	0		R <sub>C</sub> ≥ 0.6 NM (1111.2 m) or unknown	NIC = 0				
9		Not Present	0	0		--	Airborne Position Message (§2.2.3.2.3)		R <sub>C</sub> < 7.5 m	NIC = 11	Baro Altitude
10			0	0		--			R <sub>C</sub> < 25 m	NIC = 10	
11	1		1	--	R <sub>C</sub> < 75 m	NIC = 9					
	0		0	--	R <sub>C</sub> < 0.1 NM (185.2 m)	NIC = 8					
12	0		0	--	R <sub>C</sub> < 0.2 NM (370.4 m)	NIC = 7					
13	0		1	--	R <sub>C</sub> < 0.3 NM (555.6 m)	NIC = 6					
	0		0	--	R <sub>C</sub> < 0.5 NM (925 m)						
	1		1	--	R <sub>C</sub> < 0.6 NM (1111.2 m)						
14	0		0	--	R <sub>C</sub> < 1.0 NM (1852 m)	NIC = 5					
15	0		0	--	R <sub>C</sub> < 2 NM (3.704 km)	NIC = 4					
16	1		1	--	R <sub>C</sub> < 4 NM (7.408 km)	NIC = 3					
	0		0	--	R <sub>C</sub> < 8 NM (14.816 km)	NIC = 2					
17	0		0	--	R <sub>C</sub> < 20 NM (37.04 km)	NIC = 1					
18	0		0	--	R <sub>C</sub> ≥ 20 NM (37.04 km) or unknown	NIC = 0					
19	0	Not Applicable			Reserved	Not Applicable	Not Applicable	Difference between “Baro Altitude” and “GNSS Height (HAE)”			
	1 – 4				Airborne Velocity Message (§2.2.3.2.6)						
	5 – 7				Reserved						
20	Not Present	0	0	--	Airborne Position Message	R <sub>C</sub> < 7.5 m	NIC = 11	GNSS Height (HAE)			
21		0	0	--		R <sub>C</sub> < 25 m	NIC = 10				

22		0	0	--	(§2.2.3.2.3)	$R_c \geq 25$ m or unknown	NIC = 0	
----	--	---	---	----	--------------	-------------------------------	---------	--

**Step 3:****Verification of (NIC) on Receipt of ADS-B Messages**☐ Version Two (2)

Set up to simulate Version Two (2) ADS-B Messages by inputting data directly to the ADS-B Receiving Subsystem being sure to first input an Aircraft Operational Status Message indicating Version Two. Using Table 53. input the TYPE Code and NIC Supplement-A, NIC Supplement-B and NIC Supplement-C values found in each row of the table and verify that the corresponding NIC value is reflected in the next output State Vector Report. Repeat this procedure for each row in Table 53. for both Airborne and Surface Position Messages.

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			

- 9 Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.

Exercise result:

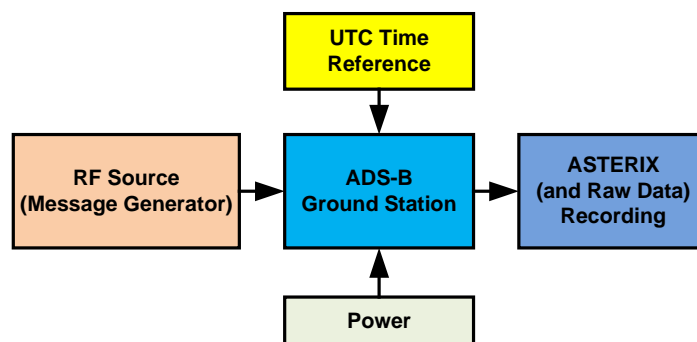
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 56: Verification Exercise Result

## KK.1.12 Verification SUT requirements

N/A

## KK.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:



- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## KK.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## KK.1.15 Platform Configuration

N/A

## KK.1.16 Configuration(s) Identification of the Verification Platform

N/A

## KK.1.17 Links to other Verification Exercises

N/A

## KK.1.18 Representatively level/ limitations

N/A

## KK.2 Exercises Planning and management

### KK.2.1 Activities

N/A

#### KK.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and KK.1.13 in order to meet the Test Preconditions.

#### KK.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### KK.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## KK.2.2 Human Resources

N/A

## KK.2.3 Responsibilities in the exercise

N/A

## KK.2.4 Training

N/A

## KK.2.5 Time planning

N/A

## KK.2.6 Risks

N/A

## KK.2.7 Errors and Observation handling

N/A

## KK.3 Analysis Specification

### KK.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in input.

### KK.3.2 Analysis method

N/A

### KK.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix LL Verification Exercise EXE-15.04.05.a- TS.0060.0140 GS: “NAC<sub>p</sub>” Subfield in Target State and Status Messages

### LL.1 Exercise Scope and Justification

#### LL.1.1 Exercise Level

The level of the exercise is functional.

#### LL.1.2 Exercise Type

The type of the exercise is Test.

#### LL.1.3 Description of the system being addressed

ADS – B Ground Station.

#### LL.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### LL.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### LL.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### LL.1.7 Inputs

1090MHz Extended Squitter Messages.

#### LL.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## LL.1.9 Entrance criteria

Start the generation of the input data.

## LL.1.10 Exit Criteria

Finished recording and performed analysis.

## LL.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0140/ "NAC<sub>P</sub>" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The "NACP" subfield in the Target State and Status Message is encoded in accordance with Table 57.

Table 57: Navigation Accuracy Category for Position (NACP) Encoding

Coding		95% Horizontal Accuracy Bounds (EPU)	Comment	Notes
(Binary)	(Decimal)			
0000	0	EPU $\geq$ 18.52 km ( $\geq$ 10 NM)	Unknown accuracy	1
0001	1	EPU < 18.52 km (10 NM)	RNP-10 accuracy	1, 3
0010	2	EPU < 7.408 km (4 NM)	RNP-4 accuracy	1, 3
0011	3	EPU < 3.704 km (2 NM)	RNP-2 accuracy	1, 3
0100	4	EPU < 1852 m (1 NM)	RNP-1 accuracy	1, 3
0101	5	EPU < 926 m (0.5 NM)	RNP-0.5 accuracy	1, 3
0110	6	EPU < 555.6 m (0.3 NM)	RNP-0.3 accuracy	1, 3
0111	7	EPU < 185.2 m (0.1 NM)	RNP-0.1 accuracy	1, 3
1000	8	EPU < 92.6 m (0.05 NM)	e.g., GPS (with SA on)	1
1001	9	EPU < 30 m	e.g., GPS (SA off)	1, 2, 4
1010	10	EPU < 10 m	e.g., WAAS	1, 2, 4
1011	11	EPU < 3 m	e.g., LAAS	1, 2, 4
1100	12	Reserved		
1101	13	Reserved		
1110	14	Reserved		
1111	15	Reserved		

**Step 1:**

**Establish Initial Conditions**

**Step 1:**

**Target State and Status Message Initialization**

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with valid Mode Control Panel Selected Altitude data in order to initialize transmission of Target State and Status Messages.

**Step 2:****Verification of NACP Transmission**

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with each of the EPU values indicated in Table 57.

Verify that for each input NACP parameter that is specified by the EPU value in Table 2-71, that the system generates ADS-B Messages with the NACP subfield set equal to the corresponding binary coding value shown in Table 57.

**Step 3:****Verification of NACP – Data Lifetime**

Rerun the Test Procedure in Step 1. Remove the data source input for valid trajectory information for a period of at least 2 seconds. Verify that “ME” bits 40 – 43 in the Target State and Status Message are set to a value of ZERO (binary 0000).

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw			

	data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

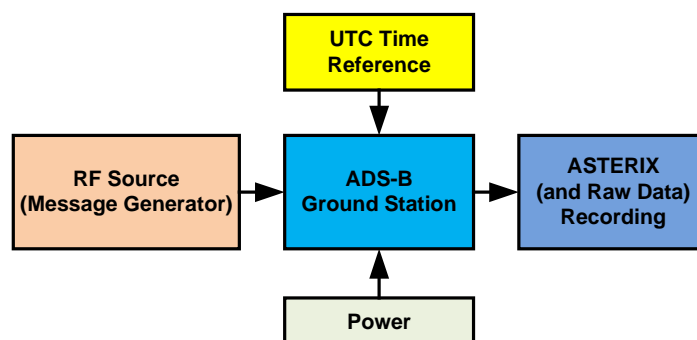
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 58: Verification Exercise Result

## LL.1.12 Verification SUT requirements

N/A

## LL.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

founding members



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- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## LL.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## LL.1.15 Platform Configuration

N/A

## LL.1.16 Configuration(s) Identification of the Verification Platform

N/A

## LL.1.17 Links to other Verification Exercises

N/A

## LL.1.18 Representatively level/ limitations

N/A

## LL.2 Exercises Planning and management

### LL.2.1 Activities

N/A

#### LL.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and LL.1.13 in order to meet the Test Preconditions.

#### LL.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### LL.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## LL.2.2 Human Resources

N/A

## LL.2.3 Responsibilities in the exercise

N/A

## LL.2.4 Training

N/A

## LL.2.5 Time planning

N/A

## LL.2.6 Risks

N/A

## LL.2.7 Errors and Observation handling

N/A

## LL.3 Analysis Specification

### LL.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### LL.3.2 Analysis method

N/A

### LL.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.



## Appendix MM Verification Exercise EXE-15.04.05.a-TS.0060.0150 GS: “NAC<sub>v</sub>” Subfield in Airborne Velocity Messages - Subtype=1

### MM.1 Exercise Scope and Justification

#### MM.1.1 Exercise Level

The level of the exercise is functional.

#### MM.1.2 Exercise Type

The type of the exercise is Test.

#### MM.1.3 Description of the system being addressed

ADS – B Ground Station.

#### MM.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### MM.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### MM.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### MM.1.7 Inputs

1090MHz Extended Squitter Messages.

#### MM.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## MM.1.9 Entrance criteria

Start the generation of the input data.

## MM.1.10 Exit Criteria

Finished recording and performed analysis.

## MM.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0150/ "NAC<sub>V</sub>" Subfield in Airborne Velocity Messages - Subtype=1

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The "NACV" subfield is used to indicate the Navigation Accuracy Category for Velocity as specified in Table 59. These test procedures are intended for use for Airborne Velocity Messages of all Subtypes. The type and values of the input Velocity data should be set so as to generate Airborne Velocity Messages for all appropriate Subtype fields.

**Note:** Subsequent to Revision A of the 1090 MHz ADS-B MOPS, the Federal Aviation Administration requested RTCA SC-159 to develop test procedures for a velocity accuracy test to characterize the 95% horizontal and 95% vertical velocity accuracies during normal maneuvers of GNSS equipment, as specified in RTCA/DO-229D, RTCA/DO-316, and RTCA/DO-253C receiver MOPS, which do not provide a specific velocity accuracy output. These tests can be used to substantiate Global Positioning System (GPS), GPS/Space-Based Augmentation System (SBAS), or GPS/Ground-Based Augmentation System (GBAS) equipment to support an ADS-B  $NAC_V=1$  requirement of horizontal velocity error less than 10 meters/second (95th percentile with HDOP of 1.5 or less) and vertical velocity error less than 50 feet/second (95th percentile, with VDOP of 3.0 or less). Additional test procedures were developed to substantiate equipment that supports a  $NAC_V=2$  requirement of horizontal velocity error less than 3 meters/second and vertical velocity error less than 15 feet/second. However, these tests are not adequate for demonstrating more stringent ADS-B  $NAC_V$  levels (i.e.,  $NAC_V=3$ , or greater), but are expected to be developed as more demanding ADS-B applications mature. The results of these tests can be used to substantiate the setting of a  $NAC_V$  value to be used when ADS-B position and velocity are provided by the GPS equipment, presuming that that equipment does not have a specific velocity accuracy output.

Table 59: Determining NACV Based on Position Source Declared Horizontal Velocity Error

Navigation Accuracy Category for Velocity		
Coding		Horizontal Velocity Error
(Binary)	(Decimal)	
000	0	Unknown or $\geq 10$ m/s
001	1	$< 10$ m/s
010	2	$< 3$ m/s
011	3	$< 1$ m/s
100	4	$< 0.3$ m/s

#### Step 1:

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages by providing velocity information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set up the system to enable broadcast of Airborne Velocity Messages. Set the ADS-B Transmitting Subsystem to Airborne status. Provide valid non-zero velocity data to the ADS-B System.

From an external source, input 95% accuracy figures of merit for horizontal velocity, and verify that for each horizontal velocity error value in Table 59 that the system generates Airborne Velocity Messages with the NACV subfield set equal to the corresponding binary coding value shown for the NACV subfield in Table 59.

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			

2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

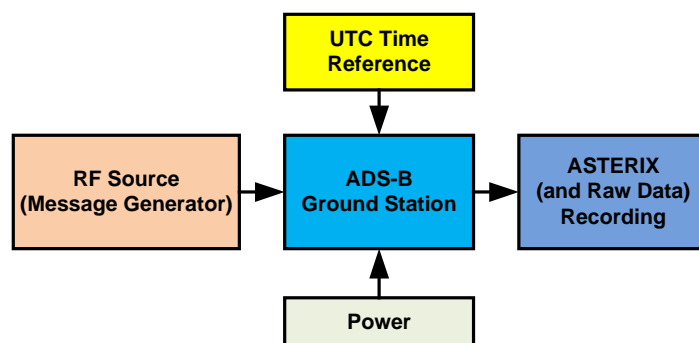
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 60: Verification Exercise Result

## MM.1.12 Verification SUT requirements

N/A

## MM.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## MM.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## **MM.1.15 Platform Configuration**

N/A

## **MM.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **MM.1.17 Links to other Verification Exercises**

N/A

## **MM.1.18 Representatively level/ limitations**

N/A

## **MM.2 Exercises Planning and management**

### **MM.2.1 Activities**

N/A

#### **MM.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and MM.1.13 in order to meet the Test Preconditions.

#### **MM.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **MM.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **MM.2.2 Human Resources**

N/A

### **MM.2.3 Responsibilities in the exercise**

N/A

### **MM.2.4 Training**

N/A

### **MM.2.5 Time planning**

N/A

### **MM.2.6 Risks**

N/A

## MM.2.7 Errors and Observation handling

N/A

## MM.3 Analysis Specification

### MM.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### MM.3.2 Analysis method

N/A

### MM.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix NN Verification Exercise EXE-15.04.05.a- TS.0060.0160 GS: “Selected Heading Status”, “Selected Heading Sign”, and “Selected Heading”

### NN.1 Exercise Scope and Justification

#### NN.1.1 Exercise Level

The level of the exercise is functional.

#### NN.1.2 Exercise Type

The type of the exercise is Test.

#### NN.1.3 Description of the system being addressed

ADS – B Ground Station.

#### NN.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### NN.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### NN.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### NN.1.7 Inputs

1090MHz Extended Squitter Messages.

#### NN.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.



## NN.1.9 Entrance criteria

Start the generation of the input data.

## NN.1.10 Exit Criteria

Finished recording and performed analysis.

## NN.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0160/ "Selected Heading Status", "Selected Heading Sign", and "Selected Heading"

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

As a part of verification of ADS-B transmission device message processor characteristics, or more specific, as a part of verification of ADS-B Transmission Device Data Processing and Message Formatting, the following validation test procedure shall be done. The purpose of the following test procedure is to verify that Selected Heading data ("Selected Heading Status", "Selected Heading Sign", and "Selected Heading") provided in the Target State and Status Messages are properly reported in accordance with RTCA DO-260B (§2.2.3.2.7.1.3.5 through §2.2.3.2.7.1.3.7).

### Step 1:

#### Setup of Selected Heading Data

For each line Item in Table 61, via the appropriate interface, provide the ADS-B Transmitting Subsystem with Selected Heading data having a value as indicated in the "Data Value" (degrees) Column in Table 61.

Table 61: Selected Heading data in Target State and Status Messages (ARINC Label "101")

Item #	Generic Selected Heading Input (degrees) [binary (BNR)]				Target State and Status Encoding of Selected Heading				
	Type of Value	Status	Sense (Note 1)	Data Value (degrees)	Sense (Note 1)	Decimal Value (degrees)	Status (bit 30)	Sign (bit 31) (Note 2)	Binary Value (bits 32-39)

1	Basic	Valid	West (CCW)	-120.234375 (239.765625)	Left	-120.234375 (239.765625)	1	1	0101 0101
2	Basic	Valid	East (CW)	119.53125	Right	119.53125	1	0	1010 1010
3	Basic	Valid	West (CCW)	-24.609375 (335.390625)	Left	-24.609375 (335.390625)	1	1	1101 1101
4	Basic	Valid	West (CCW)	-90.000 (270.000)	Left	-90.000 (270.000)	1	1	1000 0000
5	Basic	Valid	East (CW)	135.000	Right	135.000	1	0	1100 0000
6	Rounded (1/4 LSB)	Valid	West (CCW)	-120.0585937 (239.94140625)	Left	-120.234375 (239.765625)	1	1	0101 0101
7	Rounded (1/2 LSB)	Valid	West (CCW)	-119.8828125 (240.1171875)	Left	-119.53125 (240.46875)	1	1	0101 0110
8	Invalid	Invalid	East (CW)	119.53125	Not Applicable	0.000	0	0	0000 0000

**Notes:**

1. Input data Sense refers to (a) Positive, being Clockwise (CW), commonly meaning East of North, or (b) Negative, being Counter-Clockwise (CCW), commonly meaning West of North.
2. The Sign Bits is „1“ for Negative, West of North, or Counter-Clockwise (CCW). The Sign Bit is „0“ for Positive, East of North, or Clockwise (CW).

**Step 2:**

**Verification of Selected Heading Status, Sign, and Data**

For each line Item given in Table 61, verify that Target State and Status Messages are properly transmitted having:

1. Selected Heading Status (“ME” bit 30, Message Bit 62) set as indicated in the “Status (bit 30)” Column of Table 61,
2. Selected Heading Sign (“ME” bit 31, Message Bit 63) set as indicated in the “Sign (bit 31)” Column of Table 61, and
3. Selected Heading Data (“ME” bits 32-39, Message bits 64-71) set as indicated in the “Binary Value (bits 32-39)” Column of Table 61.

**Step 3:**

**Discontinue Selected Heading Data**

Discontinue the provisioning of all Selected Heading information (e.g., Status, Sign, Data) as was provided in Step 1, e.g., Table 61.

**Step 4:**

**Verification of Selected Heading Data Lifetime**

At least 5 seconds after the execution of Step 3, verify that Target State and Status Messages are properly transmitted having all Selected Heading information (“ME” bits 30-39, Message bits 62-71) set to ZERO (0).

## Verification of the Selected Heading

As a part of verification of ADS-B Report Characteristics, or more specific, as a part of verification of the Target State Report, the following validation test procedure shall be done. The Selected Heading parameter uses the least significant bit of byte 15 and the 8 bits of byte 16 to encode the heading values specified in RTCA DO-260B (§2.2.3.2.7.1.3.7).

### Step 1:

#### Initialization

Provide valid ADS-B Position and Velocity Messages to the ADS-B Receiving Subsystem such that the ADS-B Report Assembly Function enters the Track State and is outputting Reports to the Report Buffer. Verify that the Report Type

Coding bits 7 through 4 of byte 0 are set to THREE (binary 0011) to indicate Target State Report.

### Step 2:

#### Verification of Selected Heading

Provide a valid Target State and Status Message to the ADS-B Receiving Subsystem. Verify that bits 31-39 of the Target State and Status Message are mapped directly to the Target State Report in the least significant bit of byte 15 and the 8 bits of byte 16 of that report.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			

6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

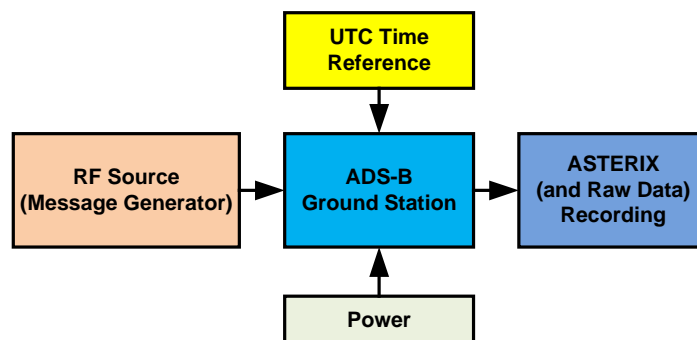
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 62: Verification Exercise Result

## NN.1.12 Verification SUT requirements

N/A

## NN.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- **Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## NN.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## NN.1.15 Platform Configuration

N/A

## NN.1.16 Configuration(s) Identification of the Verification Platform

N/A

## NN.1.17 Links to other Verification Exercises

N/A

## NN.1.18 Representatively level/ limitations

N/A

## NN.2 Exercises Planning and management

### NN.2.1 Activities

N/A

#### NN.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and NN.1.13 in order to meet the Test Preconditions.

### **NN.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

### **NN.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

## **NN.2.2 Human Resources**

N/A

## **NN.2.3 Responsibilities in the exercise**

N/A

## **NN.2.4 Training**

N/A

## **NN.2.5 Time planning**

N/A

## **NN.2.6 Risks**

N/A

## **NN.2.7 Errors and Observation handling**

N/A

## **NN.3 Analysis Specification**

### **NN.3.1 Data collection methods**

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### **NN.3.2 Analysis method**

N/A

### **NN.3.3 Data logging requirements**

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix OO Verification Exercise EXE-15.04.05.a-TS.0060.0170 GS: “MCP/FCU Selected Altitude or FMS Selected Altitude” Subfield in Target State and Status Messages

### OO.1 Exercise Scope and Justification

#### OO.1.1 Exercise Level

The level of the exercise is functional.

#### OO.1.2 Exercise Type

The type of the exercise is Test.

#### OO.1.3 Description of the system being addressed

ADS – B Ground Station.

#### OO.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### OO.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### OO.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### OO.1.7 Inputs

1090MHz Extended Squitter Messages.

#### OO.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## OO.1.9 Entrance criteria

Start the generation of the input data.

## OO.1.10 Exit Criteria

Finished recording and performed analysis.

## OO.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0170/ "MCP/FCU Selected Altitude or FMS Selected Altitude" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following procedure is to verify that Selected Altitude data is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.3.

### Step 1:

#### Setup of MCP / FCU Selected Altitude Data

For each line Item in Table 63 via the appropriate interface, provide the ADS-B Transmitting Subsystem with Mode Control Panel Selected Altitude having a value as indicated in the "Data Value" (feet) Column in Table 63.

Table 63: MCP/FCU Selected Altitude in Target State and Status Messages (ARINC Label '102')

Item #	Generic MCP / FCU Selected Altitude Input (BNR)			Target State and Status Encoding of MCP / FCU Selected Altitude		
	Type of Value	Status	Data Value (feet)	TYPE (bit 9)	Decimal Value (feet)	Binary Value (bit 10 ----- 20)
1	Basic	Valid	43,648.00	0	43,648.00	101 0101 0101
2	Basic	Valid	21,792.00	0	21,792.00	010 1010 1010
3	Basic	Valid	23,352.00	0	23,352.00	011 0111 0111
5	Basic	Valid	65,472.00	0	65,472.00	111 1111 1111
6	Basic	Rounded (1/4 LSB)	52,392.00	0	52,384.00	110 0110 0110
7	Basic	Rounded (1/2 LSB)	52,400.00	0	52,416.00	110 0110 0111
8	Invalid	Invalid	21,792.00	0	0.00	000 0000 0000



## Step 2:

### Setup of FMS Selected Altitude Data

For each line Item in Table 64, via the appropriate interface, provide the ADS-B Transmitting Subsystem with FMS Selected Altitude having a value as indicated in the "Data Value" (feet) Column in Table 64. Provide at least one data value from while provided the data for Line Item #1 through 7 in Table 63. Do not provide any data from Table 64 when providing data for Line Item #8 in Table 63.

Table 64: FMS Selected Altitude in Target State and Status Messages (ARINC Label '102')

Item #	Generic FMS Selected Altitude Input (BNR)			Target State and Status Encoding of FMS Selected Altitude		
	Type of Value	Status	Data Value (feet)	TYPE (bit 9)	Decimal Value (feet)	Binary Value (bit 10 ----- 20)
1	Basic	Valid	37,088.00	1	37,088.00	100 1000 1000
2	Basic	Valid	13,600.00	1	13,600.00	001 1010 1010
3	Basic	Valid	22,880.00	1	22,880.00	010 1100 1100
5	Basic	Valid	60,032.00	1	60,032.00	111 0101 0101
6	Basic	Rounded (1/4 LSB)	25,640.00	1	25,632.00	011 0010 0010
7	Basic	Rounded (1/2 LSB)	25,648.00	1	25,664.00	011 0010 0011
8	Invalid	Invalid	13,600.00	1	0.00	000 0000 0000

## Step 3:

### Verification of MCP / FCU Selected Altitude Data

For each line Item given in Table 63, verify that Target State and Status Messages are properly transmitted having:

- (1).Selected Altitude Type, (bit 9), set as indicated in the "TYPE" (bit 9) Column of Table 63.
- (2).Selected Altitude Binary Value, set as indicated in the "Binary Value" (bit 10 --- 20) Table 63.

## Step 4:

### Discontinue MCP / FCU Selected Altitude Data

Discontinue the provisioning of all MCP / FCU Selected Altitude data as was provided in Step 1, e.g., Table 63.

## Step 5:

### Verification of FMS Selected Altitude Data

For each line Item given in Table 64, verify that Target State and Status Messages are properly transmitted having:

- (1).Selected Altitude Type, (bit 9), set as indicated in the "TYPE" (bit 9) Column of Table 64, and
- (2).Selected Altitude Binary Value, set as indicated in the "Binary Value" (bit 10 --- 20) Column of Table 64.

## Step 6:

### Discontinue FMS Selected Altitude Data

Discontinue the provisioning of all MCP / FCU Selected Altitude data as was provided in Step 1, e.g., Table 63.

## Step 7:

### Verification of Selected Altitude Data – Data Lifetime

At least 5 seconds after the execution of Step "f," verify that Target State and Status Messages are properly transmitted having:

- (1).Selected Altitude Type, (bit 9), set to ZERO (0).
- (2).Selected Altitude Binary Value, set to ZERO (0).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

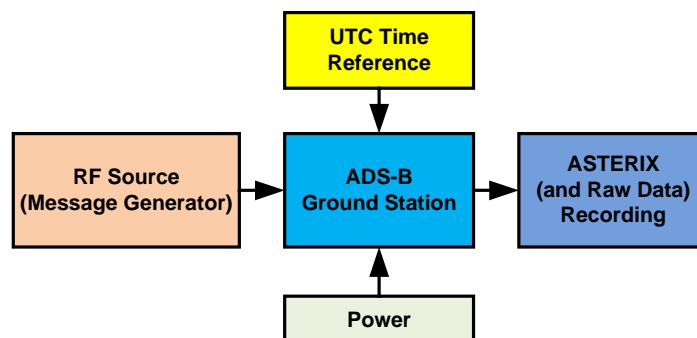
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 65: Verification Exercise Result

## OO.1.12 Verification SUT requirements

N/A

## OO.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **OO.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **OO.1.15 Platform Configuration**

N/A

### **OO.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **OO.1.17 Links to other Verification Exercises**

N/A

### **OO.1.18 Representatively level/ limitations**

N/A

## **OO.2 Exercises Planning and management**

### **OO.2.1 Activities**

N/A

#### **OO.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and OO.1.13 in order to meet the Test Preconditions.

#### **OO.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **OO.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **OO.2.2 Human Resources**

N/A

### **OO.2.3 Responsibilities in the exercise**

N/A

### **OO.2.4 Training**

N/A

## OO.2.5 Time planning

N/A

## OO.2.6 Risks

N/A

## OO.2.7 Errors and Observation handling

N/A

## OO.3 Analysis Specification

### OO.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### OO.3.2 Analysis method

N/A

### OO.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix PP Verification Exercise EXE-15.04.05.a-TS.0060.0180 GS: “Barometric Pressure Setting (Minus 800 millibars)” Subfield in Target State and Status Messages

### PP.1 Exercise Scope and Justification

#### PP.1.1 Exercise Level

The level of the exercise is functional.

#### PP.1.2 Exercise Type

The type of the exercise is Test.

#### PP.1.3 Description of the system being addressed

ADS – B Ground Station.

#### PP.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### PP.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### PP.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### PP.1.7 Inputs

1090MHz Extended Squitter Messages.

#### PP.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## PP.1.9 Entrance criteria

Start the generation of the input data.

## PP.1.10 Exit Criteria

Finished recording and performed analysis.

## PP.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0180/ "Barometric Pressure Setting (Minus 800 millibars)"  
Subfield in Target State and Status Messages

Pass Criteria: This test is passed, when the recorded output has data items and corresponding values as expected.

Exercise Type: Test

Precondition(s):

- Test equipment is setup as described above
- GS under test is active, and ready for test.

Note(s): N/A

Device(s) in use: SUT is ADS-B GS.

The purpose of the following procedure is to verify that Barometric Pressure Setting data is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.4.

### Step 1:

#### Setup of Barometric Pressure Setting Data

For each line Item in Table 66, via the appropriate interface, provide the ADS-B Transmitting Subsystem with Barometric Pressure Setting data having a value as indicated in the "Data Value" (millibars) Column in Table 66.

Table 66: Barometric Pressure Setting in Target State and Status Messages  
(ARINC Label '234')

Item #	Barometric Pressure Setting Data Input			Target State and Status Encoding of Barometric Pressure Setting	
	Type of Value	Status	Data Value (millibars)	Decimal Value (millibars) (minus 800)	Binary Value (bit 21 ----- 29)
1	Basic	Valid	942.7	142.4	0 1011 0001
2	Basic	Valid	923.2	123.2	1 0101 0101
3	Basic	Valid	1208.0	408.0	1 1111 1111
5	Basic	Valid	927.2	127.2	0 1010 1010
6	Basic	Rounded (1/4 LSB)	1099.4	299.2	1 0111 0111
7	Basic	Rounded (1/2 LSB)	1099.6	300.0	1 0111 1000
8	Invalid	Valid	1208.5	0.000	0 0000 0000
9	Invalid	Valid	799.6	0.000	0 0000 0000
10	Invalid	Invalid	927.2	0.00	0 0000 0000

**Step 2:****Verification of Barometric Pressure Setting Data**

For each line Item given in Table 66, verify that Target State and Status Messages are properly transmitted having Barometric Pressure Setting Binary Value set as indicated in the "Binary Value" (bit 21 – 29) Column of Table 66.

**Step 3:****Discontinue Barometric Pressure Setting Data**

Discontinue the provisioning of all Barometric Pressure Setting data as was provided in Step 1, e.g., Table 66.

**Step 4:****Verification of Barometric Pressure Setting Data – Data Lifetime**

At least 5 seconds after the execution of Step "3," verify that Target State and Status Messages are properly transmitted having Barometric Pressure Setting Binary Value (bit 21 --- 29) set to ZERO (0).

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			



4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

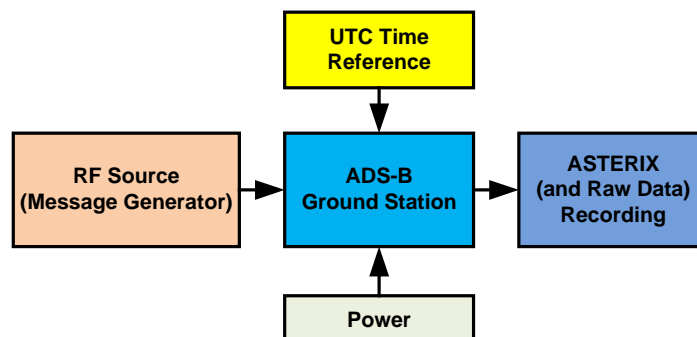
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 67: Verification Exercise Result

## PP.1.12 Verification SUT requirements

N/A

## PP.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS-B

- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

#### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

#### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

#### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## PP.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## PP.1.15 Platform Configuration

N/A

## PP.1.16 Configuration(s) Identification of the Verification Platform

N/A

## PP.1.17 Links to other Verification Exercises

N/A

## PP.1.18 Representatively level/ limitations

N/A

## PP.2 Exercises Planning and management

### PP.2.1 Activities

N/A

#### PP.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and PP.1.13 in order to meet the Test Preconditions.

#### PP.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### PP.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### PP.2.2 Human Resources

N/A

### PP.2.3 Responsibilities in the exercise

N/A

### PP.2.4 Training

N/A

### PP.2.5 Time planning

N/A

### PP.2.6 Risks

N/A

### PP.2.7 Errors and Observation handling

N/A

## PP.3 Analysis Specification

### PP.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### PP.3.2 Analysis method

N/A

### PP.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix QQ Verification Exercise EXE-15.04.05.a- TS.0060.0190 GS: “Status of MCP/FCU Mode Bits” Subfield in Target State and Status Messages

### QQ.1 Exercise Scope and Justification

#### QQ.1.1 Exercise Level

The level of the exercise is functional.

#### QQ.1.2 Exercise Type

The type of the exercise is Test.

#### QQ.1.3 Description of the system being addressed

ADS – B Ground Station.

#### QQ.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### QQ.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### QQ.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirements:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### QQ.1.7 Inputs

1090MHz Extended Squitter Messages.

#### QQ.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## QQ.1.9 Entrance criteria

Start the generation of the input data.

## QQ.1.10 Exit Criteria

Finished recording and performed analysis.

## QQ.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0190/ "Status of MCP/FCU Mode Bits" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "Status of MCP / FCU Mode Bits" information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.11.

### Step 1:

#### Initialization with NO Status

Ensure that No information is being provided to the ADS-B Transmitting Subsystem that would indicate the status of Autopilot Engaged, VNAV Mode Engaged, Altitude Hold Mode, Approach Mode or LNAV Mode Engaged.

### Step 2:

#### Verification of NO Status

Verify that Target State and Status Messages are properly transmitted having the "Status of MCP / FCU Mode Bits" subfield ("ME" bit 47, Message bit 79) set to ZERO (0).

### Step 3:

#### Initialization with Status

Via the appropriate interface(s), provide the ADS-B Transmit Subsystem with the status of Autopilot Engaged, VNAV Mode Engaged, Altitude Hold Mode Approach Mode and LNAV Mode Engaged, with the status indicating "Not Engaged" for each of the status parameters.

### Step 4:

#### Verification of Provided Status

Verify that Target State and Status Messages are properly transmitted having the "Status of MCP / FCU Mode Bits" subfield ("ME" bit 47, Message bit 79) set to ONE (1).

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

#### Exercise result:

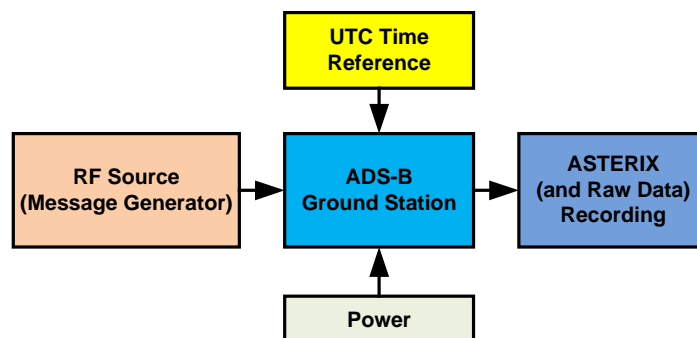
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 68: Verification Exercise Result

## QQ.1.12 Verification SUT requirements

N/A

## QQ.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.



#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **QQ.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **QQ.1.15 Platform Configuration**

N/A

### **QQ.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **QQ.1.17 Links to other Verification Exercises**

N/A

### **QQ.1.18 Representatively level/ limitations**

N/A

## **QQ.2 Exercises Planning and management**

### **QQ.2.1 Activities**

N/A

#### **QQ.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and QQ.1.13 in order to meet the Test Preconditions.

#### **QQ.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **QQ.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **QQ.2.2 Human Resources**

N/A

### **QQ.2.3 Responsibilities in the exercise**

N/A

### **QQ.2.4 Training**

N/A

## QQ.2.5 Time planning

N/A

## QQ.2.6 Risks

N/A

## QQ.2.7 Errors and Observation handling

N/A

## QQ.3 Analysis Specification

### QQ.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### QQ.3.2 Analysis method

N/A

### QQ.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix RR Verification Exercise EXE-15.04.05.a- TS.0060.0200 GS: “Autopilot Engaged” Subfield in Target State and Status Messages

### RR.1 Exercise Scope and Justification

#### RR.1.1 Exercise Level

The level of the exercise is functional.

#### RR.1.2 Exercise Type

The type of the exercise is Test.

#### RR.1.3 Description of the system being addressed

ADS – B Ground Station.

#### RR.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### RR.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### RR.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### RR.1.7 Inputs

1090MHz Extended Squitter Messages.

#### RR.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## RR.1.9 Entrance criteria

Start the generation of the input data.

## RR.1.10 Exit Criteria

Finished recording and performed analysis.

## RR.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0200/ "Autopilot Engaged" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "Autopilot Engaged" information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.12.

### Step 1:

#### Initialization with Autopilot NOT Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Autopilot is Not Engaged.

### Step 2:

#### Verification of Autopilot NOT Engaged

Verify that Target State and Status Messages are properly transmitted having the "Autopilot Engaged" subfield ("ME" bit 48, Message bit 80) set to ZERO (0).

### Step 3:

#### Initialization with Autopilot Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Autopilot is Engaged.

### Step 4:

#### Verification of Autopilot Engaged

Verify that Target State and Status Messages are properly transmitted having the "Autopilot Engaged" subfield ("ME" bit 48, Message bit 80) set to ONE (1).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

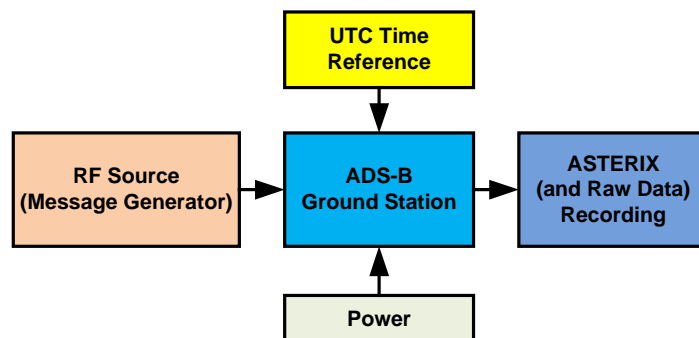
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 69: Verification Exercise Result

## RR.1.12 Verification SUT requirements

N/A

## RR.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## RR.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## RR.1.15 Platform Configuration

N/A

## RR.1.16 Configuration(s) Identification of the Verification Platform

N/A

## RR.1.17 Links to other Verification Exercises

N/A

## RR.1.18 Representatively level/ limitations

N/A

## RR.2 Exercises Planning and management

### RR.2.1 Activities

N/A

#### RR.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and RR.1.13 in order to meet the Test Preconditions.

#### RR.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### RR.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### RR.2.2 Human Resources

N/A

### RR.2.3 Responsibilities in the exercise

N/A

### RR.2.4 Training

N/A

### RR.2.5 Time planning

N/A

## RR.2.6 Risks

N/A

## RR.2.7 Errors and Observation handling

N/A

## RR.3 Analysis Specification

### RR.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### RR.3.2 Analysis method

N/A

### RR.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.



## Appendix SS Verification Exercise EXE-15.04.05.a- TS.0060.0210 GS: “VNAV Mode Engaged” Subfield in Target State and Status Messages

### SS.1 Exercise Scope and Justification

#### SS.1.1 Exercise Level

The level of the exercise is functional.

#### SS.1.2 Exercise Type

The type of the exercise is Test.

#### SS.1.3 Description of the system being addressed

ADS – B Ground Station.

#### SS.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### SS.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### SS.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### SS.1.7 Inputs

1090MHz Extended Squitter Messages.

#### SS.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## SS.1.9 Entrance criteria

Start the generation of the input data.

## SS.1.10 Exit Criteria

Finished recording and performed analysis.

## SS.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0210/ "VNAV Mode Engaged" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "VNAV Mode Engaged" information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.13.

### Step 1:

#### Initialization with VNAV Mode Not Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the VNAV Mode is Not Engaged.

### Step 2:

#### Verification of VNAV Mode Not Engaged

Verify that Target State and Status Messages are properly transmitted having the "VNAV Mode Engaged" subfield ("ME" bit 49, Message bit 81) set to ZERO (0).

### Step 3:

#### Initialization with VNAV Mode Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the VNAV Mode is Engaged.

### Step 4:

#### Verification of VNAV Mode Engaged

Verify that Target State and Status Messages are properly transmitted having the "VNAV Mode Engaged" subfield ("ME" bit 49, Message bit 81) set to ONE (1).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

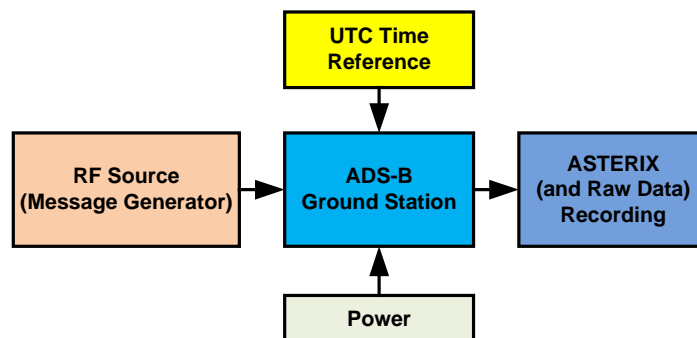
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 70: Verification Exercise Result

## SS.1.12 Verification SUT requirements

N/A

## SS.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## SS.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## SS.1.15 Platform Configuration

N/A

## SS.1.16 Configuration(s) Identification of the Verification Platform

N/A

## SS.1.17 Links to other Verification Exercises

N/A

## SS.1.18 Representatively level/ limitations

N/A

## SS.2 Exercises Planning and management

### SS.2.1 Activities

N/A

#### SS.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and SS.1.13 in order to meet the Test Preconditions.

#### SS.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### SS.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### SS.2.2 Human Resources

N/A

### SS.2.3 Responsibilities in the exercise

N/A

### SS.2.4 Training

N/A

### SS.2.5 Time planning

N/A

## SS.2.6 Risks

N/A

## SS.2.7 Errors and Observation handling

N/A

## SS.3 Analysis Specification

### SS.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### SS.3.2 Analysis method

N/A

### SS.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix TT Verification Exercise EXE-15.04.05.a- TS.0060.0220 GS: Test “Altitude Hold Mode” Subfield in Target State and Status Messages

### TT.1 Exercise Scope and Justification

#### TT.1.1 Exercise Level

The level of the exercise is functional.

#### TT.1.2 Exercise Type

The type of the exercise is Test.

#### TT.1.3 Description of the system being addressed

ADS – B Ground Station.

#### TT.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### TT.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### TT.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

Identifier	OBJ-15.04.05.a-TS.0060.0061
Objective	The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.

OBJ-15.04.05.a-TS.0060.0063
The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.

#### TT.1.7 Inputs

1090MHz Extended Squitter Messages.

#### TT.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## TT.1.9 Entrance criteria

Start the generation of the input data.

## TT.1.10 Exit Criteria

Finished recording and performed analysis.

## TT.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0220 / "Altitude Hold Mode" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "Altitude Hold" information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.14.

### Step 1:

#### Initialization with Altitude Hold Mode Not Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Altitude Hold Mode is Not Engaged.

### Step 2:

#### Verification of VNAV Not Engaged

Verify that Target State and Status Messages are properly transmitted having the "Altitude Hold" subfield ("ME" bit 50, Message bit 82) set to ZERO (0).

### Step 3:

#### Initialization with Altitude Hold Mode Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Altitude Hold Mode is Engaged.

### Step 4:

#### Verification of Altitude Hold Mode Engaged

Verify that Target State and Status Messages are properly transmitted having the "Altitude Hold" subfield ("ME" bit 50, Message bit 82) set to ONE (1).

Exercise Procedure:



Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

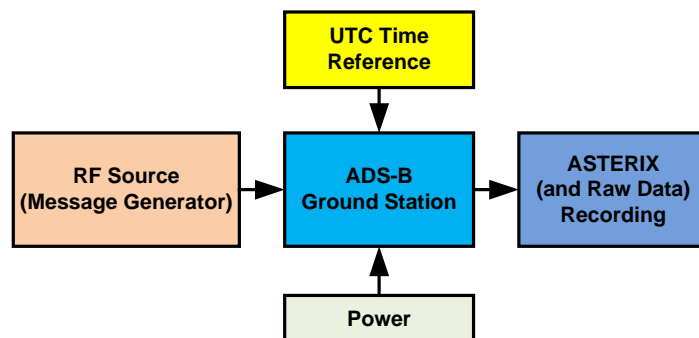
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 71: Verification Exercise Result

## TT.1.12 Verification SUT requirements

N/A

## TT.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## TT.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## TT.1.15 Platform Configuration

N/A

## TT.1.16 Configuration(s) Identification of the Verification Platform

N/A

## TT.1.17 Links to other Verification Exercises

N/A

## TT.1.18 Representatively level/ limitations

N/A

## TT.2 Exercises Planning and management

### TT.2.1 Activities

N/A

#### TT.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and TT.1.13 in order to meet the Test Preconditions.

#### TT.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### TT.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### TT.2.2 Human Resources

N/A

### TT.2.3 Responsibilities in the exercise

N/A

### TT.2.4 Training

N/A

### TT.2.5 Time planning

N/A

## TT.2.6 Risks

N/A

## TT.2.7 Errors and Observation handling

N/A

## TT.3 Analysis Specification

### TT.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### TT.3.2 Analysis method

N/A

### TT.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix UU Verification Exercise EXE-15.04.05.a- TS.0060.0230 GS: “Approach Mode” Subfield in Target State and Status Messages

### UU.1 Exercise Scope and Justification

#### UU.1.1 Exercise Level

The level of the exercise is functional.

#### UU.1.2 Exercise Type

The type of the exercise is Test.

#### UU.1.3 Description of the system being addressed

ADS – B Ground Station.

#### UU.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### UU.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### UU.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### UU.1.7 Inputs

1090MHz Extended Squitter Messages.

#### UU.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## UU.1.9 Entrance criteria

Start the generation of the input data.

## UU.1.10 Exit Criteria

Finished recording and performed analysis.

## UU.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0230 / “Approach Mode” Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that “Approach Mode” information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.16.

### Step 1:

#### Initialization with Approach Mode Not Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Approach Mode is Not Engaged.

### Step 2:

#### Verification of Approach Mode Not Engaged

Verify that Target State and Status Messages are properly transmitted having the “Approach Mode” subfield (“ME” bit 52, Message bit 84) set to ZERO (0).

### Step 3:

#### Initialization with Approach Mode Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the Approach Mode is Engaged.

### Step 4:

#### Verification of Approach Mode Engaged

Verify that Target State and Status Messages are properly transmitted having the “Approach Mode” subfield (“ME” bit 52, Message bit 84) set to ONE (1).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

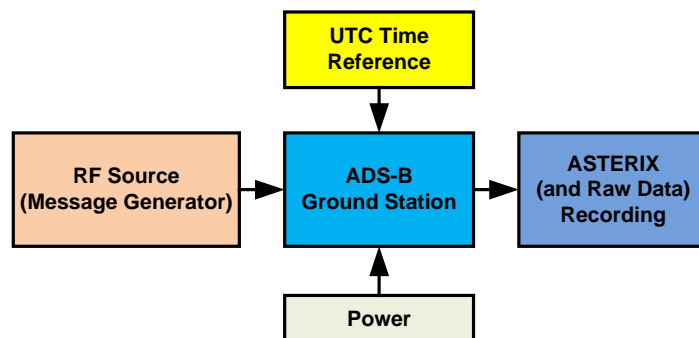
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 72: Verification Exercise Result

## UU.1.12 Verification SUT requirements

N/A

## UU.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.



## UU.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## UU.1.15 Platform Configuration

N/A

## UU.1.16 Configuration(s) Identification of the Verification Platform

N/A

## UU.1.17 Links to other Verification Exercises

N/A

## UU.1.18 Representatively level/ limitations

N/A

## UU.2 Exercises Planning and management

### UU.2.1 Activities

N/A

#### UU.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and UU.1.13 in order to meet the Test Preconditions.

#### UU.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### UU.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### UU.2.2 Human Resources

N/A

### UU.2.3 Responsibilities in the exercise

N/A

### UU.2.4 Training

N/A

### UU.2.5 Time planning

N/A

## UU.2.6 Risks

N/A

## UU.2.7 Errors and Observation handling

N/A

## UU.3 Analysis Specification

### UU.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### UU.3.2 Analysis method

N/A

### UU.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix VV Verification Exercise EXE-15.04.05.a-TS.0060.0240 GS: “LNAV Mode Engaged” Subfield in Target State and Status Messages

### VV.1 Exercise Scope and Justification

#### VV.1.1 Exercise Level

The level of the exercise is functional.

#### VV.1.2 Exercise Type

The type of the exercise is Test.

#### VV.1.3 Description of the system being addressed

ADS – B Ground Station.

#### VV.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### VV.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### VV.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### VV.1.7 Inputs

1090MHz Extended Squitter Messages.

#### VV.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## VV.1.9 Entrance criteria

Start the generation of the input data.

## VV.1.10 Exit Criteria

Finished recording and performed analysis.

## VV.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0240 / "LNAV Mode Engaged" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The purpose of the following test procedure is to verify that "LNAV Mode Engaged" information is properly reported in accordance with RTCA DO260B §2.2.3.2.7.1.3.18.

### Step 1:

#### Initialization with LNAV Mode Not Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the LNAV Mode is Not Engaged.

### Step 2:

#### Verification of LNAV Mode Not Engaged

Verify that Target State and Status Messages are properly transmitted having the "LNAV Mode Engaged" subfield ("ME" bit 54, Message bit 86) set to ZERO (0).

### Step 3:

#### Initialization with LNAV Mode Engaged

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with the information necessary to establish that the LNAV Mode is Engaged.

### Step 4:

#### Verification of LNAV Mode Engaged

Verify that Target State and Status Messages are properly transmitted having the "LNAV Mode Engaged" subfield ("ME" bit 54, Message bit 86) set to ONE (1).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

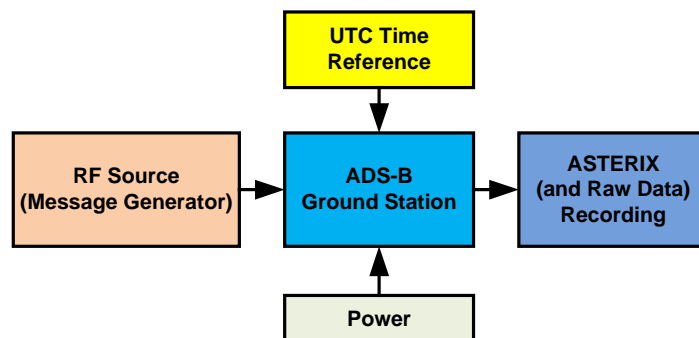
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 73: Verification Exercise Result

## VV.1.12 Verification SUT requirements

N/A

## VV.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## VV.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## VV.1.15 Platform Configuration

N/A

## VV.1.16 Configuration(s) Identification of the Verification Platform

N/A

## VV.1.17 Links to other Verification Exercises

N/A

## VV.1.18 Representatively level/ limitations

N/A

## VV.2 Exercises Planning and management

### VV.2.1 Activities

N/A

#### VV.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and VV.1.13 in order to meet the Test Preconditions.

#### VV.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### VV.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### VV.2.2 Human Resources

N/A

### VV.2.3 Responsibilities in the exercise

N/A

### VV.2.4 Training

N/A

### VV.2.5 Time planning

N/A

## VV.2.6 Risks

N/A

## VV.2.7 Errors and Observation handling

N/A

## VV.3 Analysis Specification

### VV.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### VV.3.2 Analysis method

N/A

### VV.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.



## Appendix WW Verification Exercise EXE-15.04.05.a- TS.0060.0250 GS: “Mode A (4096) Code” Subfield in Aircraft Status Messages

### WW.1 Exercise Scope and Justification

#### WW.1.1 Exercise Level

The level of the exercise is functional.

#### WW.1.2 Exercise Type

The type of the exercise is Test.

#### WW.1.3 Description of the system being addressed

ADS – B Ground Station.

#### WW.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### WW.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### WW.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### WW.1.7 Inputs

1090MHz Extended Squitter Messages.

#### WW.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## WW.1.9 Entrance criteria

Start the generation of the input data.

## WW.1.10 Exit Criteria

Finished recording and performed analysis.

## WW.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0250 / "Mode A (4096) Code" Subfield in Aircraft Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

The ADS-B Transmitting Subsystem will broadcast the Mode A (4096) Code setting in the Extended Squitter Aircraft Status Message (TYPE=28, Subtype=1).

### Step 1:

Configure the ADS-B Transmitting Subsystem to transmit Airborne Position Messages. Set the ADS-B Transmitting Subsystem to Airborne status. Produce valid Airborne Position Messages at the nominal rate with valid position and altitude data. Verify that the ADS-B Transmitting Subsystem begins to transmit Extended Squitter Aircraft Status Messages at the nominal rate with the TYPE Subfield set to 28 (binary 1 1100) and the Subtype Subfield set to ONE (binary 001). Verify that the Mode A Code being broadcast is the one set by the pilot.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			

3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

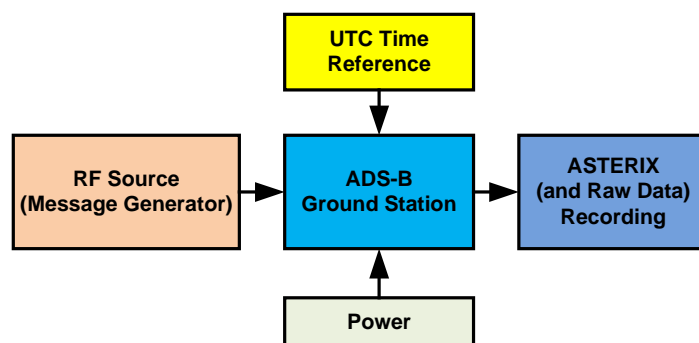
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 74: Verification Exercise Result

## WW.1.12 Verification SUT requirements

N/A

## WW.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## WW.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## **WW.1.15 Platform Configuration**

N/A

## **WW.1.16 Configuration(s) Identification of the Verification Platform**

N/A

## **WW.1.17 Links to other Verification Exercises**

N/A

## **WW.1.18 Representatively level/ limitations**

N/A

## **WW.2 Exercises Planning and management**

### **WW.2.1 Activities**

N/A

#### **WW.2.1.1 Preparatory activities**

Setup the tools/equipment listed in 3.5 and WW.1.13 in order to meet the Test Preconditions.

#### **WW.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **WW.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **WW.2.2 Human Resources**

N/A

### **WW.2.3 Responsibilities in the exercise**

N/A

### **WW.2.4 Training**

N/A

### **WW.2.5 Time planning**

N/A

### **WW.2.6 Risks**

N/A

## WW.2.7 Errors and Observation handling

N/A

## WW.3 Analysis Specification

### WW.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### WW.3.2 Analysis method

N/A

### WW.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix XX Verification Exercise EXE-15.04.05.a- TS.0060.0260 GS: “Movement” Subfield in ADS-B Surface Position Messages

### XX.1 Exercise Scope and Justification

#### XX.1.1 Exercise Level

The level of the exercise is functional.

#### XX.1.2 Exercise Type

The type of the exercise is Test.

#### XX.1.3 Description of the system being addressed

ADS – B Ground Station.

#### XX.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### XX.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### XX.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System is capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
--

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### XX.1.7 Inputs

1090MHz Extended Squitter Messages.

#### XX.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## XX.1.9 Entrance criteria

Start the generation of the input data.

## XX.1.10 Exit Criteria

Finished recording and performed analysis.

## XX.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0260 / "Movement" Subfield in ADS-B Surface Position Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure will verify that the ADS-B Transmitting Subsystem correctly outputs Surface Position Messages with the correct "Movement" subfield data encoded, in accordance with the encoding provided in Table 75, in DF=17 Messages for Transponder-Based Systems, and DF=18 Messages for Non-Transponder-Based Systems.

Table 75: "Movement" Subfield Code Definitions

Coding (Decimal)	Meaning	Quantization
0	No Movement Information Available	
1	Aircraft Stopped (Ground Speed = 0 knots)	
2	0 knots < Ground Speed ≤ 0.2315 km/h (0.125 kt)	
3 - 8	0.2315 km/h (0.125 kt) < Ground Speed ≤ 1.852 km/h (1 kt)	0.2700833 km/h steps
9 - 12	1.852 km/h (1 kt) < Ground Speed ≤ 3.704 km/h (2 kt)	0.463 km/h (0.25 kt) steps
13 - 38	3.704 km/h (2 kt) < Ground Speed ≤ 27.78 km/h (15 kt)	0.926 km/h (0.50 kt) steps
39 - 93	27.78 km/h (15 kt) < Ground Speed ≤ 129.64 km/h (70 kt)	1.852 km/h (1.00 kt) steps
94 - 108	129.64 km/h (70 kt) < Ground Speed ≤ 185.2 km/h (100 kt)	3.704 km/h (2.00 kt) steps
109 - 123	185.2 km/h (100 kt) < Ground Speed ≤ 324.1 km/h (175 kt)	9.26 km/h (5.00 kt) steps
124	324.1 km/h (175 kt) < Ground Speed	
125	Reserved for Aircraft Decelerating	
126	Reserved for Aircraft Accelerating	
127	Reserved for Aircraft Backing-Up	

### Step 1:

#### "Movement" Verification - Part 1

Configure the ADS-B Transmitting Subsystem to transmit Surface Position Messages by providing position information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set up the system to enable



broadcast of Surface Position Messages at the nominal rate. Set the ADS-B Transmitting Subsystem to "On Ground" status. Provide valid, non-zero "Movement" data to the ADS-B System. Discontinue the "Movement" data and verify that when "Movement" data is not provided to the ADS-B Transmitting Subsystem, the "Movement" subfield is set to ZERO (binary 000 0000).

**Step 2:****"Movement" Verification - Part 2**

Set up the ADS-B Transmitting Subsystem as above and set the "Movement" input to represent a "Movement" of greater than or equal to Zero knots, but less than 0.125 knots. Verify that the "Movement" subfield is set to TWO (binary 000 0010). Increase the "Movement" input to a value greater than 0.126 knots and less than 0.270 knots, and verify that the "Movement" subfield is set to THREE (binary 000 0011).

**Step 3:****"Movement" Verification - Part 3**

Continue to increase the "Movement" input in increments equal to those identified in Table 75 for values greater than or equal to ONE knot and less than 175 knots. Verify that for each such increment, the encoding of the "Movement" subfield is equal to that specified in Table 75. Increase the Ground Speed input data to exactly 175 knots and verify that the "Movement" subfield is set to 124. Continue increasing the Ground Speed data input for values greater than 175 knots and verify that the "Movement" subfield continues to be set at 124.

**Note:** The last three encodings (125, 126, 127) of the "Movement" subfield in Table 75 are reserved to indicate high levels of ground speed change, etc. The precedence of the codes is not defined yet, as inputs that would be required are not currently available.

**Step 4:****Setting "Aircraft Stopped" when "Low" broadcast rate is selected as specified in RTCA DO260B§2.2.5.1.9.b.**

Ensure that the equipment is set to the "On the Ground" condition and that the appropriate valid ADS-B Surface Position data is provided such that the position is changing at a rate of 10.1 meters in any 30 seconds interval. Provide valid, non-zero "Movement" data to the ADS-B Transmitting Subsystem. Verify that the "Movement" subfield is set to a value greater than or equal to decimal TWO (2).

Input new ADS-B Surface Position data with the position data changing at a rate of 9.9 meters in any 30 seconds interval. At least 61 seconds after the input of the new data, verify that the "Movement" subfield is set to decimal ONE (1) "Aircraft Stopped."

Input new ADS-B Surface Position data such that the position is 10.1 meters away from the previous position. One (1) second after inputting the new data, verify that the ADS-B Surface Position Messages "Movement" subfield is set to a value greater than or equal to decimal TWO (2).

For a Transponder-Based system, send an external RCS command to switch to low broadcast rate and verify that Surface Position Messages "Movement" subfield continues to be transmitted with an encoded value greater than or equal to decimal TWO (2).

**Exercise Procedure:**

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			

2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

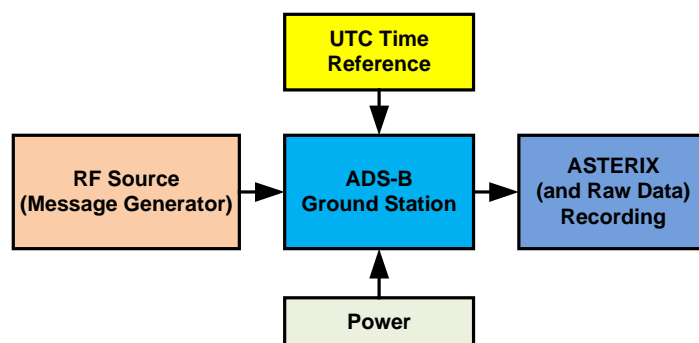
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 76: Verification Exercise Result

## XX.1.12 Verification SUT requirements

N/A

## XX.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## XX.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## XX.1.15 Platform Configuration

N/A

## XX.1.16 Configuration(s) Identification of the Verification Platform

N/A

## XX.1.17 Links to other Verification Exercises

N/A

## XX.1.18 Representatively level/ limitations

N/A

## XX.2 Exercises Planning and management

### XX.2.1 Activities

N/A

#### XX.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and XX.1.13 in order to meet the Test Preconditions.

#### XX.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### XX.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### XX.2.2 Human Resources

N/A

### XX.2.3 Responsibilities in the exercise

N/A

### XX.2.4 Training

N/A

### XX.2.5 Time planning

N/A

### XX.2.6 Risks

N/A

## XX.2.7 Errors and Observation handling

N/A

## XX.3 Analysis Specification

### XX.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### XX.3.2 Analysis method

N/A

### XX.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix YY Verification Exercise EXE-15.04.05.a- TS.0060.0270 GS: “SUBTYPE” Code Subfield in Surface System Status Messages

### YY.1 Exercise Scope and Justification

#### YY.1.1 Exercise Level

The level of the exercise is functional.

#### YY.1.2 Exercise Type

The type of the exercise is Analysis.

#### YY.1.3 Description of the system being addressed

ADS – B Ground Station.

#### YY.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### YY.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### YY.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### YY.1.7 Inputs

Design documentation.

#### YY.1.8 Outputs

N/A

#### YY.1.9 Entrance criteria

N/A

## YY.1.10 Exit Criteria

N/A

## YY.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0270 / "SUBTYPE" Code Subfield in Surface System Status Messages

Pass Criteria: N/A

Exercise Type: N/A

Precondition(s): N/A

Note(s): N/A

Device(s) in use: SUT is ADS-B GS.

**No specific test procedure is required to validate "SUBTYPE" Code Subfield in Surface System Status Messages.**

The "SUBTYPE" Code subfield is a 3-bit ("ME" bits 6 – 8, Message bits 38 – 40) subfield that shall be used to indicate the source of the Surface System Status Message as specified in Table 77.

Table 77: "SUBTYPE" Subfield in Surface System Status Messages

SUBTYPE Code Subfield Encoding (decimal)	Meaning
0	Reserved
1	Multilateration System Status (Allocated for national use)
2 – 7	Reserved

Compliance with this requirement will be checked by design evidence.

Exercise result:

	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 78: Verification Exercise Result

## YY.1.12 Verification SUT requirements

N/A

## YY.1.13 Exercise Tool, Verification Technique and/or Platform

N/A

## YY.1.14 Verification Platform needs

N/A

## YY.1.15 Platform Configuration

N/A

## YY.1.16 Configuration(s) Identification of the Verification Platform

N/A

## YY.1.17 Links to other Verification Exercises

N/A

## YY.1.18 Representatively level/ limitations

N/A

## YY.2 Exercises Planning and management

### YY.2.1 Activities

N/A

#### YY.2.1.1 Preparatory activities

NA

#### YY.2.1.2 Execution activities

N/A

#### YY.2.1.3 Post execution activities

N/A

### YY.2.2 Human Resources

N/A

### YY.2.3 Responsibilities in the exercise

N/A

### YY.2.4 Training

N/A



## YY.2.5 Time planning

N/A

## YY.2.6 Risks

N/A

## YY.2.7 Errors and Observation handling

N/A

## YY.3 Analysis Specification

### YY.3.1 Data collection methods

N/A

### YY.3.2 Analysis method

In the 15.4.5b project the Analysis Method will be defined according to Internal Industry Procedures.

### YY.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix ZZ Verification Exercises EXE-15.04.05.a- TS.0060.0280 GS: “Reserved for ADS-R Flag” Subfield in Target State and Status Messages

### ZZ.1 Exercise Scope and Justification

#### ZZ.1.1 Exercise Level

The level of the exercise is functional.

#### ZZ.1.2 Exercise Type

The type of the exercise is Test.

#### ZZ.1.3 Description of the system being addressed

ADS – B Ground Station.

#### ZZ.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### ZZ.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### ZZ.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0060.0061
-----------------------------

The aim of this objective is to check that the ADS-B Surveillance System <b>is</b> capable to decode the ADS-B message, in order to extract the available information, in accordance with the introduced changes in the DO-260B standard.
---

OBJ-15.04.05.a-TS.0060.0063
-----------------------------

The aim of this objective is to check that the ADS-B System ground surveillance domain is able to transform the introduced DO-260B changes into Standard ASTERIX Category 21 data items.
--

#### ZZ.1.7 Inputs

1090MHz Extended Squitter Messages.

#### ZZ.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system ‘Raw data output’ reports.

## ZZ.1.9 Entrance criteria

Start the generation of the input data.

## ZZ.1.10 Exit Criteria

Finished recording and performed analysis.

## ZZ.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0060.0280 / "Reserved for ADS-R Flag" Subfield in Target State and Status Messages

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

ADS-B 1090ES Rebroadcast Messages are transmitted from a 1090ES ADS-B Ground Station as a rebroadcast of an ADS-B Message that was received by that Ground Station on an alternate ADS-B Data Link. The Airborne ADS-B Transmitting Subsystem will always transmit a ZERO (0) in "ME" bit 51 of the Target State and Status Message.

These test procedures verify that "ME" bit 51 of the transmitted DF=17 Target State and Status Message from an Airborne ADS-B Transmitting Subsystem is always ZERO (0).

### Step 1:

#### Target State and Status Message Initialization

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with valid Mode Control Panel Selected Altitude data in order to initialize transmission of Target State and Status Messages.

### Step 2:

#### Verification of ADS-R Flag

Set the ADS-B Transmitting Subsystem to Airborne status. Verify that Target State and Status Messages are broadcast with the "ME" bit 51 (Message bit 83) set to ZERO (0).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test			

	configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

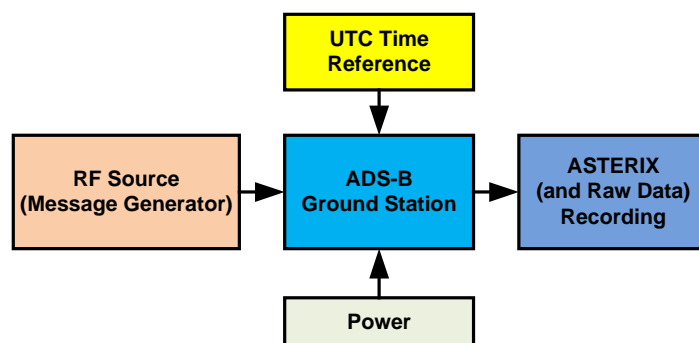
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 79: Verification Exercise Result

## ZZ.1.12 Verification SUT requirements

N/A

## ZZ.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

## ZZ.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

## ZZ.1.15 Platform Configuration

N/A

## ZZ.1.16 Configuration(s) Identification of the Verification Platform

N/A

## ZZ.1.17 Links to other Verification Exercises

N/A

## ZZ.1.18 Representatively level/ limitations

N/A

## ZZ.2 Exercises Planning and management

### ZZ.2.1 Activities

N/A

#### ZZ.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and ZZ.1.13 in order to meet the Test Preconditions.

#### ZZ.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### ZZ.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### ZZ.2.2 Human Resources

N/A

### ZZ.2.3 Responsibilities in the exercise

N/A

### ZZ.2.4 Training

N/A

### ZZ.2.5 Time planning

N/A

### ZZ.2.6 Risks

N/A

## ZZ.2.7 Errors and Observation handling

N/A

## ZZ.3 Analysis Specification

### ZZ.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### ZZ.3.2 Analysis method

N/A

### ZZ.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix AAA Verification Exercises EXE-15.04.05.a- TS.0070.0000 GS: of the Velocity versus Position Check

### AAA.1 Exercise Scope and Justification

#### AAA.1.1 Exercise Level

The level of the exercise is functional.

#### AAA.1.2 Exercise Type

The type of the exercise is Test.

#### AAA.1.3 Description of the system being addressed

ADS – B Ground Station.

#### AAA.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

#### AAA.1.5 Required Datasets

1090MHz Extended Squitter Messages input and 1090GS ASTERIX output.

#### AAA.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0070.0064
-----------------------------

The aim of this objective is to check that the ADS-B System validates ADS-B report consistency by evaluating the ADS-B received target velocity against the ADS-B received target position change.
--

#### AAA.1.7 Inputs

1090MHz Extended Squitter Messages.

#### AAA.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

#### AAA.1.9 Entrance criteria

Start the generation of the input data.

#### AAA.1.10 Exit Criteria

Finished recording and performed analysis.



## AAA.1.11 Exercise procedure

**Exercise ID/Title:** EXE-15.4.5.a-TS.0070.0000 / Verification Exercises of the Velocity versus Position Check

**Pass Criteria:** This test is passed, when the recorded output has data items and corresponding values as expected.

**Exercise Type:** Test

**Precondition(s):**

- Test equipment is setup as described above
- GS under test is active, and ready for test.

**Note(s):** N/A

**Device(s) in use:** SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to produce a target report containing information if consistency check velocity versus position is performed, and if it is, if the result is VALID or NOT VALID.

### Step 1:

This test step verifies that the 1090 ES Ground Station is not performing consistency check velocity versus position because this function is switched off.

Scenario simulates an ADS-B aircraft. Since consistency check velocity versus position is switched off, ASTERIX reports of the target do not have information (NOT VALIDATED).

### Step 2:

This test step verifies that the 1090 ES Ground Station is performing consistency check velocity versus position because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs position and velocity values do match. ASTERIX reports of the target do have information (VALID).

### Step 3:

This test step verifies that the 1090 ES Ground Station is performing consistency check velocity versus position because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs position and velocity values do not match: reported position change is too small compared to reported velocity. ASTERIX reports of the target do have information (NOT VALID).

### Step 4:

This test step verifies that the 1090 ES Ground Station is performing consistency check velocity versus position because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs position and velocity values do not match: reported position change is too big compared to reported velocity. ASTERIX reports of the target do have information (NOT VALID).

#### Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

#### Exercise result:

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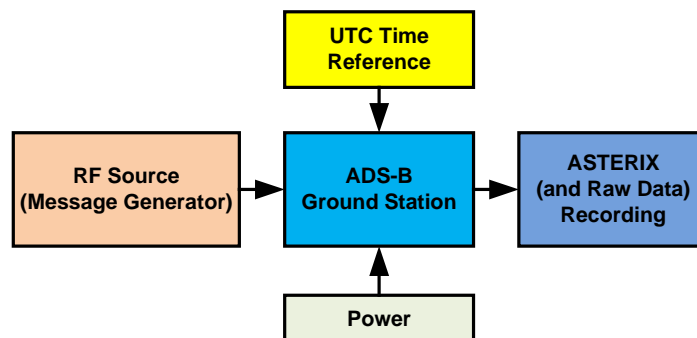
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 80: Verification Exercise Result

## AAA.1.12 Verification SUT requirements

N/A

## AAA.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS-B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

### Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

### Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS-B Ground Station or 1090 Receiver) like:

- Target data stream** with inside the information extracted by the ADS-B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).
- Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

### UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

#### ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

### **AAA.1.14 Verification Platform needs**

See section 3.5 Verification Platform Needs.

### **AAA.1.15 Platform Configuration**

N/A

### **AAA.1.16 Configuration(s) Identification of the Verification Platform**

N/A

### **AAA.1.17 Links to other Verification Exercises**

N/A

### **AAA.1.18 Representatively level/ limitations**

N/A

## **AAA.2 Exercises Planning and management**

### **AAA.2.1 Activities**

N/A

#### **AAA.2.1.1 Preparatory activities**

Set up the tools/equipment listed in 3.5 and AAA.1.13 in order to meet the Test Preconditions.

#### **AAA.2.1.2 Execution activities**

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

#### **AAA.2.1.3 Post execution activities**

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

### **AAA.2.2 Human Resources**

N/A

### **AAA.2.3 Responsibilities in the exercise**

N/A

### **AAA.2.4 Training**

N/A

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## AAA.2.5 Time planning

N/A

## AAA.2.6 Risks

N/A

## AAA.2.7 Errors and Observation handling

N/A

## AAA.3 Analysis Specification

### AAA.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

### AAA.3.2 Analysis method

N/A

### AAA.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

## Appendix BBB Preliminary Coverage Matrix

The project intends to import all requirements defined in this document (Verification Method, associated Verification Objectives and Verification Exercise in which these Verification Objectives are embedded) as well as the lower level derived requirements as specified in Deliverables D5 and D18, into a requirements management tool (like DOORS).

Such a tool will then generate an overall traceability matrix which could be included in this document at a later stage (i.e. in one of the forthcoming iterations).

**-END OF DOCUMENT -**