

**SASS-C DOCUMENT**

**FOR**

**Application of ASTERIX for SMART-SDG:  
ASTERIX 244 for Transmission of  
Reference Trajectory State Vectors**

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# DOCUMENT IDENTIFICATION SHEET

## DOCUMENT DESCRIPTION

### Document Title

Application of ASTERIX for SMART-SDG: ASTERIX 244 for Transmission of Reference Trajectory State Vectors

EWP DELIVERABLE REFERENCE NUMBER

**PROGRAMME REFERENCE INDEX**

**EDITION :**

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### Abstract

### Keywords

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## ELECTRONIC BACKUP

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## DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
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### DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

<b>EDITION</b>	<b>DATE</b>	<b>REASON FOR CHANGE</b>	<b>SECTIONS PAGES AFFECTED</b>
0.1	September 2002	Creation of the document	ALL
0.2	October 02	Update	ALL
0.3	October 02	Corrections on comments from EEC	ALL
0.4	November 02	Corrections on comments from Tarkan SEVIM	I244/030, I244/040, I244/080
0.5	May 2005	Completion of UAP table Addition of fields for connection to Airborne Surveillance Data Processor Other editorial changes	5.3 I244/180 I244/190

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## **1. INTRODUCTION**

### **1.1 Scope**

**1.1.1** This document describes the structure for the transmission of Trajectory State Vectors to SMART3 between the TG (Traffic Generator) and the SDG (Surveillance Data Generator).

**1.1.2** This document defines the data out of Category 244.

## **2. REFERENCES**

### **2.1 General**

The following Documents and Standards contain provisions which, through references in this text, constitute provisions of this Eurocontrol Standard Document.

At the time of publication of this Eurocontrol Standard Document, the editions indicated for the referenced documents and standards were valid.

Any revision of the referenced ICAO Documents shall be immediately taken into account to revise this Eurocontrol Standard Document.

Revisions of the other referenced documents shall not form part of the provisions of this Eurocontrol Standard Document until they are formally reviewed and incorporated into this Eurocontrol Standard Document.

In the case of a conflict between the requirements of this Eurocontrol Standard Document and the contents of the other referenced documents, this Eurocontrol Standard Document shall take precedence.

### **2.2 Reference Documents**

1. EUROCONTROL STANDARD DOCUMENT 000-1-92. Directives for the Uniform Drafting and Presentation of Eurocontrol Standard Documents. 1992.
2. EUROCONTROL STANDARD DOCUMENT SUR.ET1.ST05.2000-STD-01-01. All Purpose Structured Eurocontrol suRveillance Information Exchange - ASTERIX, edition 1.26 November 2000.
3. EUROCONTROL STANDARD DOCUMENT SUR.ET1.ST05.2000-STD-12-01 Transmission of ADS-B Messages
4. EUROCONTROL STANDARD DOCUMENT SUR.ET1.ST05.2000-STD-02a-01 Transmission of Monoradar Target Report
5. POEMS DOCUMENT SUR.ET2.ST03.3115-SPC-04-01 Transmission of Monoradar Target Reports



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### 3. DEFINITIONS, ACRONYMS AND ABBREVIATIONS

#### 3.1 Definitions

For the purposes of this Eurocontrol Document, the following definitions shall apply:

- 3.1.1 Catalogue of Data Items:** List of all the possible Data Items of each Data Category describing the Data Items by their reference, structure, size and units (where applicable).
- 3.1.2 Data Block:** Unit of information seen by the application as a discrete entity by its contents. A Data Block contains one or more Record(s) containing data of the same category.
- 3.1.3 Data Category:** Classification of the data in order to permit inter alia an easy identification.
- 3.1.4 Data Field:** Physical implementation for the purpose of communication of a Data Item, it is associated with a unique Field Reference Number and is the smallest unit of transmitted information.
- 3.1.5 Data Item:** The smallest unit of information in each Data Category.
- 3.1.6 Record:** A collection of transmitted Data Fields of the same category preceded by a Field Specification field, signalling the presence/absence of the various Data Fields
- 3.1.7 User Application Profile:** The mechanism for assigning Data Items to Data Fields, and containing all necessary information which needs to be standardised for the successful encoding and decoding of the messages.

## 3.2 Acronyms and Abbreviations

For the purposes of this Eurocontrol Document, the following shall apply:

°	Degree (angle)
<b>ADS-B</b>	Automatic Dependent Surveillance - Broadcast
<b>ASTERIX</b>	All Purpose <b>ST</b> ructured <b>Eurocontrol</b> su <b>R</b> veillance Information <b>EX</b> change
<b>CAT</b>	Data Category
<b>EATMP</b>	European Air Traffic Management Programme
<b>FRN</b>	Field Reference Number
<b>FSPEC</b>	Field Specification
<b>FX</b>	Field Extension Indicator
<b>ICAO</b>	International Civil Aviation Organization
<b>LEN</b>	Length Indicator
<b>LSB</b>	Least Significant Bit
<b>PSR</b>	Primary Surveillance Radar
<b>RE</b>	Reserved Expansion Indicator
<b>REP</b>	Field Repetition Indicator
<b>s</b>	second, unit of time
<b>SAC</b>	System Area Code
<b>SDPS</b>	Surveillance Data Processing System
<b>SIC</b>	System Identification Code
<b>SP</b>	Special Purpose Indicator
<b>SSR</b>	Secondary Surveillance Radar
<b>STFRDE</b>	Surveillance Task Force on Radar Data Exchange
<b>SURT</b>	Surveillance Team (EATMP)
<b>UAP</b>	User Application Profile (see Definitions )
<b>UTC</b>	Co-ordinated Universal Time
<b>WGS-84</b>	World Geodetic System 84

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## **4. GENERAL PRINCIPLES**

### **4.1 General**

This document describes the application of ASTERIX to Trajectory State Vectors.

### **4.2 Time Management**

The time-stamping shall comply with ICAO Annex 5.

### **4.3 Unused Bits in Data Items.**

Decoders of ASTERIX data shall never assume and rely on specific settings of spare or unused bits. However in order to improve the readability of binary dumps of ASTERIX records, it is recommended to set all spare bits to zero.

#### 4.4 User Application Profile and Data Blocks

4.5.1 A single User Application Profile (UAP) is defined and shall be used for ADS-B messages.

4.5.2 Data Blocks shall have the following layout.

<b>CAT = 244</b>	<b>LEN</b>	<b>FSPEC</b>	Items of the first record		<b>FSPEC</b>	Items of the last record
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where:

- Data Category (CAT) = 244, is a one-octet field indicating that the Data Block contains Session and Service Control messages;
- Length Indicator (LEN) is a two-octet field indicating the total length in octets of the Data Block, including the CAT and LEN fields;
- FSPEC is the Field Specification.

#### 4.5 Composition of Messages

4.6.1 Messages shall be composed of Data Items assembled in the order defined by the Field Reference Number (FRN) in the associated UAP.

4.6.2 When sent, items shall always be transmitted in a Record with the corresponding FSPEC bits set to one.

## 5. LAYOUT OF MESSAGES

### 5.1 Standard Data Items

The standardised Data Items which shall be used for the transmission of ADS-B messages are defined in Table 1 and described in the following pages.

**Table 1 - Data Items of Category 244**

<b>Data Item Reference Number</b>	<b>Description</b>	<b>System Units</b>
I244/010	Trajectory Identifier	N.A.
I244/020	Time of Day	1/128 sec.
I244/030	Lat/Long position	Latitude: 90/2 <sup>31</sup> degrees Longitude: 180/2 <sup>31</sup> degrees
I244/040	Geometric Altitude	6.25 ft
I244/045	Flight Level	0.25 FL
I244/050	Ground Speed	0.22 Kts
I244/055	Air Speed	For IAS: 2 <sup>-14</sup> NM/s For Mach: 0.001
I244/060	Course	0.0055°
I244/065	Magnetic Heading	0.0055°
I244/070	Geometric Vertical Rate	6.25 ft/minute
I244/075	Barometric Vertical Rate	6.25 ft/minute
I244/080	Ground Accelerations	200/2 <sup>15</sup> m/s <sup>2</sup>
I244/095	Rate of Turn	1/8 °/s
I244/100	Projected Profile	N.A.
I244/115	Selected Flight Level	0.25 FL
I244/120	ICAO 24-bit address	N.A.
I244/130	Mode-3/A Code	N.A.
I244/140	Target Identification	N.A.
I244/150	Aircraft Type	N.A.
I244/160	ADS-B Emitter Category	N.A.
I244/170	Target Status	N.A.
I244/180	Accuracy/Integrity	N.A.
I244/190	Link Status	N.A.



Octet no. 3								Octet no. 4							
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
Latitude in WGS - 84															LSB

Octet no. 5								Octet no. 6							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Longitude in WGS - 84															

Octet no. 7								Octet no. 8							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Longitude in WGS - 84															LSB

bits-64/33	(Latitude)	In WGS.84 in two's complement. Range -90 <= latitude <= 90 deg.
bit 33	(LSB)	= $90/2^{31}$ degrees = $4.19 * 10^{-08}$ degrees.  This corresponds to a resolution of at least $4.69 * 10^{-03}$ meters
bits-32/1	(Longitude)	In WGS.84 in two's complement. Range -180 <= longitude <= 180 deg.
Bit-1	(LSB)	= $180/2^{31}$ degrees = $8.38 * 10^{-08}$ degrees  This corresponds to a resolution of at least $9.37 * 10^{-03}$ meters.

**NOTES**

Positive longitude indicates East. Positive latitude indicates North.

**5.2.4 Data Item I244/040, Geometric Altitude (Ground)**

**Definition :** Geometric Altitude wrt WGS-84, in two's complement form.

**Format :** Two-Octet fixed length data item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Flight Level															LSB

bit 16/1                      -1500 ft <= Altitude <= 150.000 ft  
 (LSB) = 6.25 ft

1. Altitude LSB is required to be thinner than 10 ft by ICAO
2. Definition taken from paragraph 4.2.3.2 Altitude of [Ref. 4]





16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Track Angle															LSB

bits 16-1            Track Angle  
                           (LSB)            =  $360^\circ / 2^{16} = 0.0055^\circ$

**5.2.9            Data Item I244/065, Magnetic Heading (Air)**

**Definition :**    Magnetic Heading (Element of Air Vector)

**Format :**        Two-Octet fixed length data item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Heading															LSB

bits 16-1            Magnetic Heading  
                           (LSB)            =  $360^\circ / 2^{16} = 0.0055^\circ$

**5.2.10          Data Item I244/070, Geometric Vertical Rate (Ground)**

**Definition :**    Geometric Vertical Rate, in two's complement form, with reference to WGS-84.

**Format :**        Two-Octet fixed length data item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Vertical Rate															LSB

bits 16-1            Geometric Vertical Rate  
                           (LSB)            = 6.25 feet/minute

**5.2.11          Data Item I244/075, Barometric Vertical Rate (Air)**

**Definition :**    Barometric Vertical Rate, in two's complement form

**Format :**        Two-Octet fixed length data item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Vertical Rate															LSB

bits 16-1            Barometric Vertical Rate  
                           (LSB)            = 6.25 feet/minute

**5.2.12          Data Item I244/080, "Ground" Accelerations (Ground)**

**Definition :**    Along, Across and Vertical Accelerations related to the air vector.

**Format :** Six-Octet fixed length data item.  
**Structure:**

Octet no. 1								Octet no. 2							
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
Along Acceleration															LSB

Octet no. 3								Octet no. 4							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Across Acceleration															LSB

Octet no. 5								Octet no. 6							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Vertical Acceleration															LSB

bits 48-33      Along Acceleration  
 (LSB)            =  $200/2^{15} \text{ m/s}^2 \cong 0.012 \text{ kts/s}$   
 Maximum value =  $200 \text{ m/s}^2 (20G) \cong 400 \text{ kts/s}$

**NOTE -** A positive value represents an acceleration, whereas a negative value represents a deceleration.

bits 48-33      Across Acceleration in two's complement form  
 (LSB)            =  $200/2^{15} \text{ m/s}^2 \cong 0.012 \text{ kts/s}$   
 Maximum value =  $200 \text{ m/s}^2 (20G) \cong 400 \text{ kts/s}$

**NOTE -** A positive value represents an acceleration to right, whereas a negative value represents an acceleration to left.

bits 16-1        Vertical Acceleration in two's complement form  
 (LSB)            =  $200/2^{15} \text{ m/s}^2 \cong 1.22 \text{ ft/min*s}$   
 Maximum value =  $200 \text{ m/s}^2 \cong 40,000 \text{ ft/min*s}$

**NOTE -** A positive value represents an upward acceleration, whereas a negative value represents a downward acceleration.

**5.2.13 Data Item I244/095, Rate Of Turn (Air)**

**Definition :** Rate of Turn, in two's complement form.  
**Format :** One-Octet fixed length data item.  
**Structure:**

Octet no. 1							
8	7	6	5	4	3	2	1
Rate of Turn							LSB

Bits-8/2                      Rate of Turn

(LSB) = 1/8 °/s  
 Maximum value = 16 °/s

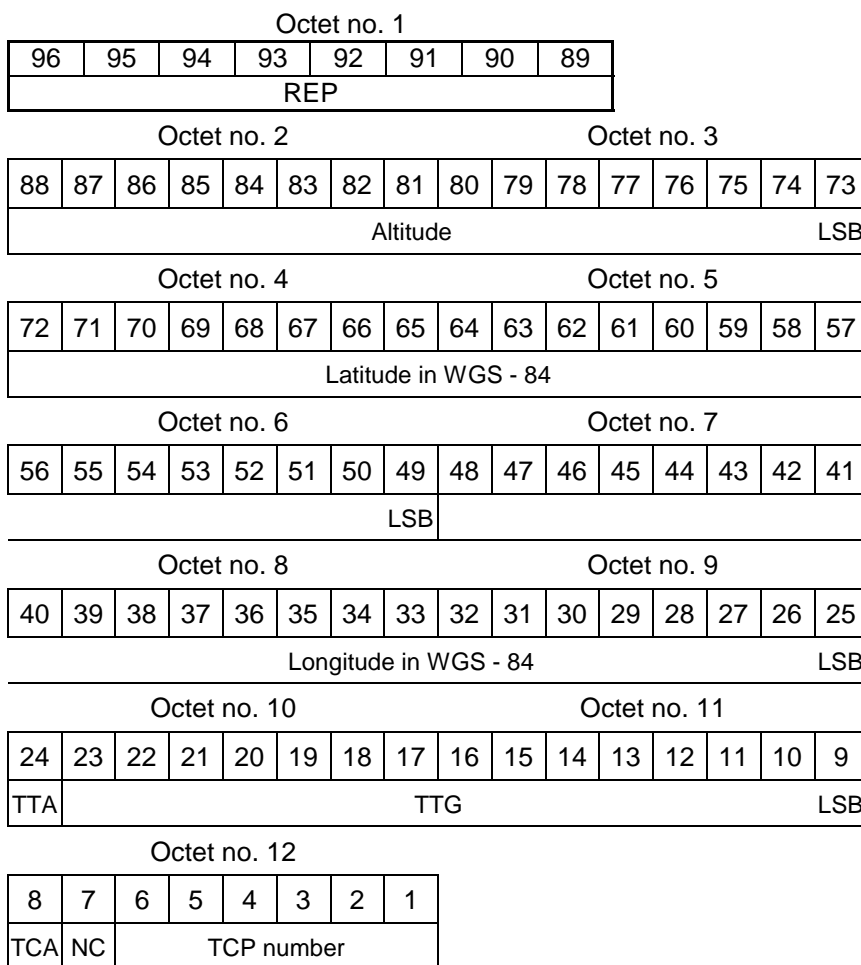
**NOTE** - A positive value represents a right turn, whereas a negative value represents a left turn.

**5.2.14 Data Item I244/100, ADS-B Projected Profile (I021/110) (Ground)**

**Definition :** Reports indicating the predicted position and altitude of the aircraft at some points in time.

**Format :** One-octet repetition factor, followed by a series of 11-octet reports

**Structure:**



bits-96/89	(REP)	Repetition Factor
bits-88/73	(Altitude)	LSB= 10ft -1500 ft <= altitude <= 150000 ft
bits-72/49	(Latitude)	In WGS.84 in two's complement. -90 <= latitude <= 90 deg. LSB = 180/2 <sup>23</sup> deg. = approx.2.145767*10 <sup>-05</sup> deg.

bits-48/25	(Longitude)	In WGS.84 in two's complement. -180 <= longitude <= 180 deg. LSB = 180/2 <sup>23</sup> deg. = approx.2.145767*10 <sup>-05</sup> deg.
Bit-24	(TTA)	= 0 TTG available = 1 TTG not available
Bits-23/9	(TTG)	Time to Go LSB = 0.125 minute
Bit-8	(TCA)	= 0 TCP number available = 1 TCP number not available
Bit-7	(NC)	= 0 TCP compliance = 1 TCP non-compliance
Bits-6/1	(TCP Number)	Trajectory Change Point number

**NOTES**

1. TTG is relative to I244/030 Time of Day.
2. NC is set to one when the aircraft will not fly the path described by the TCP data.
3. TCP numbers start from zero.

**5.2.15 Data Item I244/115, ADS-B Selected Flight Level (I021/147) (Air)**

**Definition :** Aircrew selected Flight Level as input in the Mode Control Panel (MCP) or equivalent, in two's complement form.

**Format :** Two-Octet fixed length data item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	Selected Flight Level													LSB	

Bit 16 (V) = 0 valid selected flight level  
 = 1 invalid selected flight level

Bits 15/1 -15 FL <= Selected Flight Level <= 1500 FL  
 (LSB) = 1/4 FL

**NOTE -** The data is only valid (V = 0) when the aircraft is being flown in automatic flight mode.

**5.2.16 Data Item I244/120, ICAO 24bits Address**

**Definition:** 24 bits address (emitter identifier) assigned to each target.

**Format:** Three-octet fixed length Data Item.

**Structure:**

Octet no. 1							
24	23	22	21	20	19	18	17
Target							

Octet no. 2								Octet no. 3							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Address															

bits-24/1

24-bits address, A23 to A0

### 5.2.17 Data Item I244/130, Mode-3/A Code

**Definition:** Mode-3/A code converted into octal representation.

**Format:** Two-octet fixed length Data Item.

**Structure:**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	0	0	0	A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1

bit-16 (V) = 0 Code validated  
 = 1 Code not validated

bit-15/13 Spare bits set to 0

bits-12/1 Mode-3/A reply in octal representation

**NOTE -** The need for the Validation bit has not been discussed so far.

### 5.2.18 Data Item I244/140, Target Identification

**Definition:** Target (aircraft or vehicle) identification in 8 characters, as reported by the target.

**Format:** Six-octet fixed length Data Item.

**Structure:**

Octet no. 1								Octet no. 2							
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
MSB				Character 1				Character 2				Character 3			
Octet no. 3								Octet no. 4							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
				Character 4				Character 5							
Octet no. 5								Octet no. 6							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Character 6				Character 7				Character 8				LSB			

bits-48/1

Characters 1-8 (coded on 6 bits each) defining target identification when flight plan is available or the registration marking when no flight plan is available.

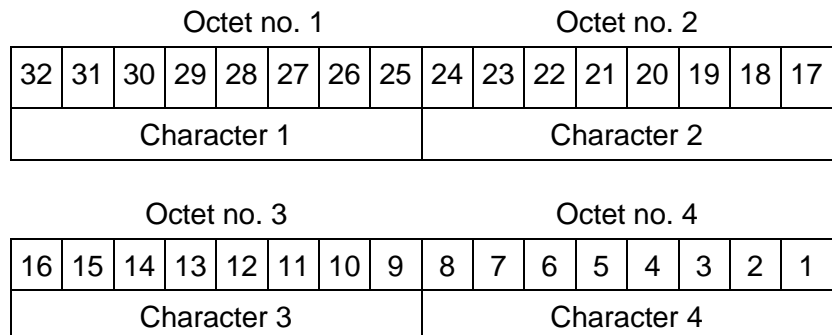
**NOTE** - Bit-48 is the MSB of character 1. Bit-1 is the LSB of character 8.

**5.2.19 Data Item I244/150, Aircraft Type**

**Definition :** Type of aircraft, as defined in ICAO Document 4444.

**Format:** Four octet fixed length data item.

**Structure:**



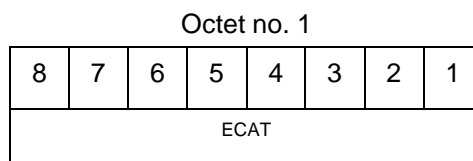
**NOTE** - Each one of the four bytes composing the type of an aircraft contains an ASCII Character (upper-case alphanumeric characters with trailing spaces).

**5.2.20 Data Item I244/160, ADS-B Emitter Category (I021/020)**

**Definition :** Characteristics of the originating ADS-B unit

**Format :** One-Octet fixed length data item.

**Structure:**



Bits-8/1

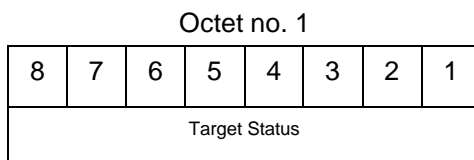
(ECAT)

- 1 = light aircraft <= 7000 kg
- 2 = reserved
- 3 = 7000 kg < medium aircraft < 136000 kg
- 4 = reserved
- 5 = 136000 kg <= heavy aircraft
- 6 = highly manoeuvrable (5g acceleration capability) and high speed (>400 knots cruise)
- 7 to 9 = reserved
- 10 = rotocraft
- 11 = glider / sailplane

- 12 = lighter-than-air
- 13 = unmanned aerial vehicle
- 14 = space / transatmospheric vehicle
- 15 = ultralight / handglider / paraglider
- 16 = parachutist / skydiver
- 17 to 19 = reserved
- 20 = surface emergency vehicle
- 21 = surface service vehicle
- 22 = fixed ground or tethered obstruction
- 23 to 24 = reserved

**5.2.21 Data Item I244/170, Target Status**

**Definition :** Status of the target  
**Format :** One-octet fixed length Data Item  
**Structure:**

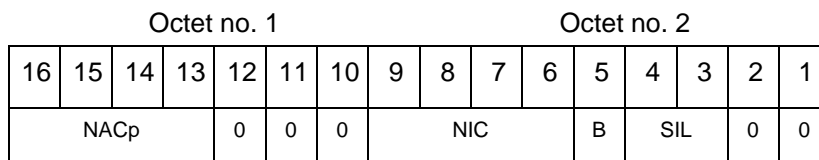


**Bits-8/1 Target Status**

- 1 = No emergency / not reported
- 2 = General emergency
- 3 = Lifeguard / medical
- 4 = Minimum fuel
- 5 = No communications
- 6 = Unlawful interference

**5.2.22 Data Item I244/180, Accuracy/Integrity**

**Definition:** Accuracy and Integrity information conform to DO242A  
**Format:** Two-octet fixed length Data Item.  
**Structure:**



Bits 16/13 (NACp) – Navigation Accuracy Category for position (DO242A)

Bits 12/10 Not Used.

Bits 09/06 (NIC) – Navigation Integrity Category (DO242A)

Bit 05 (B) – Barometric Altitude Integrity Code (DO242A)

Bit 04/03 (SIL) – Surveillance Integrity Level (DO242A)

### 5.2.23 Data Item I244/190, Link Status

**Definition :** Status of the datalink equipment

**Format :** One-Octet fixed length data item.

**Structure:**

Octet no. 1

8	7	6	5	4	3	2	1
Link Status							

Bit 8: 0 = 1090 ES Link not operational  
1 = 1090 ES Link operational

Bit7: 0 = VDL4 Link not operational  
1 = VDL4 Link operational

Bit 6: 0 = UAT Link not operational  
1 = UAT Link operational

Bit5/1: Spare



### 5.3 User Application Profile for Category 244

The following User Application Profile shall be used for the transmission of Trajectory Update.

**Table 2 – ADS-B Messages UAP**

FRN	Data Item	Information	Length
1	I244/010	Trajectory Identifier	2
2	I244/020	Time of Day	3
3	I244/030	Lat/Long Position	8
4	I244/040	Geometric Altitude	2
5	I244/045	Flight Level	2
6	I244/050	Ground Speed	2
7	I244/055	Air Speed	2
FX	-	Field extension indicator	-
8	I244/60	Course	2
9	I244/65	Magnetic Heading	2
10	I244/70	Geometric Vertical Rate	2
11	I244/75	Barometric Vertical Rate	2
12	I244/80	Ground Accelerations	6
13	I244/95	Rate Of Turn	1
14	I244/100	Projected Profile	1+N*11
FX	-	Field extension indicator	-
15	I244/115	Selected Flight Level	2
16	I244/120	ICAO 24-bit Address	3
17	I244/130	Mode-3/A Code	2
18	I244/140	Target Identification	6
19	I244/150	Aircraft Type	4
20	I244/160	ADS_B Emitter Category	1
21	I244/170	Target Status	1
FX	-	Field extension indicator	-
22	I244/180	Accuracy/Integrity	2
23	I244/190	Link Status	1
24	-	Spare	-
25	-	Spare	-
26	-	Spare	-
27	RE	Reserved Expansion Field	1+
28	SP	Special Purpose Field	1+
FX	-	Field extension indicator	-

In the above table

- the first column indicates the Field Reference Number (FRN) associated to each Data Item used in the UAP;
- the fourth column gives the format and the length of each item, a stand-alone figure indicates the octet-count of a fixed-length Data Item, 1+ indicates a variable-length Data Item comprising a first part of 1 octet followed by n-octets extents as necessary.