

**EUROCONTROL STANDARD DOCUMENT  
FOR  
SURVEILLANCE DATA EXCHANGE**

**Part 14 : Category 020  
Multilateration Data**

**SUR.ET1.ST05.2000-STD-14-02**

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# DOCUMENT IDENTIFICATION SHEET

## DOCUMENT DESCRIPTION

**Document Title**  
Multilateration Data

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### Abstract

This document describes the application of ASTERIX messages to the transmission of multilateration target reports and service messages.

### Keywords

Multilateration Data  
Data Item

ASTERIX  
Category 20

Target Reports  
UAP

Service Messages

**CONTACT PERSON :** D.Doukas

**TEL :** 3460

**DIVISION :** DAS/CSM

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## ELECTRONIC BACKUP

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Microsoft Windows	Type : Hard disk	
	Media Identification :	

**DOCUMENT APPROVAL**

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

<b>AUTHORITY</b>	<b>NAME AND SIGNATURE</b>	<b>DATE</b>
SUR Domain Manager	J. Berends	
SURT Chairman	M. Rees	
EATM/DAS Director	B. Redeborn	

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## **EXECUTIVE SUMMARY**

This document describes the general concepts and the message layout for the application of ASTERIX category 20 for the transmission of information derived by multilateration systems.

## INTRODUCTION

### **1.1            Scope**

- 1.1.1**            This document describes the message structure for the transmission of multilateration target reports and service messages.
- 1.1.2**            A complex of MLT (transmitter)/receivers and a central processing system is seen as a mono sensor.

## **2. REFERENCES**

### **2.1 General**

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

At the time of publication of this Eurocontrol 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 Document.

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

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

### **2.2 Reference Documents**

1. Eurocontrol Standard 000-1-92. Directives for the Uniform Drafting and Presentation of Eurocontrol Standard Documents. 1992.
2. Eurocontrol Standard SUR.ET1.ST05.2000-STD-01-01. All Purpose Structured Eurocontrol Surveillance Information Exchange - ASTERIX. Edition 1.28, Working Draft, December 2001.

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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 | <b>Catalogue of Data Items:</b>  | List of all possible Data Items of each Data Category describing the Data Items by their reference, structure, size and units (where applicable).  |
| 3.1.2 | <b>Data Block:</b>               | 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 | <b>Data Category:</b>            | Classification of the data in order to allow for, inter alia, an easy identification.  |
| 3.1.4 | <b>Data Field:</b>               | 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 | <b>Data Item:</b>                | The smallest unit of information in each Data Category.  |
| 3.1.6 | <b>Measured Item:</b>            | A piece of information (e.g. the position of a target) derived from the sensor information and transmitted without any smoothing.  |
| 3.1.7 | <b>Record:</b>                   | 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                         |
| 3.1.8 | <b>User Application Profile:</b> | 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>ASTERIX</b>	<b>A</b> ll Purpose <b>S</b> Tstructured <b>E</b> urocontrol su <b>R</b> veillance Information <b>E</b> Xchange
<b>CAT</b>	Data Category
<b>EATM</b>	European Air Traffic Management
<b>FL</b>	Flight Level, unit of altitude (expressed in 100's of feet)
<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>kt</b>	knot = NM/hour, unit of speed
<b>LEN</b>	Length Indicator
<b>LSB</b>	Least Significant Bit
<b>MLT</b>	Multilateration
<b>NM</b>	Nautical Mile, unit of distance (1852 metres)
<b>PSR</b>	Primary Surveillance Radar
<b>RDE-FG</b>	Radar Data Exchange Focus Group
<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>SIC</b>	System Identification Code
<b>SMR</b>	Surface Movement Radar
<b>SMS</b>	Surface Movement System
<b>SP</b>	Special Purpose Indicator
<b>SPI</b>	Special Position Identification
<b>SSR</b>	Secondary Surveillance Radar
<b>SURT</b>	Surveillance Team (EATM)
<b>UAP</b>	User Application Profile (see Definitions )
<b>UTC</b>	Coordinated Universal Time
<b>WAM</b>	Wide Area Multilateration
<b>WGS-84</b>	World Geodetic System 84

## **4. GENERAL PRINCIPLES**

### **4.1 General**

For the transmission of MLT data of the following two types of messages have been defined:

- target reports,
- service messages.

### **4.2 Time Management**

#### **4.2.1 Definition**

The time stamp shall be consistent with the reported target position.

#### **4.2.2 Requirements for Time Stamping**

The timestamping shall comply with ICAO Annex 5.

### **4.3 Projection Systems and Geographical Coordinates**

Two different types of Coordinate reference systems are supported.

#### **4.3.1 Coordinates Expressed in the Local 2D Coordinate Reference System (Cartesian Representation):**

The exported position can be expressed in a 2D Cartesian Coordinate system, which is a plane tangential to the WGS-84 Ellipsoid at the location of the reference point. The origin of the Cartesian Coordinate system coincides with the published system origin. The Y-axis points to the geographical north at that position. The X-axis is perpendicular to the Y-axis and points to the east. The X, Y Coordinates are calculated using either the measured height or an assumed target height and apply a suitable projection technique for the final 3D to 2D conversion (e.g. a stereographical projection).

All tracker derived information elements, shall be a consistent set of values, expressed in the same Coordinate reference system (state vector components and the corresponding elements of the track quality vector).

#### **4.3.2 Coordinates Expressed in WGS-84 Format (Geographical Coordinates):**

The exported position can be expressed in a 2D or 3D WGS-84 format. In case of 3D representation the item 020/091 (Measured Height) has to be used in combination with item 020/041 (Position in WGS-84 Coordinates).

#### **4.4 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.

#### **4.5 Definitions and Addressing Concepts**

In order to address sources in an unambiguous way, a simple abstract model for concepts like sensors or systems has been designed.

##### **4.5.1 Sensor**

In the framework of Category 020 a multilateration sensor is:

- a complex of MLT (transmitter)/receivers and a central processing system

##### **4.5.2 System**

In the framework of category 020 a System is a Sensor.

##### **4.5.3 Addressing Concepts: Assigning SAC/SIC Codes**

By convention a dedicated and unambiguous SAC/SIC code shall be assigned to every System.

#### **4.6 Target Reports**

Target reports include reports from a multilateration system.

#### **4.7 Service Messages**

Three types of service messages have been identified:

- Start of Update Cycle (for a system using a cyclic update mechanism, these messages shall be used to signal the start of a new data renewal cycle),
- Periodic Status Messages (these messages should be used by systems to indicate their status periodically),
- Event-triggered Status Messages (these messages should be used by systems to indicate their status in case of events).



## 4.8 User Application Profile and Data Blocks

**4.8.1** A single User Application Profile (UAP) is defined and shall be used for both target reports and service messages.

**4.8.2** Data Blocks shall have the following layout.

<b>CAT = 020</b>	<b>LEN</b>		<b>FSPEC</b>	Items of the first record	<b>FSPEC</b>	Items of the last record
------------------	------------	--	--------------	---------------------------	--------------	--------------------------

where:

- Data Category (CAT) = 020, is a one-octet field indicating that the Data Block contains Multilateration data;
- 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.

## 4.9 Composition of Messages

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

**4.9.2** 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 Multilateration data are defined in Table 1 and described on the following pages.

**Table 1 - Standard Data Items of Category 020**

Data Item Ref. No.	Description	Resolution
I020/000	Message Type	N.A.
I020/010	Data Source Identifier	N.A.
I020/020	Target Report Descriptor	N.A.
I020/030	Warning/Error Conditions	N.A.
I020/041	Position in WGS-84 Coordinates	180/2 <sup>25°</sup>
I020/042	Position in Cartesian Coordinates	0.5 m
I020/070	Mode-3/A Code in Octal Representation	N.A.
I020/080	Mode-3/A Code Confidence Indicator	N.A.
I020/090	Flight Level in Binary Representation	¼ FL
I020/100	Mode-C Code and Code Confidence Indicator	N.A.
I020/105	Geometric Altitude (WGS-84)	6.25 ft
I020/140	Time of Day	1/128 s
I020/161	Track Number	N.A.
I020/170	Track Status	N.A.
I020/202	Calculated Track Velocity in Cartesian Coord.	0.25 m/s
I020/210	Calculated Acceleration	0.25 m/s <sup>2</sup>
I020/220	Target Address	N.A.
I020/230	Comms/ACAS Capability and Flight Status	N.A.
I020/245	Target Identification	N.A.
I020/250	Mode S MB Data	N.A.
I020/260	ACAS Resolution Advisory Report	N.A.
I020/300	Vehicle Fleet Identification	N.A.
I020/310	Pre-programmed Message	N.A.
I020/400	Contributing Receivers	N.A.
I020/500	Position Accuracy	0.25 / 0.25m
I020/550	System Status	N.A.

## 5.2 Description of Standard Data Items

### 5.2.1 Data Item I020/000, Message Type

**Definition:** This Data Item allows for a more convenient handling of the messages at the receiver side by further defining the type of information.

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

**Structure:**



bits-8/1

Message Type

**Encoding rule :**

This data item shall be present in every ASTERIX record.

**NOTES**

1. In applications where data of various types is exchanged, the Message Type Data Item facilitates the proper message handling at the receiver side.
2. All Message Type values are reserved for common standard use.
3. The following set of Message Types are standardised for category 020 records:
  - 001 Target Report
  - 002 Start of Update Cycle
  - 003 Periodic Status Message
  - 004 Event-triggered Status Message

The list of items present for the four message types is defined in the following table. M stands for mandatory, O for optional, X for never present.

**Table 2 – Items per Message Types**

Item	Type	001 Target Report	002 Start of Update Cycle	003 Periodic Status Message	004 Event Status Message
I020/000	Message Type	M	M	M	M
I020/010	Data Source Identifier	M	M	M	M
I020/020	Target Report Descriptor	M	X	X	X
I020/030	Warning/Error Conditions	O	X	X	X
I020/041	Position in WGS-84 Coordinates	O	X	X	X
I020/042	Position in Cartesian Coordinates	O	X	X	X
I020/070	Mode-3/A Code in octal representation	O	X	X	X
I020/080	Mode-3/A Code Confidence Indicator	O	X	X	X
I020/090	Flight Level in Binary Representation	O	X	X	X
I020/100	Mode-C Code and Code Confidence Indicator	O	X	X	X
I020/105	Geometric Altitude (WGS-84)	O	X	X	X
I020/140	Time of Day	M	M	M	M
I020/161	Track Number	O	X	X	X
I020/170	Track Status	O	X	X	X
I020/202	Calculated Track Velocity in Cartesian Coordinates	O	X	X	X
I020/210	Calculated Acceleration	O	X	X	X
I020/220	Target Address	O	X	X	X
I020/230	Comms/ACAS Capability and Flight Status				
I020/245	Target Identification	O	X	X	X
I020/250	Mode S MB Data	O	X	X	X
I020/300	Vehicle Fleet Identification	O	X	X	X
I020/310	Pre-programmed Message	O	X	X	X
I020/400	Contributing Receivers	O	X	X	X
I020/500	Position Accuracy	O	X	X	X
I020/550	System Status	X	O	M	M

**5.2.2****Data Item I020/010, Data Source Identifier****Definition:** Identification of the system from which the data are received.**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
SAC								SIC							

bits-16/9 (SAC) System Area Code

bits-8/1 (SIC) System Identification Code

### 5.2.3 Data Item I020/020, Target Report Descriptor

**Definition:** Type and characteristics of the data as transmitted by a system.

**Format:** Variable length Data Item comprising a first part of one-octet, followed by one-octet extents as necessary.

**Structure  
of First Part:**

Octet no. 1							
8	7	6	5	4	3	2	1
TYP							FX
SSR	MS	HF	VDL4	UAT	DME	0	

bits-8/2	(TYP)	bit 8	= 1	SSR multilateration
			= 0	no SSR multilateration
		bit 7	= 1	Mode-S multilateration
			= 0	no Mode-S multilateration
		bit 6	= 1	HF multilateration
			= 0	no HF multilateration
		bit 5	= 1	VDL Mode 4 multilateration
			= 0	no VDL Mode 4 multilateration
		bit 4	= 1	UAT multilateration
			= 0	no UAT multilateration
		bit 3	= 1	DME/TACAN multilateration
			= 0	no DME/TACAN multilateration
		bit 2	=	spare bit set to 0
bit-1	(FX)		= 0	End of Data Item
			= 1	Extension into first extent

### Structure of First Extent:

Octet no. 1

8	7	6	5	4	3	2	1
RAB	SPI	CHN	GBS	CRT	SIM	TST	FX

bit-8	(RAB)	= 0	Report from target transponder
		= 1	Report from field monitor (fixed transponder)
bit-7	(SPI)	= 0	Absence of SPI
		= 1	Special Position Identification
bit-6	(CHN)	= 0	Chain 1
		= 1	Chain 2
bit-5	(GBS)	= 0	Transponder Ground bit not set
		= 1	Transponder Ground bit set
bit-4	(CRT)	= 0	No Corrupted reply in multilateration
		= 1	Corrupted replies in multilateration
bit-3	(SIM)	= 0	Actual target report
		= 1	Simulated target report
bit-2	(TST)	= 0	Default
		= 1	Test Target
bit-1	(FX)	= 0	End of Data Item
		= 1	Extension into next extent

**5.2.4****Data Item I020/030, Warning/Error Conditions**

**Definition:** Warning/error conditions detected by a system for the target report involved.

**Format:** Variable length Data Item comprising a first part of one-octet, followed by one-octet extents as necessary.

**Structure:**

Octet no. 1							
8	7	6	5	4	3	2	1
W/E Value							FX

bits-8/2 (W/E Value) Warning/error condition value

bit-1 (FX) = 0 End of Data Item  
 = 1 Extension into first extent  
 (next W/E condition value)

Warning/Error Code	Description
0	Not defined; never used.
1	Multipath Reply (Reflection)
3	Split plot
10	Phantom SSR plot
11	Non-Matching Mode-3/A Code
12	Mode C code / Mode S altitude code abnormal value compared to the track
15	Transponder anomaly detected
16	Duplicated or Illegal Mode S Aircraft Address
17	Mode S error correction applied
18	Undecodable Mode C code / Mode S altitude code

**Encoding Rule:**

This Data item is optional. When used, it shall be transmitted only if different from zero.

**NOTES**

1. It has to be stressed that a series of one or more W/E conditions can be reported per target report.
2. Data conveyed in this item are of secondary importance, and can generally also be derived from the processing of mandatory items.
3. Definitions can be found in SUR.ET1.ST03.1000-STD-01-01 Radar Sensor Performance Analysis.
4. The coding of Warning/Errors is kept consistent with category 048.

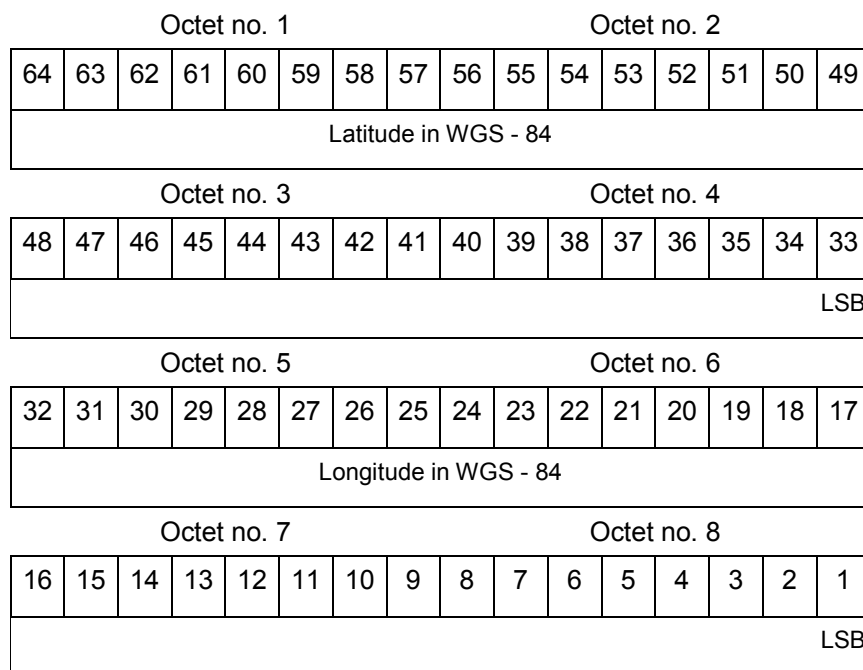


### 5.2.5 Data Item I020/041, Position in WGS-84 Coordinates

**Definition :** Position of a target in WGS-84 Coordinates.

**Format :** Eight-octet fixed length Data Item

**Structure:**



bits-64/33	(Latitude)	In WGS-84 in two's complement. Range -90 <= latitude <= 90 deg.
	(LSB)	= $180/2^{25}$ degrees
bits-32/1	(Longitude)	In WGS-84 in two's complement. Range -180 <= longitude < 180 deg.
	(LSB)	= $180/2^{25}$ degrees

The LSB provides a resolution better than 0.6m.

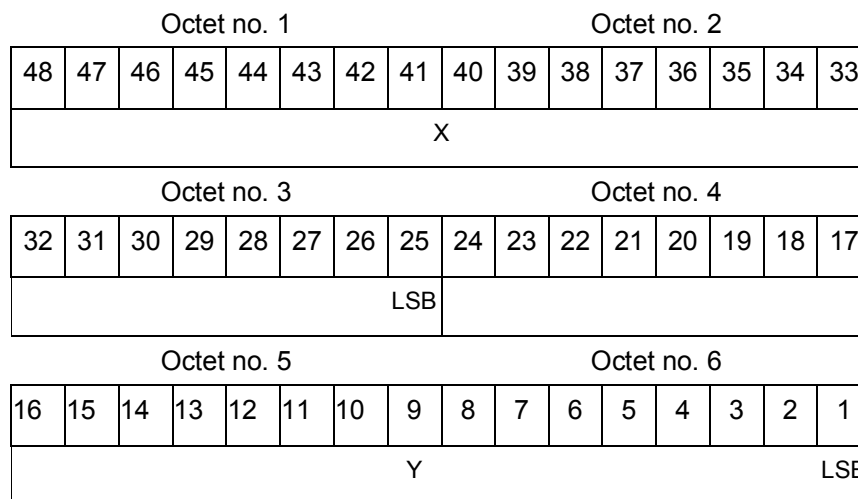
**NOTE:** At least one of these items (I020/041 or I020/042) must be sent if available

**5.2.6****Data Item I020/042, Position in Cartesian Coordinates**

**Definition:** Calculated position in Cartesian Coordinates, in two's complement representation.

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

**Structure:**



bits 48/25 = X

bit 25 (LSB) = 0.5 m, max range=+/-4194.3km (~2265 NM)

bits 24/1 = Y

bit 1 (LSB) = 0.5 m, max range=+/-4194.3km (~2265 NM)

**NOTE:** At least one of these items (I020/041 or I020/042) must be sent if available

### 5.2.7 Data Item I020/070, Mode-3/A Code in Octal Representation

**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	G	L	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 (G) = 0 Default  
= 1 Garbled code

bit-14 (L) = 0 Mode-3/A code derived from  
the reply of the transponder  
= 1 Mode-3/A code not extracted  
during the last scan

bit-13 Spare bit set to 0

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

#### Encoding Rule:

- For Mode S, once a Mode-3/A code is seen, that code shall be sent every scan, provided the radar is receiving replies for that aircraft.
- Bit 14 (L) will be set when the Mode 3/A Code was taken from the Track file

#### NOTES

- Bit 15 (G) is set to one when an error correction has been attempted.
- Bit 16 (V) is normally set to zero, but can exceptionally be set to one to indicate a non-validated Mode-3/A code (e.g. alert condition detected, but new Mode-3/A code not successfully extracted).

**5.2.8 Data Item I020/080, Mode-3/A Code Confidence Indicator**

**Definition:** Confidence level for each bit of a Mode-3/A reply as provided by a monopulse SSR station.

**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
0	0	0	0	QA4	QA2	QA1	QB4	QB2	QB1	QC4	QC2	QC1	QD4	QD2	QD1

bits-16/13 Spare bits set to 0

bits-12/1 (QXi) = 0 High quality pulse Xi  
 = 1 Low quality pulse Xi

**Encoding Rule:**

This data item shall only be sent when at least one pulse is of low quality. It represents the confidence level for each reply bit of the Mode-3/A code of the plot.

### 5.2.9 Data Item I020/090, Flight Level in Binary Representation

**Definition:** Flight Level (Mode S Altitude) converted into binary two's complement 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	G	Flight Level												LSE	

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

bit-15	(G)	= 0	Default
		= 1	Garbled code

bits-14/1 (Flight Level)  
LSB= 1/4 FL

**Encoding Rule:**

This data item shall be sent when Mode S altitude code is present and decodable. It represents the flight level of the plot, even if associated with a track.

## NOTES

1. When Mode C code / Mode S altitude code is present but not decodable, the “Undecodable Mode C code / Mode S altitude code” Warning/Error should be sent in I020/030.
2. When local tracking is applied and the received Mode S altitude code corresponds to an abnormal value (i.e: the difference in altitude between the current and the previous plot exceeds a predefined system threshold), the “Mode C code / Mode S altitude code abnormal value compared to the track” Warning/Error should be sent in I020/030.
3. The value shall be within the range described by ICAO Annex 10
4. For Mode S, bit 15 (G) is set to one when an error correction has been attempted.

**5.2.10 Data Item I020/100, Mode-C Code and Code Confidence Indicator**

**Definition:** Mode-C height in Gray notation as received from the transponder together with the confidence level for each reply bit as provided by a MSSR/Mode S station.

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

**Structure:**

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
V	G	0	0	C1	A1	C2	A2	C4	A4	B1	D1	B2	D2	B4	D4

Octet no. 3								Octet no. 4							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	0	0	0	QC1	QA1	QC2	QA2	QC4	QA4	QB1	QD1	QB2	QD2	QB4	QD4

bit-32 (V) = 0 Code validated  
 = 1 Code not validated

bit-31 (G) = 0 Default  
 = 1 Garbled code

bits-30/29 Spare bits set to 0

bits-28/17 Mode-C reply in Gray notation

bits-16/13 Spare bits set to 0

bits-12/1(QXi) = 0 High quality pulse Xi  
 = 1 Low quality pulse Xi

**Encoding Rule:**

This data item shall only be sent when a not validated or undecodable Mode C code has been received. For Mode A/C, it represents the confidence level for each reply bit of the Mode C code of the plot. For Mode S, if this item is sent because of an undecodable Mode-C code received in a Mode S altitude reply, all pulse quality bits will be set to high (zero).

**NOTES**

1. For Mode S, D1 is also designated as Q, and is used to denote either 25ft or 100ft reporting.
2. For Mode S, bit-31 (G) is set when an error correction has been attempted.

**5.2.11 Data Item I020/105, Geometric Altitude (WGS-84)**

**Definition:** Vertical distance between the target and the projection of its position on the earth's ellipsoid, as defined by WGS84, 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
Geometric Altitude (WGS-84)															LSB

bits-16/1    Geometric Altitude (WGS-84)  
 LSB= 6.25 ft  
 Range= +/- 204 800 ft

**5.2.12 Data Item I020/140, Time of Day**

**Definition:** Absolute time stamping expressed as UTC.

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

**Structure:**

Octet no. 1								Octet no. 2								Octet no. 3							
24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Time								Of								Day							

bit-1            (LSB)            1/128 s

**NOTE -** The time of day value is reset to zero each day at midnight.

**5.2.13 Data Item I020/161, Track Number**

**Definition:** An integer value representing a unique reference to a track record within a particular track file.

**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
0	0	0	0	TRACK NUMBER(0...4095)											

bits-16/13

Spare bits set to zero.

bits-12/1

Track number.



**5.2.14 Data Item I020/170, Track Status****Definition:** Status of track.**Format:** Variable length Data Item comprising a first part of one-octet, followed by one-octet extents as necessary.**Structure of First Part:**

Octet no. 1							
8	7	6	5	4	3	2	1
CNF	TRE	CST	CDM		MAH	STH	FX

bit-8	(CNF)	= 0	Confirmed track
		= 1	Track in initiation phase
bit-7	(TRE)	= 0	Default
		= 1	Last report for a track
bits-6	(CST)	= 0	Not extrapolated
		= 1	Extrapolated
bit-5/4	(CDM)	= 00	Maintaining
		= 01	Climbing
		= 10	Descending
		= 11	Invalid
bit-3	(MAH)	= 0	Default
		= 1	Horizontal manoeuvre
bit-2	(STH)	= 0	Measured position
		= 1	Smoothed position
bit-1	(FX)	= 0	End of Data Item
		= 1	Extension into first extent

### Structure of First Extent:

Octet no. 1							
8	7	6	5	4	3	2	1
GHO	0	0	0	0	0	0	FX

bit-8 (GHO) = 0 Default  
= 1 Ghost track

Bit 7/2 Spare bits set to 0

bit-1 (FX) = 0 End of Data Item  
= 1 Extension into second extent

### NOTES

1. Bit-8 (GHO) is used to signal that the track is suspected to have been generated by a fake target.

## 5.2.15

### Data Item I020/202, Calculated Track Velocity in Cartesian Coordinates

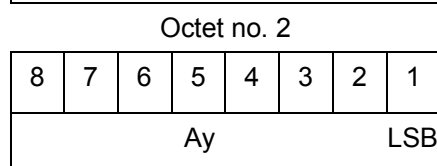
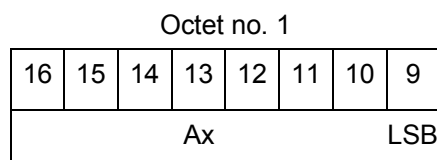
**Definition:** Calculated track velocity expressed in Cartesian Coordinates, in two's complement representation.

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

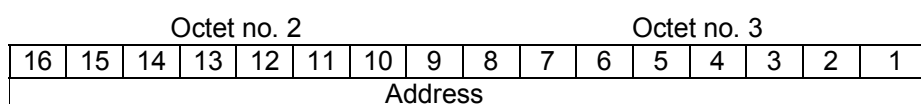
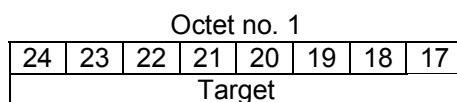
### Structure:

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Vx															LSB
Octet no. 3								Octet no. 4							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Vy															LSB

bit-17 & 1 (LSB) = 0.25 m/s,  
Max.range =  $\pm 8192$ m/s

**5.2.16 Data Item I020/210, Calculated Acceleration****Definition :** Calculated Acceleration of the target, in two's complement form.**Format :** Two-Octet fixed length data item.**Structure:**

bits 9 & 1                      (LSB)                      = 0.25 m/s<sup>2</sup>  
 Max. range ± 31 m/s<sup>2</sup>

**5.2.17 Data Item I020/220, Target Address****Definition:** Target address (ICAO 24-bit address) assigned uniquely to each Target.**Format:** Three-octet fixed length Data Item.**Structure:**

bits-24/1

24-bits Target Address, A23 to A0

**5.2.18 Data Item I020/230, Communications/ACAS Capability and Flight Status**

**Definition:** Communications capability of the transponder, capability of the on-board ACAS equipment and flight status.

**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
COM			STAT			0	0	MSSC	ARC	AIC	B1A	B1B			

bits-16/14 (COM)

Communications capability of the transponder

= 0 No communications capability (surveillance only)

= 1 Comm. A and Comm. B capability

= 2 Comm. A, Comm. B and Uplink ELM

= 3 Comm. A, Comm. B, Uplink ELM and Downlink ELM

= 4 Level 5 Transponder capability

5 to 7 Not assigned

bits-13/11 (STAT)

Flight Status

= 0 No alert, no SPI, aircraft airborne

= 1 No alert, no SPI, aircraft on ground

= 2 Alert, no SPI, aircraft airborne

= 3 Alert, no SPI, aircraft on ground

= 4 Alert, SPI, aircraft airborne or on ground

= 5 No alert, SPI, aircraft airborne or on ground

6 - 7 Not assigned

bits-10/9 (spare)

spare bits set to zero

bit-8 (MSSC)

Mode-S Specific Service Capability

= 0 No

= 1 Yes

bit-7 (ARC)

Altitude reporting capability

= 0 100 ft resolution

= 1 25 ft resolution

bit-6 (AIC)

Aircraft identification capability

= 0 No

= 1 Yes

bit-5 (B1A)

BDS 1,0 bit 16

bits 4/1 (B1B)

BDS 1,0 bits 37/40

**Encoding Rule:**

This item shall be present in every ASTERIX record conveying data related to a Mode S target. If the datalink capability has not been extracted yet, bits 16/14 shall be set to zero.

### 5.2.19 Data Item I020/245, Target Identification

**Definition:** Target (aircraft or vehicle) identification in 8 characters.

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

**Structure:**

Octet no. 1							
56	55	54	53	52	51	50	49
STI	0	0	0	0	0	0	0

Octet no. 2												Octet no. 3			
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. 4												Octet no. 5			
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
				Character 4						Character 5					

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

bits-56/55 (STI) = 00 Callsign or registration downlinked from transponder

= 01 Registration downlinked from transponder

= 10 Callsign downlinked from transponder

= 11 Not defined

bits-54/49 Spare bits set to zero

bits-48/1 Characters 1-8 (coded on 6 bits each) defining target identification.

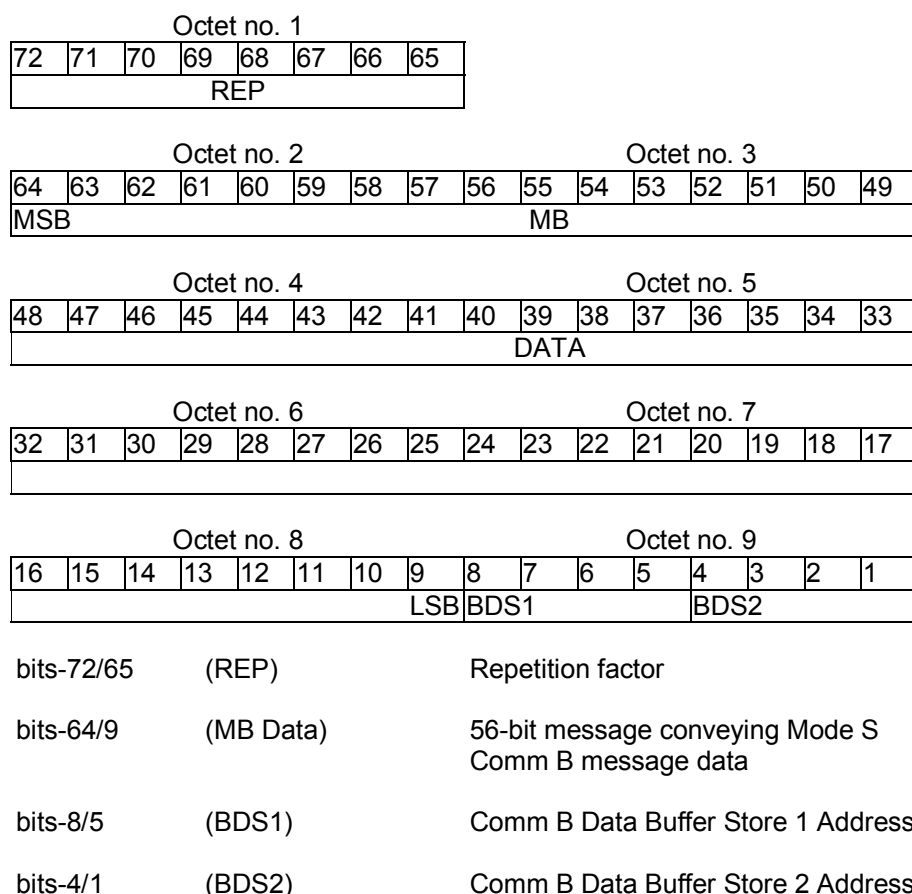
**NOTE:** See ICAO document Annex 10, Volume IV, section 3.1.2.9 for the coding rules.

**5.2.20 Data Item I020/250, Mode S MB Data**

**Definition:** Mode S Comm B data as extracted from the aircraft transponder.

**Format:** Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one BDS report comprising one seven octet BDS register and one octet BDS code.

**Structure:**

**NOTES**

1. For the transmission of BDS20, item 245 is used.

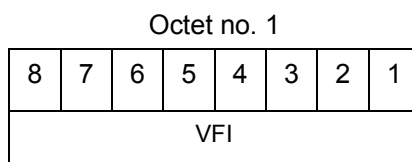
**5.2.21 Data Item I020/260, ACAS Resolution Advisory Report**

**Definition:** Currently active Resolution Advisory (RA), if any, generated by the ACAS associated with the transponder transmitting the report and threat identity data.

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

**Structure:**

Octet no. 1							Octet no. 2								
56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41
Octet no. 3							Octet no. 4								
40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
MB DATA															
Octet no. 5							Octet no. 6								
24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
							Octet 7								
							8	7	6	5	4	3	2	1	

**5.2.22 Data Item I020/300, Vehicle Fleet Identification****Definition:** Vehicle fleet identification number.**Format:** One octet fixed length Data Item.**Structure:**

Bits 8-1	(VFI)	= 0	Unknown
		= 1	ATC equipment maintenance
		= 2	Airport maintenance
		= 3	Fire
		= 4	Bird scarer
		= 5	Snow plough
		= 6	Runway sweeper
		= 7	Emergency
		= 8	Police
		= 9	Bus
		= 10	Tug (push/tow)
		= 11	Grass cutter
		= 12	Fuel
		= 13	Baggage
		= 14	Catering
		= 15	Aircraft maintenance
		= 16	Flyco (follow me)



**5.2.23 Data Item I020/310, Pre-programmed Message**

**Definition:** Number related to a pre-programmed message that can be transmitted by a vehicle.

**Format:** One octet fixed length Data Item.

**Structure:**

Octet no. 1							
8	7	6	5	4	3	2	1
TRB		MSG					

Bit-8 (TRB) = 0 Default  
= 1 In Trouble

Bits 7-1 (MSG) = 1 Towing aircraft  
= 2 "Follow me" operation  
= 3 Runway check  
= 4 Emergency operation (fire, medical...)  
= 5 Work in progress (maintenance, birds scarer, sweepers...)

**5.2.24 Data Item I020/400, Contributing Receivers**

**Definition:** Overview of Receiver Units, which have contributed to the Target Detection

**Format:** Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one Contributing Receiver Units list comprising one octet

**Structure:**

Octet no. 1							
16	15	14	13	12	11	10	9
REP							

Octet no. 2							
8	7	6	5	4	3	2	1

Bits 16/9 (REP) Repetition Factor

Bit  $x$  ( $1 \leq x \leq 8$ ) RUX Contribution  
= 0 RUX has NOT contributed to the target detection  
= 1 RUX has contributed to the target detection

**5.2.25 Data Item I020/500, Position Accuracy****Definition:** Standard Deviation of Position**Format:** Compound Data Item, comprising a primary subfield of one octet, followed by one or more defined subfields.**Structure of Primary Subfield:**

Octet no. 1							
8	7	6	5	4	3	2	1
GDP	SDP	SDA	0	0	0	0	0

Bit-8	(GDP)	Subfield #1: GDOP of Position
		= 0 Absence of Subfield #1
		= 1 Presence of Subfield #1
Bit-7	(SDP)	Subfield #2: Standard Deviation of Position
		= 0 Absence of Subfield #2
		= 1 Presence of Subfield #2
Bit-6	(SDA)	Subfield #3 Standard Deviation of Geometric Altitude
		=0 Absence of Subfield #3
		=1 Presence of Subfield #3
bits-5/1	(Spare)	Subfields #4/7: Spare
		= 0 Absence of Subfield
		= 1 Presence of Subfield

### Structure of Subfield # 1:

## GDOP of Position

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
GDP-x LSB								GDP-y LSB							

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

bits-32/25	(GDP-x)	GDOP along x axis LSB= 0.25
bits-24/17	(GDP-y)	GDOP along y axis LSB= 0.25
bits-16/1	(GDP-xy)	GDOP LSB= 0.25 <sup>2</sup>

**Structure of Subfield # 2:****Standard Deviation of Position**

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

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

Octet no. 5								Octet no. 6							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$\sigma_{xy}$															LSB

bits-48/33 ( $\sigma_x$ ) Standard Deviation of X component  
LSB= 0.25 m

bits-32/17 ( $\sigma_y$ ) Standard Deviation of Y component  
LSB= 0.25 m

bits-16/1 ( $\sigma_{xy}$ ) Covariance in two's complement form  
LSB= 0.25 m<sup>2</sup>

**Structure of Subfield # 3:****Standard Deviation of Geometric Altitude (WGS 84)**

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$\sigma_{GA}$															LSB

bits-16/1 ( $\sigma_{GA}$ ) Standard Deviation of Geometric Altitude  
LSB= 0.5 m

**5.2.26 Data Item I020/550, System Status**

**Definition:** Information concerning the configuration and status of a System.

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

**Structure:**

Octet no. 1							
8	7	6	5	4	3	2	1
NOGO		OVL	TSV	TTF	0	0	0

bits-8/7	(NOGO)		Operational Release Status of the System
		= 00	Operational
		= 01	Degraded
		= 10	NOGO
		= 11	undefined
bit-6	(OVL)		Overload indicator
		= 0	No overload
		= 1	Overload
bit-5	(TSV)		Time Source Validity
		= 0	valid
		= 1	invalid
bit-4	(TTF)	= 0	Test Target Operative
		= 1	Test Target Failure
bits-3/1	Spare bits set to zero		

### 5.3 Standard User Application Profile

5.3.1 The following UAP shown in Table 3 shall be used for the transmission of target reports and service messages :

**Table 3 - Standard UAP**

FRN	Data Item	Information	Length in Octets
1	I020/010	Data Source Identifier	2
2	I020/000	Message Type	1
3	I020/020	Target Report Descriptor	1+
4	I020/140	Time of Day	3
5	I020/041	Position in WGS-84 Coordinates	8
6	I020/042	Position in Cartesian Coordinates	6
7	I020/202	Calculated Track Velocity in Cartesian Coord.	4
FX	-	Field Extension Indicator	-
8	I020/161	Track Number	2
9	I020/170	Track Status	1+
10	I020/070	Mode-3/A Code in Octal Representation	2
11	I020/080	Mode-3/A Code Confidence Indicator	2
12	I020/090	Flight Level in Binary Representation	2
13	I020/100	Mode-C Code and Code Confidence Indicator	4
14	I020/220	Target Address	3
FX	-	Field Extension Indicator	-
15	I020/245	Target Identification	7
16	I020/250	Mode S MB Data	1+8n
17	I020/105	Geometric Altitude (WGS-84)	2
18	I020/210	Calculated Acceleration	2
19	I020/300	Vehicle Fleet Identification	1
20	I020/310	Pre-programmed Message	1
21	I020/500	Position Accuracy	1+n
FX	-	Field Extension Indicator	-
22	I020/400	Contributing Receivers	1+1+
23	I020/550	System Status	1
24	I020/230	Comms/ACAS Capability and Flight Status	1+
25	I020/260	ACAS Resolution Advisory Report	7
26	I020/030	Warning/Error Conditions	1+
27	SP	Special Purpose Field	-
28	RE	Reserved Expansion Field	-
FX	-	Field Extension Indicator	-

where:

- the first column indicates the 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 one-octet followed by n-octet extents as necessary.