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SURVEILLANCE DATA EXCHANGE

Part 18 : Category 019

Multilateration System Status Messages

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Abstract

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

Keywords

Multilateration Data, ASTERIX, Service Messages
Data Item, Category 19, UAP

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

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DOCUMENT CHANGE RECORD

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EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
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1.0	November 2005	Chapter 4.3.1 updated in line with Cat. 020 Document status changed to Proposed Issue	Page 7
	June 2006	Document status changed to Released Issue	
1.1	March 2007	Document ID-Sheet updated Signature Page updated Reference to ASTERIX Website added Editorial “clean-up” Correction in item I019/551	Doc. ID-Sheet Signature Pg 5.2.2 Almost all 5.2.5
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1.3	November 2010	Signature page updated Reference Document [2] updated Encoding Rule for I019/140 updated Note added to item I019/550	iii Page 3 Page 12 5.2.4

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This document describes the general concepts and the message layout for the application of ASTERIX category 19 for the transmission of service and status messages related to multilateration systems.

1. INTRODUCTION

1.1 Scope

1.1.1 This document describes the message structure for the transmission of multilateration service and system status 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 1.30, Released Issue, November 2007.

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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 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 allow for, 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 Measured Item: A piece of information (e.g. the position of a target) derived from the sensor information and transmitted without any smoothing.

3.1.7 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

3.1.8 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)
ASTERIX	**A**ll Purpose **ST**ructured **E**urocontrol su**R**veillance **I**nformation E**X**change
CAT	Data Category
DOP	Dilution Of Precision
EATM	European Air Traffic Management
FL	Flight Level, unit of altitude (expressed in 100's of feet)
FRN	Field Reference Number
FSPEC	Field Specification
FX	Field Extension Indicator
ICAO	International Civil Aviation Organization
kt	knot = NM/hour, unit of speed
LEN	Length Indicator
LSB	Least Significant Bit
MLT	Multilateration
NM	Nautical Mile, unit of distance (1852 metres)
PSR	Primary Surveillance Radar
RDE-FG	Radar Data Exchange Focus Group
RE	Reserved Expansion Indicator
REP	Field Repetition Indicator
s	second, unit of time
SAC	System Area Code
SIC	System Identification Code
SMR	Surface Movement Radar
SMS	Surface Movement System
SP	Special Purpose Indicator
SPI	Special Position Identification
SSR	Secondary Surveillance Radar
SURT	Surveillance Team (EATM)
UAP	User Application Profile (see Definitions)
UTC	Coordinated Universal Time
WAM	Wide Area Multilateration
WGS-84	World Geodetic System 84

4. GENERAL PRINCIPLES

4.1 General

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

- target reports,
- service and status messages.

This document describes the service and status messages only. The target report messages are described in part 14, category 020 of the ASTERIX documents.

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 as defined in item I019/600. 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 019/610 (Height of MLT System Reference Point) has to be used in combination with item 019/600 (Position of the MLT System Reference Point).

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 019 a multilateration sensor is:

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

4.5.2 System

In the framework of category 019 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. They are described in part 14 as ASTERIX category 020.

4.7 Service Messages

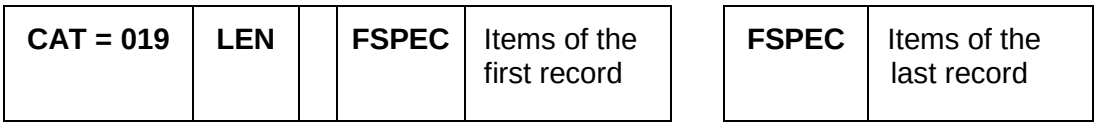
Three types of service messages have been identified:

- 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.



where:

- Data Category (CAT) = 019, is a one-octet field indicating that the Data Block contains Multilateration System Status 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.

4.9 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 019

Data Item Ref. No.	Description	Resolution
I019/000	Message Type	N.A.
I019/010	Data Source Identifier	N.A.
I019/140	Time of Day	1/128 s
I019/550	System Status	N.A.
I019/551	Tracking Processor Detailed Status	N.A.
I019/552	Remote Sensor Detailed Status	N.A.
I019/553	Reference Transponder Detailed Status	N.A.
I019/600	Position of the MLT System Reference Point	$180/2^{30}$°
I019/610	Height of the MLT System Reference Point	0.25 m
I019/620	WGS-84 Undulation	1 m

5.2 Description of Standard Data Items

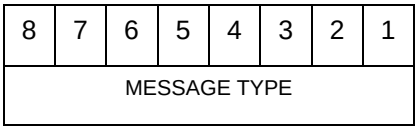
5.2.1 Data Item I019/000, Message Type

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:

Octet no. 1



bits-8/1 Message Type

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 019 records:

- 001 Start of Update Cycle
- 002 Periodic Status Message
- 003 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 Start of Update Cycle	002 Periodic Status Message	003 Event Status Message
I019/000	Message Type	M	M	M
I019/010	Data Source Identifier	M	M	M
I019/140	Time of Day	M	M	M
I019/550	System Status	O	M	M
I019/551	Tracking Processor Detailed Status	O	O	O
I019/552	Remote Sensor Detailed Status	O	O	O
I019/553	Reference Transponder Detailed Status	O	O	O
I019/600	Position of the MLT System Reference Point	O	O	X
I019/610	Height of the MLT System Reference Point	O	O	X
I019/620	WGS-84 Undulation	O	O	X

NOTE: Data item I019/140 “Time of Day” shall be present in every ASTERIX record, except in case of failure of all sources of time-stamping.

5.2.2 Data Item I019/010, Data Source Identifier

Definition: Identification of the system from which the data is 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							

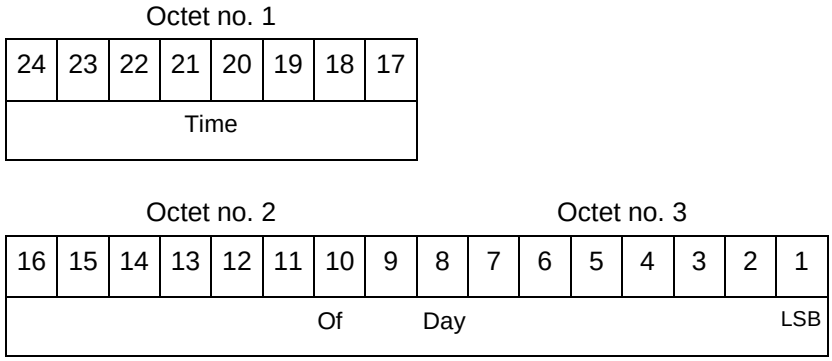
bits-16/9 (SAC) System Area Code

bits-8/1 (SIC) System Identification Code

NOTE: The up-to-date list of SACs is published on the Eurocontrol Web Site (http://www.eurocontrol.int/asterix).

5.2.3 Data Item I019/140, Time of Day

Definition: Absolute time stamping expressed as UTC.
Format: Three-octet fixed length Data Item.
Structure:



bit-1 (LSB) 1/128 s

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

5.2.4 Data Item I019/550, 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		

Encoding Rule:

This data item shall only be sent once every minute, or event driven, if the status has changed.

NOTE: A time source is considered as valid when either externally synchronised or running on a local oscillator within the required accuracy of UTC.

5.2.5 Data Item I019/551, Tracking Processor Detailed Status

Definition: Information concerning the configuration and status of the Tracking processors.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
TP 1	TP 1	TP2	TP2	TP 3	TP 3	TP4	TP4

bit-8	TP 1	= 1	Exec
		= 0	Standby
bit-7	TP 1	= 1	Good
		= 0	Faulted
bit-6	TP 2	= 1	Exec
		= 0	Standby
bit-5	TP 2	= 1	Good
		= 0	Faulted
bit-4	TP 3	= 1	Exec
		= 0	Standby
bit-3	TP 3	= 1	Good
		= 0	Faulted
bit-2	TP 4	= 1	Exec
		= 0	Standby
bit-1	TP 4	= 1	Good
		= 0	Faulted

Note: Both Bits of one TP set to zero means, that this TP is not used in the system.

Encoding Rule:

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

5.2.6 Data Item I019/552, Remote Sensor Detailed Status

Definition: Information concerning the configuration and status of the Remote Sensors (RS)

Format: Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one report comprising a status of one Remote Sensor (RS).

Structure:

Octet no. 1

24	23	22	21	20	19	18	17
REP							

Octet no. 2 Octet no. 3

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
RS Identification								RS Type				Status			

bits-24/17	(REP)	Repetition factor
bits-16/9	RS Identification	8-bit Identification number of RS
bits-8/5	RS Type	4-bit Type of RS
bits-4/1	Status	
bit-8	Spare bit set to zero	0
bit-7	Receiver 1090 MHz	= 1 present
bit-6	Transmitter 1030 MHz	= 1 present
bit-5	Transmitter 1090 MHz	= 1 present
bit-4	RS Status	= 1 Good
		= 0 Faulted
bit-3	RS Operational	= 1 Online
		= 0 Offline
bit-2	Spare bit set to zero	0
bit-1	Spare bit set to zero	0

Encoding Rule:

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

5.2.7 Data Item I019/553, Reference Transponder Detailed Status

Definition: Information concerning the configuration and status of the Reference Transponder.

Format: Variable length Data Item comprising a first part of one-octet, followed by one-octet extents as necessary (depending on the number of Reference Transponders).

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Ref Trans 1		Spare	Spare	Ref Trans 2		Spare	FX

bit-8/7	Ref Trans 1 Status	= 11	Good
		= 10	Faulted
		= 01	Warning
		= 00	
bit-6	Spare bit set to zero		
bit-5	Spare bit set to zero		
bit-4/3	Ref Trans 2 Status	= 11	Good
		= 10	Faulted
		= 01	Warning
		= 00	
bit-2	Spare bit set to zero		
bit-1	FX	= 0	End of Data Item
		= 1	Extension into first extent

Structure of First Extent:

Octet no. 2

8	7	6	5	4	3	2	1
Ref Trans 3		Spare	Spare	Ref Trans 4		Spare	FX

bit-8/7	Ref Trans 3 Status	= 11	Good
		= 10	Faulted
		= 01	Warning
		= 00	
bit-6	Spare bit set to zero		
bit-5	Spare bit set to zero		
bit-4/3	Ref Trans 4 Status	= 11	Good
		= 10	Faulted
		= 01	Warning
		= 00	
bit-2	Spare bit set to zero		
bit-1	FX	= 0	End of Data Item
		= 1	Extension into first extent

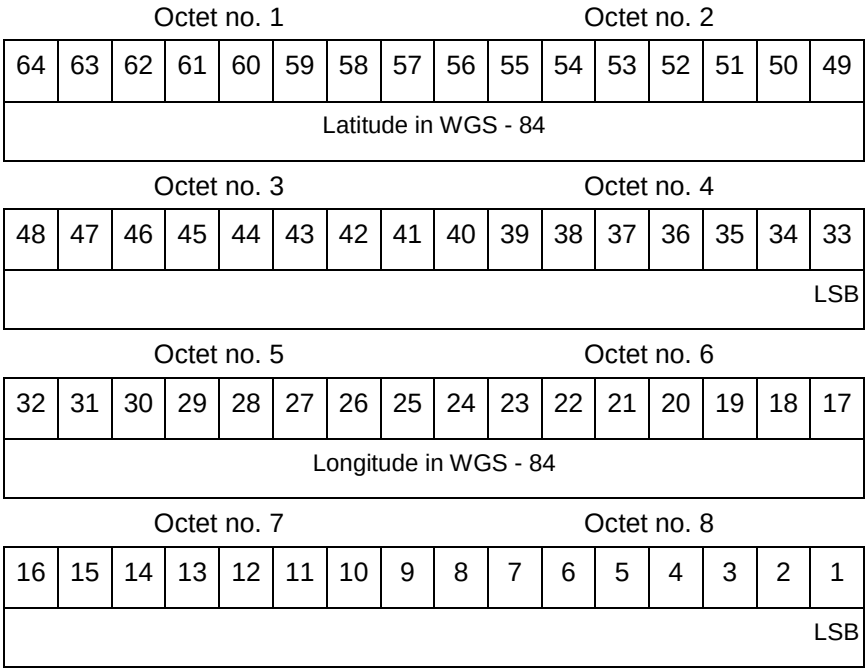
This goes on as many as Reference Transponders are available.

Encoding Rule:

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

5.2.8 Data Item I019/600, Position of the MLT System Reference Point

Definition : Position of the MLT reference point 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)	= $180/2^{30}$ degrees
bits-32/1	(Longitude)	In WGS-84 in two's complement. Range -180 <= longitude < 180 deg.
	(LSB)	= $180/2^{30}$ degrees

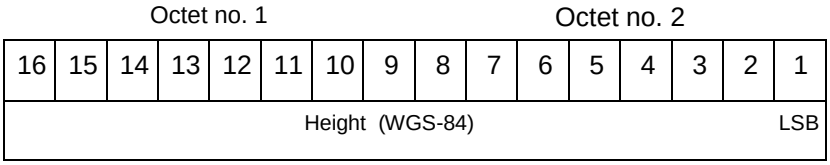
The LSB provides a resolution better than 0.02m.

5.2.9 Data Item I019/610, Height of the MLT System Reference Point

Definition: Height of the MLT system reference point in two's complement form. The height shall use mean sea level as the zero reference level.

Format: Two-octet fixed length Data Item.

Structure:



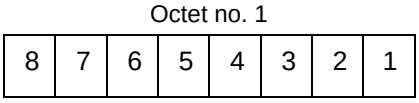
bits-16/1 Height (WGS-84) above MSL
LSB= 0.25 m
Range= +/- 8 192 m

5.2.10 Data Item I019/620, WGS-84 Undulation

Definition: WGS-84 undulation value of the MLT system reference point, in meters. Geoid undulation value is the difference between the ellipsoidal height and the height above mean sea level

Format: One-octet fixed length Data Item.

Structure:



bits-8/1 WGS-84 Undulation value (MSL)
LSB= 1 m
Range= +/- 127 m

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	I019/010	Data Source Identifier	2
2	I019/000	Message Type	1
3	I019/140	Time of Day	3
4	I019/550	System Status	1
5	I019/551	Tracking Processor Detailed Status	1
6	I019/552	Remote Sensor Detailed Status	1+
7	I019/553	Reference Transponder Detailed Status	1+
FX	-	Field Extension Indicator	-
8	I019/600	Position of the MLT System Reference point	8
9	I019/610	Height of the MLT System Reference point	2
10	I019/620	WGS-84 Undulation	1
11	-	Spare	-
12	-	Spare	-
13	RE	Reserved Expansion Field	-
14	SP	Special Purpose 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.