Proyectos de Gestión de Tránsito Aéreo

ASTERIX

18/09/2025

eetac
Escola d'Enginyeria de Telecomunicació i Aeroespacial de Castelldefels
UNIVERSITAT POLITÈCNICA DE CATALUNYA

¿WHAT IS ASTERIX?

***A**ll-purpose **s**truc**t**ured **E**UROCONTROL su**r**veillance **i**nformation e**x**change*

ASTERIX is a set of documents defining the low level ('down to the bit') implementation of a data format used for exchanging surveillance-related information and other ATM applications.

ASTERIX is designed for communication media with limited bandwidth. This is why it follows rules that enable it to transmit all the information needed, with the smallest data load possible.

Eurocontrol ASTERIX

Definitions (3)

LET'S START WITH ASTERIX!

All the information in these slides is extracted from Eurocontrol Specifications documents. This presentation is only a breaf explanation of ASTERIX. To know more about the topic check these documents uploaded in ATENEA.

3.1 Definitions

For the purposes of this EUROCONTROL Specification, 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. This principle is used until and including edition 2.1 of Part 1.
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.

Source Eurocontrol

Organisation of the Data (4.2)

The data exchanged over the communication medium between the different users shall be classified into Data Categories.

The purpose of such a classification shall be to:

- *-Allow easy identification and subsequent processing of the data*
- *-Facilitate the dispatching of the data to the appropriate application task in the receiving unit*

Up to 256 Data Categories defined:

- *-Data Categories 000 to 127 for standard civil and military applications;*
- *-Data Categories 128 to 240 reserved for special civil and military applications;*
- *-Data Categories 241 to 255 used for both civil and military non-standard applications*

ASTERIX Categories 1

CAT	Description Latest Available Edition (REF = Reserved Expansion Field)	Data Source / Remarks	Part	Blocking Allowed (Note 1)	AMG Relation (Note 2)
CAT000	Time Synchronisation Messages	The use of this category by MADAP has been terminated and it will no longer be maintained by the AMG!	-	Yes	Managed
CAT001	Monoradar Data Target Reports, from a Radar Surveillance System to an SDPS (plots and tracks from PSRs, SSRs, MSSRs, excluding Mode S and ground surveillance) Edition: 1.4, dated 18 August 2022	Replaced by CAT048	2a	Yes	Managed
CAT002	Monoradar Service Messages (status, North marker, sector crossing messages) Edition: 1.1, dated 01 April 2021	Replaced by CAT034	2b	Yes	Managed
CAT003	Distribution of Synthetic Air Traffic Data	The use of this category by MADAP has been terminated and it will no longer be maintained by the AMG!	-	Yes	Managed
CAT004	Safety Nets Messages Edition: 1.12, dated 28 October 2020 REF: Edition 1.3, dated 24 February 2020	Safety Nets Server	17	Yes	Managed
CAT007	Directed Interrogation Messages Edition 1.11, dated 19 April 2022 REF: Edition 1.7, dated 19 April 2022	Mode-S Station	21	Yes	Managed
CAT008	Monoradar Derived Weather Information Edition 1.3, dated 01 April 2021	Monoradar	3	Yes	Managed
CAT009	Multisensor Derived Weather Information Edition 2.1, dated 22 October 2014	Multi-sensor weather system Used by the DWD - Deutscher Wetterdienst	-	Yes	Managed
CAT010	Monosensor Surface Movement Data Edition 1.1, dated 01 March 2007	Surface Movement Radar	7	Yes	Managed
CAT011	Advanced-SMGCS Data Edition 1.3, dated 11 May 2020	A-SMGCS System	8	Yes	Managed
CAT012	Monoradar Target Reports	Reserved for PAR	22	No	Managed
CAT013	Monoradar Service Messages	Reserved for PAR	23	No	Managed
CAT014	Monoradar Weather Reports	Reserved for PAR	24	No	Managed

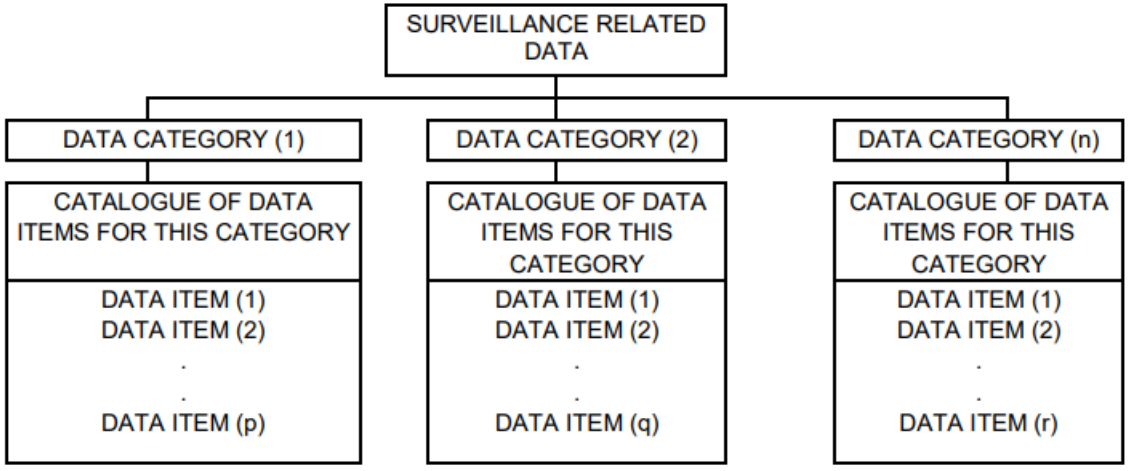
ASTERIX Categories 2

CAT	Description Latest Available Edition (REF = Reserved Expansion Field)	Data Source / Remarks	Part	Blocking Allowed (Note 1)	AMG Relation (Note 2)
CAT015	INCS (Independent Non-Cooperative Surveillance) Target Reports Edition 1.1, dated 19 March 2021	INCS Systems	28	No	Managed
CAT016	INCS Configuration Reports Edition 1.0, dated 15 July 2019	INCS Systems	30	No	Managed
CAT017	Mode S Surveillance Co-ordination Function messages Edition 1.3, dated 01 January 2009 REF: Edition 1.0, dated 01 June 2005	Mode-S Station	5	Yes	Managed
CAT018	Mode S Data-Link Function messages Edition 1.7, dated 08 November 2015	Mode-S Station	6	Yes	Managed
CAT019	MLT System Status Messages Edition 1.3, dated 01 December 2010	Multilateration Ground Station	18	Yes	Managed
CAT020	MLT Messages Edition 1.10, dated 19 February 2021 REF: Edition 1.4, dated 11 December 2020	Multilateration Ground Station	14	Yes	Managed
CAT021	ADS-B Messages 2.6, dated 21 December 2021 REF: Edition 1.5, dated 21 December 2021	ADS-B Ground Station	12	Yes	Managed
CAT022	TIS-B Management Messages	Reserved for ADS-B Ground Station	13	Yes	Managed
CAT023	CNS/ATM Ground Station Service Messages Edition 1.3, dated 27 September 2021	ADS-B Ground Station	16	Yes	Managed
CAT024	ADS-C Messages	Reserved for ADS-C Ground Station	25	Yes	Managed
CAT025	CNS/ATM Ground System Status Report Edition 1.5, dated 01 July 2021	ATM Ground Systems	26	No	Managed
CAT030	Exchange of Air Situation Pictures	*Obsolete ARTAS category – Removed from ASTERIX Website*	-	Yes	Coordinated
CAT031	Sensors Information messages	Obsolete *ARTAS category* – Removed from ASTERIX Website	-	Yes	Coordinated
CAT032	Miniplan Reports to an SDPS Edition 1.1, dated 11 December 2020 REF: Edition 1.0, 30 August 2021	Flight Data Processing System (FDPS)	29	Yes	Managed
CAT033	ADS-B Messages Edition 1.1, dated 06 April 2021	ADS-B Ground Station - *Reserved for FAA*	-	Yes	Coordinated

ASTERIX Categories 3

CAT	Description Latest Available Edition (REF = Reserved Expansion Field)	Data Source / Remarks	Part	Blocking Allowed (Note 1)	AMG Relation (Note 2)
CAT034	Transmission of Monoradar Service Messages Edition 1.29, dated 15 March 2021	PSR Radar SSR Radar M-SSR Radar Mode-S Station	2b	Yes	Managed
CAT048	Monoradar Target Reports Edition 1.31, 03 October 2022 REF: Edition 1.11, 01 December 2022	PSR Radar SSR Radar M-SSR Radar Mode-S Station	4	Yes	Managed
CAT061	SDPS Session and Service Control Messages Edition 1.2, dated 30 April 2007	Surveillance Data processing System (SDPS)	11	Yes	Managed
CAT062	System Track Data Edition 1.20, dated 13 February 2023 REF: Edition 1.3, dated 13 February 2023	Surveillance Data processing System (SDPS)	9	Yes	Managed
CAT063	Sensor Status Messages Edition 1.6, dated 04 August 2020 REF: Edition 1.0, dated 04 August 2020	Surveillance Data processing System (SDPS)	10	Yes	Managed
CAT065	SDPS Service Status Messages Edition 1.6, dated 21 March 2023 REF: Edition 1.2, dated 21 March 2023	Surveillance Data processing System (SDPS)	15	Yes	Managed
CAT094	System Track Data	Surveillance Data processing System (SDPS) *Next version of Category 062 – Under development*	9	No	Managed

Organisation of the Data (4.2)



	USER APPLICATION PROFILE							
	DATA FIELD (1)	DATA FIELD (2)	DATA FIELD (3)	DATA FIELD (4)	DATA FIELD (5)	DATA FIELD (6)	DATA FIELD (7)	DATA FIELD (8)
DATA ITEM (1)		x						
DATA ITEM (2)						x		
DATA ITEM (3)	x							
DATA ITEM (4)				x				
DATA ITEM (5)								
...								
DATA ITEM (x)			x					
DATA ITEM (x + 1)								x
...								
DATA ITEM (q)					x			

Source Eurocontrol

Data Items and Catalogue of Data Items (4.2.2-4.2.4)

A Data Item is the smallest unit of information defined and standardised. For each Data Category, a Catalogue of Data Items shall be standardised

Each Data Item shall be given a unique reference which unambiguously identifies this item in the relevant catalogue

The Data Item symbolic reference shall consist of an eight-character reference of the form Innn/AAA, where:

- *-I indicates that this represents a Data Item;*
- *-nnn is a three digit decimal number which indicates the Data Category to which this Data Item belongs (000 to 255);*
- *-AAA is a three digit decimal number which indicates the data item.*

For the purpose of communication, the various Data Items shall be assigned to Data Fields, each having a length of an integral number of octets and referenced by a Field Reference Number (FRN).

The correspondence between Data Items and Data Fields shall be standardised for each relevant application by the User Application Profile (UAP). The UAP should be unique per Category

Examples of Data Items and Catalogue of Data Items

Data Item Ref. No.	Description
I034/000	Message Type
I034/010	Data Source Identifier
I034/020	Sector Number
I034/030	Time of Day
I034/041	Antenna Rotation Period
I034/050	System Configuration & Status
I034/060	System Processing Mode
I034/070	Message Count Values
I034/090	Collimation Error
I034/100	Generic Polar Window
I034/110	Data Filter
I034/120	3D-position of source

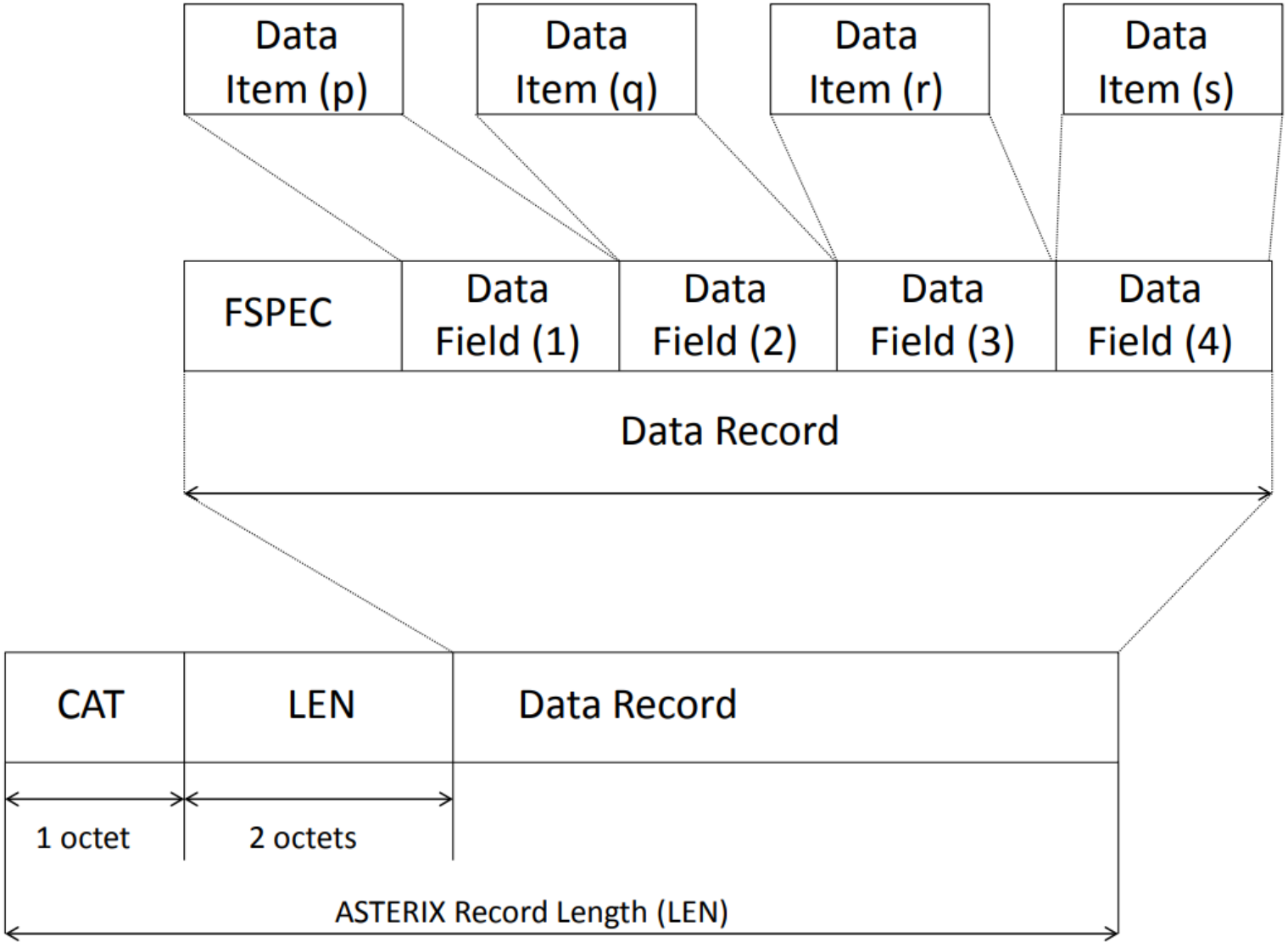
Data Item Ref. No.	Description
I008/000	Message Type
I008/010	Data Source Identifier
I008/020	Vector Qualifier
I008/034	Sequence of Polar Vectors in SPF Notation
I008/036	Sequence of Cartesian Vectors in SPF Notation
I008/038	Sequence of Weather Vectors in SPF Notation
I008/040	Contour Identifier
I008/050	Sequence of Contour Points in SPF Notation
I008/090	Time of Day
I008/100	Processing Status
I008/110	Station Configuration Status
I008/120	Total number of Items Constituting One Weather Picture

Data Item Reference Number	Description
I021/008	Aircraft Operational Status
I021/010	Data Source Identification
I021/015	Service Identification
I021/016	Service Management
I021/020	Emitter Category
I021/040	Target Report Descriptor
I021/070	Mode 3/A Code
I021/071	Time of Applicability for Position
I021/072	Time of Applicability for Velocity
I021/073	Time of Message Reception for Position
I021/074	Time of Message Reception for Position – High Precision
I021/075	Time of Message Reception for Velocity
I021/076	Time of Message Reception for Velocity – High Precision
I021/077	Time of Report Transmission
I021/080	Target Address
I021/090	Quality Indicators
I021/110	Trajectory Intent
I021/130	Position in WGS-84 co-ordinates
I021/131	Position in WGS-84 co-ordinates, high resolution
I021/132	Message Amplitude
I021/140	Geometric Height
I021/145	Flight Level
I021/146	Selected Altitude
I021/148	Final State Selected Altitude
I021/150	Air Speed
I021/151	True Air Speed
I021/152	Magnetic Heading
I021/155	Barometric Vertical Rate
I021/157	Geometric Vertical Rate
I021/160	Airborne Ground Vector
I021/161	Track Number
I021/165	Track Angle Rate
I021/170	Target Identification
I021/200	Target Status
I021/210	MOPS Version
I021/220	Met Information
I021/230	Roll Angle
I021/250	Mode S MB Data
I021/260	ACAS Resolution Advisory Report
I021/271	Surface Capabilities and Characteristics
I021/295	Data Ages
I021/400	Receiver ID

Data Item Ref. No.	Description
I048/010	Data Source Identifier
I048/020	Target Report Descriptor
I048/030	Warning/Error Conditions/Target Classification
I048/040	Measured Position in Slant Polar Co-ordinates
I048/042	Calculated Position in Cartesian Co-ordinates
I048/050	Mode-2 Code in Octal Representation
I048/055	Mode-1 Code in Octal Representation
I048/060	Mode-2 Code Confidence Indicator
I048/065	Mode-1 Code Confidence Indicator
I048/070	Mode-3/A Code in Octal Representation
I048/080	Mode-3/A Code Confidence Indicator
I048/090	Flight Level in Binary Representation
I048/100	Mode-C Code and Confidence Indicator
I048/110	Height Measured by a 3D Radar
I048/120	Radial Doppler Speed
I048/130	Radar Plot Characteristics
I048/140	Time of Day
I048/161	Track/Plot Number
I048/170	Track Status
I048/200	Calculated Track Velocity in Polar Representation
I048/210	Track Quality
I048/220	Aircraft Address
I048/230	Communications / ACAS Capability and Flight Status
I048/240	Aircraft Identification
I048/250	Mode S MB Data
I048/260	ACAS Resolution Advisory Report

Source Eurocontrol

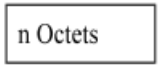
The General Message Structure (4.3)



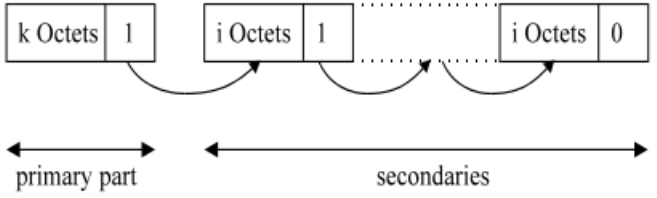
Standard Data Field Formats (4.3.4)

The length of Standard Data Fields shall be either fixed or variable, as defined below:

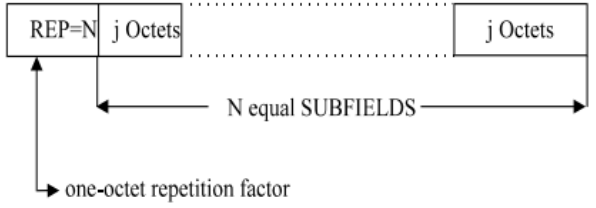
-Fixed length Data Fields shall comprise a fixed number of octets.



-Extended length Data Fields being of a variable length, shall contain a primary part of predetermined length, immediately followed by a number of secondary parts, each of predetermined length. The presence of the next following secondary part shall be indicated by the setting to one of the Least Significant Bit (LSB) of the last octet of the preceding part (either the primary part or a secondary part). This bit which is reserved for that purpose is called the Field Extension Indicator (FX).



Repetitive Data Fields, depicted in Figure 3, being of a variable length, shall comprise a one-octet Field Repetition Indicator (REP) signalling the presence of N consecutive sub-fields each of the same pre-determined length.



Standard Data Field Formats (4.3.4)

The length of Standard Data Fields shall be either fixed or variable, as defined below:

-Compound Data Fields, depicted in Figure 4, being of a variable length, shall comprise a primary subfield, followed by data subfields. The primary subfield determines the presence or absence of the subsequent data subfields. It comprises a first part of one octet extendible using the Field Extension (FX) mechanism. The definition, structure and format of the data subfields are part of the description of the relevant Compound Data Item. Data subfields shall be either fixed length, extended length, explicit length or repetitive, but not compound

Primary Subfield

Octet No.1

8	7	6	5	4	3	2	1
SF1	SF2	SF3	SF4	SF5	SF6	SF7	FX

bits-8/2	(SF n)	= 0	Absence of Subfield n
		= 1	Presence of Subfield n
bit-1	(FX)	= 0	End of Primary Subfield
		= 1	Extension of Primary Subfield into next octet

Data Subfield No 1

Octet No.1 Octet No.2

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Item of Information 1															

.
.
.
.
.

Data Subfield No 7

Octet No.1

8	7	6	5	4	3	2	1
Item of Information 7							

Field Organisation (4.3.7)

In a Record, Data Fields shall be sent in the order of increasing FRNs

The minimum length of the FSPEC field shall be one octet, which allows the composition of Records consisting of any combination of Data Fields with FRNs from one up to and including seven

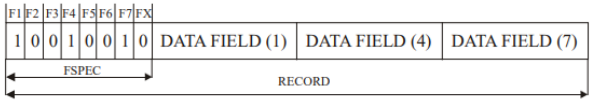
When Data Fields with FRNs greater than seven have to be transmitted the FSPEC extension mechanism shall be used. The LSB in the FSPEC field is called the Field Extension Indicator (FX)

STRUCTURE OF THE FIELD SPECIFICATION (FSPEC)

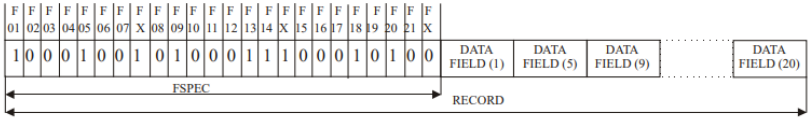
F1 to F7: FIELD PRESENCE INDICATOR | = 0 Data Field not present | = 1 Data Field present

FX : FIELD EXTENSION INDICATOR | = 0 No Field Specification extension | = 1 Following octet contains a Field Specification extension

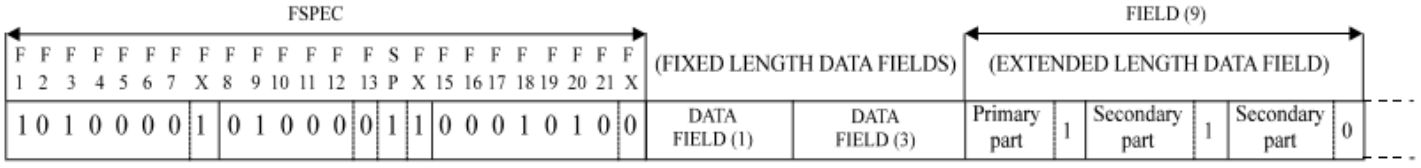
EXAMPLE OF ONE-OCTET FSPEC

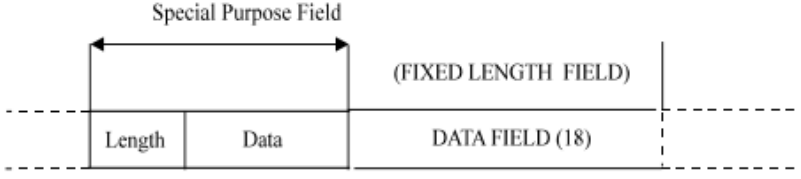


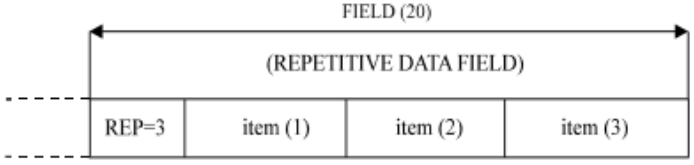
EXAMPLE OF A MULTI-OCTET FSPEC



Overall record structure example







Conventions (5)

All bit positions within a one octet field shall be numbered right to left from one to eight.

For a field consisting of n octets (with n>1):

The octets shall be numbered left to right from one to n;

The bit positions shall be numbered right to left from one to n x 8.

With an FSPEC field the following exceptions for bit positions shall apply:

In a one-octet FSPEC the bits will be numbered left to right from one to eight;

In a FSPEC consisting of p octets (with p>1) the bits will be numbered left to right from one to px8.

Negative values shall be represented in two's complement form.

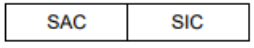
Time stamping shall be expressed as Co-ordinated Universal Time (UTC)

ASTERIX ADDRESSING SCHEME (6)

In order to avoid ambiguity, every system shall have a unique identification in an area where ASTERIX is used for the exchange of data.

To allow for flexible adaptation of the system configuration to user requirements, virtualisation of an ASTERIX system shall be permitted resulting in the allocation of more than one SIC to a physical ASTERIX system. The allocation of the SAC remains the responsibility of the AMG (ASTERIX Maintenance Group)

The ASTERIX System Identifier format shall be composed of two subfields as illustrated below:



	Field Name	Element Type	Field Size
SAC	System Area Code	Binary	One octet
SIC	System Identification Code	Binary	One octet

ASTERIX ADDRESSING SCHEME (6)

In order to avoid ambiguity, every system shall have a unique identification in an area where ASTERIX is used for the exchange of data.

System Area Code (SAC)

The SAC field shall consist of an eight-bit number assigned to a geographical area or a country.

The SAC field format shall be as:

b	b	b	b	b	b	b	b

where b represents a binary digit

System Identification Code (SIC)

The SIC shall consist of an eight-bit number assigned to every system (surveillance station, processing system, server, etc.) located in the geographical area or country defined by the SAC.

SAC ALLOCATION EXAMPLE

SAC(Hexa)	Country/Geographical Area	Binary Representation
10		
11	Ukraine	0001 0001
12	Monaco	0001 0010
13		
14	Spain	0001 0100
15		
16	Hungary	0001 0110
17	Bosnia-Herzegovina	0001 0111
18	Republic of North Macedonia	0001 1000
19	Croatia	0001 1001