EUROCONTROL Specification for Surveillance Data Exchange

ASTERIX Part 31 Category 205 Radio Direction Finder Reports

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ASTERIX Part 31 Category 205 Radio Direction Finder Reports

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Abstract

This document specifies the contents of ASTERIX Category 205 reports used for the transmission of Radio Direction Finder Reports.

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DOCUMENT APPROVAL

This document has been approved by the ASTERIX Maintenance Group (AMG).

For management approval of the complete set of ASTERIX documentation refer to Part 1.

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1. INTRODUCTION

1.1 Scope of ASTERIX Category 205

This document describes the application of ASTERIX to Radio Direction Finder Reports.

This document defines the data out of Category 205. Status information of RDF receivers or RDF systems should be sent using ASTERIX Category 025.

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 Specification SPEC-0149, edition 2.4, 24 October 2016
"EUROCONTROL Specification for Surveillance Data Exchange – Part 1 All Purpose Structured EUROCONTROL Surveillance Information Exchange – ASTERIX".

3. DEFINITIONS, ACRONYMS AND ABBREVIATIONS

3.1 Definitions

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

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).
Data Category:	Classification of the data in order to permit inter alia an easy identification.
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.
Data Item:	The smallest unit of information in each Data Category.
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.
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 reports.

3.2 Acronyms and Abbreviations

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

°	Degree (angle)
AGL	Above Ground Level
AMG	ASTERIX Maintenance Group
ASTERIX	**A**ll Purpose **ST**ructured EUROCONTROL su**R**veillance **I**nformation E**X**change
CAT	Data Category
FRN	Field Reference Number
FSPEC	Field Specification
FX	Field Extension Indicator
ICAO	International Civil Aviation Organization
LEN	Length Indicator
LSB	Least Significant Bit
RDF	Radio Direction Finder
RE	Reserved Expansion Indicator
REP	Field Repetition Indicator
s	second, unit of time
SAC	System Area Code
SIC	System Identification Code
SP	Special Purpose Indicator
UAP	User Application Profile (see Definitions)
UTC	Coordinated Universal Time
WGS-84	World Geodetic System 1984

4. GENERAL PRINCIPLES

4.1 General

ASTERIX Category 205, Radio Direction Finder Reports, defines a message structure allowing transmitting RDF Sensor Reports as well as reports from an RDF processing system, providing positional information as result of this processing.

4.2 Time Management

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 Records

A single User Application Profile (UAP) is defined and shall be used for RDF Sensor Reports and RDF Processing System Reports.

The composition of ASTERIX records of Category 205 shall follow the rules as described in Edition 2.2 (or later) of Part 1 of the ASTERIX documentation, chapter 4.3.2.5.

Data records shall have the following layout.

CAT = 205	LEN	FSPEC	Data Item	Data Item	Data Item

where:

- Data Category (CAT) = 205, is a one-octet field indicating that the record contains information defined for Radio Direction Finder Reports;
- Length Indicator (LEN) is a two-octet field indicating the total length in octets of the record, including the CAT and LEN fields;
- FSPEC is the Field Specification.

Note: Blocking of multiple records sharing a single CAT and LEN field pair is not supported for Category 205 records.

4.5 Composition of Records

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

When sent, items shall always be transmitted in a record with the corresponding FSPEC Bits set to one.

4.6 Implementation Dependent Data Items

To prevent ambiguities in interpretation, content and encoding of data items is defined as accurately as possible. However, there are conditions, which do not allow such strict definition and where there may be differences in the implementation depending on the system.

Such a data item will be marked as “implementation dependent” in a note. The exact meaning of the data item shall then be described in the Interface Control Document (ICD) of the respective system. In such a case, the provisions of the ICD will reflect the actual implementation of the data item.

In this specification, the following data items are marked as “implementation dependent”:

- I205/100 (Quality of Measurement)
- I205/120 (Contributing Sensors)
- I205/170 (Sensor Identification)

5. LAYOUT OF REPORTS

5.1 Standard Data Items

The standardised Data Items, which shall be used for the transmission of UAS Identification and Target Reports, are defined in Table 1 and described in the following pages.

Table 1 - Data Items of Category 205

Data Item Reference Number	Description	Resolution
I205/000	Message Type	N.A.
I205/010	Data Source Identifier	N.A.
I205/015	Service Identification	N.A.
I205/030	Time of Day	1/128 s
I205/040	Report Number	N.A.
I205/050	Position in WGS-84 Coordinates	$180/2^{25}$ deg
I205/060	Position in Cartesian Coordinates	0.5 m
I205/070	Local Bearing	0.1 deg
I205/080	System Bearing	0.1 deg
I205/090	Radio Channel Name	N/A
I205/100	Quality of Measurement	N/A
I205/110	Estimated Uncertainty	100 m
I205/120	Contributing Sensors	N/A
I205/130	Conflicting Transmitter Position in WGS-84 Coordinates	$180/2^{25}$ deg
I205/140	Conflicting Transmitter Position in Cartesian Coordinates	0.5 m
I205/150	Conflicting Transmitter Estimated Uncertainty	100 m
I205/160	Track Number	N/A
I205/170	Sensor Identification	N/A
I205/180	Signal Level	0.01 dBµV
I205/190	Signal Quality	N/A
I205/200	Signal Elevation	0.01 deg

5.2 Description of Standard Data Items

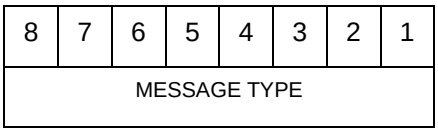
5.2.1 Data Item I205/000, Message Type

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

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1



bits-8/1 (TYP) Message Type

Notes: The following set of Message Types is standardized for category 205 records:

001 System Position Report

002 System Bearing Report

003 System Position Report of conflicting transmission

004 System Detection End Report

005 Sensor Data Report

Encoding Rule : See Table 2.

The list of items present for the message types is defined in Table 2. M stands for mandatory, O for optional, C for conditional (depending on other factors as specified in the respective footnote) and X for never present.

Item	Type	001 System Position Report	002 System Bearing Report	003 System Position Report of conflicting transmiss.	004 System Detection End Rport	005 Sensor Data Report
I205/000	Message Type	M	M	M	M	M
I205/010	Data Source Identifier	M	M	M	M	M
I205/015	Service Identification	O	O	O	O	O
I205/030	Time of Day	C[1]	C[1]	C[1]	C[1]	C[1]
I205/040	Report Number	M	M	M	O	X
I205/050	Position in WGS-84 Coordinates	C[2]	C[2]	C[2]	X	X
I205/060	Position in Cartesian Coordinates	C[2]	C[2]	C[2]	X	X
I205/070	Local Bearing	X	C[3]	X	X	M
I205/080	System Bearing	X	C[4]	X	X	X
I205/090	Radio Channel Name	M	M	M	M	M
I205/100	Quality of Measurement	O	O	O	X	X
I205/110	Estimated Uncertainty	M	X	M	X	X
I205/120	Contributing sensors	O	O	O	X	X
I205/130	Conflicting Transmitter Position in WGS-84 Coordinates	X	X	O	X	X
I205/140	Conflicting Transmitter Position in Cartesian Coordinates	X	X	O	X	X
I205/150	Conflicting Transmitter Estimated Range	X	X	O	X	X
I205/160	Track Number	O	X	X	X	X
I205/170	Sensor Identification	X	X	X	X	C[5]
I205/180	Signal Level	X	X	X	X	O
I205/190	Signal Quality	X	X	X	X	O
I205/200	Signal Elevation	X	X	X	X	O

Table 2: Encoding Rules per Message Type

1 Item sent in all reports, except in case of failure of all Time Sources.

2 For Message Types 1, 2 and 3, at least one of the items I205/050 or I205/060 shall be sent.

3 For Message Type 2, if the position is given with item I205/050, item I205/070 shall be sent too.

4 For Message Type 2, if the position is given with item I205/060, item I205/080 shall be sent too.

5 For Message Type 5, if the RDF Sensor SAC/SIC is not unique, item I205/170 is mandatory.

5.2.2 Data Item I205/010, Data Source Identifier

Definition: Identification of the Radio Direction Finder System or Sensor from which the report 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

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

Encoding Rule : See Table 2

5.2.3 Data Item I205/015, Service Identification

Definition: Identification of the service provided to one or more users.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
SRV							

bits 8/1 (SRV) Service Identification

Notes: The service identification is allocated by the system.

Encoding Rule : See Table 2

5.2.4 Data Item I205/030, Time of Day

Definition: UTC time of transmission of this ASTERIX message.

Format: Three-octet fixed length Data Item.

Structure

Octet no. 1

24	23	22	21	20	19	18	17
Time of Day							

Octet no. 2 Octet no. 3

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Time of Day (continued)															LSB

bits-24/1	(TOD)	Time of Day (UTC) at which the ASTERIX message was transmitted LSB = 2^{-7} s = 1/128 s

Notes: The TOD value is reset to zero at every midnight UTC.

Encoding Rule : See Table 2.

5.2.5 Data Item I205/040, Report Number

Definition: Sequential and cyclic number of position detection reports.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Report Number							

bits 8/1 (Report Number) 0 <= Report Number < 256

Notes: The number is incremented if there is a new position or bearing detected, independent from the respective channel. The report number shall also be incremented if, during the ongoing position or bearing detection, the position or bearing value is deviating by a system-defined threshold from the previous one. If the message type (I205/000) changes to another Detection Report, the report number is incremented as well.

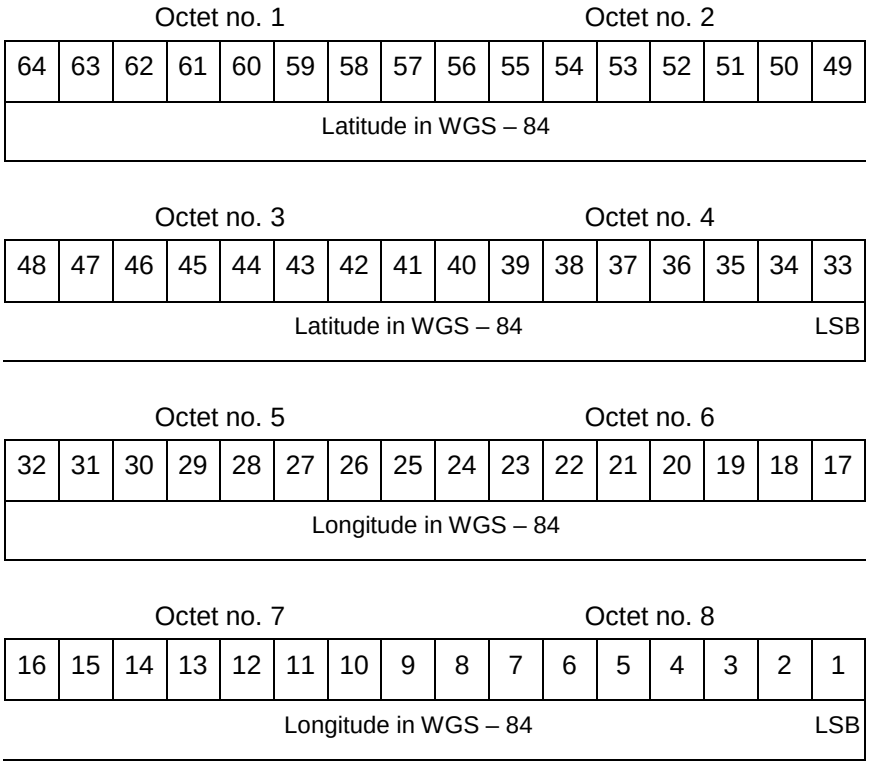
Encoding Rule : See Table 2.

5.2.6 Data Item I205/050, Position in WGS-84 Coordinates

Definition: Calculated position in WGS-84 Coordinates.

Format: Eight-octet fixed length Data Item.

Structure:



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

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

Notes: The LSB provides a resolution at least better than 0.6 meters.
For reports of Message Type 001 and 003, the item shall contain the estimated position of the transmitting aircraft.
For reports of Message Type 002, the item shall contain the position of the bearing starting point, i.e. the position of the respective RDF sensor.

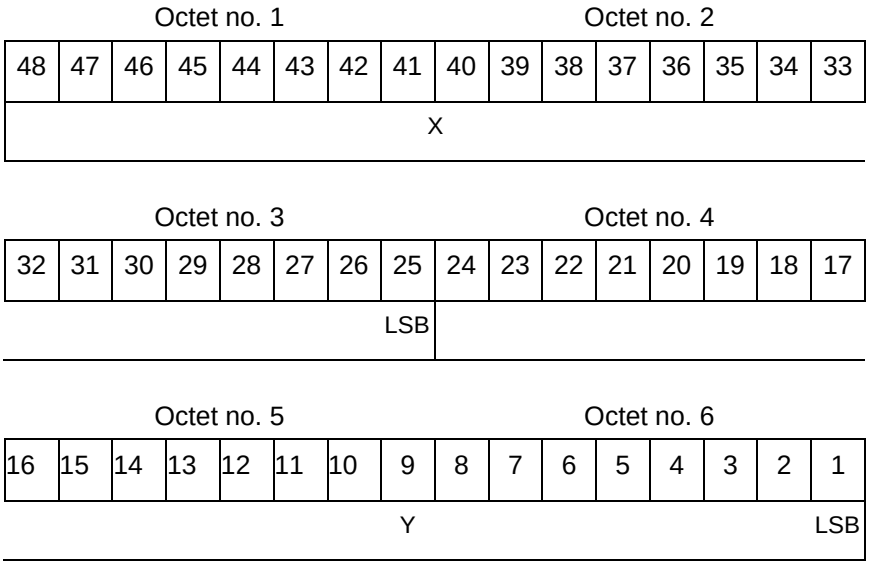
Encoding Rule : See Table 2.

5.2.7 Data Item I205/060, Position in Cartesian Coordinates

Definition: Calculated position in Cartesian Coordinates.

Format: Six-octet fixed length Data Item.

Structure:



bits-48/25	(X)	In Cartesian Coordinates in two's complement. LSB = 0.5 m.
bits-24/1	(Y)	In Cartesian Coordinates in two's complement. LSB = 0.5 m.

Notes: The Cartesian coordinates are relative to an agreed System Reference Point. The System Reference Point may be communicated in ASTERIX category 025, item 600.

For reports of Message Type 001 and 003, the item shall contain the estimated position of the transmitting aircraft.
For reports of Message Type 002, the item shall contain the position of the bearing starting point, i.e. the position of the respective RDF sensor.

Encoding Rule : See Table 2.

5.2.8 Data Item I205/070, Local Bearing

Definition: Bearing of the detected radio transmission, starting at the position contained in I205/050 and given relative to this position.

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
THETA															LSB

bits-16/1 (THETA) The angle is given in degrees, in clock-wise notation, starting with 0 degrees for the geographical North.
LSB = 0.01deg

0.00 deg <= THETA < 360.00 deg

Encoding Rule : See Table 2.

5.2.9 Data Item I205/080, System Bearing

Definition: Bearing of the detected radio transmission, starting at the position contained in I205/060, projected to the Cartesian Coordinate System relative to the System Reference Point (as used for I205/ 060).

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
THETA															LSB

bits-16/1 (THETA) The angle is given in degrees, in clock-wise notation, starting with 0 degrees for the geographical North.
LSB = 0.01deg

0.00 deg <= THETA < 360.00 deg

Encoding Rule : See Table 2.

5.2.10 Data Item I205/090, Radio Channel Name

Definition: Name of the channel the radio transmission is detected on.

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
NU1								NU2							

Octet no. 3 Octet no. 4

40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
NU3								NU4							

Octet no. 5 Octet no. 6

24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
NU5								NU6							

Octet no. 7

8	7	6	5	4	3	2	1
NU7							

Notes: NU1 till NU7 contain digits or a decimal point in ASCII representation, specifying the name of the radio channel. Channel names that could be provided with less than 6 digits shall be filled with trailing zeroes (e.g. 121.100).

This channel name is not identical with the actual physical frequency.

Encoding Rule : See Table 2.

5.2.11 Data Item I205/100, Quality of Measurement

Definition: Quality of the measurement provided by the Radio Direction Finder system.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Quality							

bits-8/1 (Quality)

Note: The actual meanings of the bits are application dependent.

Encoding Rule : See Table 2.

5.2.12 Data Item I205/110, Estimated Uncertainty

Definition: Uncertainty estimation of the RDF System. The transmitter is expected to be within the provided radius around the calculated position.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Range							

bits-8/1 (Range) LSB = 100 m,
0m <= Range <= 25.5 km

Encoding Rule : See Table 2.

5.2.13 Data Item I205/120, Contributing Sensors

Definition: The identification of the RDF sensors that contributed to the detection of the radio transmitter.

Format: Repetitive data item starting with a one-octet Field Repetition Indicator (REP) followed by at least one RDF receiver identification 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
IDENT							

Notes: The actual identification of the receivers is application dependent.

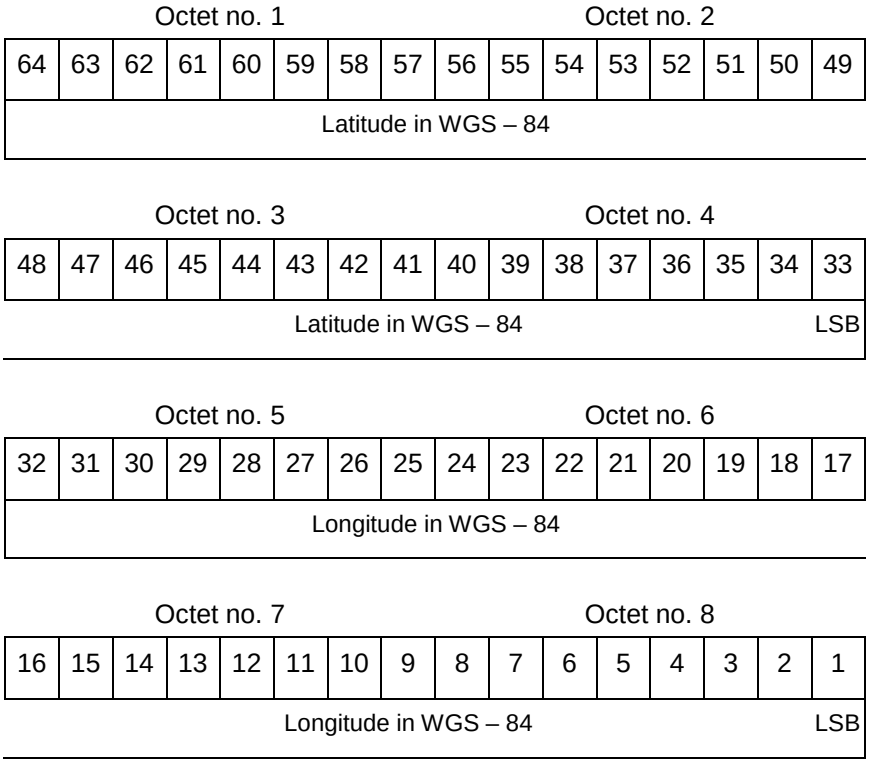
Encoding Rule : See Table 2..

5.2.14 Data Item I205/130, Conflicting Transmitter Position in WGS-84 Coordinates

Definition: Calculated position in WGS-84 Coordinates. This is the position of a second transmitter on the same frequency and overlapping in time with the transmitter position communicated in data item I205/050.

Format: Eight-octet fixed length Data Item.

Structure:



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

Notes: The LSB provides a resolution at least better than 0.6 meters.

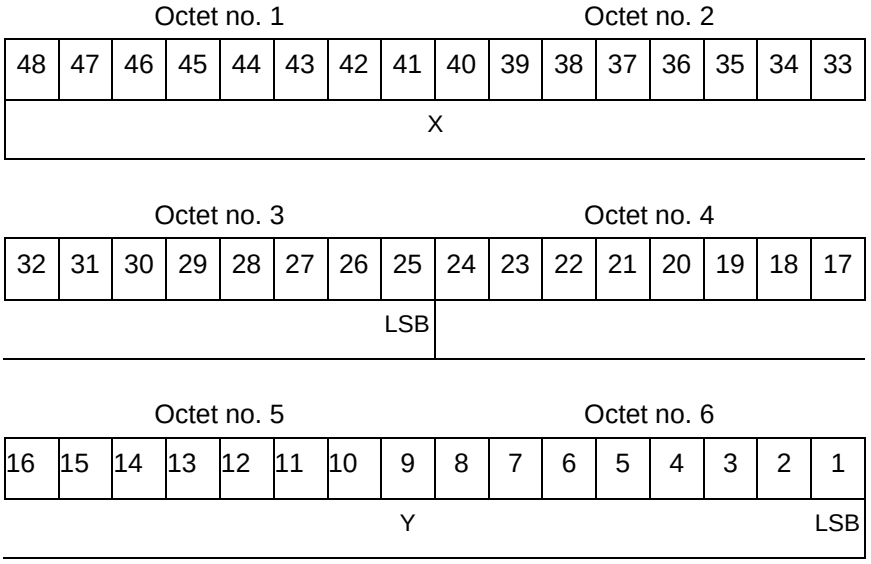
Encoding Rule : See Table 2..

5.2.15 Data Item I205/140, Conflicting Transmitter Position in Cartesian Coordinates

Definition: Calculated position in Cartesian Coordinates. This is the position of a second transmitter on the same frequency and overlapping in time with the transmitter position communicated in data item I205/060.

Format: Six-octet fixed length Data Item.

Structure:



bits-48/25	(X)	In Cartesian Coordinates in two's complement. LSB = 0.5 m.
bits-24/1	(Y)	In Cartesian Coordinates in two's complement. LSB = 0.5 m.

Notes: The Cartesian coordinates are relative to an agreed System Reference Point. The System Reference Point may be communicated in ASTERIX category 025, item 600.

Encoding Rule : See Table 2..

5.2.16 Data Item I205/150, Conflicting Transmitter Estimated Uncertainty

Definition: Range uncertainty estimation of the RDF System for the Conflicting Transmitter, i.e. a transmitter on the same frequency and with a timely overlapping transmission. The transmitter is estimated to be within the provided radius around the detected position.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Range							

bits-8/1 (Range) LSB = 100 m,
0m <= Range <= 25.5 km

Encoding Rule : See Table 2..

5.2.17 Data Item I205/160, Track Number

Definition: Unique identification of a track at the calculated RDF position.

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
	TRACK NUMBER															LSB

Encoding Rule : See Table 2..

5.2.18 Data Item I205/170, Sensor Identification

Definition: Unique identification of an RDF sensor.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
IDENT							

Notes: For Message Type 5 (Sensor Data Report) in I205/000, the item has to be used if there is no unique SAC/SIC defined for each RDF Sensor.

The actual identification number is application dependent.

Encoding Rule : See Table 2.

5.2.19 Data Item I205/180, Signal Level

Definition: The level of the signal received by an RDF sensor.

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
SIGNAL															LSB

bits-16/1 (SIGNAL) Signal Level in two’s complement
LSB = 1/100 dBµV (decibel microvolt)

Encoding Rule : See Table 2..

5.2.20 Data Item I205/190, Signal Quality

Definition: Relative quality of the received signal as estimated by the RDF sensor.

Format: One-octet fixed length Data Item.

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Quality							

bits-8/1	(Quality)	255 corresponds to the best quality, 0 to the worst quality.

Encoding Rule : See Table 2..

5.2.21 Data Item I205/200, Signal Elevation

Definition: The elevation of the signal received by an RDF sensor.

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
ELEVATION															LSB

bits-16/1 (ELEVATION) Elevation of the received signal in two's complement.
LSB = 1/100 deg (degree)
-90.00 deg <= ELEVATION <= 90.0 deg

Encoding Rule : See Table 2..

5.3 Transmission of Radio Direction Finder Reports

5.3.1 User Application Profile for Category 205

The User Application Profile (UAP) of Table 3 shall be used for the transmission of Radio Direction Finder reports.

Table 3 – UAP for Radio Direction Finder Reports

FRN	Data Item	Information	Length
1	I205/010	Data Source Identifier	2
2	I205/015	Service Identification	1
3	I205/000	Message Type	1
4	I205/030	Time of Day	3
5	I205/040	Report Number	1
6	I205/090	Radio Channel Name	7
7	I205/050	Position in WGS-84 Coordinates	8
FX	-	Field Extension Indicator	-
8	I205/060	Position in Cartesian Coordinates	6
9	I205/070	Local Bearing	2
10	I205/080	System Bearing	2
11	I205/100	Quality of Measurement	1
12	I205/110	Estimated Uncertainty	1
13	I205/120	Contributing Sensors	1+1*N
14	I205/130	Conflicting Transmitter Position in WGS-84 Coordinates	8
FX	-	Field Extension Indicator	-
15	I205/140	Conflicting Transmitter Position in Cartesian Coordinates	6
16	I205/150	Conflicting Transmitter Estimated Uncertainty	1
17	I205/160	Track Number	2
18	I205/170	Sensor Identification	1
19	I205/180	Signal Level	2
20	I205/190	Signal Quality	1
21	I205/200	Signal Elevation	2
FX	-	Field Extension Indicator	-

22	SP	Special Purpose Field	1+
23	-	Reserved for Future Use	-
24	-	Reserved for Future Use	-
25	-	Reserved for Future Use	-
26	-	Reserved for Future Use	-
27	-	Reserved for Future Use	-
28	-	Reserved for Future Use	-
FX	-	Field Extension Indicator	-

Notes:

1. The first column indicates the Field Reference Number (FRN) associated to each Data Item used in the UAP
2. 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-octet extensions as necessary.

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