

**EUROCONTROL Specification
for Surveillance Data
Exchange
ASTERIX Part 17
Category 004 Appendix A
Reserved Expansion Field**

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Abstract		
This document specifies the contents of the Reserved Expansion Field of ASTERIX Category 004 messages used for the transmission of Safety Net Messages.		
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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.

DOCUMENT CHANGE RECORD

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

EDITION NUMBER	EDITION DATE	REASON FOR CHANGE	PAGES AFFECTED
1.0	April 2008	Creation	All
1.1	August 2017	Migration to new Specification Template	All
		ET1 – Extended Information Target 1 added	2.5
		ET1 – Extended Information Target 1 added	2.6
		CON – Conflict Information added	2.7
		TTG – Time to Go added	2.8
		FBD – Deviation of Expected Flight Behaviour	2.9

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1. INTRODUCTION

1.1 Scope

This document describes the way to encode information in the Reserved Expansion Field of ASTERIX Cat 004 (Safety Net Messages).

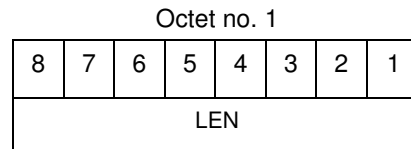
2. DESCRIPTION OF THE CONTENT OF THE RESERVED EXPANSION FIELD

2.1 Length Indicator

Definition : This field indicates the total length in octets of the Reserved Expansion Field (including the REF length indicator itself)

Format : One-octet fixed length Data Item

Structure:



bits 8-1

(LEN)

Length of REF in octets,
including the Length Indicator
itself.

Encoding Rule :

This item shall be present in every REF

2.2 Items indicator

Definition : This field indicates what are the items encoded in the REF
Format : Variable Length Data Item, comprising of a primary subfield of one octet, followed by one-octet extensions as necessary

Structure:

Octet no. 1							
8	7	6	5	4	3	2	1
TI1	TI2	ET1	ET2	CON	TTG	FBD	FX

bit 8	(TI1)	= 0	Information Target 1 is not present in the REF
		= 1	Information Target 1 is present in the REF
bit 7	(TI2)	= 0	Information Target 2 is not present in the REF
		= 1	Information Target 2 is present in the REF
bit 6	(ET1)	= 0	Extended Information Target 1 is not present in the REF
		= 1	Extended Information Target 1 is present in the REF
bit 5	(ET2)	= 0	Extended Information Target 2 is not present in the REF
		= 1	Extended Information Target 2 is present in the REF
bit 4	(CON)	= 0	Conflict Information is not present in the REF
		= 1	Conflict Information is present in the REF
bit 3	(TTG)	= 0	Time to Go is not present in the REF
		= 1	Time to Go is present in the REF
bit 2	(FBD)	= 0	Deviation from Expected Flight Behaviour is not present in the REF
		= 1	Deviation from Expected Flight Behaviour is present in the REF
bit 1	(FX)		Field Extension Indicator
		= 0	End of Item
		= 1	Extension into next octet

Encoding Rule :

This item shall be present in every REF

2.3 Information on Target 1 in Conflict

Definition: Information on Target #1 Involved in the Conflict

Format: Compound data item comprising one primary subfield of one octet, followed by up to 4 subfields

Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
PW1	PC1	MC1	V1	0	0	0	FX

bit-8, octet 1 (PW1) Subfield #1: Current Position Target 1 (WGS84)

=0 Absence of Subfield #1
=1 Presence of Subfield #1

bit-7, octet 1 (PC1) Subfield #2: Current Position Target 1 (Cartesian Coordinates)

=0 Absence of Subfield #2
=1 Presence of Subfield #2

bit-6, octet 1 (MC1) Subfield #3: Current Mode C Target 1

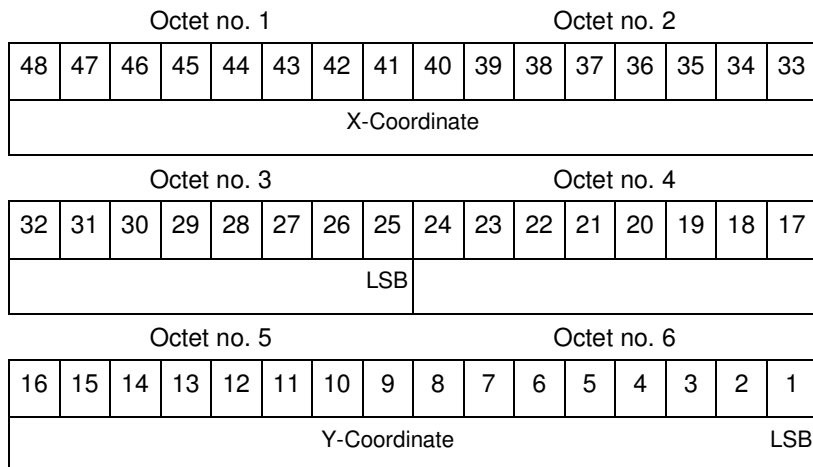
=0 Absence of Subfield #3
=1 Presence of Subfield #3

bit-5, octet 1 (V1) Subfield #4: Current Velocity Target 1

=0 Absence of Subfield #4
=1 Presence of Subfield #4

bits-4/2, octet 1 (Spare) Spare bits, set to 0

bit-1, octet 1 (FX) = 0 End of Primary Subfield
= 1 Extension of Primary Subfield into next octet

Structure of Subfield # 2:**Current Position Target 1 (Cartesian Coordinates)****Definition :** Current position of target 1 in Cartesian Coordinates.**Format :** Six-octet fixed length Data Item**Structure:**

bits-48/25 (X-Coordinate) Current X-position in two's complement

(LSB) = 0.5m

bits-24/1 (Y-Coordinate) Current Y-position in two's complement

(LSB) = 0.5m

The LSB provides a resolution better than 0.6m.

Structure of Subfield # 3:**Current Mode C Target 1****Definition :** Last Measured Mode C Code of Target 1.**Format :** Two-octet fixed length Data Item**Structure:**

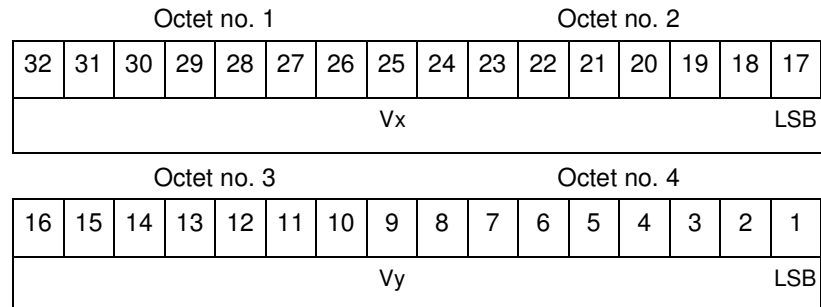
Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	MC										LSB			

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

bit-15 (G) =0 default
=1 Code garbled

bits-14/1 (MC) Last measured Mode C in
two's complement

(LSB) = ¼ FL

Structure of Subfield #4:**Current Track Velocity Target 1****Definition :** Current Velocity of Target 1.**Format :** Four-octet fixed length Data Item**Format :**

bits-32/17	(Vx)	Velocity, x-component in two's complement (LSB) = 0.25m/s
bits-16/1	(Vy)	Velocity, y-component in two's complement (LSB) = 0.25m/s

Encoding Rule :

This item is optional

2.4 Information on Target 2 in Conflict

Definition: Information on Target #2 Involved in the Conflict

Format: Compound data item comprising one primary subfield of one octet, followed by up to 4 subfields

Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
PW2	PC2	MC2	V2	0	0	0	FX

bit-8, octet 1 (PW2) Subfield #1: Current Position Target 2 (WGS84)

=0 Absence of Subfield #1
=1 Presence of Subfield #1

bit-7, octet 1 (PC2) Subfield #2: Current Position Target 2 (Cartesian Coordinates)

=0 Absence of Subfield #2
=1 Presence of Subfield #2

bit-6, octet 1 (MC2) Subfield #3: Current Mode C Target 2

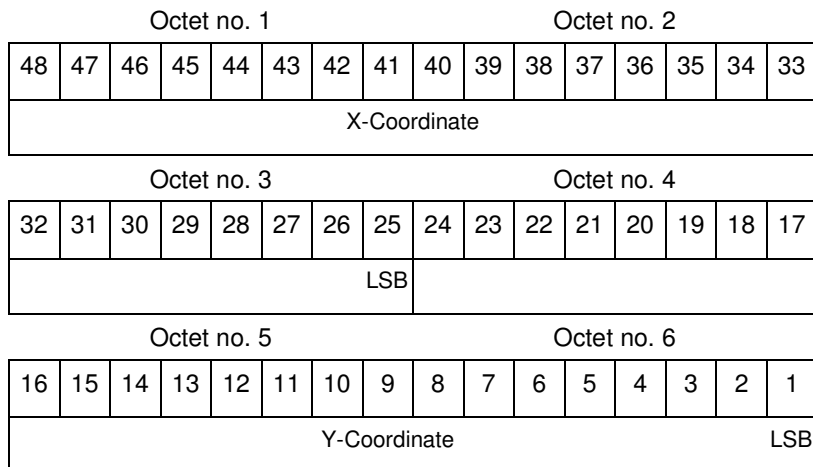
=0 Absence of Subfield #3
=1 Presence of Subfield #3

bit-5, octet 1 (V2) Subfield #4: Current Velocity Target 2

=0 Absence of Subfield #4
=1 Presence of Subfield #4

bits-4/2, octet 1 (Spare) Spare bits, set to 0

bit-1, octet 1 (FX) = 0 End of Primary Subfield
= 1 Extension of Primary Subfield into next octet

Structure of Subfield # 2:**Current Position Target 2 (Cartesian Coordinates)****Definition :** Current position of target 2 in Cartesian Coordinates.**Format :** Six-octet fixed length Data Item**Structure:**

bits-48/25 (X-Coordinate) Current X-position in two's complement

(LSB) = 0.5m

bits-24/1 (Y-Coordinate) Current Y-position in two's complement

(LSB) = 0.5m

The LSB provides a resolution better than 0.6m.

Structure of Subfield # 3:**Current Mode C Target 2****Definition :** Last Measured Mode C Code of Target 2.**Format :** Two-octet fixed length Data Item**Structure:**

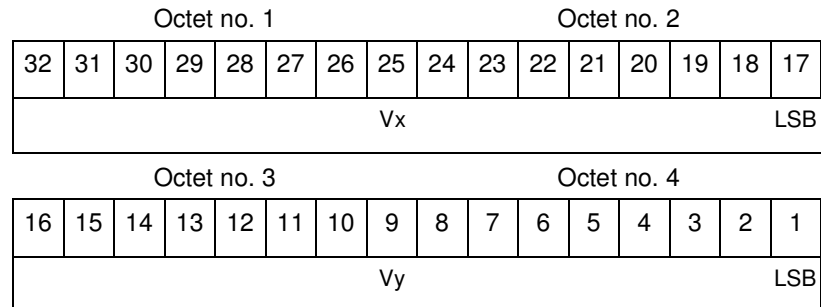
Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	MC										LSB			

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

bit-15 (G) =0 default
=1 Code garbled

bits-14/1 (MC) Last measured Mode C in
two's complement

(LSB) = ¼ FL

Structure of Subfield #4:**Current Track Velocity Target 2****Definition :** Current Velocity of Target 2.**Format :** Four-octet fixed length Data Item**Format :**

bits-32/17	(Vx)	Velocity, x-component in two's complement (LSB) = 0.25m/s
bits-16/1	(Vy)	Velocity, y-component in two's complement (LSB) = 0.25m/s

Encoding Rule :

This item is optional

2.5 Extended Information – Target 1

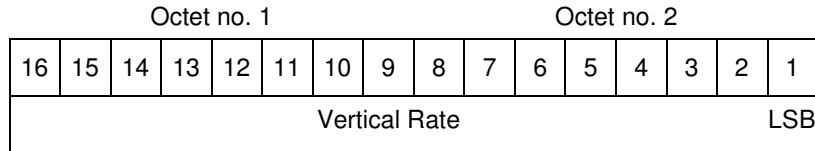
Definition: Extended information on Target #1 Involved in the Conflict

Format: Compound data item comprising one primary subfield of one octet, followed by up to 7 subfields

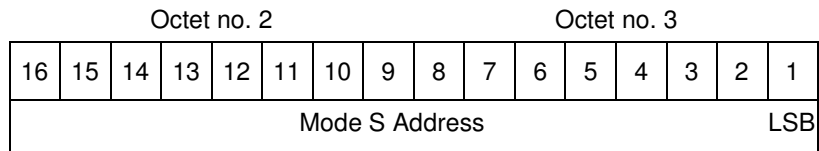
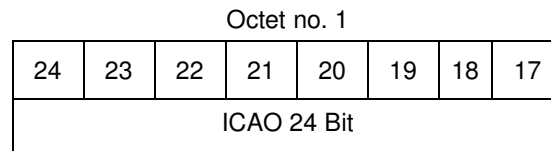
Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
VR1	MS1	TR1	PG1	AT1	QN1	VL1	FX

- bit-8, octet 1 (VR1) Subfield #1: Vertical Rate Target 1
 =0 Absence of Subfield #1
 =1 Presence of Subfield #1
- bit-7, octet 1 (MS1) Subfield #2: Mode S Address Target 1
 =0 Absence of Subfield #2
 =1 Presence of Subfield #2
- bit-6, octet 1 (TR1) Subfield #3: Trajectory Information Target 1
 =0 Absence of Subfield #3
 =1 Presence of Subfield #3
- bit-5, octet 1 (PG1) Subfield #4: Parameter Group Target 1
 =0 Absence of Subfield #4
 =1 Presence of Subfield #4
- bit-4, octet 1 (AT1) Subfield #5: Additional Track Information Target 1
 =0 Absence of Subfield #5
 =1 Presence of Subfield #5
- bit-3, octet 1 (QN1) Subfield #6: Applicable QNH Target 1
 =0 Absence of Subfield #6
 =1 Presence of Subfield #6
- bit 2, octet 1 (VL1) Subfield #7: Vertical Limiter Target 1
 =0 Absence of Subfield #7
 =1 Presence of Subfield #7
- bit-1, octet 1 (FX) = 0 End of Primary Subfield
 = 1 Extension of Primary Subfield into next octet

Structure of Subfield # 1:**Vertical Rate of Target 1****Definition :** Vertical Rate (Rate of Climb/Descent) Target 1**Format :** Two-octet fixed length Data Item**Structure:**

bits-16/1

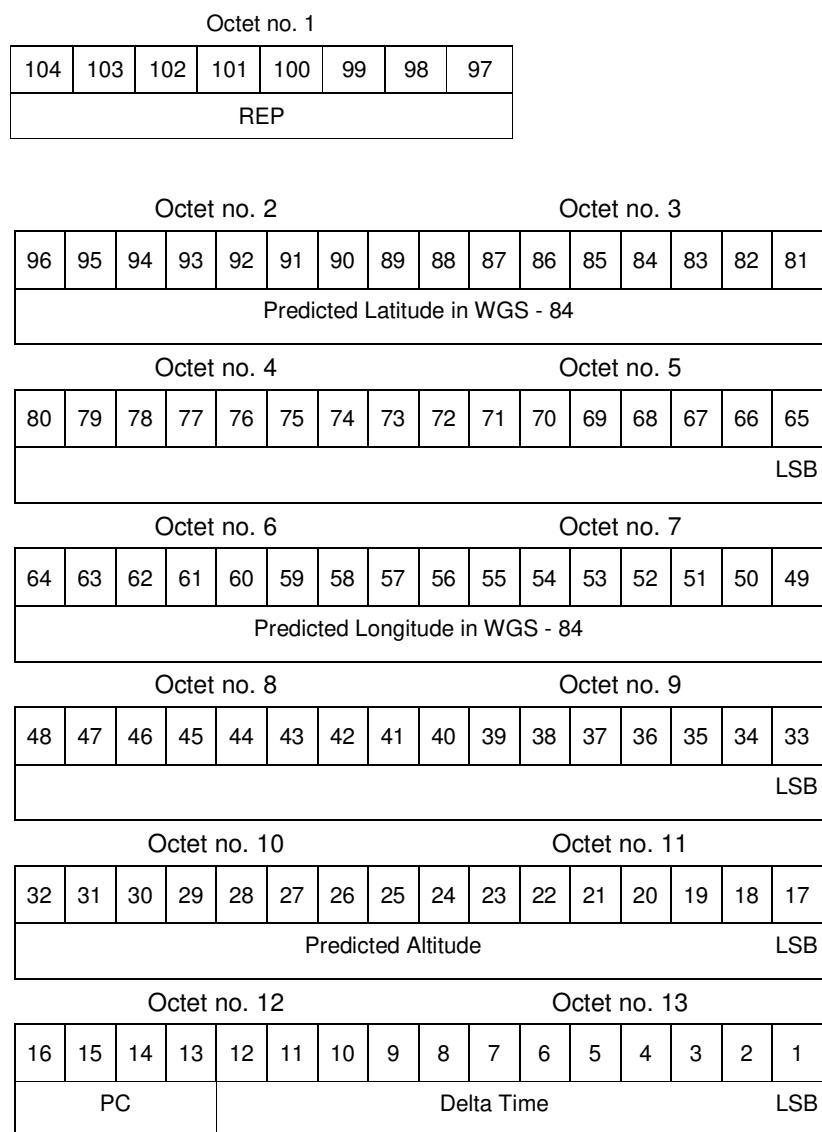
Vertical Rate in two's complement form
(LSB) = 6.25 feet/minute**Structure of Subfield # 2:****Mode S Address of Target 1****Definition :** ICAO 24 Bit Address of Target 1**Format :** Three-octet fixed length Data Item**Structure:**

bits-24/1

ICAO 24 Bit Mode S Address, A23 to A0 of Aircraft 1
involved in a conflict

Structure of Subfield # 3:**Trajectory Information Target 1****Definition :** Trajectory Information for Target 1**Format :** Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one twelve byte trajectory point description.

The trajectory point description contains the latitudinal and longitudinal position followed by a two octet altitude field, and a two octet field containing the characteristic of and the time at the point.

Structure:

bits 104/97 (REP)

indicates the number of points defined subsequently

bits-96/65	(Latitude)	in WGS-84 in two's complement. Range $-90 \leq \text{latitude} \leq 90$ deg. (LSB) = $180/2^{25}$ degrees
bits-64/33	(Longitude)	in WGS-84 in two's complement. Range $-180 \leq \text{longitude} < 180$ deg. (LSB) = $180/2^{25}$ degrees The LSB provides a resolution better than 0.6m.
bits-32/17	(Alt)	Altitude in two's complement (LSB) = 25 feet
bits 16/13	(PC)	Point Characteristics 0 = Default value 1 = Fly-by Point 2 = Fly-over Point 3 = Starting Point of Turn 4 = Starting Point of Linear Motion Segment 5-15 (reserved)
bits 12/1	(Delta Time)	Delta time in two's complement (LSB) = 1 second Time of the point is (Reference Time) + (Delta Time) Reference time is contained in I004/020 (Time of Message)

**Structure of Subfield # 5:
Additional Track Information for Target 1****Definition:** Additional Track Status information for Target 1**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
Additional Track Status Target 1							FX

NOTE: The contents of this data item is implementation dependent and **shall** be described in detail in the Interface Control Document (ICD) of the system generating the ASTERIX record.

An **example implementation** is presented below in order to illustrate the potential contents of this field. Please note that the **actual implementation may be different and refer to the respective system ICD.**

EXAMPLE IMPLEMENTATION

The following example of an existing implementation in the TopSky Safety Nets provides an illustration of how this data item could be used:

Octet no. 1

8	7	6	5	4	3	2	1
MHYP	VL			CTL	COP	0	FX

bit-8 (MHYP) Main Hypothesis used (see **Note 1** below)
 = 0 default value (straight line prediction)
 = 1 Manoeuvre Prediction used either vertically or horizontally for track 1

bit-7/5 (VL) Vertical Limitation
 = 0 default value (no vertical limit)
 = 1 Cleared FL used
 = 2 FSSA used
 = 3 SAL used
 = 4 IFL used

Bit-4 (CTL) Controlled Flight Indication
 = 0 Controlled Flight
 = 1 Uncontrolled Flight

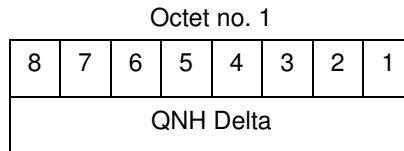
Bit-3 (COP) Coupled Indication (See **Note 2** below)
 = 0 Coupled Track
 = 1 Uncoupled Track

bit-2 set to zero

bit-1 (FX) Extension Indication
 = 0 No extension

NOTE 1: The main hypothesis is the trajectory that is most likely to be followed, based upon either controller input (e.g. Cleared Flight Level), downlinked data (e.g. Selected Altitude) or other procedure related data. In this case the back-up hypothesis is a simpler straight line prediction. In the event that no additional data items (Cleared Flight Level or Selected Altitude) are available, then it is common for the main hypothesis to be a straight line prediction, and for no back up hypothesis to be executed.

NOTE 2: A coupled track is a track where flight-plan data has been coupled with the track. In some contexts also the term “correlated” is used instead of “coupled”.

Structure of Subfield #6**Applicable QNH Target 1****Definition:** Applicable QNH Value in hPa for target 1.**Format:** One octet fixed length data item.**Structure:**

bits-8/1

QNH Delta

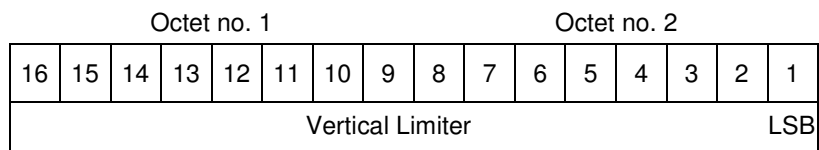
LSB = 1 hPa

NOTE: The applicable QNH value is computed as (QNH Delta) + 850 hPa.**NOTE:** The applicable QNH **shall** be only transmitted when the value is different from 1013 hPa.

Structure of Subfield #7**Vertical Limiter for Target 1**

Definition: Vertical limitation applied for Target 1 indicating at which Flight Level / Altitude the aircraft is predicted to level off according to the Hypothesis used for the vertical prediction of the flight path.

Format: Two octet fixed length data item.

Structure:

bits-16/1 Vertical limiter in two's complement form
 (LSB) = 25 feet
 VLmin = -1500ft
 VLmax = 150000 ft

Encoding Rule :

This item is optional

2.6 Extended Information – Target 2

Definition: Extended information on Target #2 Involved in the Conflict

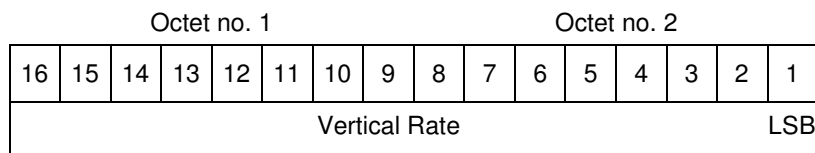
Format: Compound data item comprising one primary subfield of one octet, followed by up to 7 subfields

Structure of Primary Subfield of Compound Data Item:

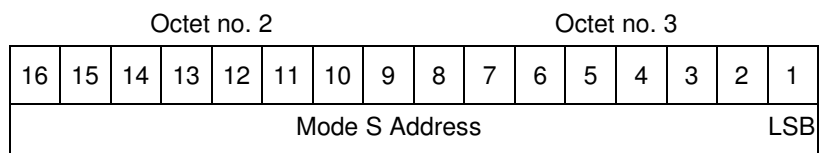
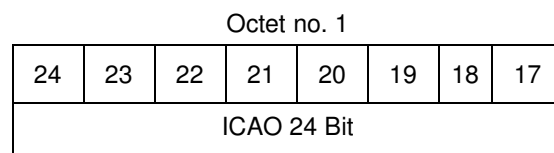
Octet no. 1

8	7	6	5	4	3	2	1
VR2	MS2	TR2	PG2	AT2	QN2	VL2	FX

- bit-8, octet 1 (VR2) Subfield #1: Vertical Rate Target 2
 =0 Absence of Subfield #1
 =1 Presence of Subfield #1
- bit-7, octet 1 (MS2) Subfield #2: Mode S Address Target 2
 =0 Absence of Subfield #2
 =1 Presence of Subfield #2
- bit-6, octet 1 (TR2) Subfield #3: Trajectory Information Target 2
 =0 Absence of Subfield #3
 =1 Presence of Subfield #3
- bit-5, octet 1 (PG2) Subfield #4: Parameter Group Target 2
 =0 Absence of Subfield #4
 =1 Presence of Subfield #4
- bit-4, octet 1 (AT2) Subfield #5: Additional Track Information Target 2
 =0 Absence of Subfield #5
 =1 Presence of Subfield #5
- bit-3, octet 1 (QN2) Subfield #6: Applicable QNH Target 2
 =0 Absence of Subfield #6
 =1 Presence of Subfield #6
- bit 2, octet 1 (VL2) Subfield #7: Vertical Limiter Target 2
 =0 Absence of Subfield #7
 =1 Presence of Subfield #7
- bit-1, octet 1 (FX) = 0 End of Primary Subfield
 = 1 Extension of Primary Subfield into next octet

Structure of Subfield # 1:**Vertical Rate of Target 2****Definition :** Vertical Rate (Rate of Climb/Descent) Target 2**Format :** Two-octet fixed length Data Item**Structure:**

bits-16/1

Vertical Rate in two's complement form
(LSB) = 6.25 feet/minute**Structure of Subfield # 2:****Aircraft Mode S Address of Target 2****Definition :** ICAO 24 Bit Address of Target 2**Format :** Three-octet fixed length Data Item**Structure:**

bits-24/1

ICAO 24 Bit Mode S Address, A23 to A0 of Aircraft 2
involved in a conflict

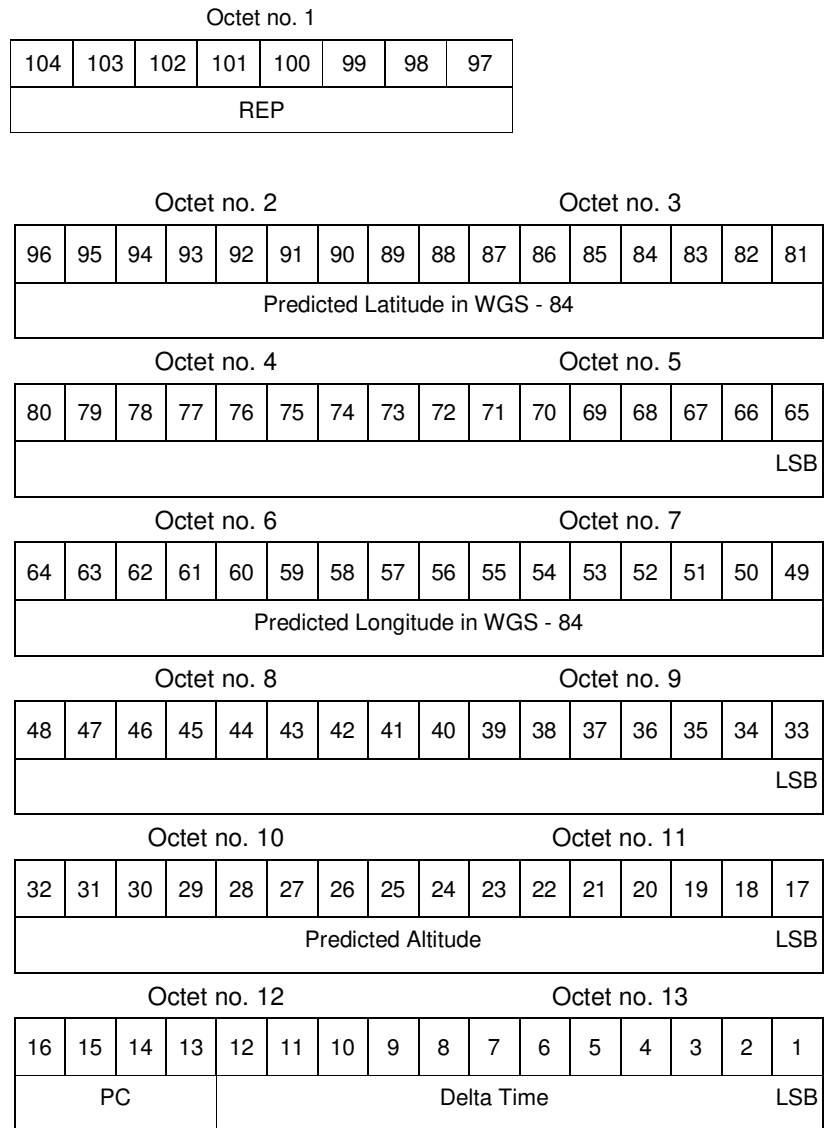
Structure of Subfield # 3:
Trajectory Information Target 2

Definition : Trajectory Information for Target 2

Format : Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one twelve byte trajectory point description.

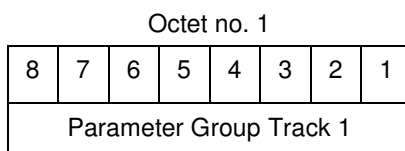
The trajectory point description contains the latitudinal and longitudinal position followed by a two octet altitude field, and a two octet field containing the characteristic and the time of the point.

Structure:



bits 104/97 (REP) indicates the number of points defined subsequently

bits-96/65	(Latitude)	in WGS-84 in two's complement. Range $-90 \leq \text{latitude} \leq 90$ deg. (LSB) = $180/2^{25}$ degrees
bits-64/33	(Longitude)	in WGS-84 in two's complement. Range $-180 \leq \text{longitude} < 180$ deg. (LSB) = $180/2^{25}$ degrees The LSB provides a resolution better than 0.6m.
bits-32/17	(Alt)	Altitude in two's complement (LSB) = 25 feet
bits 16/13	(PC)	Point Characteristics 0 = Default value 1 = Fly-by Point 2 = Fly-over Point 3 = Starting Point of Turn 4 = Starting Point of Linear Motion Segment 5-15 (reserved)
bits 12/1	(Delta Time)	Delta time in two's complement (LSB) = 1 second Time of the point is (Reference Time) + (Delta Time) Reference time is I004/020 (Time of Message)

Structure of Subfield # 4:**Parameter Group applicable for Target 2****Definition:** Parameter Group selected by Safety Net for target 2**Format:** One-octet fixed length Data Item**Structure:**

Allowed Range: 0-255

Note: The Parameter Group for a certain track indicates which Safety Net parameters are applicable for this track, based on its position. It describes the parameters and their settings for the specific safety net function generating the message applicable to the target based on its position. For instance there could be different threshold values for alerts for targets operating in different types of airspace.

The parameters forming a pre-determined Parameter Group are implementation dependent and function specific. They **shall** be described in the ICD of the respective system.

**Structure of Subfield # 5:
Additional Track Information for Target 2****Definition:** Additional Track Status information for Track 2**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
Implementation specific information							FX

NOTE: The contents of this data item is implementation dependent and **shall** be described in detail in the Interface Control Document (ICD) of the system generating the ASTERIX record.

Below find an **example implementation** to illustrate the potential contents of this field. Please note that the **actual implementation may be different and refer to the respective system ICD.**

EXAMPLE IMPLEMENTATION

The following example of an existing implementation in the TopSky Safety Nets provides an idea of how a potential use of this data item could look like:

Octet no. 1

8	7	6	5	4	3	2	1
MHYP	VL			CTL	COP	0	FX

bit-8 (MHYP) Main Hypothesis used (see **Note 1** below)
 = 0 default value (straight line prediction)
 = 1 Manoeuvre Prediction used either vertically or horizontally for track 1

bit-7/5 (VL) Vertical Limitation
 = 0 default value (no vertical limit)
 = 1 Cleared FL used
 = 2 FSSA used
 = 3 SAL used
 = 4 IFL used

Bit-4 (CTL) Controlled Flight Indication
 = 0 Controlled Flight
 = 1 Uncontrolled Flight

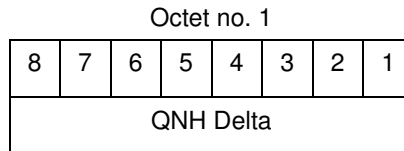
Bit-3 (COP) Coupled Indication (See **Note 2** below)
 = 0 Coupled Track
 = 1 Uncoupled Track

bit-2 set to zero

bit-1 (FX) Extension Indication
 = 0 No extension

NOTE 1: The main hypothesis is the trajectory that is most likely to be followed, based upon either controller input (e.g. Cleared Flight Level), downlinked data (e.g. Selected Altitude) or other procedure related data. In this case the back-up hypothesis is a simpler straight line prediction. In the event that no additional data items (Cleared Flight Level or Selected Altitude) are available, then it is common for the main hypothesis to be a straight line prediction, and for no back up hypothesis to be executed.

NOTE 2: A coupled track is a track where flight-plan data has been coupled with the track. In some contexts also the term “correlated” is used instead of “coupled”.

Structure of Subfield #6**Applicable QNH Target 2****Definition:** Applicable QNH Value in hPa for target 2.**Format:** One octet fixed length data item.**Structure:**

bits-8/1

QNH Delta

LSB = 1 hPa

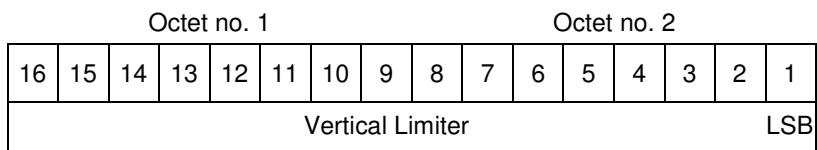
Note: The applicable QNH value is computed as (QNH Delta) + 850 hPa.

Note: The applicable QNH shall be only transmitted when the value is different from 1013 hPa.

Structure of Subfield #7**Vertical Limiter for Target 2**

Definition: Vertical limitation applied for Target 2 indicating at which Flight Level / Altitude the aircraft is predicted to level off according to the Hypothesis used for the vertical prediction of the flight path.

Format: Two octet fixed length data item.

Structure:

bits-16/1 Vertical limiter in two's complement form
 (LSB) = 25 feet
 VLmin = -1500ft
 VLmax = 150000 ft

Encoding Rule :

This item is optional

2.7 CON - Conflict Information

Definition: Conflict Information

Format: Compound data item comprising a primary subfield of up to two octets, followed by up to 9 subfields

Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
16	15	14	13	12	11	10	9
FHV	LHV	FVV	LVV	DET	MIS	CSA	FX

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

bit-16	(FHV)	Subfield #1: Time to Start of First Horizontal Infringement =0 Absence of Subfield #1 =1 Presence of Subfield #1
bit-15	(LHV)	Subfield #2: Time to End of Last Horizontal Infringement =0 Absence of Subfield #2 =1 Presence of Subfield #2
bit-14	(FVV)	Subfield #3: Time to Start of First Vertical Infringement =0 Absence of Subfield #3 =1 Presence of Subfield #3
bit-13	(LVV)	Subfield #4: Time to End of Last Vertical Infringement =0 Absence of Subfield #4 =1 Presence of Subfield #4
bit-12	(DET)	Subfield #5: Detection Counter =0 Absence of Subfield #5 =1 Presence of Subfield #5
bit-11	(MIS)	Subfield #6: Miss Counter =0 Absence of Subfield #6 =1 Presence of Subfield #6

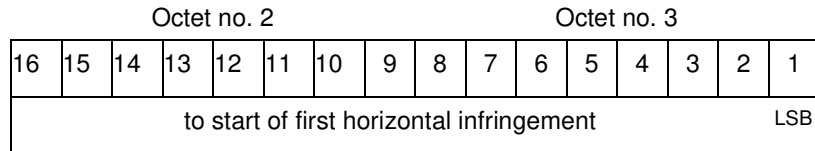
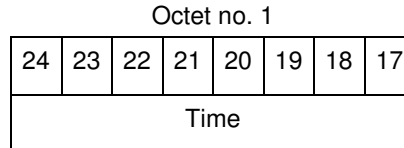
bit-10	(CSA)	Subfield #7: Supplementary Conflict Status =0 Absence of Subfield #7 =1 Presence of Subfield #7
bit-9	(FX)	= 0 End of Primary Subfield = 1 Extension of Primary Subfield into next octet
bit-8	(PGC)	Subfield #8: Parameter Group applicable to Conflict =0 Absence of Subfield #8 =1 Presence of Subfield #8
bit-7	(HYP)	Subfield #9: Hypothesis Summary =0 Absence of Subfield #9 =1 Presence of Subfield #9
bits-6/2	(Spare)	Spare bits, set to 0
bit-1	(FX)	= 0 End of Primary Subfield = 1 Extension of Primary Subfield into next octet

Structure of Subfield # 1: Time to Start of First Horizontal Infringement

Definition: The Time to Start of First Horizontal Infringement indicates the delta time from the time of message (I004/020) to the start of the first horizontal infringement of safety net parameters (e.g. STCA parameters) within the look-ahead time.

Format : Three-octet fixed length Data Item.

Structure:



bit-16 (LSB) = 2^{-7} s = 1/128 s

NOTES

Many STCA systems calculate the infringement (predicted separation below STCA parameters) from a horizontal and a vertical perspective. An alert is issued when the times of horizontal and vertical infringements overlap. The first and last horizontal Violation Time indicates when the STCA calculations in the horizontal plane would result in an infringement of the STCA parameters applicable.

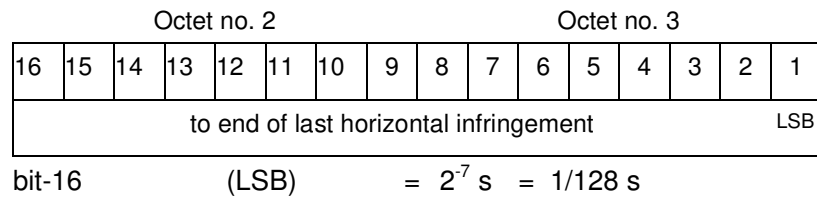
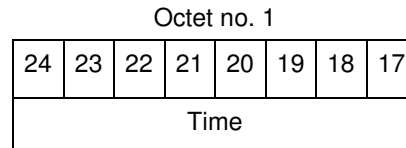
STCA systems look a certain time into the future. This time is called look ahead time.

Structure of Subfield #2:**Time to End of Last Horizontal Infringement**

Definition : The Time to End of Last Horizontal Infringement indicates the delta time from the time of message (I004/020) to the end of the last horizontal infringement of safety net parameters (e.g. STCA parameters) within the look-ahead time.

Format : Three-octet fixed length Data Item.

Structure:



NOTES Many STCA systems calculate the infringement from a horizontal and a vertical perspective. The first and last horizontal Violation Time indicates when the STCA calculations in the horizontal plane would result in an infringement of the STCA parameters applicable. The first and last infringement times describe a time interval where the distance between the two aircraft are below a corresponding STCA parameters.

Structure of Subfield #3**Time to Start of First Vertical Infringement**

Definition : The Time to Start of First Vertical Infringement indicates the delta time from the time of message (I004/020) to the start of the first vertical infringement of safety net parameters (e.g. STCA parameters) within the look-ahead time.

Format : Three-octet fixed length Data Item.

Structure:

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

Octet no. 2							Octet no. 3								
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
to start of first vertical infringement														LSB	
bit-16				(LSB)			$= 2^{-7} \text{ s} = 1/128 \text{ s}$								

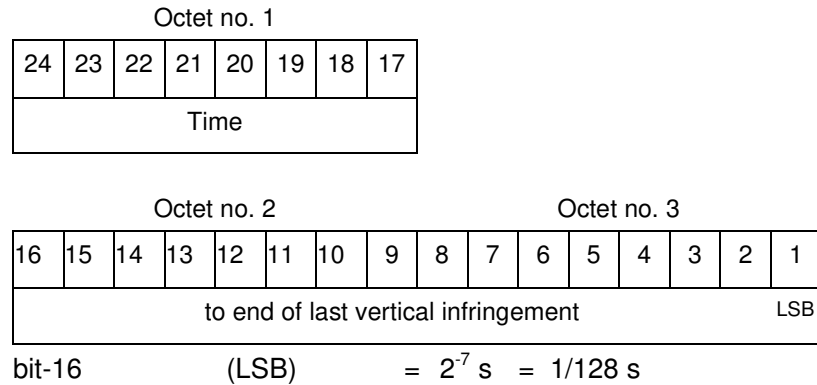
NOTES Many STCA systems calculate the infringement from a horizontal and a vertical perspective. The first and last vertical Violation Time indicates when the STCA calculations in the vertical plane would result in an infringement of the STCA parameters applicable.

Structure of Subfield 4**Time to End of Last Vertical Infringement**

Definition : The Time to End of Last Vertical Infringement indicates the delta time from the time of message (I004/020) to the end of the last vertical infringement of safety net parameters (e.g. STCA parameters) within the look-ahead time.

Format : Three-octet fixed length Data Item.

Structure:



NOTES Many STCA systems calculate the infringement from a horizontal and a vertical perspective. The first and last vertical Violation Time indicate when the STCA calculations in the vertical plane would result in an infringement of the STCA parameters applicable.

Structure of Subfield #5**Detection Counter of Conflict**

Definition : This data item indicates how many times the Safety Net has internally detected a conflict.

Format: One-octet fixed length Data Item

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
Detection Counter							

Allowed Range for detection counter: 1-255.

- NOTES**
- Upper limits may be implementation dependent.
 - Many Safety Nets only declare an alert on the output, when the alert has been confirmed by a number of subsequent internal calculations over several processing cycles. The detection counter indicates, how often the safety net parameters have been infringed according to the internal calculations.

Note that detection of a conflict internally, may not lead to a conflict output by the Safety Net.

Structure of Subfield #6**Miss Counter of Conflict**

Definition : This data item indicates how many times the Safety Net has internally missed a conflict, after having declared a conflict.

Format: Two-octet fixed length Data Item

Structure:

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

Allowed Range for miss counter: 0-255.

- NOTES**
- Upper limits may be implementation dependent.
 - Once an Alert has been declared it will be kept alive for a certain period of time to prevent a flickering indication on the CWP. During this time it is possible that the system internally is no longer detecting a conflict depending on its internal parameters. The miss counter indicates the number of “non-detects” during this period of time.

Structure of Subfield #7

Supplementary Conflict Status

Definition : This data items provides supplementary Conflict Status information

Format: Variable length data field containing a first part or two octets followed by one octet extensions as required

Structure:

Octet no. 1

16	15	14	13	12	11	10	9
Status at current position							0

Octet no. 2

8	7	6	5	4	3	2	1
Status at start of conflict							FX

Bits-16/10: Conflict Status at Current Position

Bit-9: Spare bit, set to "0"

Bits-8/2: Conflict Status at Start of Conflict

Bit-1: = 0 End of Item

= 1 Extension into next octet

Note: The values for this field are implementation specific **shall** be described in the System ICD.

Note: The FX-mechanism allows for the specification of additional instances of the Status Information.

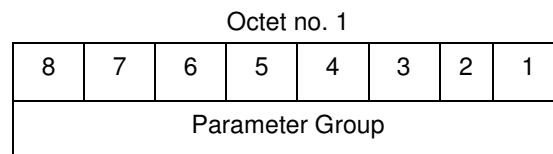
Implementation Examples (please note that other values are possible):

For STCA the status fields could contain the following values:

- 1: Converging
- 2: Slow Diverging
- 3: Diverging

For APM the status fields could take the following values:

- 1: Deviation below glideslope
- 2: Deviation above glideslope
- 3: Lateral Deviation

Structure of Subfield #8**Parameter Group of Conflict****Definition :** Parameter Group applicable for the alert**Format:** One octet fixed length Data Item**Structure:**

Parameter Group Values: 0-255.

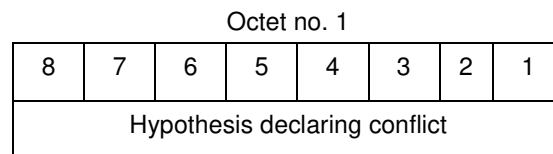
Note: The values for this field are implementation specific **shall** be described in the System ICD.

Structure of Subfield #9**Hypothesis Used for Conflict Detection****Definition :**

Hypothesis responsible for conflict detection

Format:

Fixed length field containing one octet.

Structure:

The hypothesis declaring a conflict will be indicated by the following values:

1: Main Hypothesis

2: Backup Hypothesis

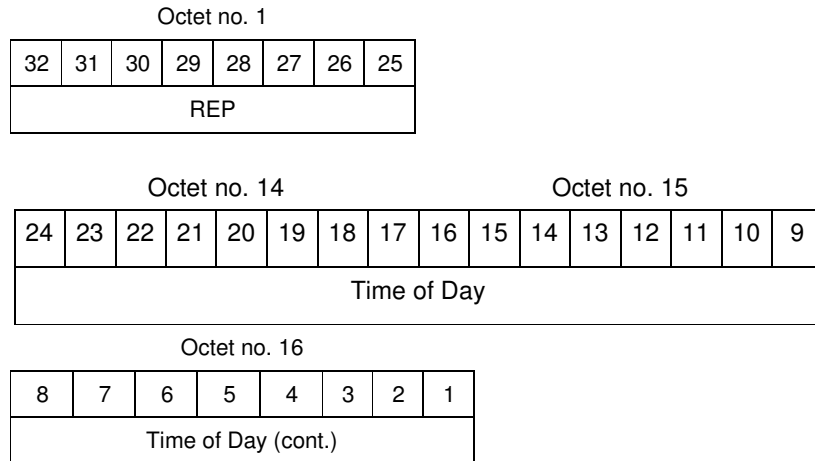
3-255 (reserved for future use)

NOTE: The main hypothesis is the trajectory that is most likely to be followed, based upon either controller input (e.g. Cleared Flight Level), downlinked data (e.g. Selected Altitude) or other procedure related data. In this case the back-up hypothesis is a simpler straight line prediction. In the event that no additional data items (Cleared Flight Level or Selected Altitude) is available, then it is common for the main hypothesis to be a straight line prediction, and for no back up hypothesis to be executed

2.8 TTG – Time to Go

Definition: Time it takes for a condition to become true

Format : Repetitive Data Item starting with a one-octet Field Repetition Indicator (REP) followed by at least one three-octet Time of Day field.



bits 128/121	Indicates the number of times defined subsequently
bits-24/1	Time remaining before Condition 1 becomes true (LSB) = (2^7) sec = 1/128 sec

NOTE: The “Time to Go” data item implements the possibility for a system to indicate how long it will take for a condition to become true. The condition is implementation specific and **shall be described in the Interface Control Document of the respective system**. In the implementation example described below, the condition is the distance between two aircraft in conflict. However, since the description of the data item is generic, other conditions (like an aircraft reaching a specific position in the airspace or on the aerodrome surface) may be defined as well.

In case the parameters for any of the defined conditions cannot be fulfilled, all bits in the respective “Time of Day” entry **shall** be set to “1”

Implementation example: the EUROCONTROL Maastricht UAC has implemented this function to indicate how long it will take for two aircraft in conflict to reach a distance of 8NM from each other (Condition 1) or 5NM from each other (Condition 2).

If in this case a conflict would be raised at a distance between the two aircraft of 6NM, all bits for the first entry would be set to “1”.

2.9 FBD –Deviations from Expected Flight Behaviour

Definition : This item provides information on a deviation of an aircraft from its expected flight behaviour.

Format : Compound Data Item, comprising a primary subfield of one octet, followed by the indicated subfields.

Structure of Primary Subfield:

Octet no. 1							
8	7	6	5	4	3	2	1
SD	VRD	PD	HD	SLD	0	0	FX

bit-8 (SD) Subfield #1: Speed Deviation
 = 0 Absence of Subfield #1
 = 1 Presence of Subfield #1

bit-7 (VRD) Subfield #2: Vertical Rate deviation
 = 0 Absence of Subfield #2
 = 1 Presence of Subfield #2

bit-6 (PD) Subfield #3: Pressure deviation
 = 0 Absence of Subfield #3
 = 1 Presence of Subfield #3

bit-5 (HD) Subfield #4: Heading Deviation
 = 0 Absence of Subfield #4
 = 1 Presence of Subfield #4

bit-4 (SLD) Subfield #5: Slope Deviation
 = 0 Absence of Subfield #5
 = 1 Presence of Subfield #5

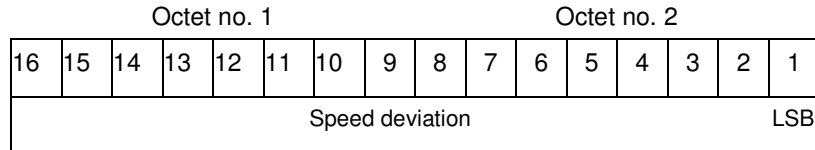
bit-3/2 Spare Bit, Set to 0

bit-1 (FX) Extension Indicator
 = 0 no extension
 = 1 extension

Structure of Subfield #1:**Speed Deviation:**

Definition : Speed Deviation from expected speed, in two's complement form.

Format : Two-octet fixed length Data Item.



bits 16/1

(Speed deviation)

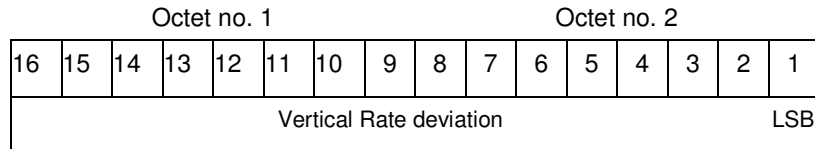
LSB = 2^{-14} NM/s \cong 0.22 kt

NOTE - Positive value if aircraft is above expected speed
Negative value if aircraft is below expected speed

Structure of Subfield #2:**Vertical Rate Deviation:**

Definition : Rate Deviation from expected vertical rate, in two's complement form.

Format : Two-octet fixed length Data Item.



bits 16/1

(Rate deviation)

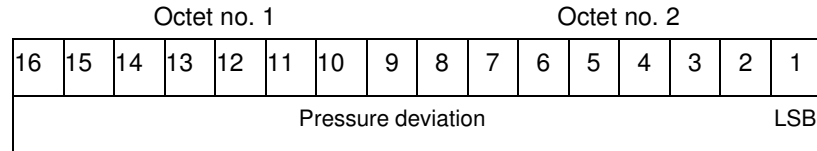
LSB = 6.25 feet/minute

NOTE - Positive value if aircraft is above expected vertical rate
Negative value if aircraft is below expected vertical rate

Structure of Subfield #3:**Pressure Deviation:**

Definition : Difference between the actual QNH and the Downlinked Airborne Parameter (DAP) value “Barometric Pressure Setting (BPS)”, in two’s complement form.

Format : Two-octet fixed length Data Item.



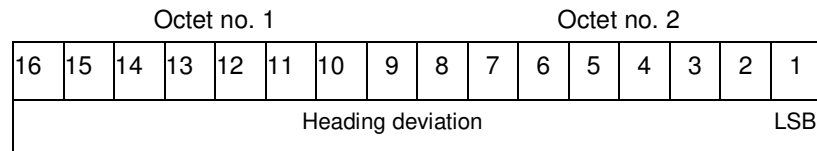
bits 16/1 (Pressure deviation)
LSB = 0.1mb

NOTE - Positive value if BPS is above actual QNH
Negative value if BPS is below actual QNH

Structure of Subfield #4:**Heading Deviation:**

Definition : Heading Deviation from expected heading, in two’s complement form.

Format : Two-octet fixed length Data Item.



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

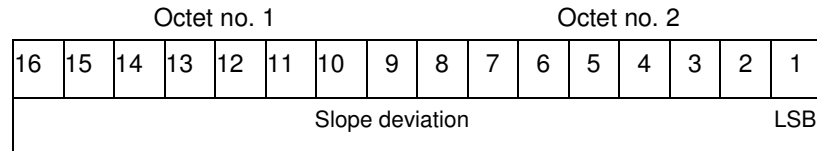
The range used in this field is from -180 to +180 degrees (-180 degrees excluded from the range).

NOTE - Positive value if aircraft’s heading is right compared to the expected heading
Negative value if aircraft’s heading is left compared to the expected heading

Structure of Subfield #5:**Slope Deviation:**

Definition : Slope Deviation from expected guide-slope parameters configured in the safety net, in two's complement form.

Format : Two-octet fixed length Data Item.



bits 16/1

(Heading deviation)

$$\text{LSB} = 360^\circ / 2^{16} \cong 0.0055^\circ$$

Note: This item would be typically encoded for APM.

Encoding Rule:

The Reserved Expansion Field is optional.