Asterix category 020 - Multilateration Target Reports

category: 020

edition: 1.10

date: 2021-02-19

Preamble

Surveillance data exchange.

Description of standard data items

I020/010 - Data Source Identifier

definition: Identification of the system from which the data are received

Group

I020/010/SAC - System Area Code

Element
bit size: 8
Raw Content

I020/010/SIC - System Identification Code

Element
bit size: 8
Raw Content

Note:

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

I020/020 - Target Report Descriptor

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

Extended

I020/020/SSR

Element
bit size: 1
Values:

0: Non-Mode S 1090MHz multilateration
1: No Non-Mode S 1090MHz multilat

I020/020/MS

Element
bit size: 1
Values:

0: Mode-S 1090 MHz multilateration
1: No Mode-S 1090 MHz multilateration

I020/020/HF

Element
bit size: 1
Values:

0: HF multilateration

1: No HF multilateration

I020/020/VDL4

Element
bit size: 1
Values:

0: VDL Mode 4 multilateration
1: No VDL Mode 4 multilateration

I020/020/UAT

Element
bit size: 1
Values:

0: UAT multilateration
1: No UAT multilateration

I020/020/DME

Element
bit size: 1
Values:

0: DME/TACAN multilateration
1: No DME/TACAN multilateration

I020/020/OT

Element
bit size: 1
Values:

0: Other Technology Multilateration
1: No Other Technology Multilateration

(FX) - extension bit

I020/020/RAB

Element
bit size: 1
Values:

0: Report from target transponder
1: Report from field monitor (element transponder)

I020/020/SPI

Element
bit size: 1
Values:

0: Absence of SPI
1: Special Position Identification

I020/020/CHN

Element
bit size: 1
Values:

0: Chain 1
1: Chain 2

I020/020/GBS

Element
bit size: 1
Values:

0: Transponder Ground bit not set
1: Transponder Ground bit set

I020/020/CRT

Element
bit size: 1
Values:

0: No Corrupted reply in multilateration
1: Corrupted replies in multilateration

I020/020/SIM

Element
bit size: 1
Values:

0: Actual target report
1: Simulated target report

I020/020/TST

Element
bit size: 1
Values:

0: Default
1: Test Target

(FX) - extension bit

I020/030 - Warning/Error Conditions

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

Repetitive

With FX extension bit.

Element
bit size: 7
Values:

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

Notes:

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

I020/041 - Position In WGS-84 Coordinates

definition: Position of a target in WGS-84 Coordinates.

Group

I020/041/LAT - Latitude

Element
bit size: 32
Signed quantity
LSB = $180/2^{2}5$ ° ≈ $5.36441802978515625e-6$ °
unit: ”°”
>= -90.0
<= 90.0

I020/041/LON - Longitude

Element
bit size: 32
Signed quantity
LSB = $180/2^{2}5$ ° ≈ $5.36441802978515625e-6$ °
unit: ”°”
>= -180.0
< 180.0

I020/042 - Position in Cartesian Coordinates

definition: Calculated position in Cartesian Coordinates, in two’s complement representation.

Group

I020/042/X - X-coordinate

Element
bit size: 24
Signed quantity
LSB = $1/2$ m ≈ 0.5 m
unit: ”m”
>= -4194300.0
<= 4194300.0

I020/042/Y - Y-coordinate

Element
bit size: 24
Signed quantity
LSB = $1/2$ m ≈ 0.5 m
unit: ”m”
>= -4194300.0
<= 4194300.0

I020/050 - Mode-2 Code in Octal Representation

definition: Mode-2 code converted into octal representation.

Group

I020/050/V - Validated

Element
bit size: 1
Values:

- **0:** Code validated
- **1:** Code not validated

I020/050/G - Garbled

Element
bit size: 1
Values:

0: Default
1: Garbled code

I020/050/L

Element
bit size: 1
Values:

0: Mode-2 code derived from the reply of the transponder
1: Smoothed Mode-2 code as provided by a local tracker n

Spare bits: 1

I020/050/MODE2 - Mode-2 Reply in Octal Representation

Element
bit size: 12
Octal string (3-bits per char)

I020/055 - Mode-1 Code in Octal Representation

definition: Mode-1 code converted into octal representation.

Group

I020/055/V - Validated

Element
bit size: 1
Values:

0: Code validated
1: Code not validated

I020/055/G - Garbled

Element
bit size: 1
Values:

0: Default
1: Garbled code

I020/055/L

Element
bit size: 1
Values:

0: Mode-1 code derived from the reply of the transponder
1: Smoothed Mode-1 code as provided by a local tracker

I020/055/MODE1 - Mode-1 Code in Octal Representation

Element
bit size: 5
Raw Content

I020/070 - Mode-3/A Code in Octal Representation

definition: Mode-3/A code converted into octal representation.

Group

I020/070/V - Validated

Element
bit size: 1
Values:

0: Code validated
1: Code not validated

I020/070/G - Garbled

Element
bit size: 1
Values:

0: Default
1: Garbled code

I020/070/L

Element
bit size: 1
Values:

0: Mode-3/A code derived from the reply of the transponder
1: Mode-3/A code not extracted during the last update period

Spare bits: 1

I020/070/MODE3A - Mode-3/A Reply in Octal Representation

Element
bit size: 12
Octal string (3-bits per char)

Notes:

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

I020/090 - Flight Level in Binary Representation

definition: Flight Level (Mode S Altitude) converted into binary two's complement representation.

Group

I020/090/V - Validated

Element
bit size: 1
Values:

0: Code validated
1: Code not validated

I020/090/G - Garbled

Element
bit size: 1
Values:

0: Default
1: Garbled code

I020/090/FL - Flight Level

Element
bit size: 14
Signed quantity
LSB = $1/2^2$ FL ≈ 0.25 FL
unit: ”FL”

Notes:

1. When Mode C code / Mode S altitude code is present but not decodable, the “Undecodable Mode C code / Mode S altitude code” Warning/Error should be sent in I020/030.

2. When local tracking is applied and the received Mode S altitude code corresponds to an abnormal value (i.e: the difference in altitude between the current and the previous plot exceeds a predefined system threshold), the “Mode C code / Mode S altitude code abnormal value compared to the track“ Warning/Error should be sent in I020/030.
3. The value shall be within the range described by ICAO Annex 10
4. For Mode S, bit 15 (G) is set to one when an error correction has been attempted.

I020/100 - Mode C Code

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

Group

I020/100/V - Validated

Element
bit size: 1
Values:

- **0:** Code validated
- **1:** Code not validated

I020/100/G - Garbled

Element
bit size: 1
Values:

- **0:** Default
- **1:** Garbled code

Spare bits: 2

I020/100/MODEC - Mode-C Reply in Gray Notation

Element
bit size: 12
Raw Content

Spare bits: 4

I020/100/QC1 - Quality Pulse C1

Element
bit size: 1
Values:

- **0:** High quality pulse C1
- **1:** Low quality pulse C1

I020/100/QA1 - Quality Pulse A1

Element
bit size: 1
Values:

- **0:** High quality pulse A1
- **1:** Low quality pulse A1

I020/100/QC2 - Quality Pulse C2

Element
bit size: 1
Values:

- **0:** High quality pulse C2
- **1:** Low quality pulse C2

I020/100/QA2 - Quality Pulse A2

Element
bit size: 1
Values:

0: High quality pulse A2
1: Low quality pulse A2

I020/100/QC4 - Quality Pulse C4

Element
bit size: 1
Values:

0: High quality pulse C4
1: Low quality pulse C4

I020/100/QA4 - Quality Pulse A4

Element
bit size: 1
Values:

0: High quality pulse A4
1: Low quality pulse A4

I020/100/QB1 - Quality Pulse B1

Element
bit size: 1
Values:

0: High quality pulse B1
1: Low quality pulse B1

I020/100/QD1 - Quality Pulse D1

Element
bit size: 1
Values:

0: High quality pulse D1
1: Low quality pulse D1

I020/100/QB2 - Quality Pulse B2

Element
bit size: 1
Values:

0: High quality pulse B2
1: Low quality pulse B2

I020/100/QD2 - Quality Pulse D2

Element
bit size: 1
Values:

0: High quality pulse B2
1: Low quality pulse B2

I020/100/QB4 - Quality Pulse B4

Element
bit size: 1
Values:

0: High quality pulse B4
1: Low quality pulse B4

I020/100/QD4 - Quality Pulse D4

Element
bit size: 1
Values:

0: High quality pulse D4
1: Low quality pulse D4

Notes:

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

I020/105 - Geometric Height (WGS-84)

definition: Vertical distance between the target and the projection of its position on the earth's ellipsoid, as defined by WGS84, in two's complement form.

Element
bit size: 16
Signed quantity
LSB = $25/2^2$ ft ≈ 6.25 ft
unit: "ft"
>= -204800.0
<= 204800.0

I020/110 - Measured Height (Local Cartesian Coordinates)

definition: Height above local 2D co-ordinate system in reference to the MLT System Reference Point as defined in item I019/610, in two's complement form, based on a direct measurement not related to barometric pressure.

Element
bit size: 16
Signed quantity
LSB = $25/2^2$ ft ≈ 6.25 ft
unit: "ft"
>= -204800.0
<= 204800.0

I020/140 - Time of Day

definition: Absolute time stamping expressed as UTC.

Element
bit size: 24
Unsigned quantity
LSB = $1/2^7$ s ≈ $7.8125e-3$ s
unit: "s"

I020/161 - Track Number

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

Group

Spare bits: 4

I020/161/TRN - Track Number

Element
bit size: 12
Raw Content

I020/170 - Track Status

definition: Status of a track.

Extended

I020/170/CNF

Element
bit size: 1
Values:

- **0:** Confirmed track
- **1:** Track in initiation phase

I020/170/TRE

Element
bit size: 1
Values:

- **0:** Default
- **1:** Last report for a track

I020/170/CST

Element
bit size: 1
Values:

- **0:** Not Coasted
- **1:** Coasted

I020/170/CDM

Element
bit size: 2
Values:

- **0:** Maintaining
- **1:** Climbing
- **2:** Descending
- **3:** Invalid

I020/170/MAH

Element
bit size: 1
Values:

- **0:** Default
- **1:** Horizontal manoeuvre

I020/170/STH

Element
bit size: 1
Values:

- **0:** Measured position
- **1:** Smoothed position

(FX) - extension bit

I020/170/GHO

Element
bit size: 1
Values:

- **0:** Default
- **1:** Ghost track

Spare bits: 6

(FX) - extension bit

Notes:

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

I020/202 - Calculated Track Velocity in Cartesian Coordinates

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

Group

I020/202/VX

Element
bit size: 16
Signed quantity
LSB = $1/2^2$ m/s ≈ 0.25 m/s
unit: "m/s"
>= -8192.0
<= 8192.0

I020/202/VY

Element
bit size: 16
Signed quantity
LSB = $1/2^2$ m/s ≈ 0.25 m/s
unit: "m/s"
>= -8192.0
<= 8192.0

I020/210 - Calculated Acceleration

definition: Calculated Acceleration of the target, in two's complement form.

Group

I020/210/AX

Element
bit size: 8
Signed quantity
LSB = $1/2^2$ m/s² ≈ 0.25 m/s²
unit: "m/s²"
>= -31.0
<= 31.0

I020/210/AY

Element
bit size: 8
Signed quantity
LSB = $1/2^2$ m/s² ≈ 0.25 m/s²
unit: "m/s²"
>= -31.0
<= 31.0

Notes:

1. Maximum value means "maximum value or above"

I020/220 - Target Address

definition: Target address (24-bit address) assigned to each Target.

Element
bit size: 24
Raw Content

Note:

The type of address (ICAO or non-ICAO address, type of message) is defined by the CF-indication in Data Item I020/020, second extension, bits 8/7.

I020/230 - Communications/ACAS Capability and Flight Status

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

Group

I020/230/COM - Communications Capability of the Transponder

Element
bit size: 3
Values:

- **0:** No communications capability (surveillance only)
- **1:** Comm. A and Comm. B capability
- **2:** Comm. A, Comm. B and Uplink ELM
- **3:** Comm. A, Comm. B, Uplink ELM and Downlink ELM
- **4:** Level 5 Transponder capability
- **5:** Not assigned
- **6:** Not assigned
- **7:** Not assigned

I020/230/STAT - Flight Status

Element
bit size: 3
Values:

- **0:** No alert, no SPI, aircraft airborne
- **1:** No alert, no SPI, aircraft on ground
- **2:** Alert, no SPI, aircraft airborne
- **3:** Alert, no SPI, aircraft on ground
- **4:** Alert, SPI, aircraft airborne or on ground
- **5:** No alert, SPI, aircraft airborne or on ground
- **6:** Not assigned
- **7:** Information not yet extracted

Spare bits: 2

I020/230/MSSC - Mode-S Specific Service Capability

Element
bit size: 1
Values:

- **0:** No
- **1:** Yes

I020/230/ARC - Altitude Reporting Capability

Element
bit size: 1
Values:

- **0:** 100 ft resolution
- **1:** 25 ft resolution

I020/230/AIC - Aircraft Identification Capability

Element
bit size: 1
Values:

- **0:** No
- **1:** Yes

I020/230/B1A - BDS 1,0 Bit 16

Element
bit size: 1
Raw Content

I020/230/B1B - BDS 1,0 Bits 37/40

Element
bit size: 4
Raw Content

I020/245 - Target Identification

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

Group

I020/245/STI

Element
bit size: 2
Values:

- **0:** Callsign or registration not downlinked from transponder
- **1:** Registration downlinked from transponder
- **2:** Callsign downlinked from transponder
- **3:** Not defined

Spare bits: 6

I020/245/CHR - Characters 1-8 (coded on 6 Bits Each) Defining Target Identification

Element
bit size: 48
ICAO string (6-bits per char)

Notes:

1. See ICAO document Annex 10, Volume IV, section 3.1.2.9 for the coding rules.

I020/250 - BDS Register Data

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

Repetitive

Regular, 1 byte(s) REP field size.

Group

I020/250/MBDATA - 56-bit Message Conveying Mode S Comm B Message Data

Element
bit size: 56
Raw Content

I020/250/BDS1 - Comm B Data Buffer Store 1 Address

Element
bit size: 4
Raw Content

I020/250/BDS2 - Comm B Data Buffer Store 2 Address

Element
bit size: 4
Raw Content

Notes:

1. For the transmission of BDS20, item I020/245 is used.
2. For the transmission of BDS30, item I020/260 is used.

I020/260 - ACAS Resolution Advisory Report

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

Element
bit size: 56
Raw Content

Notes:

Refer to ICAO Draft SARPs for ACAS for detailed explanations.

I020/300 - Vehicle Fleet Identification

definition: Vehicle fleet identification number.

Element
bit size: 8
Values:

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

I020/310 - Pre-programmed Message

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

Group

I020/310/TRB

Element
bit size: 1
Values:

- **0:** Default
- **1:** In Trouble

I020/310/MSG

Element
bit size: 7
Values:

- **1:** Towing aircraft
- **2:** FOLLOW-ME operation
- **3:** Runway check
- **4:** Emergency operation (fire, medical...)

5: Work in progress (maintenance, birds scarer, sweepers...)

I020/400 - Contributing Devices

definition: Overview of Receiver Units, which have contributed to the Target Detection.

Repetitive

Regular, 1 byte(s) REP field size.

Group

I020/400/BIT1 - TU1/RU1 Contribution

Element
bit size: 1
Values:

0: TU1/RU1 has NOT contributed to the target detection
1: TU1/RU1 has contributed to the target detection

I020/400/BIT2 - TU2/RU2 Contribution

Element
bit size: 1
Values:

0: TU2/RU2 has NOT contributed to the target detection
1: TU2/RU2 has contributed to the target detection

I020/400/BIT3 - TU3/RU3 Contribution

Element
bit size: 1
Values:

0: TU3/RU3 has NOT contributed to the target detection
1: TU3/RU3 has contributed to the target detection

I020/400/BIT4 - TU4/RU4 Contribution

Element
bit size: 1
Values:

0: TU4/RU4 has NOT contributed to the target detection
1: TU4/RU4 has contributed to the target detection

I020/400/BIT5 - TU5/RU5 Contribution

Element
bit size: 1
Values:

0: TU5/RU5 has NOT contributed to the target detection
1: TU5/RU5 has contributed to the target detection

I020/400/BIT6 - TU6/RU6 Contribution

Element
bit size: 1
Values:

0: TU6/RU6 has NOT contributed to the target detection
1: TU6/RU6 has contributed to the target detection

I020/400/BIT7 - TU7/RU7 Contribution

Element
bit size: 1
Values:

0: TU7/RU7 has NOT contributed to the target detection
1: TU7/RU7 has contributed to the target detection

I020/400/BIT8 - TU8/RU8 Contribution

Element
bit size: 1
Values:

0: TU8/RU8 has NOT contributed to the target detection
1: TU8/RU8 has contributed to the target detection

Note:

In case of more than 8 devices connected to the system, the numbering of the field ”RUx Contribution” follows the standard ASTERIX rule: bits are numbered from right to left. The example below shows the case of a maximum of 16 devices with devices 1, 7 and 14 contributing to the target:
<TODO: add table>

I020/500 - Position Accuracy

definition: Standard Deviation of Position
Compound

I020/500/DOP - DOP of Position

Group

I020/500/DOP/X - DOP (X-Component)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2 \approx 0.25$
unit: ””

I020/500/DOP/Y - DOP (Y-Component)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2 \approx 0.25$
unit: ””

I020/500/DOP/XY - DOP (Correlation XY)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2 \approx 0.25$
unit: ””

I020/500/SDP - Standard Deviation of Position

Group

I020/500/SDP/X - SDP (X-Component)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2$ m ≈ 0.25 m
unit: ”m”

I020/500/SDP/Y - SDP (Y-Component)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2$ m ≈ 0.25 m
unit: ”m”

I020/500/SDP/XY - SDP (Correlation XY)

Element
bit size: 16
Unsigned quantity
LSB = $1/2^2 \approx 0.25$
unit: ""

I020/500/SDH - Standard Deviation of Geometric Height (WGS 84)

Element
bit size: 16
Unsigned quantity
LSB = $1/2$ m ≈ 0.5 m
unit: "m"

Note:

1. There is now a new Item for the Position Accuracy defined in the Reserved Expansion Field (REF), more complete (includes a Standard Deviation of Position in WGS-84) and is based on a different calculation method (covariance instead of correlation). It is recommended to use the new definition. Nevertheless, Item I020/500 is kept in order to prevent a full incompatibility with previous releases of ASTERIX Cat. 020 already implemented.

I020/RE - Reserved Expansion Field

definition: Expansion

Explicit (ReservedExpansion)

I020/SP - Special Purpose Field

definition: Special Purpose Field

Explicit (SpecialPurpose)

User Application Profile

- 1: `I020/010` - Data Source Identifier
- 2: `I020/020` - Target Report Descriptor
- 3: `I020/140` - Time of Day
- 4: `I020/041` - Position In WGS-84 Coordinates
- 5: `I020/042` - Position in Cartesian Coordinates
- 6: `I020/161` - Track Number
- 7: `I020/170` - Track Status
- (FX) - Field extension indicator
- 8: `I020/070` - Mode-3/A Code in Octal Representation
- 9: `I020/202` - Calculated Track Velocity in Cartesian Coordinates
- 10: `I020/090` - Flight Level in Binary Representation
- 11: `I020/100` - Mode C Code
- 12: `I020/220` - Target Address
- 13: `I020/245` - Target Identification
- 14: `I020/110` - Measured Height (Local Cartesian Coordinates)
- (FX) - Field extension indicator
- 15: `I020/105` - Geometric Height (WGS-84)
- 16: `I020/210` - Calculated Acceleration
- 17: `I020/300` - Vehicle Fleet Identification
- 18: `I020/310` - Pre-programmed Message
- 19: `I020/500` - Position Accuracy
- 20: `I020/400` - Contributing Devices
- 21: `I020/250` - BDS Register Data
- (FX) - Field extension indicator
- 22: `I020/230` - Communications/ACAS Capability and Flight Status

- 23: `I020/260` - ACAS Resolution Advisory Report
- 24: `I020/030` - Warning/Error Conditions
- 25: `I020/055` - Mode-1 Code in Octal Representation
- 26: `I020/050` - Mode-2 Code in Octal Representation
- 27: `I020/RE` - Reserved Expansion Field
- 28: `I020/SP` - Special Purpose Field
- (FX) - Field extension indicator