RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #27

Proposed NIC Supplement Flag to augment existing NIC encoding

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SUMMARY
This paper proposes a Navigational Integrity Category (NIC) Supplement flag to augment the existing NIC encoding for higher resolution containment bounds.

It is suggested that a Navigational Integrity Category (NIC) Supplement bit be used to provide higher resolution containment bounds. The proposed changes and additions are shown below in red.

2.2.4.5.2.4 "NIC" Field Encoding

The Navigation Integrity Category ("NIC") field is a 4-bit (bits 5 through 8 of byte 12) field used to allow surveillance applications to determine whether the reported geometric position has an acceptable integrity containment region for the intended use. The value of the NIC parameter specifies an integrity containment region. The NIC integrity containment region is described horizontally using the R_C parameter. The encoding of this field **shall** be as indicated in Table 2-17. The value of the NIC parameter **shall** be the highest value in Table 2-17 consistent with the NIC Input with the exception that if the NIC Input is consistent with a value of "9," "10" or "11" and the ADS-B equipment does not support the timing requirements for the Precision condition (§2.2.7.2.2), a NIC value of "8" **shall** be transmitted.

The NIC Supplement flag augments the existing NIC encoding to provide higher resolution containment regions. The "Data Lifetime" requirements are defined in §2.2.4.5.4.19.

If the NIC Input is "unavailable" for the "Data Lifetime" value listed for this input in Table 2-64, then the "NIC" **shall** default to a value of ALL ZEROs.

Table 2-17: "NIC" Encoding

NIC (binary)	NIC (decimal)	NIC Supplement Flag	Horizontal Containment Bounds
MSB … LSB			
0000	0	--	R_C Unknown
0001	1	--	R_C < 37.04 km (20 NM)
0010	2	--	R_C < 14.816 km (8 NM)
0011	3	--	R_C < 7.408 km (4 NM)
0100	4	--	R_C < 3.704 km (2 NM)
0101	5	--	R_C < 1852 m (1 NM)
0110	6	0	R_C < 1111.2 m (0.6 NM)
		1	R_C < 555.6 m (0.3 NM)
0111	7	--	R_C < 370.4 m (0.2 NM)
1000	8	--	R_C < 185.2 m (0.1 NM)
1001	9	--	R_C < 75 m
1010	10	--	R_C < 25 m
1011	11	--	R_C < 7.5 m
1100	12	--	(Reserved)
1101	13	--	(Reserved)
1110	14	--	(Reserved)
1111	15	--	(Reserved)

Notes:

1. *The "NIC" field is closely associated with the "SIL" field (defined in §2.2.4.5.4.6).*

2. *Normally, the NIC parameter can be directly determined from the Horizontal Protection Limit (HPL) or Horizontal Integrity Limit (HIL) output of the GPS/GNSS receiver. However, in the case of a non-excluded satellite failure, the containment radius may continue to be output but should not be used. In this situation, the position data has been determined to be invalid, and the NIC and NAC_P (see 2.2.4.5.4.9) parameters must be set to ZERO. For example, air transport category aircraft using the ARINC 743A interface*

standard, bit 11 of Label 130 would be monitored to detect a non-excluded GPS fault condition.

2.2.4.5.4 MODE STATUS Element

Format for the MODE STATUS element is defined in Table 2-39. This encoding **shall** apply to ADS-B Messages with PAYLOAD TYPE CODES of "1" and "3." Each of the fields shown is defined in the following subparagraphs.

Table 2-39: Format of MODE STATUS Element

Payload Byte #	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
	. . .							
18	(MSB)	**Emitter Category and Call Sign/Flight Plan ID Characters#1 and #2** (Base-40 encoding)						
19								(LSB)
20	(MSB)	**Call Sign/Flight Plan ID Characters #3, #4, and #5** (Base-40 Encoding)						
21								(LSB)
22	(MSB)	**Call Sign/Flight Plan ID Characters #6, #7, and #8** (Base 40 Encoding)						
23								(LSB)
24	**EMERGENCY/PRIORITY STATUS**			**UAT MOPS VERSION**			**SIL**	
25	(MSB)	**TRANSMIT MSO**				(LSB)	**Reserved**	
26	**NAC_P**				**NAC_V**			**NIC_{BARO}**
27	**CAPABILITY CODES**			**OPERATIONAL MODES**			**CSID**	**SIL_{SUPP}**
28	**Geo Vert Acc**		**SA Flag**	**NIC_{SUPP}**				
29	**Reserved**							
	. . .							

Note: *In the above table, where MSB and LSB are not specifically noted, the MSB is the leftmost bit and the LSB is the rightmost bit.*

2.2.4.5.4.19 Navigational Integrity Category (NIC) Supplement (NIC_{SUPP}) Flag

The "NIC Supplement" (NIC_{SUPP}) Flag in the Mode-Status Element is a one-bit flag (bit 4 of byte 28), that **shall** augment the encoding of the NIC, reported in the State Vector Element (§2.2.4.5.2.4), as defined in Table 2-17.

If the NIC Supplement input is "unavailable" for the "Data Lifetime" value listed for this input in Table 2-64, then the "NIC Supplement" **shall** default to a value of ZERO.

2.2.4.5.4.20 Reserved Bits

This Reserved Bits field is a 12-bit (bit 5 of byte 28 through bit 8 of byte 29) field used that may be used in the future to indicate the capability of a participant

to support engagement in various operations. This Reserved Bits field is reserved for future use and **shall** be set to ALL ZEROs.

Table 2-64: UAT ADS-B Transmitter Input Requirements

Element #	Input Data Element	Relevant Paragraph	Data Lifetime (seconds)	Applicable UAT Equipment Class						
				A0, B0	A1L A1S B1S	A1H, B1	A2	A3	B2	B3
1	ICAO 24-bit Address	2.2.4.5.1.3.1	n/a	M	M	M	M	M	M(1)	M(1)
2	Address Selection (ICAO vs Temporary) (3)	2.2.4.5.1.3.1 2.2.4.5.1.3.2	60	Input required only if installation is to have selectable address						
3	Latitude (2)	2.2.4.5.2.1	1.5	M	M	M	M	M	M	M
4	Longitude (2)	2.2.4.5.2.1	1.5	M	M	M	M	M	M	M
5	Altitude Type Selection (Barometric vs Geometric) (3)	2.2.4.5.2.2	60	O	O	O	O	O	n/a	M
6	Barometric Pressure Altitude	2.2.4.5.2.3	2	M	M	M	M	M	n/a	n/a
7	Geometric Altitude	2.2.4.5.2.3	1.5	M	M	M	M	M	n/a	M
8	NIC	2.2.4.5.2.4	2	M	M	M	M	M	M	M
9	Automatic AIRBORNE / ON-GROUND Indication (3)	2.2.4.5.2.5	2	O	O	M	M	M	n/a	n/a
10	North Velocity (2)	2.2.4.5.2.6.1	2	M	M	M	M	M	M	M
11	East Velocity (2)	2.2.4.5.2.6.3	2	M	M	M	M	M	M	M
12	Ground Speed	2.2.4.5.2.6.2	2	O	O	M	M	M	O	n/a
13	Track Angle	2.2.4.5.2.6.4	2	O	O	M	M	M	n/a	n/a
14	Heading	2.2.4.5.2.6.4	2	O	O	M	M	M	n/a	n/a
15	Barometric Vertical Rate	2.2.4.5.2.7.1.1 2.2.4.5.2.7.1.3	2	M	M	M	M	M	n/a	n/a
16	Geometric Vertical Rate (2)	2.2.4.5.2.7.1.1 2.2.4.5.2.7.1.3	2	O	O	O	O	O	n/a	n/a
17	A/V Length and Width, and POA	2.2.4.5.2.7.2	n/a	M	M	M	M	M	M	M
18	UTC 1 PPS Timing (2)	2.2.4.5.2.8	2	M	M	M	M	M	M	M
19	Emitter Category	2.2.4.5.4.1	n/a	M	M	M	M	M	M	M
20	Call Sign	2.2.4.5.4.2	60	M	M	M	M	M	O	O
21	Emergency / Priority Status Selection	2.2.4.5.4.4	60	M	M	M	M	M	O	n/a
22	Source Integrity Level (SIL)	2.2.4.5.4.6	60	M	M	M	M	M	M	M
23	System Design Assurance (SDA)	2.2.4.5.4.8	60	M	M	M	M	M	M	M
24	SIL Supplement	2.2.4.5.4.16	60	M	M	M	M	M	M	M
25	NAC_P (2)	2.2.4.5.4.9	2	M	M	M	M	M	M	M
26	NAC_V (2)	2.2.4.5.4.10	2	M	M	M	M	M	n/a	n/a
27	NIC_{BARO}	2.2.4.5.4.11	2	Can be internally "hard coded"		M	M	M	n/a	n/a
28	Capability Codes	2.2.4.5.4.12	60	M	M	M	M	M	n/a	n/a
29	TCAS Installed and Operational	2.2.4.5.4.12.2	60	M	M	M	M	M	n/a	n/a
30	TCAS/ACAS Resolution Advisory Flag	2.2.4.5.4.13.1	18	Required only if ADS-B Transmitting Subsystem is intended for installation with TCAS/ACAS; otherwise can be "hard coded"						
31	IDENT Switch Active	2.2.4.5.4.13.2	60	M	M	M	M	M	M	n/a
32	Call Sign Identification	2.2.4.5.4.14	2	Require only if CSID logic Enabled						
33	Geometric Vertical Accuracy (GVA)	2.2.4.5.4.17	60	M	M	M	M	M	M	M
34	Single Antenna Flag	2.2.4.5.4.18	n/a	M	M	M	M	M	M	M
35	NIC Supplement Flag	2.2.4.5.4.19	2	M	M	M	M	M	M	M
36	Selected Altitude Type	2.2.4.5.6.1	60	n/a	n/a	O	M	M	n/a	n/a
37	Selected Altitude Setting	2.2.4.5.6.2	60	n/a	n/a	O	M	M	n/a	n/a
38	Barometric Pressure Setting	2.2.4.5.6.3	60	n/a	n/a	O	M	M	n/a	n/a
39	Selected Heading	2.2.4.5.6.4	60	n/a	n/a	O	M	M	n/a	n/a
40	Status of MCP/FCU Mode	2.2.4.5.6.5	60	n/a	n/a	O	M	M	n/a	n/a
41	Mode Indicators: Autopilot Engaged	2.2.4.5.6.6	60	n/a	n/a	O	M	M	n/a	n/a
42	Mode Indicators: VNAV Engaged	2.2.4.5.6.7	60	n/a	n/a	O	M	M	n/a	n/a
43	Mode Indicators: Altitude Hold Mode	2.2.4.5.6.8	60	n/a	n/a	O	M	M	n/a	n/a
44	Mode Indicators: Approach Mode	2.2.4.5.6.9	60	n/a	n/a	O	M	M	n/a	n/a
45	Radio Altitude	2.2.4.5.2.5.1	2	O	O	O	O	O	n/a	n/a
46	Pressure Altitude Disable	2.2.45.2.2	n/a	M	M	M	M	M	n/a	n/a
47	Airspeed	2.2.4.5.2.5.1	2	O	O	O	O	O	n/a	n/a
48	Flight Plan ID	2.2.4.5.4.2	60	M	M	M	M	M	n/a	n/a

O = Optional M = Mandatory (the equipment must have the ability to accept the data element)

2.4.4.5.2.4 Verification of "NIC" Field Encoding (§2.2.4.5.2.4)

Purpose/Introduction:

The Navigation Integrity Category ("NIC") field is a 4-bit (bits 5 through 8 of byte 12) field used to allow surveillance applications to determine whether the reported geometric position has an acceptable integrity containment region for the intended use. The value of the NIC parameter specifies an integrity containment region. The NIC integrity containment region is described horizontally using the R_C parameter. The encoding of this field **shall** be as indicated in Table 2-17. The value of the NIC parameter **shall** be the highest value in Table 2-17 consistent with the NIC Input with the exception that if the NIC Input is consistent with a value of "9," "10" or "11" and the ADS-B equipment does not support the timing requirements for the Precision condition (§2.2.7.2.2), a NIC value of "8" **shall** be transmitted.

The NIC Supplement flag augments the existing NIC encoding to provide higher resolution containment regions. The "Data Lifetime" requirements are defined in §2.2.4.5.4.19.

If the NIC Input is "unavailable" for the "Data Lifetime" value listed for this input in Table 2-98, then the "NIC" **shall** default to a value of ALL ZEROs.

Measurement Procedure:

Step 1: Establish Initial Conditions

Configure the ADS-B/UAT Transmitting System to broadcast UAT Messages. Provide NIC data at the nominal update rate. Provide the data externally at the interface to the ADS-B system.

Step 2: Verify "NIC" Field Encoding for UAT Messages

Set the ADS-B Transmitting Subsystem to transmit ADS-B Messages. Verify that with each of the NIC parameter input values that specifies an integrity containment radius, R_C in Table 2-17, the system generates UAT Messages such that "NIC" subfield and NIC Supplement Flag in each such message is set to the corresponding binary coding values in Table 2-17. If the ADS-B equipment does not support the timing requirements for the precision condition (§2.2.7.2.2), then verify that the NIC subfield in the transmitted UAT Messages is equal to "8," when the test cases are being run with R_C data that is provided to the ADS-B Transmitting Subsystem that is consistent with NIC values of "9," "10" or "11."

Step 3: "NIC" Field Encoding – Data Lifetime

Discontinue providing update of NIC data. After 2 seconds, verify that the "NIC" subfield and NIC Supplement Flag in the ADS-B Messages are set to ZERO (binary 0000).

Resume providing NIC data and verify that the ADS-B Message contains a "NIC" subfield set equal to the corresponding binary coding value shown in the Table 2-17.

2.4.4.5.4.19 Verification of "NIC Supplement" (NIC_{SUPP}) (§2.2.4.5.4.19)

Appropriate test procedures required to validate the requirements of $2.2.4.5.4.19 are included in §2.2.4.5.2.4.