VDL4 TM ALIGNMENT WITH DO-242A (RTCA ADS-B MASPS)

EUROCAE WG51/SG2 (VDL/4 MOPS)

1. Introduction

This paper presents a series of change proposals considered by EUROCAE WG51/SG2 and aims at updating the VDL/4 Technical Manual for alignment with the current ADS-B MASPS (RTCA DO-242A). The sections below describe the rationale for the proposed changes and further details on the proposed change to update the Technical Manual. The Appendix contains extracts from the Technical Manual with the detailed amendment proposals.

1.1 Rationale

The State Vector Quality (SVQ) metric of position uncertainty "NUC_P" defined in the former version of the ADS-B MASPS (DO-242) has been replaced in the latest MASPS edition (DO-242A) by the SVQ metrics of integrity "NIC" and "SIL", and of position accuracy "NAC_P". The "NIC" (Navigation Integrity Category) parameter specifies an integrity containment radius and is closely related with the "SIL" (Surveillance Integrity Level) parameter that specifies the probability of the true position lying outside that containment radius without alerting.

The "NIC" and "SIL" are reported so that the level of integrity of the reported position may be assessed by the surveillance applications. Similarly, the "NAC_P" and "NAC_v" (for position and velocity respectively) are reported to assess the accuracy level of the position and velocity reports. When there is a change of navigation integrity, such as in the event of loss of primary source of navigation, the NIC, NAC, and SIL values are adjusted to represent the backup source navigation performance.

It is proposed to update the uncertainty parameters currently defined in the Technical Manual (TM) with the new integrity and accuracy parameters defined in DO-242A. These changes will align the ICAO VDL/4 TM with the current MASPS requirements, in support of the State vector (SV) and Mode Status (MS) reports.

In order to support the update rate requirements for TCP reporting with those specified in DO-242A, it is proposed to provide a means for the mobile station to adjust its reporting rate promptly upon detection of a change in TCP status. A similar process is proposed to deal with the event of SVQ status changes. It should be noted that the current MASPS provide update rate requirements only for the first TCP (TCP+0), and that update rate requirements for further TCPs will be defined in future updates of the MASPS. MS report parameters (including NAC) are primarily in support of air-ground applications whose update rate requirements are not currently defined and thus will be subject to future revision. In this instance the update rate for SVQ status change is kept at the level of the basic state vector report and a note placed indicating this rate is subject to future revision.

The proposed method for accommodating the above changes into the TM is outlined in the section below. Detailed text proposals are provided in the Appendix.

1.2 Method for implementing the updates

1.2.1 NUCp replaced by NIC in fixed part (TM 1.5.2.2)

In section 1.5.2.2, tables 1-65, 1-66 and 1-67 are modified to accommodate the integrity parameter (NIC) in the fixed part of the synchronisation burst in place of the old "NUC_P" field.

1.2.2 NUCr replaced by SIL in variable part definitons

In section 3.3 the various variable part definitions of the synchronisation burst are defined. Tables 3-2, 3-3, 3-4, 3-5, 3-8a, 3-8b, 3-9 and 3-10 are modified to accommodate the surveillance integrity level parameter "SIL" to compliment the NIC parameter introduced in the fixed part. This two-bit parameter is introduced in place of the previous three-bit "NUC_r" parameter, leaving one spare bit.

The accuracy parameters for position and velocity (NAC_p and NAC_v) are introduced in the two-slot TCP variable part definition in table 3-8a and a new table (3-8c) is introduced to define a new variable part containing the full set of State Vector Quality parameters.

The ranges for the SIL, NAC_p and NAC_v parameters are introduced in table 3-11 with references to the relevant MASPS sections for encoding.

1.2.3 Removal of TCP type indicator

The TCP type (typ) indicator bits in table 3-8a (and equivalent encoding in table 3-11) are removed and set to reserved. These spare bits may be used for future definition of additional TCP message components, such as the *turn radius.* A note explaining the potential for future modification of the current TCP message definition as a consequence of system-level requirements evolution is inserted at the foot of this table.

1.2.4 New CDTI status flag

A flag in the two-slot TCP message indicating the presence of operational CDTI equipment is included in table 3-8a (and encoding defined in table 3-11).

1.2.5 A new procedure describing the action taken by a mobile station when TCP or SVQ status changes

First, the scope of the *tc* flag (renamed tqc[1]) is extended so that, besides applying to a change in TCP status, it also flags a change in State Vector Quality status. This supports the current procedure in which the mobile flags the change in status, which provides the stimulus for the ground station to request an update.

A procedure for describing the autonomous behaviour of a mobile station on detecting a change in TCP or SVQ status is inserted above the present section text. Two new tables (3-22a and 3-22b) containing the description of the transmission rate parameters for TCP and SVQ, are inserted. A note explaining the background for the selection of the TCP and SVQ report rates and duration parameters is inserted below the new text.

[1]Note that *tc* is already used to denote the transmission definition count parameter in the Channel Management parameter transmission definition block.

Appendix: Amendment Proposals to ICAO TM text

This section provides the text proposals described in the section above in revision-marked form contained in extracts from the VDL/4 Technical Manual. The changes are illustrated below in a series of numbered steps.

1. In Section 1.5.2.2 modify the contents of the first octet in table 1-65 as shown below :

Note: the first two octets only of table 1-65 are reproduced below for illustration.

Table 1-65. Synchronization burst format

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
TCP/SVQ change flag (tqc) baro/geo altitude (b/g) CPR Format even/odd (cprf) ~~Position uncertainty (nucp)~~navigation integrity category (nic)	5	~~nucp$_4$~~ nic$_4$	~~nucp$_3$~~ nic$_3$	~~nucp$_2$~~ nic$_2$	~~nucp$_1$~~ nic$_1$	cprf	b/g	tqc	0
Latitude (lat)	6	lat$_8$	lat$_7$	lat$_6$	lat$_5$	lat$_4$	lat$_3$	lat$_2$	lat$_1$
…	…	..	..	..	..	..	..	..	..

2. In Section 1.5.2.2 modify the encoding description in table 1-66 in the first and third rows for the TCP/SVQ change flag and the NIC parameter encodings respectively, as shown below:

Note: the first four rows only of table 1-66 are reproduced below for illustration.

Table 1-66. Synchronization burst field encoding (fixed data field)

Subfield	Range	Encoding	Notes
TCP/SVQ change flag (tqc)	Boolean	Encoded as defined in Section 3.6 if the message ID (see Table 1-6a) indicates that the burst is a directed synchronisation burst. Otherwise reserved for future definition and set equal to 1.~~(see Section 3.6)~~	
time figure of merit (tfom)	0 to 3	0 = primary certified 1 = primary/non-certified 2 = secondary 3 = tertiary	(see Section 1.2.3)
~~Position~~ navigation ~~uncertainty~~ integrity category (~~nuc~~NIC~~p~~)	0 to ~~9~~15	See Table 1-67 Values 12 to 15 are reserved for future definition	
Latitude (lat)	-90 to + 90°	12-bit low-resolution encoding according to the CPR encoding algorithm adapted for VDL Mode 4, as described in Section 4	The 12-bit CPR encoding provides position to a resolution of approximately 140 m, within a segment (patch) of approximately 600 nmi
…	…	…	…

3. In section 1.5.2.2 delete the present table 1-67 and introduce a new table containing the encoding of the NIC parameter, and modify the statement directly above table 1-67, as below.

"The station shall encode its navigation ~~uncertainty~~ integrity category ~~of position~~ (~~nucp~~nic) in accordance with Table 1-67."

Table 1-67. Encoding of position ~~n~~Navigation ~~uncertainty~~ Integrity C~~c~~ategory (~~nucp~~NIC)

~~nucp~~	~~Required Navigation Performance (RNP) class~~	~~Horizontal Protection Limit (HPL) (0.9999999 integrity bound) (nmi)~~	~~Horizontal error (nmi unless otherwise stated)~~	~~Vertical error (ft)~~
			~~Horizontal and vertical errors are 95% numbers.~~	
~~0~~	~~N/A~~	~~N/A~~	~~N/A~~	~~N/A~~
~~1~~	~~RNP-10~~	~~<20~~	~~<10~~	~~reserved~~
~~2~~	~~RNP-5~~	~~<10~~	~~<5~~	~~reserved~~
~~3~~	~~RNP-1~~	~~<2~~	~~<1~~	~~reserved~~
~~4~~	~~RNP-0.5~~	~~<1~~	~~<0.5~~	~~reserved~~
~~5~~	~~e.g., NPA, DME-DME~~	~~<0.5~~	~~<0.25~~	~~reserved~~
~~6~~	~~e.g., GPS-SPS~~	~~<0.2~~	~~<0.1~~	~~reserved~~
~~7~~	~~e.g., GNSS (no SA)~~	~~<0.1~~	~~<0.05~~	~~reserved~~
~~8~~	~~e.g., SBAS~~	~~Reserved~~	~~<10m~~	~~<15m~~
~~9~~	~~e.g., GBAS~~	~~Reserved~~	~~<3m~~	~~<4m~~

NIC	Required Navigation Performance (RNP) class	Horizontal and Vertical containment radius (R_c)
0	Unknown integrity	R_c ≥20 nmi
1	RNP-10	R_c < 20 nmi
2	RNP-4	R_c < 8 nmi
3	RNP-2	R_c < 4 nmi
4	RNP-1	R_c < 2 nmi
5	RNP-0.5	R_c < 1 nmi
6	RNP-0.3	R_c <0.6 nmi
7	RNP-0.1	R_c <0.2 nmi
8	RNP-0.05	R_c < 0.1 nmi
9	Undefined	R_c < 75 m
10	Undefined	R_c < 25 m
11	Undefined	R_c < 7.5 m
12	Reserved for future definition	
13	Reserved for future definition	
14	Reserved for future definition	
15	Reserved for future definition	

4. In Section 1.5.2.2 modify the last statement (below table 1-69) as shown below:

"If the report latency is greater than 4 seconds, then ~~nucp~~ NIC shall be set to 0."

5. In Section 3.3 table 3-2 add a new row defining a new information field "Single Slot SVQ" with an ID of "5 hex" and adjust the unassigned range accordingly, as shown below.

Note: The first ten rows only are reproduced for illustration.

Table 3-2. ADS-B information fields

Information field ID (id)	ID extension 1 (id1)	ID extension 2 (id2)	Information field name
0 hex	Not present	not present	Basic
1 hex	Not present	not present	High dynamic
2 hex	Not present	not present	Full position
3 hex	Not present	not present	Basic ground
4 hex	Not present	not present	UTC time
5 hex	Not present	Not present	Single slot SVQ
~~5~~6-7 hex	Not present	not present	Available for future use
8 hex	Not present	not present	Two slot TCP
9 hex	Not present	not present	Single slot TCP
A hex	0 hex	not present	Available for future use
…	…	…	…

6. In section 3.3 table 3-3 delete the three bits assigned to the "nucr" parameter in octets 12 and 13, assign two of these bits to the "sil" parameter and set the remaining bit to "res".

Table 3-3. Information field 0 hex — Basic

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
Information field ID	11	x	x	x	x	0	0	0	0
~~Rate uncertainty~~Suveillance Integrity Level (~~nucr~~sil) 6-bit latitude offset (lat6)	12	~~nucr$_2$~~sil$_2$	~~nucr$_1$~~sil$_1$	lat6$_6$	lat6$_5$	lat6$_4$	lat6$_3$	lat6$_2$	lat6$_1$
6-bit longitude offset (lon6) baro rate/geo rate (br/gr)	13	~~nucr$_3$~~res	br/gr	lon6$_6$	lon6$_5$	lon6$_4$	lon6$_3$	lon6$_2$	lon6$_1$
Baro/geo offset (bgo)	14	altr$_9$	bgo$_7$	bgo$_6$	bgo$_5$	bgo$_4$	bgo$_3$	bgo$_2$	bgo$_1$
Altitude rate (altr)	15	altr$_8$	altr$_7$	altr$_6$	altr$_5$	altr$_4$	altr$_3$	altr$_2$	altr$_1$
Ground speed (gs)	16	gs$_8$	gs$_7$	gs$_6$	gs$_5$	gs$_4$	gs$_3$	gs$_2$	gs$_1$
Ground track (gt)	17	gs$_{11}$	gs$_{10}$	gs$_9$	gt$_5$	gt$_4$	gt$_3$	gt$_2$	gt$_1$
	18	gt$_{11}$	gt$_{10}$	gt$_9$	gt$_8$	gt$_7$	gt$_6$		

7. **In section 3.3 table 3-4 delete the three bits assigned to the "nucr" parameter in octet 14, assign two of these bits to the "sil" parameter and set the remaining bit to "res".**

Table 3-4. Information field 1 hex — High dynamic

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
information field ID	11	x	x	x	x	0	0	0	1
baro rate/geo rate (br/gr), baro/geo offset (bgo)	12	br/gr	bgo$_7$	bgo$_6$	bgo$_5$	bgo$_4$	bgo$_3$	bgo$_2$	bgo$_1$
altitude rate (altr)	13	altr$_8$	altr$_7$	altr$_6$	altr$_5$	altr$_4$	altr$_3$	altr$_2$	altr$_1$
~~rate uncertainty~~ Surveillace Integrity Level (~~nucr~~sil)	14	altr$_9$	~~nucr$_3$~~res	~~nucr$_2$~~sil$_2$	~~nucr$_1$~~sil$_1$	gs$_{12}$	gs$_{11}$	gs$_{10}$	gs$_9$
ground speed (gs)	15	gs$_8$	gs$_7$	gs$_6$	gs$_5$	gs$_4$	gs$_3$	gs$_2$	gs$_1$
4-bit longitude offset (lon4), 4-bit latitude offset (lat4)	16	lon4$_4$	lon4$_3$	lon4$_2$	lon4$_1$	lat4$_4$	lat4$_3$	lat4$_2$	lat4$_1$
ground track (gt)	17	gt$_8$	gt$_7$	gt$_6$	gt$_5$	gt$_4$	gt$_3$	gt$_2$	gt$_1$
	18	gt$_{12}$	gt$_{11}$	gt$_{10}$	gt$_9$	res	res		

8. **In section 3.3 table 3-5 delete the three bits assigned to the "nucr" parameter in octet 18, assign two of these bits to the "sil" parameter and set the remaining bit to "res".**

Table 3-5. Information field 2 hex — Full position

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
information field ID	11	x	x	x	x	0	0	1	0
6-bit latitude offset (lat6)	12	pid_{10}	pid_9	$lat6_6$	$lat6_5$	$lat6_4$	$lat6_3$	$lat6_2$	$lat6_1$
patch ID (pid)	13	pid_8	pid_7	pid_6	pid_5	pid_4	pid_3	pid_2	pid_1
baro/geo offset (bgo)	14	gt_{11}	bgo_7	bgo_6	bgo_5	bgo_4	bgo_3	bgo_2	bgo_2
6-bit longitude offset (lon6)	15	gt_{10}	gt_9	$lon6_6$	$lon6_5$	$lon6_4$	$lon6_3$	$lon6_2$	$lon6_1$
ground track (gt)	16	gt_8	gt_7	gt_6	gt_5	gt_4	gt_3	gt_2	gt_1
ground speed (gs)	17	gs_8	gs_7	gs_6	gs_5	gs_4	gs_3	gs_2	gs_1
~~rate uncertainty~~ Surveillance Iintegrity Level (~~nucr~~sil)	18	gs_{11}	gs_{10}	gs_9	~~$nucr_3$~~r es	~~$nucr_2$~~si l_2	~~$nucr_1$~~si l_1		

9. **In section 3.3 table 3-8a delete the three bits assigned to the "nucr" parameter, assign two of these bits to the "sil" parameter and set the remaining bit to "res". Move the three Status bits (st) in octet 41 to the reserved bits in octet 38 and change the "st" bits in octet 41 to "nacv". Insert a new row (octet 42) and assign four bits to "nucr" and one bit each to "nicb", "cdti", "acas" and "ra". Finally, add a note under table 3-8a, as shown below:**

Table 3-8a. Information field 8 hex — Two slot TCP/SVQ

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
information field ID	11	x	x	x	x	1	0	0	0
TCP latitude (lat)	12	lat_8	lat_7	lat_6	lat_5	lat_4	lat_3	lat_2	lat_1
	13	$balt_{12}$	$balt_{11}$	$balt_{10}$	$balt_9$	lat_{12}	lat_{11}	lat_{10}	Lat_9
base altitude (balt)	14	$balt_8$	$balt_7$	$balt_6$	$balt_5$	$balt_4$	$balt_3$	$balt_2$	$Balt_1$
longitude (lon)	15	lon_8	lon_7	lon_6	lon_5	lon_4	lon_3	lon_2	Lon_1
	16	ttg_6	ttg_5	lon_{14}	lon_{13}	lon_{12}	lon_{11}	lon_{10}	Lon_9
time to go (ttg)~~/TCP type (typ)~~	17	ttg_4	ttg_3	ttg_2	ttg_1	restyp_4	res~~typ_3~~	res~~typ_2~~	res~~typ_1~~
TCP+1 latitude (lat)	18	lat_8	lat_7	lat_6	lat_5	lat_4	lat_3	lat_2	Lat_1
	19	$balt_{12}$	$balt_{11}$	$balt_{10}$	$balt_9$	lat_{12}	lat_{11}	lat_{10}	Lat_9
base altitude (balt)	20	$balt_8$	$balt_7$	$balt_6$	$balt_5$	$balt_4$	$balt_3$	$balt_2$	$balt_1$
longitude (lon)	21	lon_8	lon_7	lon_6	lon_5	lon_4	lon_3	lon_2	Lon_1
	22	ttg_6	ttg_5	lon_{14}	lon_{13}	lon_{12}	lon_{11}	lon_{10}	Lon_9
time to go (ttg)~~/TCP type (typ)~~	23	ttg_4	ttg_3	ttg_2	ttg_1	restyp_4	res~~typ_3~~	res~~typ_2~~	res~~typ_1~~
TCP+2 latitude (lat)	24	lat_8	lat_7	lat_6	lat_5	lat_4	lat_3	lat_2	lat_1
	25	$balt_{12}$	$balt_{11}$	$balt_{10}$	$balt_9$	lat_{12}	lat_{11}	lat_{10}	lat_9
base altitude (balt)	26	$balt_8$	$balt_7$	$balt_6$	$balt_5$	$balt_4$	$balt_3$	$balt_2$	$balt_1$
longitude (lon)	27	lon_8	lon_7	lon_6	lon_5	lon_4	lon_3	lon_2	lon_1
	28	ttg_6	ttg_5	lon_{14}	lon_{13}	lon_{12}	lon_{11}	lon_{10}	lon_9
time to go (ttg)~~/TCP type (typ)~~	29	ttg_4	ttg_3	ttg_2	ttg_1	restyp_4	res~~typ_3~~	res~~typ_2~~	res~~typ_1~~
TCP+3 latitude (lat)	30	lat_8	lat_7	lat_6	lat_5	lat_4	lat_3	lat_2	lat_1
	31	$balt_{12}$	$balt_{11}$	$balt_{10}$	$balt_9$	lat_{12}	lat_{11}	lat_{10}	lat_9
base altitude (balt)	32	$balt_8$	$balt_7$	$balt_6$	$balt_5$	$balt_4$	$balt_3$	$balt_2$	$balt_1$
longitude (lon)	33	lon_8	lon_7	lon_6	lon_5	lon_4	lon_3	lon_2	lon_1
	34	ttg_6	ttg_5	lon_{14}	lon_{13}	lon_{12}	lon_{11}	lon_{10}	lon_9
time to go (ttg)~~/TCP type (typ)~~	35	ttg_4	ttg_3	ttg_2	ttg_1	restyp_4	res~~typ_3~~	res~~typ_2~~	res~~typ_1~~
call sign left (csl)	36	csl_8	csl_7	csl_6	csl_5	csl_4	csl_3	csl_2	csl_1
	37	csl_{16}	csl_{15}	csl_{14}	csl_{13}	csl_{12}	csl_{11}	csl_{10}	csl_9
status (st)	38	st$_3$~~res~~	st$_2$~~res~~	st$_1$~~res~~	csl_{21}	csl_{20}	csl_{19}	csl_{18}	csl_{17}
call sign right (csr)	39	csr_8	csr_7	csr_6	csr_5	csr_4	csr_3	csr_2	csr_1
	40	csr_{16}	csr_{15}	csr_{14}	csr_{13}	csr_{12}	csr_{11}	csr_{10}	csr_9

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
SVQ ~~status (st)~~ NAC_v (nacv)	41	$nacv_3$~~s t3~~	$nacv_2$~~s t2~~	$nacv_1$~~s t1~~	csr_{21}	csr_{20}	csr_{19}	csr_{18}	csr_{17}
NAC_p (nacp), CDTI display capability (cdti), NIC_{baro} flag (nicb) ACAS operational flag (acas), Resolution Advisory active flag (ra)	42	$nacp_4$	$nacp_3$	$nacp_2$	$nacp_1$	cdti	nicb	acas	ra
current patch ID (pid)	~~42~~43	pid_8	pid_7	pid_6	pid_5	pid_4	pid_3	pid_2	pid_1
6-bit latitude offset (lat6)	~~43~~44	pid_{10}	pid_9	$lat6_6$	$lat6_5$	$lat6_4$	$lat6_3$	$lat6_2$	$lat6_1$
~~rate uncertainty (nucr),~~ 6-bit longitude offset (lon6), baro rate/geo rate (br/gr)	~~44~~45	$altr_9$	br/gr	$lon6_6$	$lon6_5$	$lon6_4$	$lon6_3$	$lon6_2$	$lon6_1$
altitude rate (altr)	46	$altr_8$	$altr_7$	$altr_6$	$altr_5$	$altr_4$	$altr_3$	$altr_2$	$altr_1$
aircraft category (ac) SIL (sil)	~~46~~47	res~~nuc r3~~	sil_2~~nuc r2~~	sil_1~~nuc r1~~	ac_5	ac_4	ac_3	ac_2	ac_1
ground speed (gs)	~~47~~48	gs_8	gs_7	gs_6	gs_5	gs_4	gs_3	gs_2	gs_1
ground track (gt)	~~48~~49	gs_{11}	gs_{10}	gs_9	gt_5	gt_4	gt_3	gt_2	gt_1
	~~49~~50	gt_{11}	gt_{10}	gt_9	gt_8	gt_7	gt_6	~~res~~	~~res~~

Note.-- The detailed definition of the TCP information fields and their operational usage is still under discussion in the aviation community. As a consequence, the TCP format definition described above may be subject to future revision.

10. In section 3.3 following table 3-8b, insert a new table (3-8c) defining a single-slot SVQ parameters variable part as shown below:

Table 3-8c. Information field 5 hex — Single Slot SVQ

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
Information field ID	11	x	x	x	x	0	1	0	1
NAC_p	12	0	0	0	1	$nacp_4$	$nacp_3$	$nacp_2$	$nacp_1$
NAC_v (nacv), SIL (sil), NIC_{baro} (nicb), ACAS operational flag (acas), Resolution Advisory active flag (ra)	13	$nacv_3$	$nacv_2$	$nacv_1$	sil_2	sil_1	nicb	acas	ra
status (st) and aircraft category (ac)	14	st_3	st_2	st_1	ac_5	ac_4	ac_3	ac_2	ac_1
Reserved for future definition	15	res	res	res	res	res	res	res	res
Reserved for future definition	16	res	res	res	res	res	res	res	res
Reserved for future definition	17	res	res	res	res	res	res		

Note.-- The detailed definition of the SVQ information fields and their operational usage is still under discussion in the aviation community. As a consequence, the SVQ format definition described above may be subject to future revision. Currently there is discussion in the aviation community to provide further information such as describing the ADS-B position reference point, the length and width, the capability classes (e.g information for TCAS/ACAS, CDTI etc) and the operational mode codes (receiving ATC services, etc). There are spare octets to provide this information, when agreed in the future, but at this stage they are left unassigned to facilitate the future assignment.

11. In section 3.3 table 3-10 delete the three bits assigned to the "nucr" parameter in octet 13, assign two of these bits to the "sil" parameter and set the remaining bit to "res".

Table 3-10. Information field AA0 hex — High resolution

Description	Octet	Bit number							
		8	7	6	5	4	3	2	1
information field ID	11	x	x	x	x	1	0	1	0
	12	1	0	1	0	0	0	0	0
~~rate uncertainty~~ Surveillance Integrity Level (~~nuc~~sil)	13	res	~~nucr~~$_3$res	~~nucr~~$_2$$sil_2$	~~nucr~~$_1$$sil_1$	gs_{12}	gs_{11}	gs_{10}	gs_9
ground speed (gs)	14	gs_8	gs_7	gs_6	gs_5	gs_4	gs_3	gs_2	gs_1
8-bit longitude offset (lon8)	15	$lon8_8$	$lon8_7$	$lon8_6$	$lon8_5$	$lon8_4$	$lon8_3$	$lon8_2$	$lon8_1$
8-bit latitude offset (lat8)	16	$lat8_8$	$lat8_7$	$lat8_6$	$lat8_5$	$lat8_4$	$lat8_3$	$lat8_2$	$lat8_1$
ground track (gt)	17	gt_8	gt_7	gt_6	gt_5	gt_4	gt_3	gt_2	gt_1
turn indication (tind)	18	gt_{12}	gt_{11}	gt_{10}	gt_9	$tind_2$	$tind_1$		

12. In section 3.3 table 3-11 substitute the definition of the nucr parameter with that of the SIL parameter in the first row, insert two new rows containing the encoding for the newly instated NAC_p and NAC_V parameters, delete the TCP type (typ) encoding in row 15, and add a new row at the end of the table with the encoding of the CDTI bit, as shown below:

Table 3-11. Information field encoding (variable data field)

Subfield	Range	Encoding	Notes	
~~rate navigation uncertainty category~~Surveillance Integrity Level (~~nucr~~SIL)	0-43	Values 0, 1, 2, 3~~, 4~~ in accordance with the ~~five~~ four ~~nucr~~ SIL categories specified for ADS-B MASPS by RTCA/DO-242A §2.1.2.15.		
Position Navigation Accuracy Category (NAC_P)	0-11	Values 0 through 11 in accordance with the twelve NAC_P categories specificed for ADS-B MASPS by RTCA/DO-242A §2.1.2.13.		
Velocity Navigation Accuracy Category (NAC_V)	0-4	Values 0,1,2,3,4 in accordance with the five NAC_V categories specified for ADS-B MASPS by RTCA/DO-242A §2.1.2.14.		

Subfield	Range	Encoding	Notes
4-bit latitude (lat4)	-	A high-resolution component to enhance the 12-bit low-resolution encoding transmitted in the fixed part (see Table 1-66). Encoding of this high-resolution component is described in Section 4.6	
6-bit latitude (lat6)	-	See note above	
8-bit latitude (lat8)	-	See note above	
4-bit longitude (lon4)	-	A high-resolution component to enhance the 14-bit low-resolution encoding transmitted in the fixed part (see Table 1-66). Is described in Section 4.6	
6-bit longitude (lon6)	-	See note above	
8-bit longitude (lon8)	-	See note above	
baro/geo offset (bgo)	0-127	bgo = barometric – geometric altitude Encoding as in Table 3-12 below	
baro rate/geo rate (br/gr)	Binary	0 = altitude rate is barometric altitude rate 1 = altitude rate is geometric altitude rate	
altitude rate (altr)	-32 100 fpm to +32 100 fpm	Bit $altr_9$ encodes the sign of altitude rate of change with 0 = climb and 1 = descend. $Altr_9$ shall be set to 0 if the magnitude of altitude rate is unknown Bits $altr_8$ ... $altr_1$ encode the magnitude of altitude rate of change as specified in Table 3-14.	
ground speed (gs)	0 to 11 256 knots	Encoding as in Table 3-13	Range is 0 to 3069 knots for 11 bits and 0 to 11 256 for 12 bits. Resolution steps from 1 knot to 4 knots. Note that bit 12 is only available in the high dynamic variable part.
ground track (gt)	0° to 359.912°	due North ± $½^{N+1}$ degrees coded as 0 and decoded as due North Resolution is $360/2^N$ degrees	Ground track is the same as true track. N is the number of bits (either 11 or 12) assigned in the variable field for ground track.
turn indication (tind)	0 – 3	0 = Unknown, 1 = Left, 2 = Right and 3 = Straight	The threshold between straight and turning is an operational issue that will be specified elsewhere.
patch ID (pid)	-	Encoding is described in Section 4.8	
~~TCP type (typ)~~	~~0 – 15~~	~~Reserved for future definition~~	
UTC year (yr)	1-255	current year - 1970, 0= N/A	
UTC month (mon)	1-12	integer months	
UTC day (day)	1-31	integer days, 00= N/A	
UTC hours (h)	0-23	integer hours	
UTC minute (min)	0 to 59	integer minutes	
UTC second (sec)	0 to 60	integer seconds	Seconds run up to 60 to allow for leap seconds
slot (slt)	0 to 255	integer slots, 0 indicates the first slot in the second frame	
TCP number (no)	0 – 3	0 = current	

Subfield	Range	Encoding	Notes
		1 = next 2 = next + 1 3 = next + 2	
TCP time to go (ttg)	0 – 63	Indicates the time to reach the indicated TCP from either the current position (no – 0) or from the previous TCP (no = 1, 2 or 3). Encoding as in Table 3-17	
call sign left (csl), call sign right (csr)		Encoding for call sign: 1) Call sign shall be left justified 2) Only valid characters are A-Z, 0 – 9 and null: Assign A- Z = 0 – 25, 0 – 9 = 26 – 35, null = 36 3) Call sign shall be an eight character string "c_1, c_2, c_3, c_4, c_5, c_6, c_7, c_8" 4) csl = $c_1\ 37^3 + c_2\ 37^2 + c_3\ 37 + c_4$ 5) csr = $c_5\ 37^3 + c_6\ 37^2 + c_7\ 37 + c_8$	
aircraft category (ac)	0 – 31	Encoding as in Table 3-15	
status (st)	0 – 7	Encoding as in Table 3-16	
CDTI flag (cdti)	Binary	0 = not CDTI equipped. 1 = CDTI equipment installed and operational.	

13. In Section 3.6.4 include "SVQ" in the paragraph text as shown below:

"

3.6.4 TCP/SVQ change procedures

When the status of its first TCP changes, a mobile station shall autonomously transmit a series of synchronisation bursts containing the single-slot TCP variable part (see table 3-8b). The update interval for these transmissions shall be tci seconds and this high reporting rate shall be maintained for a period of tcd seconds, as defined in table 3-22a.

Table 3-22a. TCP update rate parameters

Symbol	Parameter name	Minimum	Maximum	Default
tci	TCP high update interval	1s	60s	2s
tcd	TCP high update rate duration	1s	60s	12s

When its SVQ status changes, a mobile station shall autonomously transmit a series of synchronisation bursts containing the single-slot SVQ variable part (see table 3-8c). The update interval for these transmissions shall be svi seconds and this high reporting rate shall be maintained for a period of svd seconds, as defined in table 3-22b.

Table 3-22b. SVQ update rate parameters

Symbol	Parameter name	Minimum	Maximum	Default
svi	SVQ high update interval	1s	60s	2s
svd	SVQ high update	1s	60s	12s

Symbol	Parameter name	Minimum	Maximum	Default
	rate duration			

Note 1.— The elements that can trigger an SVQ status change are SIL, NAC_P and NAC_V.

Note 2.— The aim is to achieve at least five reports within a twelve second period. This rate ensures that all stations have a high probability of receiving notification of an SVQ or TCP change within twelve seconds.

A mobile station which is transmitting directed synchronisation bursts which, as part of a regular periodic series of synchronisation bursts, include the two slot TCP/SVQ variable part defined in Table 3-8a, shall indicate when there is a change to any of its TCPs or to its State Vector Quality (SVQ) indicators by setting the TCP/SVQ change flag (see Section 1.5.2.2) to zero in all directed synchronisation bursts transmitted by the station.

When a mobile has set its TCP/SVQ change flag to 0, only ground stations shall be allowed to respond by issuing an ADS-B request burst requesting that the mobile transmit a synchronisation burst containing the two slot TCP/SVQ variable part.

The mobile station shall set the TCP/SVQ change flag to 1 when it has transmitted updated TCP and/or SVQ information using the two slot TCP variable part.

A station which is transmitting directed synchronisation bursts which do not include the two slot TCP/SVQ-variable part in the regular periodic series of synchronisation bursts, shall set the TCP/SVQ change flag to 1.

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