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Response to Action Item 27-12
NIC Encoding of 0.3NM Containment Radius

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Summary
During WG3 Meeting #27 and SG1 Meeting #4, agreement was reached on the need to provide for a NIC encoding of a horizontal position integrity containment bound of 0.3NM. This paper proposes to change the current Type Code 13 (JNIC=6) encoding to accommodate that provision.

1 Introduction

As discussed in WP26-07, the current encoding of horizontal position integrity containment bounds (Rc) into NIC codes is fairly coarse in the range of 0.2NM to 0.5NM compared to the level of detail needed for applications such as ADS-B-RAD. A particular case is the need for the expression of a containment bound of 0.3NM, required to support 3NM separation services (TMA) as established in Annex G[1] of the ADS-B-RAD SPR/INTEROP document (ED126, DO-yyy).

As further discussed in WP26-07, from the viewpoint of current RAIM based GPS receivers, such additional containment bounds offer additional margin (SA Aware) and/or are needed in the first place (SA ON) to assure the required availability and continuity of ADS-B position reports of sufficient quality, in support of operations such as the ADS-B-RAD 3NM separation services.

During the review of WP27-03, agreement was reached on the need to provide a NIC encoding for an R_C=0.3NM. However, there was considerable discussion on the NIC=7 supplement proposed in WP26-07, due to backwards compatibility issues primarily with existing Version 1 (DO260A) airborne receivers. As a consequence, a revised encoding of NIC=6 was considered as an alternative solution. This solution, in turn, bears potential backwards compatibility issues primarily with existing Version 1 ground receivers such as those being in operational use today in Australia and Canada.

In response, action item 27-12 was formulated to consult with Airservices Australia and Nav Canada to assess the acceptability of a revised NIC=6 encoding.

2 Summary of considered solutions for NIC encoding of Rc=0.3NM

During the discussions of WP26-07, two alternative solutions have been looked into for a NIC encoding of Rc=0.3NM. The desired preservation of backwards compatibility has thereby been recognised as the key constraint for the adoption of one of these two alternatives, i.e. to:

a) Add the use of the NIC supplement=1 for the Type Code=12 (NIC=7) encoding to express an Rc=0.3NM; or to

b) Redefine the current Type Code=13 (NIC=6) encoding, recognising that the current ADS-B-NRA operations in Australia and Canada require a maximum allowable containment bound of 0.5 NM. As a consequence, it is proposed to encode Type Code=13 with NIC supplement=0 as 0.3NM (today 0.5NM) and to encode Type Code=13 with NIC supplement=1 as 0.5NM (today 0.6NM).

Despite of both solutions proposing subtle changes, backwards compatibility is an issue.

Solution a) primarily affects backwards compatibility of fielded Version 1 avionics receivers, as these do not recognise a NIC supplement=1 for Type Code=12 and hence declare the data quality as "unknown". Operationally, for ADS-B In applications, this would inadequately render a loss of data of otherwise sufficient quality.

In addition, other receivers (such as the ground receivers operational today) might disregard a NIC supplement=1 and encode a Type Code=12 always as an Rc=0.2NM. In case of the NIC supplement=1 actually being used by Version 2 transmitters, the receiver would therefore being misled about the containment bound (interpreting 0.3NM as 0.2NM). It is acknowledged that, in

[1] "Additional Considerations for Implementing ADS-B-RAD in the U.S. National Airspace System (NAS)"

practical terms, such risk should be small in as the most demanding containment bound operationally applied today is 0.5NM.

Solution b) primarily affects backwards compatibility of Version 1 ground receivers, as these would decode Type Code=13 with NIC supplement = 1 sent by a Version 2 transmitter as 0.6NM (and not 0.5NM). Operationally, this would inadequately render a loss of data of otherwise sufficient quality for the current ADS-B-NRA applications applying a threshold of 0.5NM. This is not a concern for current and near-term ADS-B In applications and hence Version 1 airborne receivers.

Leaving aside the rather theoretical risk of some Version 1 receivers possibly encoding misleading information with the adoption of solution a), the issue at hand is that of the need for a judgement call of which backwards compatibility constraint weighs more. Effectively, this boils down to the question which currently fielded Version 1 receiver type (airborne or ground) can be expected to be upgraded first to properly decode messages from "Version 2" transmitters when fielded.

In response to action item 27-12, Airservices Australia acknowledged that a ground system change is easier to implement than an avionics change and they indeed plan to upgrade their current ground receiver software in due time, also in order to take benefit of all the other changes that will come with Version 2.

The response from NAV Canada is still outstanding but is expected to concur with the position of Airservices Australia.

3 Proposed Solution

In line with the feedback received on action item 27-12, it is proposed to adopt solution b) as described above. This would lead to the following change of Table 2-70 in §2.2.3.2.7.2.6 of RTCA DO260A, and other related parts of RTCA DO260A, as appropriate. (Note that only the Airborne part is depicted here, as the Surface NIC encoding is subject to a separate change).

<u>Table 2-70:</u> Navigation Integrity Category (NIC) Encoding.

NIC Value	Containment Radius (R_C) and Vertical Protection Limit (VPL)	Airborne	
		Airborne Position TYPE Code	NIC Supplement Code
0	R_C unknown	0, 18 or 22	0
1	R_C < 20 NM (37.04 km)	17	0
2	R_C < 8 NM (14.816 km)	16	0
3	R_C < 4 NM (7.408 km)	16	1
4	R_C < 2 NM (3.704 km)	15	0
5	R_C < 1 NM (1852 m)	14	0
6	R_C < 0.5 NM (926 m)	13	1
	R_C < 0.3 NM (555.6 m)	13	0
7	R_C < 0.2 NM (370.4 m)	12	0
8	R_C < 0.1 NM (185.2 m)	11	0
9	R_C < 75m ~~*and* VPL < 112 m~~	11	1
10	R_C < 25m ~~*and* VPL < 37.5 m~~	10 or 21	0
11	R_C < 7.5m ~~*and* VPL < 11 m~~	9 or 20	0

4 Recommendations

The meeting is invited to consider the change of Type Code 13 (NIC=6) encodings as proposed above.