RTCA Special Committee 186, Working Group 3
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ADS-B 1090ES MOPS Maintenance

Meeting #25

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GPS ALARM AND NIC REPORTING
In Response to Action Item 24-15

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Summary
This Working Paper addresses a response to Action Item 24-15 which was a result of review of an email sent by Chris Moody related to the Impact of a GPS alarm on NIC determination recorded as Potential Change #22 in Working Paper 1090-WP24-07R2 and again in 1090-WP25-03.

It was determined at the last meeting that there are situations when a GPS receiver will output an HPL or HIL that should not be used to determine NIC. A non-excluded GPS fault condition is indicated by a RAIM fault flag output, not a change in the containment radius output by the GPS receiver. Therefore, direct loading of HPL or HIL from the GNSS/GPS receiver is not correct in these circumstances. In the case of a non-excludable satellite failure, a GPS sensor will also set a separate alarm that needs to be monitored so that the containment radius is known to be invalid. To correct this, the recommendation was to have the NIC parameter set to ZERO if the sensor alarm discrete is set regardless of the reported containment radius from the GPS.

RTCA DO-229D, §2.1.1.13.2 Navigation Alert, is as follows:

> "The equipment shall provide an indication or output of the loss of navigation capability within one second of the onset of any of the following conditions:
>
> a. The absence of power (loss of function is an acceptable indicator);
> b. Equipment malfunction or failure;
> c. The presence of a condition lasting five seconds or more where there are an inadequate number of usable satellites to compute a position solution (i.e., no computed data);
> d. The presence of a condition where fault detection detects a position failure that can not be excluded within the 8.0 second time-to-alert."

Additionally, RTCA DO-229D, Appendix U, Guidance Material for Interfacing with ADS-B, in §U.4, Horizontal Protection Limit, the last paragraph states:

> "Particular attention should be paid to any alert conditions that may be indicated through other parameters or flags on the interface. When a failure is detected, the equipment may output the HUL [Horizontal Uncertainty Level] but this parameter should not be used for ADS-B. Some equipment may continue to output the HPL, but the HPL has no applicability once a failure is detected. ADS-B equipment should set the position output to invalid rather than adjusting another parameter."

To cover the condition in d) above, §4.2.3 of ARINC 743A, Failure Warning Enunciation states the following:

> "When FDE has detected a fault and the fault has not been excluded, bit 11 of label 130 - Autonomous Horizontal Integrity Limit, should be set = 1, otherwise = 0. The time to alert is 8 seconds for beta sensors.
> <RTCA DO-229 Paragraph 2.1.1.13.2d>
> <RTCA DO-229 Paragraphs 2.1.2.2.2.2.1>"

Therefore, for air transport category aircraft using ARINC standards, it appears that stipulating that bit 11 of ARINC Label 130 be used to determine when NIC should be set to 0 when a non-excluded GPS fault condition exists. Bit 11 is also used to report RAIM errors, but since NIC would be properly set to 0 in this case anyway, this should not be a problem.

If this approach is agreeable, the suggested MOPS modifications include additional Notes in Table 2-16: "TYPE" Subfield Code Definitions (DF = 17 or 18). The NIC §2.2.8.1.16 may also include the Note.

An additional question concerning the GPS fault condition is whether the NAC_P should be set to unknown since this error condition would impact NAC as well. Since RTCA DO-229D recommends setting the position to invalid, it seems that both NIC and NAC should be set to 0 so that the position information will not be used by any application.