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Proposal to Address the Addition of a New Appendix for Backward Compatibility

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Summary
This Working Paper presents the draft of a new Appendix to address the issue of backward compatibility, of a Version TWO Receiving Subsystem receiving and interpreting Messages from a Version ONE Transmitting Subsystem.

Appendix X.
Version 1 Backward Compatibility

This appendix provides guidance for decoding of information from messages transmitted by Version 1 installations when received by a Version 2 system. Table xxx below shows the UAT Message fields whose encoding or interpretation has changed between Version 1 and Version 2. Those fields not mentioned here are unchanged.

Version 2 Message Fields that are Changed Relative to Version 1	**Version 2 Receiving System Interpretation of Corresponding Bits from Version 1 Message**
Uplink Feedback (2.2.4.5.2.9)	Ignore these bits (for A-G use only)
SIL (2.2.4.5.4.6)	See Section 1 of this Appendix
SDA (2.2.4.5.4.8)	Ignore these bits (reserved bits set to ALL ZERO in Version 1)
Capability Codes (2.2.4.5.4.12)	Ignore these bits (no backward compatibility)
Operational Modes (2.2.4.5.4.13)	Ignore these bits (for A-G use only)
SIL_{supp} (2.2.4.5.4.16)	Ignore this bit (no backward compatibility)
Geometric Vertical Accuracy (2.2.4.5.4.17)	Ignore these bits (reserved bits set to ALL ZEROs in Version 1)
Single Antenna Flag (2.2.4.5.4.18)	Ignore this bit (reserved bit set to ZERO in Version 1)
Target State Element (all fields) (2.2.4.5.6)	Ignore these bits (no backward compatibility)
Antenna Offset	Ignore these bits (reserved bits set to ZERO in Version 1)

Version 1 SIL Field Definition

The Surveillance Integrity Level ("SIL") field is a 2-bit (bits 7 and 8 of byte 24) field used to define the probability of the integrity containment region described by the "NIC" field, being exceeded, for the selected geometric position source, including any external signals used by the source. The encoding of the "SIL" field **shall** be as indicated in Table 2-44. The probability specified by the SIL parameter is the largest likelihood of any one of the following occurring when a valid geometric position is provided by the selected position source:

a. a position source equipment malfunction (per hour),

b. the per sample probability of a position source error larger than the horizontal or vertical integrity containment region associated with the NIC value(s), or,

c. for GNSS, the probability of the signal-in-space causing a position error larger than the horizontal or vertical containment region associated with the NIC value(s) without an indication (see note 2 below Table 2-44), within a time period determined by the positioning source, as indicated in Table 2-44.

Table 2-44: "SIL" Encoding.

SIL (binary)	SIL (decimal)	Probability of Exceeding the Horizontal Integrity Containment Radius (R_C) Without an Indication	Probability of Exceeding the Vertical Integrity Containment Region (VPL) Without an Indication	Corresponding Hazard Classification
00	0	Unknown	Unknown	No Safety Effect
01	1	$\leq 1 \times 10^{-3}$ per flight hour or per sample	$\leq 1 \times 10^{-3}$ per flight hour or per sample	Minor
10	2	$\leq 1 \times 10^{-5}$ per flight hour or per sample	$\leq 1 \times 10^{-5}$ per flight hour or per sample	Major
11	3	$\leq 1 \times 10^{-7}$ per flight hour or per sample	$\leq 2 \times 10^{-7}$ per 150 seconds or per sample	Severe Major/ Hazardous

Notes:

1. *It is assumed that SIL is a static (unchanging) value that depends on the position sensor being used. Thus, for example, if an ADS-B participant reports a NIC code of 0 because four or fewer satellites are available for a GPS fix, there would be no need to change the SIL code until a different navigation source were selected for the positions being reported in the State Vector report.*
2. *"An indication" may include, for example, a flag for invalid position report, or a change in NIC, or switching to another data source.*
3. *The vertical integrity containment column only applies to NIC values greater than 8.*
4. *The SIL encoding is the most stringent of the horizontal or vertical values.*
5. *At the time of publication of these MOPS, it is recognized that there are three possible derivations of SIL: (a) the integrity value provided by navigation sensors with self-monitoring capability (e.g., GPS), (b) the reliability of aircraft systems given as indicated by a failure rate commensurate with the equipment design assurance, and (c) the integrity of other navigation systems, (e.g., RNP) that rely on ground-based self-monitoring equipment for integrity assurance, and for which no specific hourly integrity value can be ascribed. These three values are not readily interchangeable. Selection of the largest of the values as specified in Table 2-44 is felt to provide a reasonable bound on the order of magnitude of the probability of possible failures affecting ADS-B applications. Future revisions of this document may refine the SIL definition as more is understood.*
6. *Since the SIL is intended to reflect the integrity of the navigation source of the position information broadcast, the SIL value transmitted should be indicative of the true integrity of the ADS-B position data. A problem for installations that include currently available GNSS receivers and FMS systems is that SIL is not output by these systems. With the lack of SIL information being provided by the navigation source, implementers should not arbitrarily set a SIL value of ZERO (0) indicating unknown integrity. It is suggested, unless there is a tightly coupled navigation source where SIL can be unambiguously determined and set dynamically, that the ADS-B Transmitting Subsystem should provide for the static setting of SIL as part of the installation procedure. Most implementers are expected to determine SIL by off-line analysis of the installed configuration. This off-line analysis can be performed on the various primary and alternate means of determining the reported position. SIL is a static value for each of these configurations.*