

**RTCA Special Committee 186, Working Group 3**  
**EUROCAE WG-51, SG-1**

**ADS-B 1090ES MOPS Maintenance**

**WG-3 Meeting #30**  
**SG-1 Meeting #7**  
**Joint Session**

**RTCA Headquarters**  
**Washington DC**  
**18 – 21 August 2009**

**Proposed Updated Text for SIL Definition**  
**Revision 1**

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<b>Summary</b>
This Working Paper addresses some minor changes in the SIL definition to address concerns voiced during previous meetings.

**Text in black is unchanged from previous proposal. Text in blue is new.**

## **OPTION 1:**

### **2.2.3.2.7.1.1X Source Integrity Level (SIL)**

The “SIL” (Source Integrity Level) subfield is a 2-bit (“ME” bits 45 and 46, Message bits 77 and 78) field that shall be used to define the probability of the reported horizontal position exceeding the containment radius defined by the NIC without alerting assuming no avionics faults. **If the position source uses a SIS, the effects of a faulted SIS causing a position to be outside the NIC containment radius must also be considered when setting the SIL.**

*Note: For GNSS position sources, the faulted SIS case will represent the highest probability of exceeding the NIC containment radius. For DME and LOC based position sources the SIS is monitored for probable failures and can be assumed fault free, allowing the SIL to be based solely on the fault free avionics case.*

The SIL probability can be defined as either per sample or per hour as defined in the SIL Supplement (SIL<sub>SUPP</sub>) in Para 2.2.3.2.7.1Y.

The SIL subfield shall be encoded in accordance with Table 2-72, as specified in the Aircraft Operational Status Message. For installations where the SIL value is being dynamically updated, if an update has not been received from an on-board data source for SIL within the past 5 seconds, then the SIL subfield shall be encoded as a value of ZERO (0), indicating unknown.

*Note: The SIL and NIC should be set to unknown if the ADS-B position source does not supply an output certified to provide an indication of the integrity of the reported position (e.g. such as HPL from GNSS systems.)*

<b>SIL Value</b>	<b>Bit</b>	<b>Probability of exceeding the NIC containment radius</b>
3	11	$\leq 1 \times 10^{-7}$ Per Hour or Sample
2	10	$\leq 1 \times 10^{-5}$ Per Hour or Sample
1	01	$\leq 1 \times 10^{-3}$ Per Hour or Sample
0	00	$> 1 \times 10^{-3}$ Per Hour or Sample or Unknown

Table 2-72

## OPTION 2:

The “SIL” (Source Integrity Level) subfield is a 2-bit (“ME” bits 45 and 46, Message bits 77 and 78) field that shall be used to define the probability of the reported horizontal position exceeding the containment radius defined by the NIC. **The SIL will be based on the more probable of the following probabilities, if applicable:**

- a) The probability of the reported horizontal position exceeding the containment radius defined by the NIC without alerting assuming no avionics faults.
- b) **The probability of a Signal-In-Space (SIS) fault, if applicable, causing the reported horizontal position to exceed the containment radius defined by the NIC.**

### 2.2.3.2.7.1.1Y Source Integrity Level Supplement (SIL<sub>SUPP</sub>)

The “SIL<sub>SUPP</sub>” (Source Integrity Level Supplement) subfield is a 1-bit (“ME” bits A, Message bits C) field that shall define whether the reported SIL probability is based on a per hour probability or a per sample probability as defined in table 2.yy.

SIL Supplement	Bit	Basis for SIL Probability
1	1	Probability of exceeding NIC containment radius is based on per sample
0	0	Probability of exceeding NIC containment radius is based on per hour

Table 2.yy

• **Per Hour:** The probability of the reported horizontal position being outside the NIC containment radius in any given hour without an alert or an alert longer than the allowable time-to-alert. ~~The per hour representation will typically be used when the probability of exceeding the NIC is greater for the faulted versus fault free Signal in Space case. (When the SIS fault rate is defined as hourly)~~

*Note: The probability of exceeding the integrity containment radius for GNSS position sources is based on a per hour basis, as the NIC will be derived from the GNSS Horizontal Protection Level (HPL) which is based on a probability of  $1 \times 10^{-7}$  per hour.*

• **Per Sample:** The probability of a reported horizontal position being outside the NIC containment radius for any given sample. ~~The per sample representation will typically be used when the probability of exceeding the NIC is greater for the fault free Signal in Space case or when the position source does not depend on a SIS.~~

*Note: The probability of exceeding the integrity containment radius for IRU, DME/DME and DME/DME/LOC position sources may be based on a per sample basis.*

### OPTION 3:

#### 2.2.3.2.7.1.1X Source Integrity Level (SIL)

The “SIL” (Source Integrity Level) subfield is a 2-bit (“ME” bits 45 and 46, Message bits 77 and 78) field that shall be used to define the probability of the reported horizontal position exceeding the containment radius defined by the NIC without alerting assuming no avionics faults. *Although the SIL assumes there are no unannounced faults in the avionics system, the SIL must consider the effects of a faulted Signal-in-Space, if a Signal-in-Space is used by the position source.* The SIL probability can be defined as either per sample or per hour as defined in the SIL Supplement (SIL<sub>SUPP</sub>) in Para 2.2.3.2.7.1Y.

Notes:

1. *For GNSS position sources the HIL or HPL is provided with a probability of  $1 \times 10^{-7}$  per hour, which should be used to set the SIL to 3.*
2. *The GPS defined HPL probability rate of  $10^{-7}$  per hour is based on the GPS constellation fault rate of  $10^{-4}$  per hour and a  $10^{-3}$  probability of missed detection, given that the fault occurs. Different containment radii indicated by the HPL are all defined at the missed detection probability of  $10^{-3}$ .*
3. *Fault detection is an essential consideration in determining the SIL parameter. Fault detection assures, at a specified probability of missed detection, that the error is no greater than a specified limit without an alert.*
4. *For alternate ADS-B position sources to report integrity, they will need to be certified for their fault detection characteristics.*

The SIL subfield shall be encoded in accordance with Table 2-72, as specified in the Aircraft Operational Status Message. For installations where the SIL value is being dynamically updated, if an update has not been received from an on-board data source for SIL within the past 5 seconds, then the SIL subfield shall be encoded as a value of ZERO (0), indicating unknown.

*Note: The SIL and NIC should be set to unknown if the ADS-B position source does not supply an output certified to provide an indication of the integrity of the reported position (e.g. such as HPL from GNSS systems.)*

SIL Value	Bit	Probability of exceeding the NIC containment radius
3	11	$\leq 1 \times 10^{-7}$ Per Hour or Sample
2	10	$\leq 1 \times 10^{-5}$ Per Hour or Sample
1	01	$\leq 1 \times 10^{-3}$ Per Hour or Sample
0	00	$> 1 \times 10^{-3}$ Per Hour or Sample or Unknown

Table 2-72

#### 2.2.3.2.7.1.1Y Source Integrity Level Supplement (SIL<sub>SUPP</sub>)

The “SIL<sub>SUPP</sub>” (Source Integrity Level Supplement) subfield is a 1-bit (“ME” bits A, Message bits C) field that shall define whether the reported SIL probability is based on a per hour probability or a per sample probability as defined in table 2.yy.

SIL Supplement	Bit	Basis for SIL Probability
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1	1	Probability of exceeding NIC containment radius is based on per sample
0	0	Probability of exceeding NIC containment radius is based on per hour

Table 2.yy

• **Per Hour:** The probability of the reported horizontal position being outside the NIC containment radius in any given hour without an alert or an alert longer than the allowable time-to-alert. ~~The per hour representation will typically be used when the probability of exceeding the NIC is greater for the faulted versus fault free Signal in Space case. (When the SIS fault rate is defined as hourly)~~

*Note: The probability of exceeding the integrity containment radius for GNSS position sources is based on a per hour basis, as the NIC will be derived from the GNSS Horizontal Protection Level (HPL) which is based on a probability of  $1 \times 10^{-7}$  per hour.*

• **Per Sample:** The probability of a reported horizontal position being outside the NIC containment radius for any given sample. ~~The per sample representation will typically be used when the probability of exceeding the NIC is greater for the fault free Signal in Space case or when the position source does not depend on a SIS.~~

*Note: The probability of exceeding the integrity containment radius for IRU, DME/DME and DME/DME/LOC position sources may be based on a per sample basis.*