

ASSAP Action Item #31:

Propose Scaling / Tradeoff of NIC and SIL to Meet Application Requirements

**RTCA SC-186 WG-4 Meeting
ASSAP Subgroup**

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Presentation Outline

- **Motivation to consider Scaling**
- **Background Problem and Issues**
- **Proposed Way Forward**



Motivation for Considering Scaling

- **ASSAP may receive Traffic Tracks that have significantly higher SIL than is required to perform the active application(s)**
 - **SIL received for some traffic targets may be 3 (indicating 10^{-7} /hr. horizontal integrity) and the active application(s) may only require a SIL of 1 (indicating 10^{-3} /hr. integrity)**
 - **When SIL indicates a higher integrity than needed for the application, is it possible to scale the integrity containment region (region indicated by NIC) to the required level of integrity containment?**
 - e.g., Scale from a 10^{-7} / hr. to 10^{-3} / hr., [SIL = 3 to SIL = 1]
 - **Such scaling may significantly enhance application availability**

Enhance Availability of Surveillance Data to Support the Quality Necessary for the Application



Scaling Example

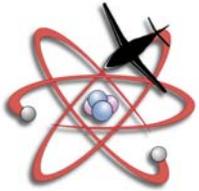
- **Example:**
 - **Reported State Data Quality:**
 - $NAC_p = 9$ (30m), $SIL = 3$ (10^{-7} /hr Horizontal), $NIC = 6$ ($R_c = 1111.2$ m)
 - **Desire to Run EV Approach, which “requires”**
 - $NAC_p \geq 7$ (185.2m), $SIL = 1$ (10^{-3} /hr Horiz.), $NIC \geq 7$ ($R_c < 370.4$ m)
- **Is the reported State Data Quality Sufficient?**
 - **Check Quality:** NAC_p , SIL , but NIC does not check
 - NIC is not good enough, it is only a “6” and not a “7”
 - **But, can we trade the containment region size (NIC) for probability confidence (SIL)?**
 - “Scale” the reported quality to an equivalent NIC at a given level of SIL . For instance, $SIL = 3$ and $NIC = 6$ quality, may be able to be shown to be equivalent to $NIC_{@SIL=1} = 7$.
 - *Note that there is a significant issue in validating the equivalence for all potential sources of position*

Possibility to Enhance Application Availability for the Received (as well as ownship) Surveillance Data



- **Appears Difficult to Scale Information**

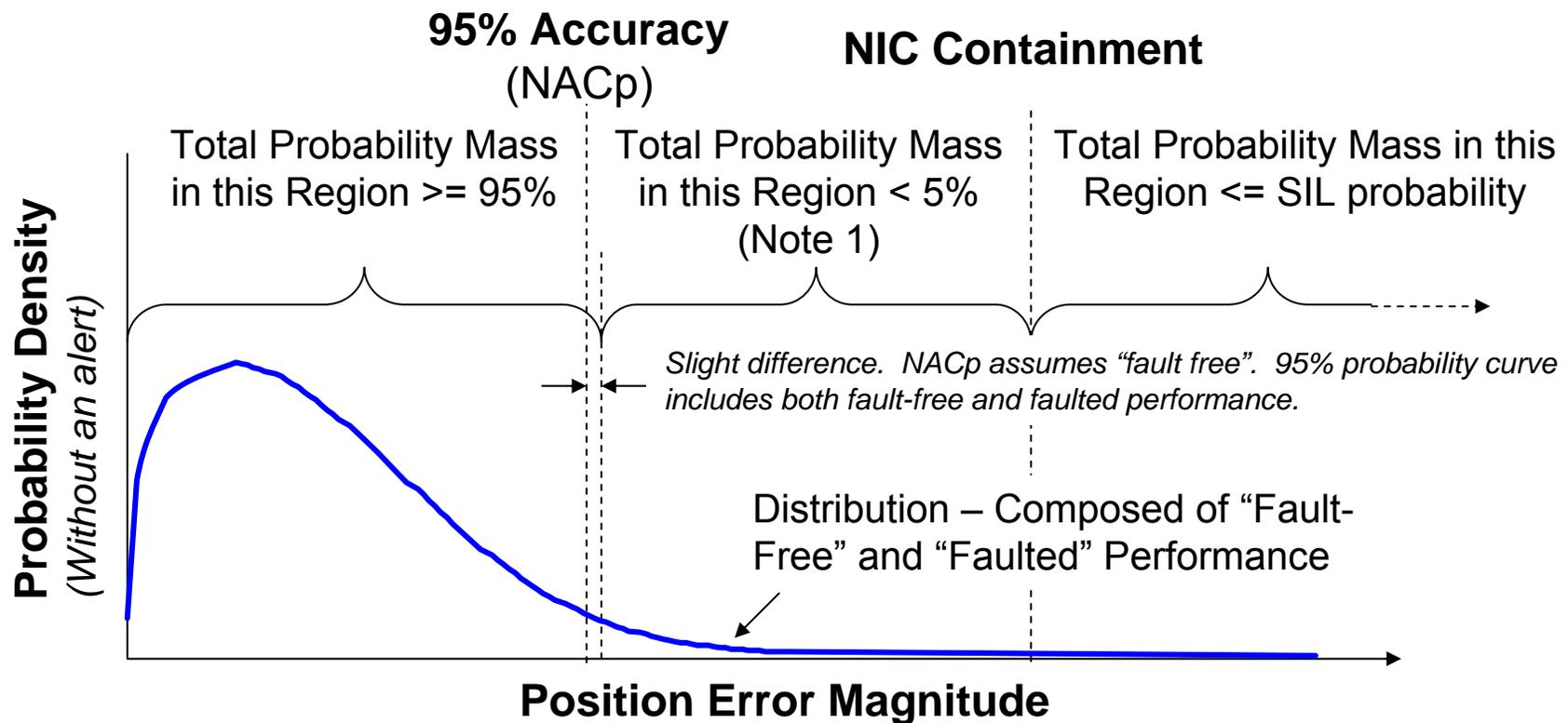
- **“Difficult” to validate for all possible navigation data sources, as well as the TIS-B / radar community for all possible ground surveillance sources**
- **Some parameters do not scale with the size of the containment region**
 - Need to understand how monitors work in the system to truncate the “tails” of the distribution to develop an appropriate integrity containment region at a different probability level
 - The monitors work differently for each position data source, so one would need to validate the scaling for each possible / acceptable source
 - Equipment integrity is one example of a parameter that does not easily scale



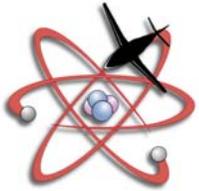
Example Issue (Page 1 of 2)

- **SIL Integrity**

- Has both a SIS component and an airborne equipment integrity component
- Typical probability density function of position error magnitude



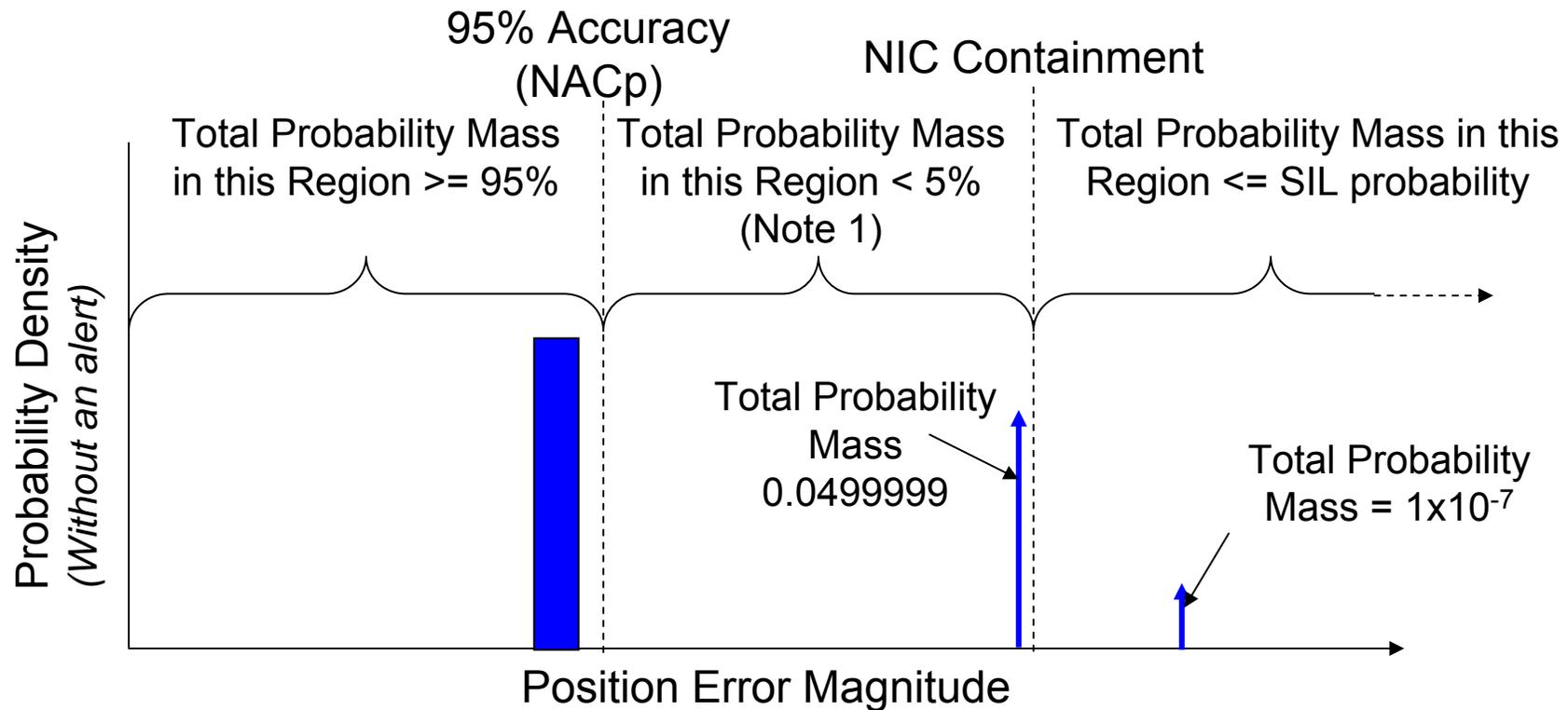
Note 1. Probability is 5% - SIL probability; which equals 0.0499999 when $SIL = 3 (10^{-7})$.



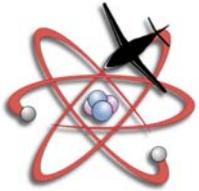
Example Issue (Page 2 of 2)

- **Hypothetical System**

- Hypothetical probability density function that meets the broadcast quality “requirements”



Scaling Would Not Work for Such a System



Three Possible Alternative Ways Forward

- **1) Require that SIL, NIC, NAC_p , and NAC_v each independently meet the requirements for the active applications as stated in the ASA MASPS**
 - This is the current baseline and way that the ASA MASPS is written.

- **2) Establish NIC scaling factors based upon SIL that will be appropriate for all possible sources of position data.**
 - Concerned about the level of difficulty validating the scaling for all possible data sources. Concerned that the only answer is “no scaling” because of the potential for a “hypothetical” system.

- **3) If the SC-186 community wants to maximize application availability of the received traffic information, then rather than scaling the received quality as identified in alternative #2, I propose the following**
 - **Write the Surveillance Application Requirements based upon received traffic information**
 - For example, traffic quality is sufficient application (A_1) when any of the following are valid:
 - When SIL = 0, quality is insufficient
 - When SIL = 1, $NIC \geq X_1$, $NAC_p \geq Y_1$, $NAC_v \geq Z_1$
 - When SIL = 2, $NIC \geq X_2$, $NAC_p \geq Y_2$, $NAC_v \geq Z_2$
 - When SIL = 3, $NIC \geq X_3$, $NAC_p \geq Y_3$, $NAC_v \geq Z_3$
 - Advantage: Keeps the problem in the surveillance community to make reasonable assumptions about application needs versus the reported quality.
 - Many of the surveillance application requirements are based upon good engineering judgment, especially the initial situational awareness applications.
 - Concern is the delay in re-evaluating the application requirements in the ASA MASPS.



Discussion of Alternatives

- **Alternative #1 (no scaling) is the baseline**
 - Require that SIL, NIC, NAC_p , and NAC_v each independently meet the requirements for the active applications
 - Very straightforward to implement
- **Alternative #2 (scaling) appears very problematic**
 - Validating that it works for all data sources
 - The author's opinion is that this is a show-stopper, unless we knew the source of position.
- **Alternative #3 Best chance of improving application availability**
 - The “cost” is more complicated requirements and more costly implementations
- **Are there any other practical Alternatives?**
- **Concern alternatives other than #1 will cause delay.**
 - Need to determine if the additional availability is “real” if we seriously consider an alternative other than #1.



Conclusion

- **My Initial Recommendations based upon the three alternatives identified**
 - **ASSAP working group move forward with Alternative #1 as the baseline (no scaling)**
 - **Consideration be given to Alternative #3 if the application requirements in the ASA MASPS are being revised**

ASSAP Subgroup Should Discuss and Reach a Consensus on Which Alternative to Pursue