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# Concerns with using NIC/NAC without Latency Considerations

**Concerns about the planned use of Integrity and Accuracy in the ADS-B MASPS:**

There seem to be problems with the NIC/NAC/NUC technical approach. Even when using both NIC and NAC another important aspect of accuracy/integrity is missing. That is latency compensation time (LCT). As things stand the navigation system can use as much latency compensation as it wants, we only impose on the navigation system that the NIC and NAC (NUC) should be "truthful" (I think). Latency compensation imposes an unknown and uncontrolled error on the data. As things stand now, the terminal systems in the NAS have a maximum latency of 2.2 seconds from data measurement to display to controller. The radar and communications only have 1.1 seconds (radar .8 sec, comm .3 sec). This means that the applications in the ATC automation system have the data in about a second, with no hidden latency compensation. The last time I was told about avionics navigation latency, the numbers ranged from a second or so to multiple seconds (added to the ADS-B delay). For a more difficult challenge, the total delay from measurement to display for PRM is 1 second. I believe ASDE-X has a 250 msec latency limit for surveillance.

Since we are addressing accuracy and integrity semi-separately, we need to consider the whole picture, and put controls on how much latency compensation there is as well as latency in general. Maybe we need to identify how much latency compensation has gone into a report, and control how compensation is done. But in any event, we still have not validated for ANY application, what spatial and temporal accuracy (or range of accuracy) is needed in the data, the integrity is defined by the application criticality (at the moment).

This may bear on another issue as well, as I understand it, Capstone has been having a lot of NUC=0 data being reported. So have we established the proper reliability requirements and testing of NUC calculations? How do we validate and impose requirements on end-to-end performance?

I don't see the value in the exhaustive list of accuracies we are considering for NAC, I believe there are already too many NUC values. From a navigation perspective I can understand the use of NIC values (HPL, VPL) for navigation, where it is desirable to safely aim towards or around fixed terrestrial objects. I do not understand their value in separating two moving objects, unless we want to use HPL and VPL as the allowable separation standard between two cooperating objects. But even with cooperating objects, this seems dangerous, in that either cooperating object could become uncooperative at any time. Mountains and runways very seldom exhibit unpredicted movement as far as we are concerned. It seems to me that accuracy values with an operations appropriate separation standard with enough 9's of integrity should be sufficient to decide to conduct an application operation.

Special consideration needs to be given to how quickly any of these values change, and how important it is to require constant transmission of any of these values.

We need to consider the stability of the NUC-NIC-NAC, LCT values in the context of the operation of an application, so that if some given avionics implementation has a problem maintaining the required accuracy etc. rating for an application (like ATC surveillance (radar) separation services), they can be de-certified (de-TSO'd??) because they are failing to meet a reliability or availability requirement.

A side note, what "aircraft/vehicle extent" should a tractor or tug pulling different aircraft or no aircraft report in its ADS-B messages? What about baggage cart trains with different numbers of trailers being pulled by the tractor? What a/v extent should TIS-B report for things?

**Recommended Actions:**

Conduct some studies, collect some data, simulate applications, validate various accuracy requirements as necessary and sufficient or change them to necessary and sufficient values. At the moment I would like to include update rate as a component of the spatial-temporal accuracy. So then: Define both accuracy and separation standards for each application, not just accuracy requirements. Vary both accuracy (spatial and temporal) and operating separation standards for the applications. Evaluate both efficiency and safety.

Evaluate NIC-NAC-NUC, LCT in a broader context. Evaluate how soon "notification" of a change in value is needed for any application (etc.). Evaluate the actual range and number of values needed. Impose more requirements (limitations) on navigation systems as ADS-B sources. Answer in the MASPS what to do with navigation sources that don't quite meet the ADS-B concept, instead of leaving it to each MOPS to figure out (i.e. some of the stuff the 1090 MOPS crew had to figure out).

Establish limits of NAC that can be reported by ADS-B for a given installation based on total latency and total latency compensation (or whatever) starting from the time the aircraft was at the position where the navigation system measurement was taken (i.e. not latency compensated or track estimated data time).

Evaluate any value in providing latency compensation time in reports, and specifying how compensation should be done (in navigation and ADS-B systems), so that user systems could undo the latency compensation.

Review how reliability and availability are specified, so that systems can be certified for specific applications, and meet the availability needed (including sustaining sufficient accuracy, etc.) to support the applications.

Review supporting data and studies that validate the benefit (safety and efficiency) and need for a/v extent, particularly in the context of a/v's that may have "wrong" or no practical means to report a/v extent.