NEW INTERFACE REQUIREMENTS: IMPLICATIONS for FUTURE

This abstract is for a presentation at the April 2018 ICNS meeting (*Integrated Communications Navigation and Surveillance*) *that I coauthored with William Woodward* (*Chairman, SAE International Aerospace Avionics Systems Division*).

Considerable momentum has recently occurred to provide enhanced interfacing requirements for navigation and tracking sensors. Ramifications are far greater than might be perceived initially; the effects can, in fact, be profound. What follows will sound like stretch-beyond-reason – but is not exaggeration. Example: Does 1 cm/sec velocity accuracy seem unrealistic? It's been achieved, for both navigation and tracking, with data from flights conducted by Ohio University. Results and algorithms are documented and in public domain (no strings). By comparison *vs* current operational system specifications, cm/sec sounds too good to be true. ADSB, for example, is not committed to provide velocity accuracy better than a ***thousand times*** higher (*10* meters per second). In each of two horizontal directions at any altitude, it produces a ***million*** times as much area of uncertainty projected ahead in time. Why that is grossly inadequate, and the opportunity to rectify it, only typify a much broader set of considerations being addressed here.

Prospects for dramatic improvement in multiple performance attributes, readily available without demanding new inventions or scientific breakthroughs, often invite incredulous reactions. Reasons for skepticism are directly traceable to procedures based on ingrained habits. Among those are concepts treating surveillance as largely separate from navigation (*i.e.*, not at all thoroughly integrated) and, in many minds, defined only in terms of position sequences, with dynamics glossed over as an afterthought. Accuracy requirements stress instantaneous position, even in operations where velocity is critical and position isn't (aircraft with dozens of meters wing span moving at 400 knots don't have to be pinpointed to within centimeters). Importance of velocity accuracy, and means to get it without correspondingly precise position, are both almost universally overlooked. Accepted GPS integrity requirements are overstated, demanding "the whole silver platter" (full fix plus an extra satellite for RAIM, with adequate geometry for each quad subset) on every update; there are documented cases wherein lower quality information was used when "loss of GPS" overstated the true situation. Even the position information itself, holding priority status within our industry's preoccupation, is expressed in ways that instantly carry severe performance limitations: preference for coordinates is essentially universal.

That last item in the preceding paragraph is about to change – and with it, all of the current unnecessary restrictions mentioned above will vanish. The primary author of this paper, Chairman of SAE Int'l Aerospace Avionics Systems Division and PNT Committee, is coordinating PNT standards development activity with key segments of the industry. What seemed too good to be true (but in fact has been validated) can now become normal. This paper will discuss how

- many old constraints can be traced to yesteryear's technology limitations
- removing them can finally enable full benefits of digitization
- long overdue assimilation of known integration methods paves the way.

Benefits are by no means limited to in-air application. Extension is readily made not only to aircraft on the ground (mitigating runway incursions, well over a thousand per year and increasing), but to maritime operation plus land vehicles and beyond. Typifying some of what's "beyond" – SAE has a Vehicle Internet of Things (VIoT) board, already addressing driverless vehicles, with plans for heavy processing assigned to Internet servers when possible. As changes proliferate at an accelerating pace, innovations thereby necessitated are being prepared in correspondence to them.