TEAMING WITH GPS

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THE BARD ON NAVSTAR

"THE FAULT, DEAR BRUTUS, IS NOT
IN OUR STARS,
BUT IN OURSELVES…"

JULIUS CAESAR, Act I, Sc 2
WILLIAM SHAKESPEARE

I. FANS – ACT II

When FAA announced to 123 nations at the ICAO CNSS/ATM Conference in Rio that GPS required a backup, a new search began.

The world's navigation and air traffic stakeholders began the search for the mix of navigation systems which, together with GPS, will provide the best service at the lowest cost to the greatest number of users.

This process is causing some adjustments to former verities around the world and at ICAO. But the outcome will improve safety, place GPS in its proper place among navigation systems, and relieve international concerns that GPS navigation and timing services can be interrupted.

II. STARTING WITH THE PROBLEM

Unfortunately, we did not start with the problem. Instead, we started with a conclusion – GPS – and moved to particulars – GPS can do everything. This is deductive reasoning at its worst, and it's no wonder that doubts have now arisen.

GPS, of course, is a marvelous technology, and the fact that it has limitations should not, and will not, obscure the fact that GPS can do so much. The technology is splendid: our management of it is not. Hence my opening quotation from Julius Caesar.

III. THE SIGNAL IN SPACE

Putting aside the very real issues of single thread safety, vulnerability, and international control, GPS is, for navigation purposes, just a signal in space. It tells you where you are. Other radionavigation signals such as VOR/DME, FMS/DME, LORAN, ILS, MLS, and TLS do the same thing, with varying degrees of accuracy, coverage, and predictability.

IV. IMPROVEMENTS IN ATC

The current navigation system is based on the 1075 VOR/DME transmitters for en route navigation and terminal maneuvering, and ILS for final precision approach. This system works very well and is ultra safe, but it is not highly efficient. FAA hopes to achieve some improvements in efficiency through technology. Let's look at the specific problems to be solved.

- EN ROUTE EFFICIENCY. The present charted airway routes go from one VOR/DME, or VOR intersection, to another. This produces an aircraft track that is a series of dog leg straight lines between navaids when the most efficient track would be a direct route from take off to landing. This is called Free Flight. We keep aircraft on the charted airways so that controllers can keep them in trail, maintain safe separation, and avoid mid-air collisions.

  To avoid mid-air collisions in the busy medium and low altitude airspace in a free flight regime, we need a new technology called "conflict probe." Conflict probe, and therefore free flight, depends on a high accuracy navigation signal, of which there are three: GPS, FMS/DME, and LORAN. Conflict probe, and therefore free flight, is not dependent on GPS alone. Any one of the three high accuracy signals will do very well.

  VOR is notoriously inaccurate (though famously safe), and does not work well with the collision avoidance requirements of free flight.

- TERMINAL MANEUVERING. Terminal maneuvering around (and between nearby) major hub airports is a great waster of time and fuel. This is because controllers must handle aircraft arriving from all directions, array them in a straight line with safe separation, and bring

them into the runway. Setting this right causes all sorts of inefficiencies: delayed descents, premature slow downs, S turns, and much more.

FAA believes much of this hand work can be automated and made more efficient. The basis of improvement here is high accuracy navigation. GPS, FMS/DME, and LORAN all will do the job. VOR navigation won't.

- TIGHTER TRACKS. The current charted airways are nine miles wide. This incredible, wasteful width is entirely the consequence of the least accurate of the navigation systems: VOR. Get rid of the VOR navigation system and the en route airways and the terminal tracks shrink by at least two thirds.

This will open a huge new opportunity for FAA's airspace design team to improve the efficient use of airspace.

Any of the three high accuracy navigation systems – GPS, FMS/DME, LORAN – will do the job.

V. VERTICAL POSITIONING.

GPS is the only radionavigation system that provides a vertical location. The other high accuracy systems – FMS/DME and LORAN – provide only lateral location.

So aircraft not equipped with GPS use another high accuracy navigation system for vertical location: an altimeter. A barometric altimeter is accurate to +/- 50 feet. Since vertical separation of aircraft is 1000 feet, the altimeter is as good as GPS for separation.

One of the real virtues of GPS is that its vertical signal permits a precision descent, called a glide slope for final approach.

But that same avionics computer than calculates a GPS precision descent can combine altimetry data and FMS/DME or LORAN lateral data … and calculate a precision descent!

If you are skeptical, consider this: US AIRWAYS, which seems to be an original thinker in navigation, has just received FAA approval for a 350' DH precision approach to Charlotte using FMS/DME plus altimetry. Neither ILS nor GPS was needed. This potential casts further doubt on the need for WAAS for air carriers.

It's the avionics computer, using a variety of inputs, that is so revolutionary. That's why I said at this ATCA meeting last year that the avionics "flying computer" was the secret of the revolution, not the signal in space.

VI. HIGH ACCURACY IS THE KEY

All of FAA's planned ATC efficiency improvements depend on high accuracy navigation. Any one of the three will do well.

And it will be difficult, if not impossible, to implement them fully if aircraft continue to fly around using VOR.

The air carrier fleet is rapidly equipping with high accuracy FMS/DME – 60% now, rising to 100% soon.

The hard core user of the VOR system is the general aviation fleet. The general aviation users can't possibly afford the expensive glass cockpit FMS/DME systems, and they probably don't need all the bells and whistles anyway. But GA can afford LORAN.

In fact, they've been begging for LORAN, and, according to AOPA's latest count, 100,000 GA aircraft already use LORAN.

VII. DOWN WITH VOR

The most important single future task for FAA and the entire user community is to figure out how to get the GA fleet into a high accuracy, low cost navigation system. GPS isn't the key because it needs a backup. The only widely acceptable, low cost alternative to VOR for the GA user is LORAN.

And both FAA and the Air Transport Association are trying to kill LORAN.

Go figure.

END