

**At the Air Traffic Control Association (ATCA), Nashville, TN, 24 October, 1996.
Transcribed from audio tapes made by the ATCA**

Introduction of panel moderator Hon. Langhorne Bond:

Our moderator for this afternoon's sessions needs very little introduction. He has served on the boards of several major corporations, been a member of the National Academy of Sciences, Committee, is chairman of the delegation to the ICAO Assembly, was a member of the inter-agency coordinating committee, member of the Executive Committee of the Transportation Research Board of the National Academy of Engineers. From 1977 to 1981 he served as Administrator of the FAA. Ladies and gentlemen, please welcome Langhorne Bond.

Hon. Langhorne Bond's opening remarks as panel moderator:

"We've chosen the topic here as the new revolution in acquisition the FAA has launched on an unsuspecting world. Freed of the constraints of Jack Brooks and the Congress and other legislative obstacles, the FAA has created a new world in acquisition and we know it will all come clear. It will take three months to buy it all, but it will go on and play without defect from now on. That is what has been said to the press.

My own experience as a resident cynic is that there is going to be somewhat more complexity to all this in the new world, statute notwithstanding. So, here is my memory of how it all used to be and indeed how it is today.

Difficult the Federal acquisition process is; it is a royal pain. The removal of all those obstacles may not cure all the difficulties at Research and Acquisition which are tied together at FAA. My memory is that the connection between research thought and the user world within FAA is tenuous at best. I'm not talking about customers who fly airplanes, but people within the agency that use the stuff. And, so long as that connection is not made within the FAA, it doesn't matter what is done with the procurement regulations.

I have also said in public that I'm for the agency and not, that the biggest problem within the agency is its Research and Development procurement end, and that the rest of the operation works not only pretty well, but the phrase I used when both Lynn Helms and I were in business was the performance of the agency was excellent and occasionally sublime. And that is true in every area but Research and Development and Acquisition.

So we have certainly hit on a good thing to talk about...

Langhorne Bond's Remarks on Navigation and GPS:

On to satellite navigation. I'm going to talk about satellite navigation - GPS. This is going to be a little more serious bit here. I would like to begin by saying that the many benefits that will flow from GPS systems in the non-civil aviation world are not meant to be encompassed by what I

have to say now, and I don't wish to deny them or misshape them in any way. But I am focusing now on what has been said about GPS for civil aviation navigation. My point that I would like to make and then substantiate is that the costs that have claimed to be saved by GPS are illusory; therefore the justification for its adoption is faulty. The functional benefits that will flow from it are greatly overstated though not non-existent, and that the user community for satellite navigation needs to be better defined. It's a much smaller group that will benefit from it than has been publicly stated so far.

As you can see I have some views on this. I regard this a another technical program advanced by the FAA in which folks have become intoxicated with the technical performance of the system and have entirely overlooked the practical problems that are associated with satellite navigation, and that sooner or later that will come to pass. This calculus of this problem, of this matter, has not seemed to touch on this so you can say you heard it here first.

I would just like to remind everybody that this is a military system. The GPS system is a military system, and it is therefore characteristic of that. Specifically, we all know that it can be degraded by a switch or some kind of coded signal from the ground. That it can be changed by military command entirely properly so. It can also be turned off by a military command. Some switch in a bunker somewhere that the U.S. military controls. And finally those of us who are not privy to any inner workings of the process wonder if it can as well be spoofed. And by that for some example I would speculate that some missile seeking the coordinates of Tinker AFB might not find that it was a wheat field in Kansas instead. That's speculation. But I guarantee you that the rest of the world wonders about that. Not only our allies but those who are not our allies as well.

This is entirely appropriate for a military system, but one wonders what the implications of all that axe for its civil aviation application. Let me begin with countries other than the U.S., and let me start with countries that have an existing high-performance ground-based navigation system such as the developed world. I wonder if anyone thinks that the British are going to unplug their ground-based navigation systems and rely instead entirely on a system that can be turned off or spoofed by anybody else, even their best ally the U.S. And we can extend that question to the French. We can extend it to the Chinese and Japanese, and the Russians and so on. The answer to that in my opinion has already been stated publicly. The answer to that is "No". GPS will not be used in the rest of the world as a substitute for ground-based navigation systems.

One of the things that have plagued those of us who have been in the middle office of the 10th floor of the FAA, is the dark thought in the night that some kind of single point failure or some calamity in the Air Traffic Control System (ATC) can turn it off. And the worst thing that can happen short of warfare to the ATC system is that one entire ATC center can do down. That has happened a few times in history and I am pleased to say that it has been dealt with fairly satisfactorily in the few times that it has happened. And when a single radar goes out we can deal with that easily. That's becoming less frequently, by the way. The point of it is that the current ground-based systems world-wide is not interdependent. It is true it is redundant. It is more costly. But nothing can happen to it to degrade or erode its performance in any practically speaking way.

It's vulnerable. A satellite-based system is going to be the picture of vulnerability out there for the rest of the world again amongst those who have a choice. Let me go on to say that if it is possible for our country to send a signal up to our satellites and turn them off, degrade them, maybe spoof them, it is possible for someone else to send that same signal up and do the same

thing. Now I would be surprised if our allies and non-allies were not out there picking off those signals analyzing them and trying to figure out what it is that we do to our GPS satellites that they cannot do in retribution as well. The answer to that of course is that they have been trying to figure that out. And so not only is it possible for us as Americans to change the GPS navigation signal, but it is entirely possible for some third party so to do.

That is also a decision for those of us who are Americans to make. Is it conceivable that we will make our civil aviation world vulnerable to some third party? Some unfriendly party that could turn off our air navigation system. If we unplug all that ground-based equipment which it is said GPS would make it possible to do, we will have an unmitigated disaster on our hands. And so I therefore predict that we will not unplug all that stuff as is predicted. We can not possibly conceive of so doing.

And then here is a subsidiary question. Exactly how much, maybe we can turn some of it off? And the answer is the amount we can turn off with satellite navigation in full use is as much as we can turn off of it today, because we may lose the satellite system. So whatever we can save money on today is what we can save money on in the future. So it is going to be limited.

Let me turn now to some areas that which are not ground-based and where there will be a real or not-well-served navigation system, and where GPS will make a big difference. It is obvious that in trans-oceanic travel that precise characteristic of GPS will be a great blessing. Those who fly over the oceans will find it very useful. It's clear that it benefits us there. And in addition, it benefits us where small airports are not served with ground-based systems such as they are too high for good VOR signals for high approach or don't have ILS on and they will get considerable benefit from GPS. They have no ground-based system now to speak of they will benefit. But largely the users of that will be general aviation, and is therefore no surprise to me that general aviation has a very high opinion of the GPS system. But it will be of little or no benefit to air carriers except trans-oceanically.

Now about the functional benefits of GPS compared to what we have today. Basically GPS has, as MLS did in its area of service, will provide a precision point-in-space wherever its service occurs. We have a ground-based system today that provides only in the ILS approach track that kind of a precision point-in-space. In theory, this ability for a precision location will be of great benefit. But let's look at the ATC system piece by piece and see where it can be used. And let us first consider the enroute environment. And the question is, do we need to provide precise location in the enroute environment compared to what we have now, largely VOR-based? And the answer to that in my opinion is "No". There has been no justification and no discussion that we need to be more precise in the enroute environment because what we have now is not unnecessarily congested and we are just fine the way we are today. So the answer to that is "No".

Let us then talk about terminal maneuvering in busy areas. We had an opportunity to use precise location in the terminal area with MLS. In its fan of precision area (and that was not exploited and hardly even considered, as a matter of fact, by the users) the air traffic service with MLS. And so I submit to you that the answer to that is probably "No" as well.

And finally, on precision approach, GPS will (assuming that all the boasts that are made for it are correct -- I accept that they are), it will present the same kind of precision approach accuracy that ILS provides today. We can get auto-land today with ILS limited now by runway taxi visibility and nothing else. GPS can do no better than that. I see no great advantage in it. So when you

look at satellite-based navigation you wonder whether what it will do. Has it any great benefit to us, and I submit that the cost savings and the replacement of the ground-based systems are entirely illusory.

So I think that covers the ground on GPS. I think that it is going to be licensed as an alternate supplemental system. I think that it will quickly world-wide will be permitted to be used. I don't doubt that. But do not conceive that the ground-based systems can anywhere be turned off. And I do not believe that its functional performance advantages exist at all in most cases other than the trans-oceanic, and the currently unserved areas in general aviation today.

Mr. Bond introduces DoD's Frank Colson:

Frank Colson is our next speaker. He comes to us from the Department of Defense. He is a product of the University of Louisville, Abilene Christian College, did a turn in uniform and has progressed the civilian defense department bureaucracy to its most rarified altitude. He is now Chairman of the Defense Federal Board. He's our guy over there. By the way, he'll have a chance to discuss my speech on GPS and its relationship between military and civil users at the end of the day. Frank Colson:

Frank Colson (U.S. Department of Defense) response to Mr. Bond's remarks.

In 1996, the late Mr. Colson worked at the Department of Defense and was Chairman of the Defense Federal Board. He was a panel member and gave a presentation on military use of navigation and guidance systems. At the close of the panel, he also gave the following remarks, in response to Mr. Bond's presentation:

"There were a couple of issues that Mr. Bond raised that I thought that may be of some value to clarify. First of all, he classified the GPS system as a military system. I would prefer to classify it as a *national* system that is being procured and managed through the defense appropriations. If you have read the recent Presidential determination, I think the fact that we view this as a national system that can satisfy both civil and military requirements is very clear.

You also raised the issue of degradation of the signal and turning the system off. As you probably know the degradation system is referred to selective availability, and that is that currently GPS accuracy is degraded to an average 100 meter accuracy. This is what we have offered to ICAO. As you know, the U.S. offered to ICAO the civil use of GPS for the foreseeable future at a 100 meter accuracy, and 6 years of advance notice if we ever decide that GPS is no longer going to be supported by the U.S. The decision to degrade the signal beyond 100 meters is not a military decision. It's a decision of the President of the United States.

I always hear this about "there's a switch." I'm going to carry around this big thing that looks like a switch and put it on top of the table and say this the GPS switch. I own it. Don't anybody touch it. The fact is that any decision to change the accuracy of GPS is not a military decision, it is a decision of the President of the U.S., and I suspect that the decision that the President would make if he ever were to make such a decision, he would weigh all the implications for the economic instability of the U.S. I would also postulate to you that as GPS becomes a integral part of our economic system, whether it's boats in the harbor or telecommunication timing,

whether it be safety of flight, whether it be navigation on the roads, the decision and the ability of the President to change the accuracy of GPS becomes near zero.

As far as turning it off, well I guess it is technically possible to turn it off. I'm not sure what that means, but technically it may be possible. That would also deny the U.S. military the ability to use GPS. If you have studied at the defense budget, you will know that we are becoming enormously dependent on GPS as an infrastructure. So to turn it off would in essence would take away our own capability.

He discussed the issue of spoofing and taking control of the signal, and I want to separate the two. One of the comments related to spoofing of the signal, that means that the receiver is given an erroneous signal by some ground source or some other source to make it look like another satellite and cause the receiver to come up with the wrong solution. While spoofing is possible I think you will find it is very difficult to do in practice, particularly with a moving target, to cause the receiver on an airframe to capture a spoofing signal to include that in the solution, and then to drive that moving target into an erroneous path is technically very difficult to do.

Another part of that, he sort of mixed the two, taking control of the satellites themselves. That is so that the GPS satellites send out an erroneous signal. While I won't say that is impossible, I would also say that if it is possible for somebody to take control of the GPS satellites and cause this to happen, then that potential adversary could take control of any satellite system, whether it be our communication satellites or intelligence satellites or whatever.

I will leave it to your own judgement about the probability of decommissioning systems based on the availability and stability of GPS. That of course is purely a civilian decision. Our job under this national scheme is to make GPS available according to the accuracy parameters that the President has decided and promised. I would also say at some point in time it would appear to me to be self-evident that there would be enough confidence that you would begin actually believing that GPS exists and that it's going to be there for a while. We've been on line for 4 years, but that may not be long enough. It may happen at the 8 year point; it may happen at the 14 year point; it may happen at the 25 year point. Eventually, somebody's going to say, "Yeah, I guess it's going to work; I guess we can use it". It kind of reminds me of the guy who walks around with the elephant gun, and his friend asks why he has the gun. He says to keep away the elephants away. His friend says there are no elephants, and he said, see the gun works.

Eventually, you are going to believe that GPS is real. As far as the ICAO issue and treaty, we contemplated how to respond to the ICAO request for an agreement, and unfortunately we do have lawyers and they said any agreement with ICAO would in fact become a treaty. If any of you folks have ever tried to work out a treaty you know why that was not a good idea. In fact, we wanted to be responsive to ICAO, and instead we made an offer and ICAO accepted that offer. Now, I'm not a lawyer but I think that constitutes a contract offer and acceptance. In our view we have a contract with ICAO. An agreement with ICAO under the parameters of our offer and their acceptance. And if you notice the essence of that agreement has also been captured in the Federal Radionavigation Plan which is signed by both the Secretary of Defense and the Secretary of Transportation.

So those are sort of some thoughts streamed to consciousness as you were going through your comments.

And by the way, if civil aviation doesn't want to use it that is fine with us as well."

Mr. Bond's response:

Well just to close it out, I think civil aviation is going to use it. My point was that it is not going to pull the plug on the ground-based systems. And as for the gravity for what would cause the President of the U.S. to do these things, I have never had any doubt that it would take a very grave situation indeed. But on the other hand, I think the chance that the President would do that if the security of the U.S. were threatened in some way is 100%, or I would so hope, and that has been noticed by other countries. I think it's a wonderful system. I think it's useful, but I think it has been gravely over-sold as to its domestic applicability and its international acceptance and that is my point.