

Review of FCC Order 20-48 Authorizing Operation of a Terrestrial Radio Network Near the GPS Frequency Bands

Mr. Dana A. Goward's Comments to NASEM Study Panel

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Good afternoon.

Eager vacationers were looking forward to their arrival in Sun Valley, Idaho as their aircraft began its approach to the airport nestled in the majestic Rocky Mountains. At the time, according to the incident report later filed with NASA, there was “an abundance of smoke in the area” limiting visibility. Air traffic control cleared the airplane to descend to 9,000 feet on a GPS-based instrument approach to the runway. GPS interference had been reported in the area earlier that day, but, again according to the report, had since cleared up. Minutes after the pilots began their descent, a radar controller 250 miles away noticed the aircraft was descending through 10,700 feet and headed straight for a 10,900 foot mountain. He immediately called the airport control tower. The aircraft was vectored away from the mountain just in time. The reporting party said, and I quote, “had the Radar Controller not noticed the problem, the flight crew and the passengers would be dead, I have no doubt.”

You all know that GPS and navigation are important. And you know that the first sign of interference in a GPS receiver is often not complete failure, but hazardously misleading information.

The interference that caused this aircraft to go off course was undoubtedly accidental. But this case reminds us that signal disruption is not just an academic concern. It has real life implications and consequences

By way of introduction, I am a lifelong practical navigator. I loved orienteering with the Scouts, served as a navigator of a patrol ship at sea, and spent years as a Coast Guard helicopter pilot dead reckoning my way at low altitude across trackless waters in the days before satellite navigation. So, I have long been and still am an avid fan of GPS.

I have also been involved in navigation policy for the last 15 years or so. My last real job was as the maritime navigation authority for the United States working for the Coast Guard. What I am not is a technologist nor engineer.

So, I am in no position to talk to you about the technical details of your tasking. Even if I wanted to do so, you have already heard from Dr. Brad Parkinson, the folks at the Department of Transportation and any number of government engineers who are the best in the business. They are much more technically competent than I could ever be.

I do hope, though, to tell you a few stories as a way of providing context, and also to suggest some things for you to consider in the way of your ultimate findings and recommendations.

I have several thoughts to share with you in my allotted time and they are inter-related. So, it will be most efficient if we hold off discussion until the end.

Some of you might be old enough to remember the movie “Cool Hand Luke” with Paul Newman. In the movie, Newman is a prisoner on a southern work gang and is a real wise guy. He mouths off to the boss, played by Strother Martin, who replies “What we have here is failure to communicate” and then has Newman’s character severely beaten. “Failure to communicate” is a tag line in the movie and is usually followed by Newman or someone else getting a severe beating. –

What a great metaphor for America today. We are not communicating well with each other at all, and things are going very badly as a result.

On a smaller scale, I am confident “failure to communicate” was a huge problem in the FCC’s decision process on the Ligado application in a couple ways.

First, there were engineers and technologists from completely different backgrounds and orientations looking at the same things and coming to completely different conclusions.

Dr. Parkinson spoke to you about the significant differences in the ways satellite based radionavigation and radiocommunications use spectrum. That means folks from these two different technical backgrounds are going to have very different unconscious assumptions, would likely see the same things different ways, and have a hard time understanding each other, even when they are talking about the same data.

I expect that in this case the Federal Communications Commission and its communications engineers had a hard time fully understanding radionavigation experts.

This phenomenon was really brought home to me when I served on an Aviation Week panel with Ligado’s CEO Doug Smith. The topic was, of course, the impact of Ligado’s proposed transmissions on aircraft operations of all kinds. At one point in the discussion, I said that “Ligado had tested GPS receivers to the point of failure.” Doug replied that was not true. They had just tested them to the point at which the receivers gave bad information.

A couple issues here. First, bad information is, of course, worse than no information all, in this case. That’s how our pilots trying to land at the Sun Valley airport almost crashed into the mountain.

And second, it seems to me from Doug’s comment, that he and other communications engineers must understand failure much differently than radionavigation engineers.

Differences in professional backgrounds can also make huge differences in the way public policy makers see issues and can fail to communicate.

Have you ever driven over a bridge and had it strain to hold up your vehicle or even collapse from under you? Probably not.

Now, have you ever heard static on a radio broadcast or had a cell phone call drop? Probably so.

These are the very practical results of the different ways transportation and communications policy makers correctly view their technologies, its uses, and risks. Transportation folks must limit risk to life and limb. So, they build in lots of buffer between the allowed vehicle weight on a bridge and the bridge's point of structural failure, for example.

Communication systems are also important, of course, but the nature of the technology, use, and risk is much different. Broadcasts can usually tolerate some degradation without failing. And even when communications are lost, a quick do-over is often possible. So, there isn't as much concern about zero degradation, or quite so much obsession with systems never failing.

Now at this point, some of you might be saying to yourself, "Well, if GPS and wireless navigation are so critical, why haven't they been made more resilient and robust? Where is the concern with no degradation and never-fail?" In this we at the RNT Foundation totally agree. That question is our reason for being.

But that is not your tasking, nor is it why we are here today. Today we are talking about preserving the navigation and timing capabilities Americans have right now. That means protecting hundreds of millions of GPS receivers that were built to function quite well in an environment established and guaranteed by the FCC. Protecting them from an environmental change that will harm many.

That's a bit of context for the first task listed for you on the National Academies web page – deciding which of the two approaches to harmful interference is more appropriate. In my mind it has to be the more conservative approach supported by the executive branch.

The second item of your tasking is to evaluate the potential harm that might be caused to "DOD operations and activities" by interference from Ligado's proposed network.

Thinking about this reminds me of the story of a war game years ago during which, in its last days, commanders were given the chance for "free play." They could insert their own problem into the game and see how forces would cope. One creative soul tried to insert the scenario "no more toner cartridges for printers or copiers." That was quickly rejected as it would have caused the war game to end almost immediately.

In your deliberations, civil GPS use is the toner cartridge. Forget weapons and other DOD-only systems for a moment. How would a significant reduction in GPS

effectiveness for all the contractors, suppliers, and employees who use non-military grade systems impact the ability of DOD to do its job?

Perhaps the problem is only going to be in the homeland. But that is where DOD trains, maintains, and equips. It is where DOD deploys the nation's largest group of first responders, the National Guard. How would all of this be impacted?

For too long in this country we have made a false and harmful distinction between national and homeland security. Between military and civil capability and strength. It is all one. This is something that China and Russia and our other adversaries know and practice, and it is one of our failings they love to exploit.

The dividing lines between civil and military GPS use are blurry, if they exist at all. I urge you to take a holistic view of DOD's operations and activities and how critical GPS is to the many essential ways DOD depends upon the civil sector.

Your third tasking item is to evaluate the effectiveness of the mitigation measures in the FCC order. By the way, the fact that these are included in the order seem to be an admission by the FCC that there will be interference.

I am sure others have spoken about the impracticalities of the mitigation measures for government devices. But 99% of America's GPS receivers are not government. The only thing in the order for them is scheme that has disruptions reported to the folks who might have caused the disruptions in the first place.

Putting the fox in charge of guarding the hen house is very effective... but only for the fox.

Don't get me wrong, the folks at Ligado are not bad people, I am sure. They are just trying to run a business. But it is very difficult to tell where any particular problem with GPS reception is coming from. And none of us wants to be put in a position where we constantly have to resolve our own conflicts of interest.

So this is unfair to both Ligado and to America.

Monitoring and mitigating the projected interference is going to be a very difficult task if it is possible at all. Despite the FCC's dramatically reducing its enforcement personnel and other resources in the last few decades, the commission is still legally responsible for spectrum enforcement and would be most effective at this.

Your last item of tasking is to report on "other issues the study committee finds relevant."

This reminds me of the "other duties as assigned" statement that used to come in every military officer's job description.

It is a great opportunity for you, though, if you find things you think might improve the way the FCC and others do things. It would be wonderful if you can help prevent these kinds of problems from coming up in the future.

One thing, we need to do in the future, is to avoid Strother Martin's "failure to communicate."

The FCC as an organization had real communications problems in this case, some of which went beyond unconscious assumptions about technology and policy.

In 2003 the commission committed to not allowing stand-alone terrestrial service in the bands reserved for satellites.

Seven years and three FCC chairs later, the commission reversed itself by REQUIRING Ligado's predecessor organization to establish a stand-alone terrestrial service in the MSS L-band. This was part of its Harbinger-Skyterra Acquisition Order.

This requirement was a drastic change to the previous policy and to the entire satellite spectrum environment. It was such a change that before it was even considered, it should have been the subject of a Notice of Proposed Rulemaking. This would have included lots of engagement and formal dialog with stakeholders.

None of this happened, of course, and that was a huge communications failure. By the way, we at the RNT Foundation think that not doing a Notice of Proposed Rulemaking was probably a violation of the Administrative Procedures Act and have said so in filings with the commission.

As you know there was all kinds of uproar as a result of the 2010 Harbinger Acquisition Order. And you know that, as a result, the FCC put the whole issue on hold in early 2012.

Then, after another 7 years and another three FCC chairs, and very little communications on the topic, the commission prepared to act again.

This time the administration's communications on the issue were contradictory and confusing. On the one hand there was NTIA, strongly supported by the Secretaries of Defense and Transportation, and by senior staff at all relevant federal departments. They formally established the executive branch's position as opposing the Ligado Networks application.

On the other hand, very senior administration officials, including Larry Kudlow, director of the President's National Economic Council, Mike Pompeo, the Secretary of State, and William Barr, the Attorney General, all made high profile public statements in favor of approval.

One wonders what authority or expertise caused these government officials to believe it was appropriate for them to comment on a technical issue pending before an independent regulator. I hate to think of the trouble I would have gotten into as a government official if I had done something like that.

This huge failure to communicate was a poster child for mixed messaging that harms citizens' faith in government.

The FCC might have helped overcome this by including its Office of Economics and Analysis in the process. The office was established in 2018 by Chairman Pai as a direct result of the commission being criticized for a lack of transparency in its decision making, and for failing to assess and consider total benefits and total costs to the nation of proposed actions.

Had the Office of Economics and Analysis reviewed the application, it would have compared the benefits to America of Ligado Networks using the spectrum as proposed, and contrast that with the costs resulting from interference with existing receivers. Given the tens of millions of GPS receivers likely impacted, one would imagine that even marginal performance reductions, just by the sheer force of large numbers, would have made it very difficult to find a net benefit to the nation.

But we don't know for sure, because, even though this was a very complex, high profile case, the FCC Chairman doesn't seem to have ever asked that question. Perhaps it was because he didn't want to know the answer.

The Chairman and other Commissioners also never asked for classified briefings from the Department of Defense, despite having received two letters from the Secretary of Defense. And, apparently, they gave no credence to a December 2019 letter from NTIA. Nor can I find any evidence they consulted with any independent radionavigation experts to try to improve their understanding of what was clearly a tidal wave of concern across a huge number of technologies and applications.

I am sure some folks at the FCC will tell you they had an official docket for comments and that they had appropriate communications before they made their decision.

But communication is more than just transmitting and receiving. It is having your messages understood and understanding what others are saying in return.

Given where we are today, I have to conclude that, ironically, the Federal Communications Commission in this case had a significant failure to communicate.

So, we are in a very uncomfortable situation with two irreconcilable perspectives on an incredibly important issue. What do we do now?

I believe the FCC has an opportunity to do right by the nation by protecting space-based uses of spectrum while also recognizing Ligado Networks' legitimate interests. It can do this by restoring the space spectrum environment by swapping out Ligado's current allocation for another set of frequencies that will clearly not interfere.

I am reliably informed that this would not be unprecedented as similar exchanges have been done before. Also, that other suitable spectrum is available for the exchange.

Not only will this eliminate the threat to space-based services, but it will also preserve the L band for future positioning, navigation, and timing use. The U.S. is well behind China and others in PNT. I am told that L band is a sweet spot, and particularly useful for such applications.

I expect that Ligado might be happier with a different spectrum allocation as it wouldn't be forever clouded by the threat of claims and lawsuits from GPS users of all persuasions. I am not an attorney, but I would imagine that their current potential legal exposure is huge, even if only a fraction of the projected interference is realized. And that is without the RETAIN Act becoming law.

We all agree that it would be great if GPS signals weren't so weak and vulnerable. If there was something we could quickly do about the tens of millions of vulnerable GPS receivers already in use for a wide variety of critical functions, many of them safety of life.

But that is not where we are. As much as we might like to, we can't go back in time. We have to deal with the world as it is and improve things as much as we can.

Best of luck and Godspeed in your efforts, I am happy to answer questions if I have any time remaining.

Video Of Comments an Q & A Available At: <https://www.nationalacademies.org/our-work/review-of-fcc-order-20-48-authorizing-operation-of-a-terrestrial-radio-network-near-the-gps-frequency-bands>