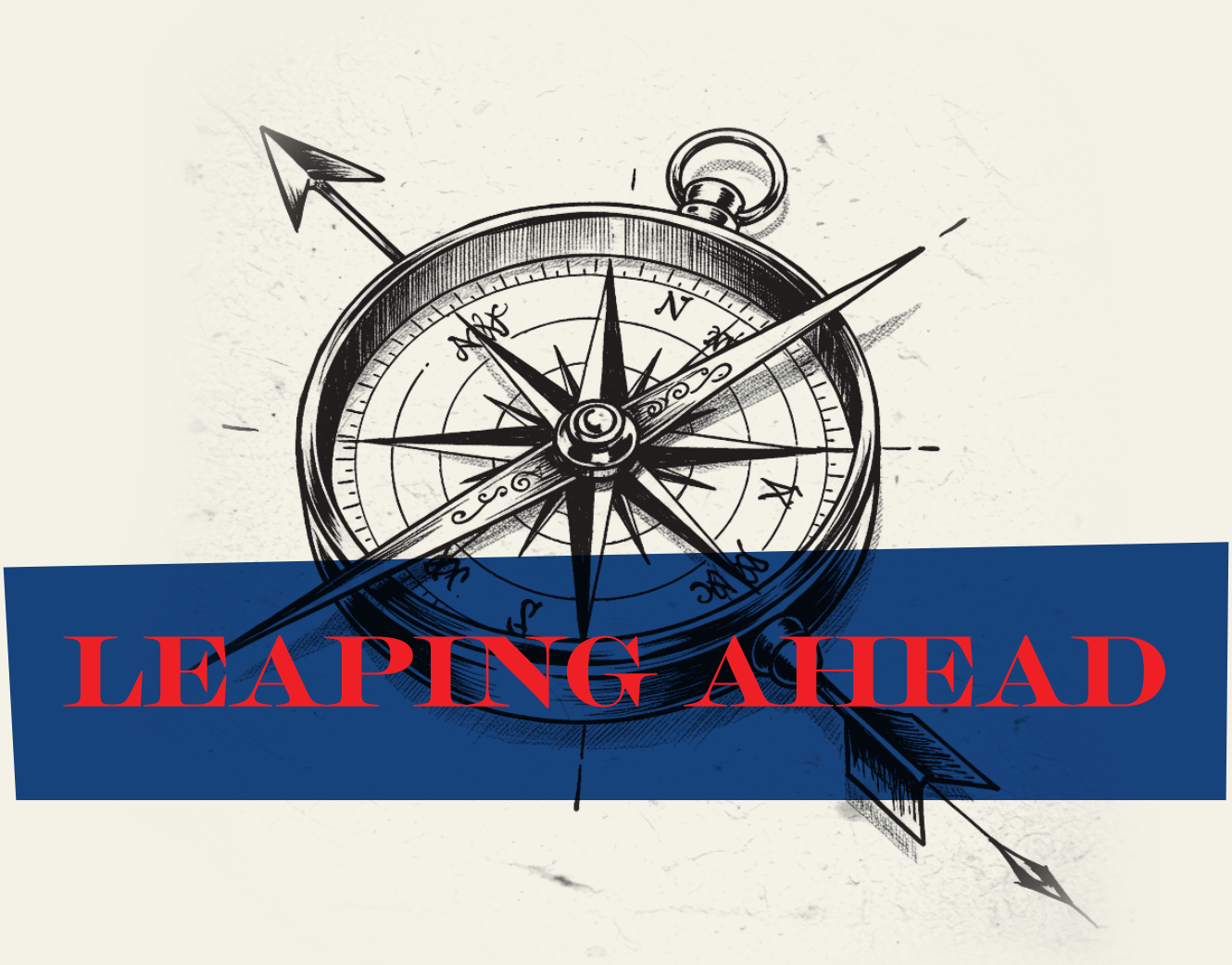
THE BULL MOOSE PROJECT



LEAPING AHEAD

SECURING AMERICA'S FUTURE WITH A 5G-BASED BACKUP TO GPS

Why the U.S. must outpace China in PNT resilience and break the gridlock which endangers our national security

Introduction

The United States has built vast military, economic, and civilian infrastructures on the backbone of the Global Positioning System (GPS). It's more than just a tool to help families get to the beach: GPS underpins telecommunications networks, electric grids, banking systems, and transportation. It guides everything from precision munitions to farming equipment to, of course, everyday smartphone navigation.

Our country's near-total reliance on a single, space-based technology has created a dangerous risk. If the United States loses access to GPS through jamming, spoofing or kinetic attack, we are more than just inconvenienced. Our military loses targeting, timing, and command capabilities. Our ships and trucks will reach their destinations much more slowly. Farmers, who have grown to rely upon GPS for successful planting and field maintenance, will be hindered. Without GPS, airplanes will be unable to take off and land safely.

In short, a successful disruption of GPS could cripple both national defense and the economy in a matter of hours. And yet, there is currently no American terrestrial (also known as ground-based) complement or backup to GPS, despite its adversaries abroad building layered redundancies on both sea and land.

These are not hypothetical concerns: real-world incidents prove the threat is substantial. In October 2022, air traffic over Dallas–Fort Worth was thrown into disarray when mysterious GPS interference froze navigation displays, forced a runway closure, and caused flight diversions over a 40-mile swath of airspace for two days.[1] Investigators suspect human jamming was the culprit, exploiting the fact that GPS signals, after a 12,500-mile journey from orbit, arrive extremely weak and can be easily drowned out or spoofed.

Natural phenomena pose risks as well. In April 2023, a severe solar storm knocked out GPS-based guidance in farm equipment, leaving Texas farmers unable to steer tractors or sow fields.[2] These episodes offer a glimpse of the potential chaos from a broader GPS outage. One industry study

[1] "Runway at DFW Airport Temporarily Closes While FAA Looks into Faulty GPS Signals," Dallas News, October 18, 2022, https://www.dallasnews.com/business/airlines/2022/10/18/runway-at-dfw-airport-temporarily-closes-while-faa-looks-into-faulty-gps-signals/.

[2] Michael Dorgan, "Solar Storm Crippled GPS Equipment, Causing Headaches for Farmers," Fox Business, May 15, 2024, https://www.foxbusiness.com/technology/solar-storm-crippled-gps-equipment-causing-headaches-farmers.

estimates a nationwide GPS failure could cost the U.S. economy up to $1.6 billion per day in lost productivity and disruptions to systems from ATMs to airlines.[3]

Recent global conflicts have further highlighted GPS vulnerabilities. As tensions flared between Iran and Israel in 2025, reports emerged of electronic interference surging near the Strait of Hormuz, one of the world's busiest oil chokepoints.[4] This disrupted ship navigation, and during the interference, two oil tankers collided and caught fire.

The Russo-Ukrainian War has also seen GPS interference, jamming, and spoofing occurring on a massive scale. This has sometimes even bled into neighboring airspace. In one incident, GPS interference emanating from the Russian exclave of Kaliningrad was so intense that commercial flights over Poland and Finland received false "Terrain — Pull Up!" warnings and had to suspend operations at regional airports.[5]

The U.S. government, including the Pentagon and the intelligence community, is keenly aware of these threats. These concerns have also crossed party lines. In 2020, President Donald Trump issued an executive order acknowledging that "disruption or manipulation" of PNT services like GPS "has the potential to adversely affect the national and economic security of the United States." The order further directed that agencies take urgent measures to foster alternative timing and navigation sources.[6] Four years later, former President Joe Biden signed an order designed to protect geolocation data from being accessed by foreign adversaries.[7]

Yet despite such directives — and decades of experts sounding alarms — the U.S. has moved too slowly to bolster PNT resiliency. We must act now to harden our PNT infrastructure before a major GPS outage or attack forces our hand in the worst possible way.

ADVERSARIAL INVESTMENTS: CHINESE, RUSSIAN, IRANIAN, AND NORTH KOREAN PNT STRATEGIES

America's adversaries have been busy future-proofing their positioning, navigation, and timing (PNT) capabilities. Of the four nations highlighted as top threats in the U.S. 2024 Annual Threat Assessment — the People's Republic of China, the Russian Federation, the Islamic Republic of

[3] O'Connor, A. C., Gallaher, M. P., Clark-Sutton, K. B., Lapidus, D., Oliver, Z., Scott, T. J., Wood, D. W., & Brown, E. G. (2019). Economic benefits of the Global Positioning System (GPS). RTI International.

[4] Maha El Dahan and Stine Jacobsen, "Two Oil Tankers Collide, Catch Fire near Strait of Hormuz," Reuters, June 17, 2025, https://www.reuters.com/world/middle-east/uk-maritime-firm-says-it-is-aware-incident-east-uaes-khor-fakkan-2025-06-17/.

[5] Michael Drummond, "'Pull up! Pull up!' Who Is Messing with GPS Signals Used by Passenger Planes - and Why?," Sky News, March 20, 2025, https://news.sky.com/story/pull-up-pull-up-who-is-messing-with-gps-signals-used-by-passenger-planes-and-why-13331351.

[6] United States, Executive Office of the President, Executive Order 13905, "Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services," February 12, 2020, *Federal Register* 85, no. 32 (February 18, 2020): 9359–61, https://www.govinfo.gov/content/pkg/FR-2020-02-18/pdf/2020-03337.pdf.

[7] United States, Executive Office of the President. Executive Order 14117, "Preventing Access to Americans' Bulk Sensitive Personal Data and United States Government-Related Data by Countries of Concern," February 28, 2024, *Federal Register* 89, no. 42 (March 1, 2024): 15215–15224, https://www.transportation.gov/pnt/executive-order-strengthening-national-resilience-through-responsible-use-positioning.

Iran, and the Democratic People's Republic of Korea — three (China, Russia, and Iran) have prioritized developing terrestrial PNT backups and complementary systems to ensure their military and critical infrastructure can function if GPS or other Global Navigation Satellite Systems (GNSS) are degraded.[8] And, as will be discussed below, all four have also engaged in "navigation warfare," the jamming or spoofing of GPS signals to undermine their adversaries' operations. These countries recognize that *denying* GPS to foes while *securing* PNT for themselves could yield a decisive strategic edge in a conflict.

China has pursued a long-term, multi-layered strategy to achieve PNT supremacy. At the 2019 Stanford PNT Symposium, Xiaochun Lu of China's National Timing Service Center unveiled an ambitious plan for a "comprehensive PNT architecture" that is "more ubiquitous, more integrated, more intelligent".[9] Centered on continual upgrades to its BeiDou satellite constellation (which now rivals GPS in global coverage), China's approach adds robust terrestrial and emerging tech layers. These include a new constellation of low-Earth orbit (LEO) navigation satellites (120 of which China has filed with the ITU to deploy), an updated nationwide Loran-C radio navigation network, enhanced inertial navigation systems, and even future quantum navigation technologies.

Crucially, China has already fielded many of these components. Its long-range Loran-C system, based on World War II technology, has operated for decades and is regularly integrated with Russia's and South Korea's systems to provide regional coverage with the Far East Radio Navigation Service. Stronger LEO signals are harder to jam than medium Earth orbit GPS signals, and China is ensuring that no single point of failure can knock out its navigation capabilities. Their investments are paying off: the U.S. Space-Based PNT Advisory Board — chaired by U.S. Coast Guard Admiral Thad Allen (Ret.) — noted in 2024 that China "and other nations are already ahead of the United States in building out resiliency to GPS," having effectively "fallen behind" in this arena.[10]

Russia, for its part, has demonstrated some of the world's most aggressive offensive counter-GPS capabilities and has matched them with renewed defensive backups. Russian forces deploy an array of truck-mounted electronic warfare systems to jam GPS signals across wide areas[11], and they have not hesitated to use them. GPS disruptions traced to Russian units have repeatedly been reported during NATO exercises in Europe and, since 2022, across Ukraine.[12] Anticipating that space-based systems like GPS or even Russia's own GLONASS could be taken offline in wartime, Russian doctrine has turned to *Chayka* — its Soviet-era LORAN-C terrestrial radio

[8] For the Threat Report, see United States, Office of the Director of National Intelligence, Annual Threat Assessment of the U.S. Intelligence Community: Unclassified Report (February 5, 2024), PDF, 41 pp., https://www.dni.gov/files/ODNI/documents/assessments/ATA-2024-Unclassified-Report.pdf.

[9] Editor, "China Leads World with Plan for 'comprehensive' PNT - GPS World," RNTF, November 15, 2019, https://rntfnd.org/2019/11/15/china-leads-world-with-plan-for-comprehensive-pnt-gps-world/#:~:text=Xiaochun%20Lu%20of%20China%E2%80%99s%20National,%E2%80%9D.

[10] United States, National Space-Based Positioning, Navigation, and Timing Advisory Board. Report of the 30th National Space-Based PNT Advisory Board Meeting and Associated Activities. Chairman's Summary Report of the 30th Meeting, July 2024. https://prod-01-alb-www-gps.woc.noaa.gov/sites/default/files/2025-06/2024-07-PNTAB-chair-memo.pdf.

[11] Withington, Thomas, "Chayka Compensates?" Armada International, April 5, 2022, https://www.armadainternational.com/2022/04/loran-navigation-system-ukraine.

[12] Michael Drummond, "'Pull up! Pull up!'"

navigation system — as a resilient fallback[13], and re-activated Chayka transmitters to support its operations in Ukraine. Three high-power stations in Bryansk, Crimea, and Belarus have provided PNT coverage to Russian military units even amid heavy GNSS jamming in the theater.

In essence, Russia dusted off a World War II-era radio nav system to blunt one of NATO's technological advantages. And it worked. Russia's investment in navigation resiliency shows that when GPS goes dark, old but robust terrestrial systems can fill the gap. In testing this in a smaller, regional war, Russia has ensured it will not be as crippled by GPS denial as a GPS-dependent American force might be if a larger fight were to break out.

Iran was among the first to use GPS spoofing as a weapon, and it has continued to innovate in the PNT sphere. Iran's 2011 capture of a U.S. RQ-170 Sentinel drone was reportedly achieved via GPS spoofing.[14] The country has also repeatedly jammed or spoofed commercial shipping GPS in the Persian Gulf and was suspected of manipulating navigation for civilian vessels that strayed off-course near its waters.

Iran also knows it could be on the receiving end of GPS denial in a conflict with the U.S. or Israel.[15] Thus, Tehran has been developing a homegrown alternative to GPS. In 2016, Iran's defense minister announced the rollout of a national "Local Positioning System (LPS)" — a terrestrial radio navigation network with five high-power transmitter stations placed strategically across the country.[16] This Iranian LPS was explicitly presented as a "substitute for GPS" to ensure positioning and timing for military and civilian use even if foreign GNSS signals are blocked. By leveraging technology "similar to those operated in Russia and China" and complying with international Loran standards, Iran is joining the small club of nations which have independent, ground-based PNT layers.

Iran has not rested on its laurels, however. After 2025's Twelve-Day War, the country began working on a plan to switch more services — including "transportation, agriculture, and the internet" — to China's BeiDou, away from GPS.[17] Iran's strategy is likely driven by the nature of asymmetric warfare: since it cannot match America's space assets or military capabilities, they must threaten GPS' usability and build their own backup to level the playing field.

Though not as technologically advanced as the other three, North Korea has also exploited GPS vulnerabilities and likely benefits from allied backup systems. Pyongyang has repeatedly

[13] Jake Thomas, "'They're Jamming Everything': Putin's Electronic Warfare Turns Tide of War," *Newsweek*, June 4, 2022, https://www.newsweek.com/theyre-jamming-everything-putins-electronic-warfare-turns-tide-war-1712784.

[14] "Iran Hijacked US Drone, Claims Iranian Engineer," NBC News, December 15, 2011, https://www.nbcnews.com/id/wbna45685870. See also: Erdbrink, Thomas. "Downed US Drone: How Iran Caught the Beast." *Christian Science Monitor*, December 9, 2011. https://www.csmonitor.com/World/Middle-East/2011/1209/Downed-US-drone-How-Iran-caught-the-beast.

[15] Agence France-Presse (AFP), "Iranians Struggle with GPS Disruption after Israel War," *France 24*, August 17, 2025, https://www.france24.com/en/live-news/20250817-iranians-struggle-with-gps-disruption-after-israel-war.

[16] "Iran Developing Homegrown Alternative to GPS," Tasnim News Agency, June 1, 2016, https://www.tasnimnews.com/en/news/2016/06/01/1090226/iran-developing-homegrown-alternative-to-gps.

[17] Jasim Al-Azzawi, "Iran's Plan to Abandon GPS Is About Much More Than Technology," *Al Jazeera*, July 27, 2025, https://www.aljazeera.com/opinions/2025/7/27/irans-plan-to-abandon-gps-is-about-much-more-than-technology.

jammed GPS signals in South Korea. In 2024, North Korean transmitters disrupted GPS signals in northwest South Korea, affecting civilian flights and ships.[18] In 2016, similar North Korean jamming forced Seoul to issue warnings to shipping and aviation companies.[19] These navigation warfare operations are a low-cost way for North Korea to impose disruption on its adversaries.

In terms of backup, North Korea reportedly received aid from Russia and China in establishing its timing systems and feasibly could have gained access to Loran technology through those partnerships. Even if this is not the case, North Korea's military is, at minimum, trained to operate in GPS-denied environments, and it is believed to be working on an indigenous timing network. While reliable details are scarce, we can infer that North Korea — like its larger allies — sees denying GPS as a weapon in and of itself, and is exploring how to mitigate the effects of GPS loss on its own forces.

Notably, all four adversaries have demonstrated or fielded anti-satellite weapons as well, meaning in a full-scale conflict they could attempt to physically destroy or disable American GPS satellites in orbit.

The risk is clear: China, Russia, Iran, and North Korea are each taking steps to guard against GPS and ensure resilient PNT. America cannot afford to ignore the possibility that these nations will target America's dependency on GPS in our national infrastructure.

THE CASE FOR A LAYERED APPROACH: BENEFITS OF A TERRESTRIAL PNT "SYSTEM-OF-SYSTEMS"

In light of these threats, experts across the defense and technology communities argue that America must adopt a layered PNT architecture, or a "system of systems," that integrates satellite-based GPS with complementary terrestrial and alternative technologies. This approach would ensure that if one link in the chain is broken, others can compensate, preserving our PNT capabilities when they are most needed. In the words of Admiral Michael Rogers (Ret.), former head of U.S. Cyber Command, "mission assurance means never trust a system that has a single point of failure. When one layer falters, another must be immediately ready to carry the load."[20] Currently, GPS is that single point of failure.

A terrestrial PNT layer is especially critical because it can address failure modes that affect all satellites equally. Every space-based GNSS — whether GPS, Galileo, or BeiDou — shares common vulnerabilities. They operate in the same frequency bands, have relatively weak signals, and can all be blinded by intense solar activity or widespread jamming from the ground. Terrestrial systems, by contrast, use different frequencies and independent infrastructure. If done right, a ground-based PNT system would have no common failure mode with GPS, meaning an attacker would have to defeat two very different technologies to truly disrupt American PNT capabilities.

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[18] "North Korean GPS Manipulation Disrupted Dozens of Planes and Vessels, South Korea Says | AP News," AP News, November 9, 2024, https://apnews.com/article/north-korea-gps-interference-jamming-aircraft-nuclear-2f6a345ffd3bcf-2875b04a758658c9c7.

[19] Deutsche Welle, "Pyongyang Jams GPS Signal Over South Korea," *Dw.Com*, April 1, 2016, https://www.dw.com/en/pyongyang-jams-gps-signal-over-south-korea/a-19157414.

[20] "Retired Admiral: America Needs a Ground-Based Backup to GPS," Dallas News, July 12, 2025, https://www.dallasnews.com/opinion/commentary/2025/07/12/retired-admiral-america-needs-a-ground-based-backup-to-gps.

Adding terrestrial PNT also improves coverage and performance in day-to-day operations. GPS signals struggle or fail entirely in many environments: indoors, underground, underwater, or in urban "canyons" with dense high-rise buildings. A well-designed ground system can penetrate where satellites cannot. The Federal Communications Commission (FCC), in a recent inquiry, noted that terrestrial radio-based PNT can operate at much stronger received signal strengths due to shorter distances and therefore "result in stronger receive signal strengths than space-based PNT technologies due to less signal propagation loss, be less vulnerable to intentional interference and space environment events, and function in certain locations where satellite signals are unavailable."[21] In addition, terrestrial transmitters can be hardened and redundantly networked in ways satellites cannot: if one ground tower goes offline, adjacent towers can fill gaps.

Plus, repair is relatively fast. This is not the case with a damaged or destroyed satellite, which leaves a coverage hole until a replacement is launched. A 2023 Virginia Tech study on PNT resiliency emphasized that space-only solutions are incomplete and "share common failure modes that could invite attacks on space-based PNT. Developing terrestrial-based PNT will have a strong deterrence role and address everyday PNT gaps."[22] In other words, a terrestrial layer not only backs up GPS but extends PNT service into new domains and thereby strengthens the overall system.

From a strategic perspective, integrating multiple PNT sources is imperative. The PNT Advisory Board's report found that the United States "faces a troubling shortfall" in PNT resilience, and explicitly concluded that America must move beyond its over-reliance on GPS alone. Chairman Admiral Allen wrote, "America's continued over-reliance on GPS for PNT makes critical infrastructure and applications vulnerable to a variety of well documented threats." His board urged pursuit of a "diverse set of PNT solutions" and noted that China and others already had such diversity.[23] In practical terms, this means combining space-based GPS, terrestrial radio navigation, and local inertial or timing systems into a resilient fabric.

Notably, Congress itself recognized the need for a GPS backup in the 2018 National Timing Resilience and Security Act, a bipartisan law requiring the establishment of a terrestrial timing system as a backup for GPS timing. At the time of passage, Senator Ted Cruz (R-TX) called such a system "crucial to the national and economic security of the United States,"[24] citing the risk that an outage of even a few hours could shut down gas stations, ATMs, and medical devices.

That congressional push has since evolved: as of March 2025, the FCC — in coordination with federal agencies — has opened a Notice of Inquiry specifically to expedite development of

[21] 1. Federal Communications Commission FCC 25-20, March 2025, https://docs.fcc.gov/public/attachments/FCC-25-20A1.pdf.

[22] David Simpson, A Day Without Space and a Call for Greater Positioning, Navigation, and Timing Resiliency in the United States, https://wireless.vt.edu/news/a-day-without-space-simpson.html.

[23] United States, National Space-Based Positioning, Navigation, and Timing Advisory Board. *Report of the 30th National Space-Based PNT Advisory Board Meeting and Associated Activities*. Chairman's Summary Report of the 30th Meeting, July 2024.

[24] "President Signs Sens. Cruz, Markey's Bipartisan National Timing Resilience and Security Act Into Law | U.S. Senator Ted Cruz of Texas," Ted Cruz, December 4, 2018, https://www.cruz.senate.gov/newsroom/press-releases/president-signs-sens-cruz-markey-and-rsquos-bipartisan-national-timing-resilience-and-security-act-into-law.

"alternative systems that provide [PNT] data" and to enable the development of "resilient backups that would protect critical operations from any disruption in GPS signals."[25] There is now broad consensus among U.S. military, industry, and policy leaders that a layered PNT approach is the only viable path forward.

The question is no longer if we need a GPS backup: it is instead how to implement one quickly and effectively.

AN OPPORTUNITY FOR AMERICAN INNOVATION: A 5G-BASED TERRESTRIAL PNT AS A SECURE, SCALABLE GPS COMPLEMENT

America doesn't need to copy China's eLoran system (as they have so often copied us). We instead need to beat them by deploying something even better.

As America charts a path to fortify its PNT architecture, one option stands out for its technical advantages, speed of deployment, and market-driven scalability: a terrestrial PNT system that rides on the infrastructure of modern 5G wireless networks. In essence, this approach repurposes part of the cellular network to broadcast timing and navigation signals, creating a nationwide backup to GPS that is *already integrated* into the devices people use every day. Instead of building Loran transmitters reminiscent of the Cold War, the U.S. can leverage cutting-edge telecommunications to deliver a "5G PNT" solution. This would enable America to leapfrog the older backup strategies of its adversaries.

A 5G-based PNT system offers several compelling benefits:

- **Stronger, Harder-to-Jam Signals:** Terrestrial 5G transmitters operate at power levels and proximities far greater than satellites. GPS satellites transmit ~20,000 km away; in contrast, a terrestrial PNT signal could come from a cell tower just a few miles or less from the receiver. In practical terms, an adversary would need orders of magnitude more jamming power to overwhelm a nearby ground signal than the whisper of GPS from space. This higher power, and the use of modern modulation techniques, also allows for robust penetration indoors and in dense urban environments where GPS is currently weak or downright unreliable. Greater signal strength means a 5G PNT backup could not only survive better against interference, but also extend precision navigation to GPS-denied locales, improving day-to-day utility for first responders and industry.
- **Resilience Through Network Redundancy:** A terrestrial PNT network can be designed with many transmitting nodes and overlapping coverage, akin to how cellular networks have multiple towers serving each area. This physical diversity yields resilience to localized damage or attacks. If one tower is taken out, receivers can pick up signals from others. An attacker attempting to jam or spoof would have to do so across an entire region, which, as noted, requires far greater effort due to higher signal power. Additionally, ground system maintenance or upgrades can be done incrementally, tower by tower, without a total service interruption. This is unlike GPS, where maintenance can create gaps or degrade accuracy if satellites fail.

[25] United States, Federal Communications Commission, "FCC Launches Proceeding on GPS Alternatives," News Release, March 27, 2025, DOC-410436A1, https://docs.fcc.gov/public/attachments/DOC-410436A1.pdf.

- **Leverages Existing 5G Ecosystem:** Perhaps the greatest appeal of a 5G-based solution is that it can piggyback on the established commercial telecom ecosystem, which regularly brings new spectrum bands online. This means rapid deployment and innovation with no taxpayer cost. The advantage is twofold: infrastructure (towers, power, backhaul networks) already exists, and end-user devices (for example, smartphones) will receive the signals via regular technology upgrade cycles. Consumers can (and already do) simply upgrade to the latest phone models, and networks can incorporate a new band capable of providing PNT information as part of 5G's ongoing rollout (and 6G's future rollout). Private capital would fund the solution, since telecom companies and service providers can incorporate PNT as a feature while accessing 15 MHz of critical low-band spectrum, in line with the FCC's approach to support industry efforts, rather than a top-down federal build.

Given these benefits, it is unsurprising that the FCC's Notice of Inquiry singled out 5G-based PNT proposals for serious consideration. Chairman Brendan Carr and others see it as a way to "leap ahead" of China instead of merely catching up. During a March 2025 interview, Chairman Carr emphasized that while the U.S. "fell deeply behind China" on PNT during the past few years, we "have the playbook" to regain leadership: just as President Trump's first term focused on winning the 5G race, now "we must do it again – with GPS" by harnessing that same 5G platform.[26]

Already, pilot projects and testing are underway. For instance, NextNav's TerraPoiNT system has demonstrated meter-level positioning and nanosecond-level timing in urban trials, using a handful of terrestrial transmitters. The U.S. Department of Transportation in 2021 conducted field tests of various GPS backup technologies and found NextNav's system was the top performer in coverage and accuracy. The technology can also complement needs like a 911 caller location. The Texas 9-1-1 Alliance has explicitly backed a ground-based GPS complement, calling it "essential" for public safety.[27] Such endorsements underscore that the benefits of a 5G PNT system extend to resilience and performance in daily life and disaster response.

REGULATORY CHALLENGES: THE FCC PROCESS AND OPPOSITION EFFORTS

In one of his first acts in office, FCC Chairman Brendan Carr initiated a Notice of Inquiry (NOI) exploring alternatives to GPS.[28] At the time, Carr said, "[b]eyond answering technical questions, we hope this effort will engage stakeholders across government and industry to encourage the development of new PNT technologies and solutions. As a nation, it is important that we catch up to other countries that are looking at robust alternatives of their own."[29]

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[26] "China Exploiting US Weakness from Biden Admin, FCC Chairman Warns: Fox Business Video," Fox Business, May 7, 2025, https://www.foxbusiness.com/video/6372465749112.

[27] "Texas 911 Agencies Back GPS Alternative at FCC - Law360," n.d., https://www.law360.com/articles/2298385/texas-911-agencies-back-gps-alternative-at-fcc.

[28] Federal Communications Commission, "FCC Launches Proceeding on GPS Complements," *Federal Communications Commission*, March 27, 2025, https://www.fcc.gov/document/fcc-launches-proceeding-gps-complements.

[29] Federal Communications Commission, "Boosting GPS and 911 for the USA," *Federal Communications Commission*, March 5, 2025, https://www.fcc.gov/news-events/blog/2025/03/05/boosting-gps-and-911-usa.

Chairman Carr's NOI builds on a proceeding that started in August 2024 (WT Docket 24-240), seeking comment on a petition for rulemaking to enable a terrestrial PNT system in the lower 900 MHz band as a GPS complement.[30] The proposal essentially involves modernizing decades-old rules for licensed spectrum with new rules built for the 5G age.

The proposal from NextNav seeks to reconfigure its existing licenses in a portion of 900 MHz (902 - 928 MHz) channels in exchange for new spectrum license rules, which would allow 5G operations that have the capability to provide PNT information. This change, while technical, would enable a widescale 3D PNT solution that is broadly available to critical infrastructure, public safety, and consumers, and has a clear path to incorporation in end-user devices; all at no cost to taxpayers. The FCC's stance is that a terrestrial solution is needed — recognizing the national security importance of creating a PNT alternative throughout a fact sheet released earlier this year — but it must weigh impacts on incumbent users of the band and navigate lobbying from various stakeholders.[31]

Almost immediately, the NOI was "flooded with opposition" to the 5G proposal, as one trade publication put it.[32] Some comments expressed concern over the impact on existing unlicensed devices; in doing so, they ignored mitigation techniques already used in the band (like repetition and frequency hopping) that could mitigate interference concerns. Others question the need for any GPS backup at all, despite the mountain of evidence of vulnerability.

A "wide range" of companies and industry groups filed comments urging the FCC to reject NextNav's proposal or to slow down. Their stated concern was that changing the rules for the 900 MHz band threatened millions of unlicensed devices that currently rely on it.

It is true that the 900 MHz band is home to unlicensed (IoT) devices and certain licensed narrowband systems. Utilities use it for smart meters, logistics firms use it for RFID readers, municipalities for Internet of things (IoT) networks (e.g., Wi-SUN and LoRa systems), and alarm companies for security sensors. These incumbents — represented by groups like the Wi-SUN Alliance, the RAIN RFID Alliance, the Security Industry Association (SIA), and others — have legitimate interests in avoiding interference or costly equipment changes. Many of them filed comments claiming that a high-power 5G signal could drown out their low-power devices. For example, the Wi-SUN Alliance argued that its smart utility networks, which rely on unlicensed spread-spectrum signals in that band, might suffer unless carefully protected.

However, beyond the technical debates, a pattern emerged: some opposition appeared less about interference and more about stalling competition or favoring alternative approaches. Notably, certain individuals and organizations have persistently advocated for an eLoran-based solution and seem hostile to the idea of a private 5G-based network taking the lead.

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[30] Federal Communications Commission, "Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment on NextNav Petition for Rulemaking," *Federal Communications Commission*, August 6, 2024, DA 24-776, https://www.fcc.gov/document/wtb-and-oet-seek-comment-nextnav-petition-rulemaking

[31] Federal Communications Commission, *Promoting the Development of Positioning, Navigation, and Timing Technologies and Solutions: Notice of Inquiry, WT Docket No. 25-110*, FCC Fact Sheet, DOC-410031A1 (March 21, 2025), https://docs.fcc.gov/public/attachments/DOC-410031A1.pdf.

[32] Jericho Casper, "FCC Flooded With Opposition to NextNav's GPS Backup Proposal," Broadband Breakfast, August 8, 2025, https://broadbandbreakfast.com/fcc-flooded-with-opposition-to-nextnavs-gps-backup-proposal.

One prominent opponent is Dana Goward of the Resilient Navigation and Timing Foundation (RNTF), a nonprofit that has championed eLoran for years. According to reporting, Goward — described as a "fanatical" critic of the Trump administration's GPS backup efforts[33] — has used op-eds and public comments to cast doubt on the FCC's direction. Plus, RNTF's coalition includes companies like UrsaNav, which builds Loran transmitters and has lobbied for government contracts to deploy eLoran, and Locata, which has said it supports Loran transmitters "being maintained as one of a range of GPS backup technologies."[34] UrsaNav, a founding member of RNTF, even suggested U.S. taxpayers subsidize a Loran system "to compete against China and Russia," noting somewhat self-servingly that those nations have ground systems. UrsaNav lists Russia and China among its "past and present clients."[35]

In short, some of the resistance at the FCC may be motivated by legacy interests wanting their solution (eLoran) to win out or simply by antipathy toward the proponents of the 5G approach.

There are also indications of extensive foreign influence in the opposition. A Breitbart investigation in May 2025 revealed that a "host of Chinese companies" co-signed letters to the FCC protesting the 900 MHz PNT proposal.[36] These Chinese manufacturers — such as Shenzhen Bonondar and Shenzhen EJEAS — claimed the 5G PNT system could undermine reliable communications in that spectrum. The letter, however, raised eyebrows: it is unusual for small Chinese device makers to actively lobby the American FCC unless prodded. It is not difficult to imagine where that prodding came from: the Chinese government. China has a strategic interest in slowing U.S. progress on GPS backups because if we race ahead, their strategic edge is negated and the market share of Chinese tech companies becomes threatened.

The FCC was urged by these letters to conduct years more testing and to not "jeopardize" existing devices. This would be a recipe for indefinite delay and would be a boon to CCP-connected companies and anti-Trump activists.

Investigations by the Bull Moose Project also have revealed the Chinese links to other organizations strongly opposed to advancing an American terrestrial GPS alternative. The U.S. Chamber of Commerce and its various coalition members — which include the LoRa Alliance, RAIN Alliance, Security Industry Association, Wi-Sun Alliance, and Z-Wave Alliance — are just some of these groups.

Many of these associations include Chinese companies, such as the ZTE Corporation, Shenzhen Makerfabs Corporation, Siterwell Electronics Co., Limited, Zhejiang Chint Electrics, Ningbo Dooya Mechanic & Electronic Technology Co., Ltd., and Taixin Semiconductor Co.

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[33] Lucas Nolan, "Trump Haters and Chinese Companies Oppose Administration's Push for the Future of GPS," Breitbart, May 21, 2025, https://www.breitbart.com/tech/2025/05/21/trump-haters-and-chinese-companies-oppose-administrations-push-for-the-future-of-gps/.

[34] Locata Corporation, *Response to U.S. Department of Transportation's Request for Public Comments on 'Complementary Positioning, Navigation, and Timing Capability'*, Docket No. DOT-OST-2015-0053 (May 22, 2015), PDF, 34 pp., https://rntfnd.org/wp-content/uploads/Nunzio_Gambale-2.pdf.

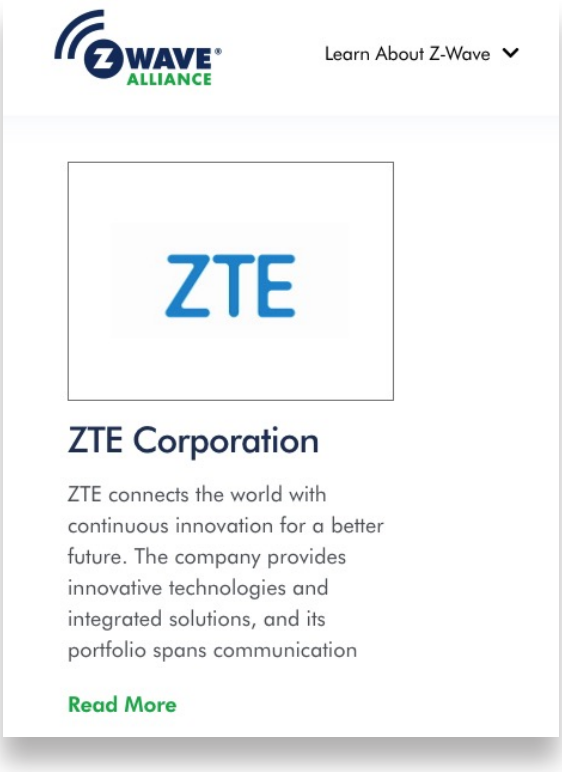
[35] UrsaNav, "Clients," *UrsaNav*, https://www.ursanav.com/clients/.

[36] Generac Power Systems Inc, "RE: NextNav Petition for Rulemaking, Enabling Next-Generation Terrestrial Positioning, Navigation, and Timing and 5G: A Plan for the Lower 900 MHz Band (902-928 MHz), Public Notice (WT Docket No. 24-240, RM-11989)," n.d., https://www.fcc.gov/ecfs/document/10920119959333/1.

One example is particularly egregious — and illustrative. This past March, Chairman Carr announced a sweeping investigation into CCP-aligned entities that "pose an unacceptable risk to America's national security, including by doing Communist China's bidding."[37] A primary target on the FCC list included the previously mentioned ZTE Corporation.

The FCC banned the company from the U.S. market after it was deemed by the agency as a national security threat.[38] In April 2025, the House Select Committee on the Chinese Communist Party issued subpoenas to ZTE, along with its U.S. affiliates, as part of a broader investigation into threats posed by CCP-linked companies operating in American networks.[39]

But despite being labeled as a national security risk, and its products being banned from 5G infrastructure and consumer devices, it remains a prominent member of the Z-Wave Alliance[40]:



[37] Federal Communications Commission, *Carr Announces Sweeping New Investigation Into CCP-Aligned Entities*, press release, DOC-410318A1 (March 21, 2025), https://docs.fcc.gov/public/attachments/DOC-410318A1.pdf.

[38] *Federal Communications Commission*, "FCC Bans Authorizations for Devices That Pose National Security Threat," Federal Communications Commission, November 25, 2022, accessed August 22, 2025, https://www.fcc.gov/document/fcc-bans-authorizations-devices-pose-national-security-threat.

[39] Select Committee on the Chinese Communist Party, "The Select: A Weekly Committee Recap (Week of 4/21)," *Select Committee on the Chinese Communist Party*, April 25, 2025, https://selectcommitteeontheccp.house.gov/media/in-the-news/select-weekly-committee-recap-week-421.

[40] Wave Alliance website, screenshot, September 4, 2025: Z-Wave Alliance website on September 4, 2025 https://z-wavealliance.org/z-wave-alliance-member-companies/.

The Z-Wave Alliance has been a leading voice behind the opposition to 5G-powered PNT, filing dozens of times in both of the FCC's open proceedings. Representatives have met with FCC staff and are engaged in an active campaign to convince the Commission to stop pursuing Chairman Carr's mission of working within government and industry to develop new PNT technologies and solutions.[41]

As discussed above, this isn't the only company with deep ties to Communist China that has infiltrated associations to advocate against securing a Trump administration national security priority. Indeed, many of the most vocal opponents of a 5G-powered PNT solution have members with CCP ties. Each of the associations below are part of a coalition formed by another vocal critic, the United States Chamber of Commerce:

TIES THAT BIND: ASSOCIATIONS WITH MEMBER CONNECTIONS TO CHINA

ASSOCIATION	NOTABLE CHINESE TIES
LoRa Alliance	Members include Chinese companies: • Shenzhen Makerfabs Corporation • Shenzhen Sunricher Technology Co., Ltd. • Huizhong Instrumentation Co., Ltd. • Lierda Science & Technology Group Co., Ltd. • Holley Technology Ltd. Members also include at least one research institution with significant Chinese ties — Nanyang Technological University — Wireless And Networked Distributed Sensing Group.
RAIN Alliance	Members include Chinese companies: • ADA (Guangdong) Intelligent Equipment Co. Ltd • Beijing Silion Technology Corp Ltd • Dongguan OSRFID Technology Co. Ltd • Donghong Intelligent Packaging Co., Ltd • SEUIC Technologies Co., Ltd • Shanghai Fudan Microelectronics Group Ltd. • Shanghai HUAYUAN Electronic Co., Ltd • Shanghai Lingdian Garment Accessories Co.,Ltd. • Shanghai Quanray Electronics Co., Ltd. • Shenzhen Chainway Information Technology Co., Ltd. • Shenzhen DTB RFID Co., Ltd • Shenzhen RICHRFID Technology Co., Ltd • Wuxi Grandtag Electronics Co., Ltd. (GRAND-TAG GROUP) • XIAMEN XINDECO IOT TECHNOLOGY LTD.

[41] Communications Daily, "NextNav Opponents Raises Concerns With FCC Staff," *Communications Daily*, July 29, 2025, https://communicationsdaily.com/article/2025/07/29/nextnav-opponents-raises-concerns-with-fcc-staff-2507280039?BC=b-c_68882a2f5e3bf.

	• RZX Technology Co., Ltd • Maxim Group • Linxens (acquired by Tsinghua Unigroup in 2018) • BoingTech • Arizon RFID Technology Co., Ltd
Security Industry Association	Members include Chinese companies: • Siterwell Electronics Co., Limited • Think-Force.
Wi-Sun Alliance	Members include Chinese companies: • HEXING • Zhejiang Chint Electrics • Eastsoft • Holley • Inhemeter (has significant contracting with China's state-owned electric utility company, the State Grid Corporation of China) • Sanxing • Zhuhai Zhonghui Microelectronics Co. LTD • Star Instrument • Gatesea • HJL – Hui Jian Lian Ke Ji (website not found) • Daikin • KESU (Shanghai) Electronic Technology Co. Ltd. (website not found) • Jiangsu Linyang Energy Co., Ltd • TrustAsia Technologies, Inc. • Taixin Semiconductor Co., Ltd
Z-Wave Alliance	Members include Chinese companies: • Focalcrest Limited • Nie-Tech Co., Ltd. • Ningbo Dooya Mechanic & Electronic Technology Co., Ltd. • Shenzhen ZVIDAR Technologies CO., LTD • Shenzhen Sunricher • ZTE Corporation – partially state owned • Shenzhen NEO Electronics Co., LTD

The FCC must now sift through these arguments and make decisions. Chairman Carr remains a champion of solving this problem through a layered approach that includes space-based and terrestrial solutions, emphasizing that national security is paramount: "Continuing to rely so heavily on one system leaves us exposed. Disruptions to GPS have the potential to undermine the

nation's economic and national security."[42] He has an ally in Congress in Senator Cruz, who is now serving as the Chairman of the Commerce Committee and has long pushed for a backup to GPS.

The key challenge for regulators is to balance speed with care. They must address the legitimate interference concerns of incumbents based on credible technical analysis without yielding to domestic and foreign actors who simply seek to block progress.

Encouragingly, technical studies are showing coexistence is feasible. Additionally, many critical devices in 900 MHz (like smart grid radios) are American-made; those manufacturers could be enlisted to adapt and improve resilience, especially if given a few years of lead time and incentives.

Ultimately, the regulatory hurdles are surmountable. But they must be tackled with a sense of urgency and unity that has sometimes been lacking. It will be important for the executive branch (through agencies like the Departments of Defense, Homeland Security, Transportation, and Commerce) to weigh in at the FCC in support of rapid action and to counterbalance special-interest objections. Indeed, in past FCC matters, the Defense Department's opposition played a large role in decisions. Here, by contrast, both the Departments of Defense and Homeland Security have supported GPS backup efforts. This clarity should continue in order to avoid further paralysis.

CONCLUSION: AMERICA MUST ACT SWIFTLY AND LEAPFROG ADVERSARIES

The writing on the wall could not be clearer. The United States — the original architect of GPS and once the unchallenged leader in PNT — now stands at a crossroads. Down one path lies continued stagnation: sticking to a GPS-only strategy, hoping incremental satellite upgrades will suffice, and risking catastrophe the first time a determined adversary or solar storm takes GPS offline.

But down the other path lies a bold leap forward: embracing a layered, "system-of-systems" approach that blends space and terrestrial technologies to secure our nation's Positioning, Navigation, and Timing. This second path is the only viable choice for a secure future.

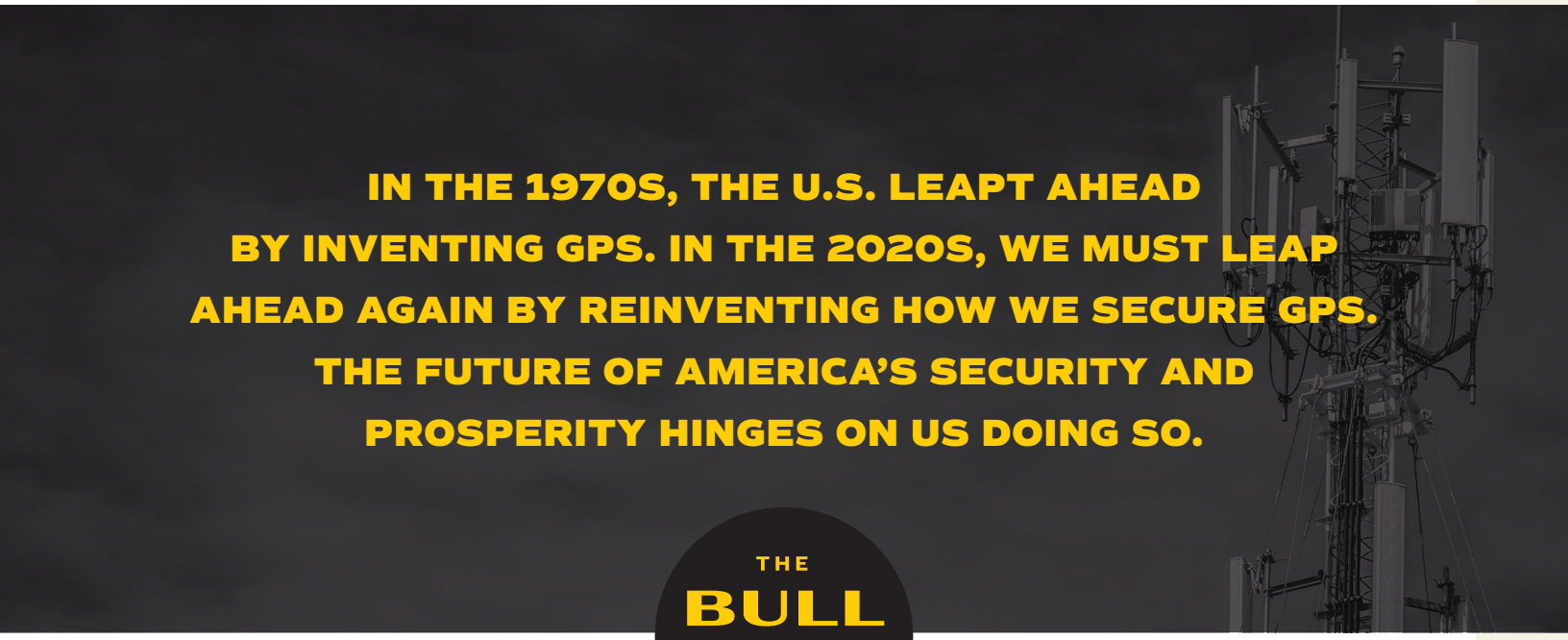
The stakes are enormous. The good news is that we know how to fix this. President Trump's 2020 executive order and bipartisan legislation laid the groundwork; they identified the problem and even mandated action. In recent months, under renewed focus, the FCC and key lawmakers have revived the initiative. We must now pick up the baton and finish the job.

Time is not on our side. Every year of delay is a year that China further entrenches its multi-layer PNT architecture, Russia refines its electronic warfare and expands Chayka, and others like Iran and North Korea experiment with new ways to sabotage GPS systems. The window for the United States to leap ahead instead of lag behind is currently wide open, but it will not remain open indefinitely.

[42] Federal Communications Commission, "Boosting GPS and 911 for the USA," *Federal Communications Commission*, March 5, 2025, https://www.fcc.gov/news-events/blog/2025/03/05/boosting-gps-and-911-usa.

Fortunately, the 5G-based terrestrial PNT solution discussed is not some distant pipe dream. Industry stands ready to build it, much of the tech has been proven in pilot projects, and integration into consumer devices could happen within a few years of launch. Experts believe that if aggressively pursued and with swift FCC action, a nationwide terrestrial PNT network could be operational before the end of President Trump's term. Achieving that goal would allow America to no longer be dangerously exposed. We would enter the next decade with a hardened PNT backbone.

The United States must act swiftly to implement a 5G-based terrestrial backup to GPS. This approach offers the fastest, most secure, and most economically efficient route to positioning and timing resiliency. The challenges are real but manageable; to solve them, we must adopt a whole-of-government approach driven by urgency. By doing so, America can re-establish itself as the vanguard of PNT innovation, much as it was when GPS was first conceived.



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