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Auctioning Military S-Band Spectrum
Understanding the Risks

By Tom Karako, Director of the Missile Defense Project

KEY TAKEAWAYS

- Auctioning off the low-3 S-band spectrum is a bad idea. Commercial use of this bandwidth for 5G risks jamming military radars and degrading missile defense capability.
- The risks of an S-band auction have been widely recognized by congressional, military, and senior defense officials across both the Biden and Trump administrations.
- For air and missile defense, the S-band is a Goldilocks zone within the electromagnetic spectrum: low enough to propagate freely through rain and other forms of weather, and high enough to accurately classify and track inbound missiles, drones, and aircraft. Alternative sensor phenomenology, such as space-based infrared, does not suffice for some threat types or for certain missile defense functions.
- For the foreseeable future, unproven proposals for “dynamic sharing” remain impracticable. The potential should continue to be studied, but no such capability has yet been demonstrated to overcome the national security threshold.
- Preserving continuous and incumbent military use of the low-3 S-band is necessary for the operation of numerous defense assets, including the Golden Dome initiative.

BACKGROUND AND CONTEXT

Electromagnetic spectrum is a scarce national resource with significant implications for national security and economic growth. The S-band, spanning from 2–4 gigahertz (GHz), is a crucial frequency for air and missile defense radar. Over the years, large portions of what were previously military bandwidths have been auctioned off. Some telecommunication associations and Chinese-dominated international telecom bodies are now pressing the Federal Communications Commission (FCC) to auction off the low-3 range of the S-band.

The low 3 S-band (3.10–3.45 GHz) is one area that has been preserved for military use alone, and for good reason.

Advocates of selling the low-3 have proposed transitioning military radars out of the S-band at the cost of hundreds of billions of dollars, years of delay, new layers of bureaucratic procedures, and the disruption of decades of intelligence gathering about how missiles appear to radars operating in the S-band.

Civilian use of this bandwidth for 5G would disrupt the operation of critical U.S. air and missile defense radars, including the Navy’s Aegis SPY family, the Army’s TPQ-53, the Marine Corps’ Ground/Air Task-Oriented Radar, and the Space Force’s Long Range Discrimination Radar. High-power radars that must track faint missile signatures thousands of miles away would be adversely affected by ambient noise from telecom use. Notably, China does not permit outside commercial use of the low-3. Those countries that do allow it degrade the ability of S-band radars to operate in their defense.

LEGISLATIVE AND POLICY IMPLICATIONS

Several legislative proposals have emerged to auction off the low-3, and there is a debate underway about the prospect of sharing. The House-passed reconciliation bill included a provision to reauthorize the FCC’s spectrum auction authority through 2034. The bill mandates that the FCC identify and auction 600 megahertz of mid-band spectrum for exclusive, licensed use in mobile or fixed broadband services. Fortunately, the legislation in its current form explicitly excludes certain frequency bands from this auction requirement, notably the 3.10–3.45 GHz band.

As the bill moves to the Senate, debates are expected to continue regarding the scope of the spectrum auction authority and the specific frequency bands to be included or exempted. This legislative debate will be better informed by clarifying the basic trade-off between commercial and military use.

Auction advocates tout the Citizens Broadband Radio Service (CBRS) as an example of sharing, but CBRS has been an effective sharing system precisely because national security assets can compress from the mid-3 to the low-3 band when they must share the 3.5–3.7 GHz band. If the low-3 is sold, the Department of Defense will have nowhere else to go.

In January 2018, thousands of Americans in Hawaii received a text message that there was an incoming ballistic missile from North Korea headed to Hawaii. Fortunately, the text message was only a test that was inadvertently sent. If that incoming threat missile had been real, however, it would have been small comfort to U.S. citizens to receive the text message slightly sooner thanks to boosted 5G, if it meant that U.S. missile defense radars were blinded, unable to track the incoming threat and do something about it.

CHALLENGES AND RISKS

Understanding the needs of the missile defense mission provides a better appreciation for why the military must keep the undisrupted use of 3.10–3.45 GHz and why proposed spectrum sharing messages are not currently viable.

Nearly all missile defense engagements have discrete functions that a radar must perform: continuous surveillance, threat detection, classification and identification compared to a threat library, tracking trajectory precisely enough to develop an interceptor solution, discriminating between lethal and nonlethal objects, and sending updates to interceptors in flight.

Rigorous testing has shown the incompatibility of 5G and high-powered radars; the former has to be off for the latter to be on. Proposals for dynamic sharing fail to account for the need to continuously surveil airspace. The CBRS approach to this has not proven effective, as it requires a central clearinghouse to adjudicate power switching. Even assuming that switching could work reliably, an enemy will not give advance notice about when an attack will come.

Auction advocates have said that alternative technologies, like infrared or thermal sensors, could substitute for S-band radar. While infrared sensors hold promise for tracking hypersonic glide vehicles, they are less useful for ballistic missile warheads or low-flying cruise missiles. Both for discrimination and developing fire control–quality tracks sufficient for interception, it is difficult to substitute for the range, power, and resolution that comes from depositing radar energy onto an incoming missile and having it reflected.

It has been suggested that artificial intelligence (AI) can somehow solve the problems of sharing. AI and machine learning hold significant promise for missile defense, especially for threat classification and discrimination of a threat cloud. AI cannot, however, overcome the need for radar or overcome the interference issue.

Despite claiming that dynamic sharing will solve the jamming problems, telecom advocates have recommended that military radars be redesigned and rebuilt to operate in an entirely different part of the spectrum. This is especially impractical. Redesigning radars and building new ones would be prohibitively expensive, take many years, and may not even be possible.

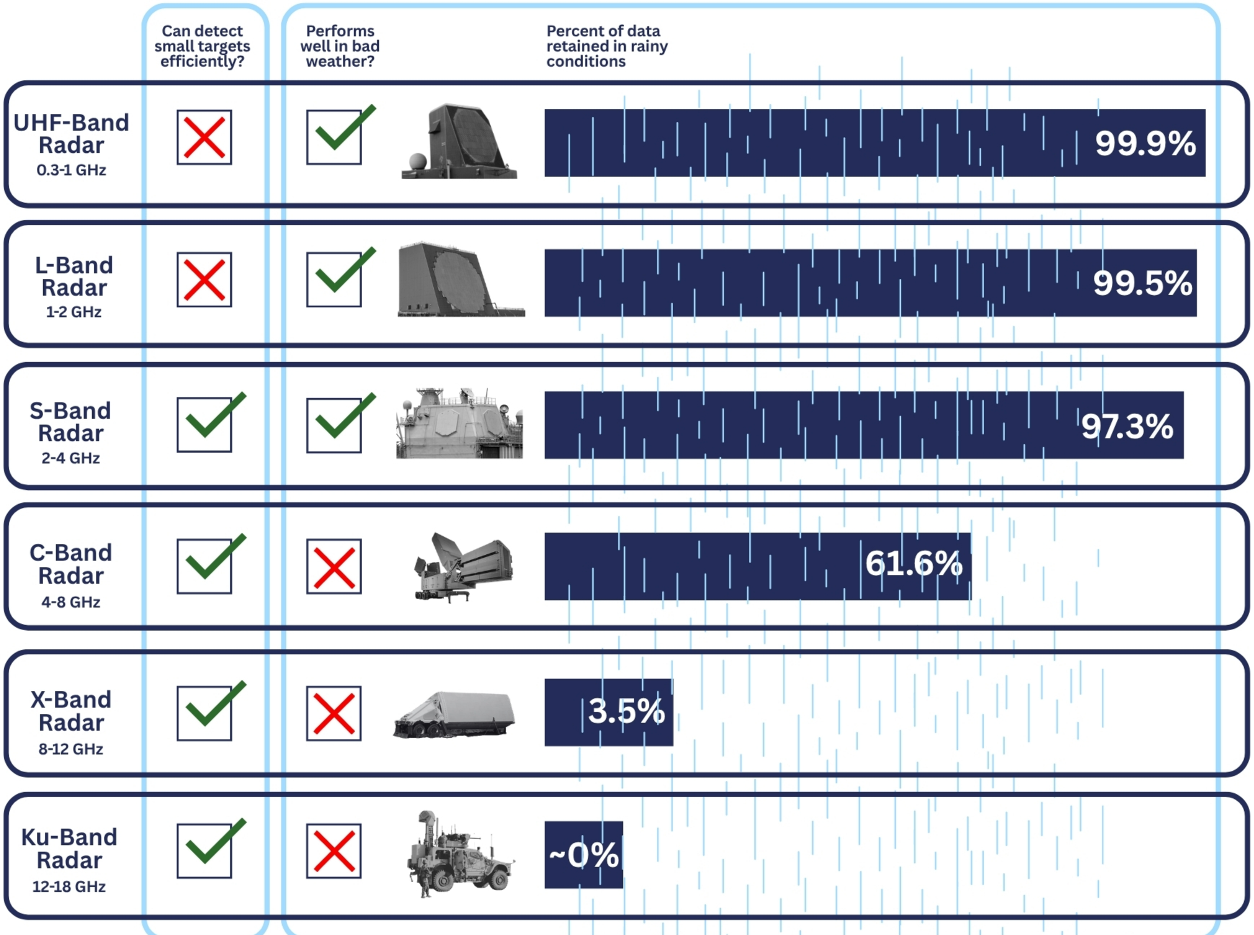
Vacating the S-band would forgo the specific ability of that bandwidth to send and receive radar energy through weather. X-band radars, for instance, have much lower weather penetration. It would also degrade the threat classification function, which relies on a library populated by decades of observations of how missile signatures appear in the S-band.

Auctioning off the low-3 S-band spectrum is a bad idea. Commercial use of this bandwidth for 5G risks jamming military radars and degrading missile defense capability at a time when air and missile threats have never been worse.

RECOMMENDATIONS

- Preserve exclusive and incumbent military access to the low-3 band for the foreseeable future and continue to study the long-term feasibility of spectrum sharing.
- Refrain from auctioning any portion of the low-3 band unless there is definitive assurance that commercial use will not compromise national security needs.
- Avoid requiring the military to reconfigure or redesign its radar systems, as doing so would entail prohibitive costs, significant delays, and unacceptable losses in operational effectiveness.

Radar Propagation Efficiency by Bandwidth



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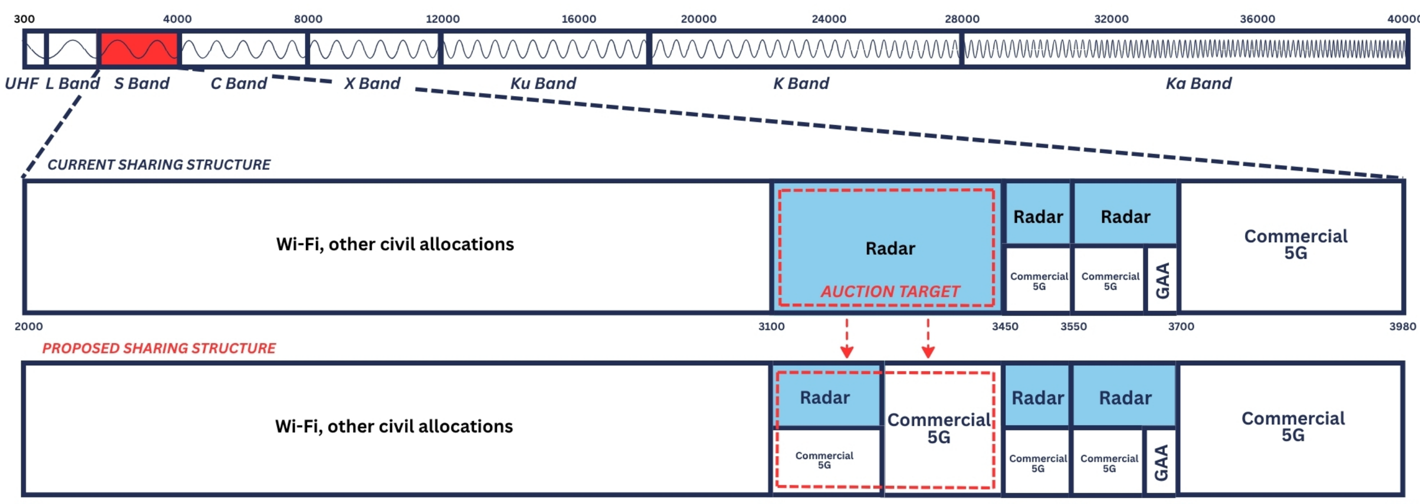
Percentage of two-way signal retained over 10km in .5 cm/hr rainfall (horizantal and vertical polarization)

International Telecommunication Union (ITU), Recommendation ITU-R P.838-3: Specific Attenuation Model for Rain for Use in Prediction Methods (Geneva, Switzerland: ITU, March 2005), https://www.itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.838-3-200503-I!!PDF-E.pdf



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