DEFEND ABOVE

SPACE-BASED WARFIGHTER COMMUNICATIONS:

THE KEY TO MODERNIZING MILITARY OPERATIONS

Leveraging a Robust U.S. Supply Chain for Assured Connectivity in Contested Environments

By Col. (Ret.) Dean Bellamy, Executive Vice President, National Security Space, Redwire Space

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In the civilian world of smart devices and the Internet of Things, continuous, instant communication is ubiquitous and often taken for granted. But in an austere and contested military theater, assured communication becomes far more challenging—especially when warfighters who need to remain in contact are using systems that fall outside of their line of sight.

During conflict, effective communications enable situational awareness, intelligence sharing, command and control, logistics coordination, and much more. Reliable, resilient communications capabilities are essential to the safety and survival of warfighters and to overall mission success.

Recent events such as the war in Ukraine have only reinforced the importance of secure, adaptable, and innovative communications in modern military operations, but strong industry partnerships are essential for the U.S. Department of Defense (DoD) and its Allies to meet and maintain this important goal.

THE BACKBONE OF JADC2

The (DoD), in particular the Space Development Agency (SDA), is looking to Low Earth Orbit (LEO) to proliferate resilient next-generation capabilities for warfighter communications. Dubbed the Proliferated Warfighter Space Architecture (PWSA) as of 2023, this large satellite constellation is intended to provide warfighters across all domains with secure, anti-jam, beyond line-of-sight connectivity.

The PWSA includes two layers: the Tracking Layer will detect enemy missiles via infrared sensing; and the Transport Layer will include hundreds of satellites in LEO with the goal to provide constant advanced communication capabilities to armed forces worldwide.

By expanding the reach of communications to users who were not previously able to connect with one another in degraded environments—for example, a sailor at sea with a soldier using a handheld radio in the desert—PWSA's Transport Layer will significantly enhance the global communications footprint of the U.S. and its Allies.

At the MilSat Symposium in 2023, SDA Director Dr. Derek Tournear referred to the Transport Layer as the "backbone" of the DoD's Joint All Domain Command and Control (JADC2) effort in space.

Tournear further described the Transport Layer as hundreds of satellites connected by laser crosslinks.

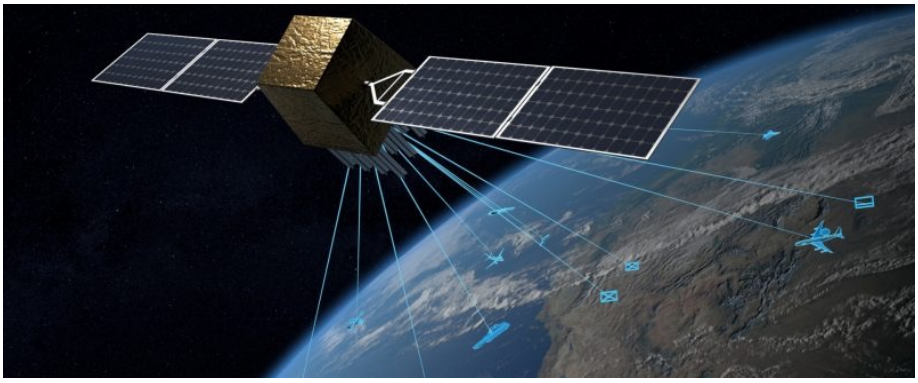
> ***"THOSE ARE WHAT ALLOW US TO MOVE THE DATA ANYWHERE AT THE SPEED OF LIGHT AND THEN TO GET THAT TO THE WARFIGHTER."***

He explained how the Tracking and Transport layers are designed to work in tandem for real-time missile warning, tracking and defense: The Tracking Layer will detect threats and "send those data to the Transport Layer so we can send those down to interceptors to take out those threats," he said.

LINK 16 ON ORBIT

Link 16 is a standardized military communications system widely used since the 1970s across domains and NATO nations to exchange data and information in real time. Until recently, Link 16's range was 300 nautical miles and limited to terminals within this line of sight.

In November 2023, three Transport Layer Tranche 0 satellites demonstrated the first Link 16 tactical message transmissions from LEO to ground using deployable, space-based antennas as repeaters. This demonstration proved that Link 16 radios operating from space can significantly expand the nominal ground communications reach of the Link 16 network, eliminating decades-old line-of-sight limitations.



Redwire has delivered nearly 50 flight antennas for Link 16 space-based connectivity. Image: Redwire

Redwire delivered five L-band Helical antennas in support of SDA's Transport Layer Tranche 0 mission, which transmitted the first Link 16 tactical messages from space. Image: Redwire

Redwire Space's antenna and radio frequency (RF) payload team provided multiple L-band Link 16 Helical antennas in support of SDA's Transport Layer Tranche 0.

Putting Link 16 antennas on orbit helps to eliminate stovepipes among U.S. services and partner nations. The Tranche 0 demonstration confirmed the feasibility of a proliferated communications architecture in cost, schedule, and scalability. Tranche 0 transmitted messages to a Five Eyes nation and over international waters, but the goal remains to test the capability over U.S. air space.

Redwire also built and delivered 44 Link 16 antennas for an undisclosed national security LEO constellation. These antennas will enable beyond line-of-sight communications for the warfighter using a secured tactical network.

HIGH QUALITY, LOW COST

A U.S. based supply chain that emphasizes the intersection of innovation and flight heritage is essential for space programs as expansive and mission critical as the PWSA.

Redwire is a world leader in the high-volume production of large antennas for high gain or low frequency missions. The company has delivered more than 50 flight antennas and is a trusted DoD partner with more than 180 antennas currently in development for multiple national security space missions.

Redwire's state-of-the-art facility in Longmont, Colo., boasts 26,000 square feet of high-bay manufacturing, integration, and testing floor space. With modular array work cells, the factory can produce more than 120 antennas per year, among other unique advantages.

ANECHOIC CHAMBER TESTING

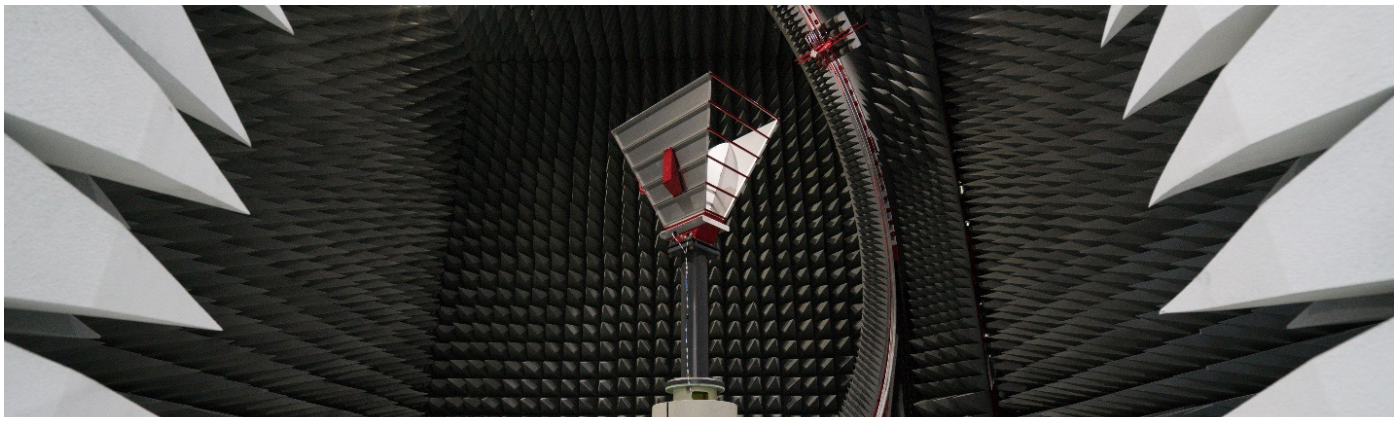
Redwire's Longmont facility includes an advanced anechoic testing chamber to evaluate and validate the performance of RF payloads prior to launch. Not often commercially available, the chamber represents Redwire's forward-thinking investment to address gaps in the commercial space market and ensure higher reliability and performance standards.

PARALLEL MANUFACTURING

The facility also employs parallel manufacturing practices to facilitate affordable and rapid manual assembly of complex space products, avoiding higher costs associated with automation. Harmonized design and manufacturing processes enable the use of similar parallel production and assembly lines to manufacture different products, enhancing efficiency and flexibility.

CONCIERGE-LEVEL SERVICE

Beyond providing spacecraft components, Redwire collaborates closely with its customers to co-engineer custom, comprehensive, and repeatable RF payload solutions. The expert team serves as a mission prime for DARPA, U.S. Space and Missile Defense Center, and European Space Agency programs, and can supply, source, and integrate all the peripheral components that constitute a complete RF payload.



Redwire's Longmont, Colo., facility can produce more than 120 flight antennas per year. Image: Redwire

Looking to the future, the full deployment of the the PWSA Transport Layer promises to revolutionize warfighter communications for the U.S. and its Allies. The proliferation of advanced, resilient communication satellites in LEO will ensure beyond-line-of-sight connectivity across systems, domains, and nations.

With industry innovations like Redwire antennas and payloads built at state-of-the-art manufacturing and testing facilities, reliable and efficient communications will become the standard. Supporting a strong U.S. supply chain can help the DoD ensure no warfighter is ever out of reach, setting a new benchmark for military communications even in the most austere and contested environments.

13th MEU ANGLICO set up Link 16 aboard USS Anchorage. Image: DVIDS

ABOUT THE AUTHOR

Retired U.S. Air Force Col. Dean Bellamy serves as executive vice president of National Security Space for Redwire, a leader in space infrastructure that brings a commercial-mindset, non-traditional capabilities, and heritage + innovation to national security space missions. Prior to entering the private sector, Col. Bellamy was a U.S. Air Force officer, who concluded his government career as chief of the Policy and Strategy Group in the National Reconnaissance Office.

LINK 16 TIMELINE

THE EVOLUTION OF LINK 16 The Link 16 communications network has transformed military communications over decades by providing a common operating picture for NATO forces. Developed in the 1970s and initially deployed in the 1980s, it has evolved to support modern, multi-domain operations. SDA's first-of-its-kind, space-based Link 16 demonstration in 2023 revealed the network's future promise.

1970s + Link 16 development began as part of the Joint Tactical Information Distribution System (JTIDS) program, aiming to enhance communication among NATO forces.

1980s + Link 16 was initially deployed on U.S. Air Force and Navy platforms, such as the E-3 Sentry AWACS and F-15 fighter jets, revolutionizing the common operating picture.

1990s + Link 16 use expanded to include more platforms, with increasing integration into coalition operations. Key platforms included the F-14 and ground command units.

2000s + The introduction of new hardware like the Multifunctional Information Distribution System (MIDS) and Small Tactical Terminal (STT) expanded Link 16 capabilities to helicopters, UAVs, and ground vehicles. This period also saw a shift toward network-centric warfare, enhancing interoperability across military assets.

2010s + The continued miniaturization and ruggedization of Link 16 equipment enabled integration into smaller platforms, including individual warfighter radios.

2020s + Ongoing improvements in bandwidth management and network flexibility ensure Link 16 remains relevant in modern, multi-domain operations.

2023 + Three SDA PWSA Transport Layer Tranche 0 satellites demonstrated the first Link 16 tactical message transmissions from LEO to ground using Redwire's deployable, space-based antennas as repeaters. This demonstration proved that Link 16 radios operating from space can significantly expand the communications reach of the Link 16 network, eliminating decades-old line-of-sight limitations.

2024 + A Space Development Agency Tranche 0 satellite with Link 16 communicated with an aircraft carrier, successfully demonstrating the first-ever Link 16 connection a U.S. Navy ship operating in international waters.