Enabling 5G from Space

Lockheed Martin's vision for commercial, industrial and military ubiquitous communications

Presented by:
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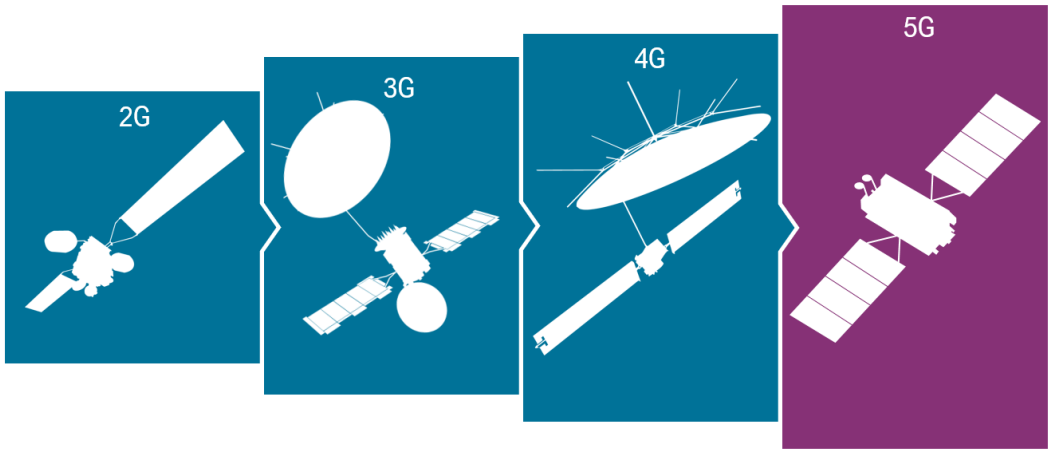
Executive Summary

Lockheed Martin is operationalizing the technical capabilities of 5th generation (5G) waveforms, software, and hardware to improve our defense products and their performance in support of our warfighters. The 5G mobile standard enables high bandwidth, low-latency data rates which are connecting smart cities, enabling autonomous vehicles and connecting devices at home and work. We are working to extend that to our warfighters operating in communications contested and denied environments, so they have access to data to perform their missions anywhere in the world.

The 5G technology standard (3GPP) Release 15 allowed traditional mobile network operators (MNOs) and technology organizations to bring 5G to their customers. Lockheed Martin (LM) is also leveraging this technology to bring 5G to our defense customers. Release 17 of the standards enhances the 5G-NR to support non-terrestrial networks (NTN). This capability enables faster connection speeds to more devices, larger data rates shared and new technologies to emerge in support of the warfighter on land and in space.

Lockheed Martin is building satellites and software to provide end-to-end systems with assured connectivity and extended coverage beyond traditional terrestrial systems. We drive innovation that supports existing terrestrial coverage, leveraging significant infrastructure investments made by the commercial sector to enable capabilities in space to continue supporting our customers' missions.

Lockheed Martin's Journey to 5G



Over the last 40 years, Lockheed Martin has developed pivotal mobile technologies, starting with the first generation (1G) all the way through 5G. The first generation included our work on ACeS (PT Asia Cellular Satellite), the first generation of Mobile Satellite Services (MSS) communications satellite which introduced voice, text and low-speed data at L-Band. ACeS proved critical for supporting the disaster relief after the 2004 Indian Ocean Earthquake and Tsunami.

When the second generation (2G) was released, it allowed for encrypted conversation and sharing of data, text messages, pictures and multi-media. Inmarsat's GSPS MSS satellite, built by Lockheed Martin, offered circuit-switched voice and data and introduced location-based services.

With the upgrade to the third generation (3G), a more commercialized version of mobile communications, there was a standardized network protocol and advancement to international roaming services and faster speeds. Lockheed Martin expanded its Iridium NEXT software to support 3G-like global connectivity. The U.S. Navy introduced similar capabilities with its Mobile User Objective System (MUOS) constellation, also built by Lockheed Martin.

By 2010, technology moved into the 4th Generation (4G) and introduced higher data rates, high quality video streaming and the commercial influx of 4G-ready handsets. 4G connectivity coincided with a cultural shift with widespread adoption of mobile smartphones and the explosion of connected apps. At the same time, MNO's dramatically expanded 4G coverage across the world. MNO's have complemented terrestrial access with satellite coverage to connect areas not traditionally well-served by cellular connectivity. The Lockheed Martin-built JCSAT-17 MSS launched industry-first 4G direct connectivity with its flexible mission processor along with a 18m mesh reflector, enabling assured communications continuity during high-volume events. A gap still remained in terms of ensuring connectivity in remote regions, satellite access has allowed for more accessibility and ensured connectivity in remote regions, including

areas previously without cellphone coverage, boats offshore, areas impacted by disasters, or during large volume events like professional sporting events.

Bringing 5G from Space to the Warfighter

In September 2020, the Space Development Agency awarded Lockheed Martin one of two contracts to develop Tranche 0 of its Transport Layer. According to Lockheed Martin CEO Jim Taiclet, “the award represents an important step toward building an interoperable connected and secure mesh network of satellites that links ground, sea and air capabilities to sensors in space.”

The SDA Transport Layer will be capable of sending and receiving secure wideband data directly to the warfighter and to weapon systems. This interoperability and inter-service networking will communicate and analyze data seamlessly to enable Joint All Domain-Operations (JADO).

JADO-enabled technology gives commanders an unprecedented level of situational awareness and the confidence to act quickly and make the right decisions under pressure. Building resilient networks & systems that quickly connect critical data across multiple domains to predict, disrupt and paralyze our adversaries. Lockheed Martin is using Agile DevSecOps to develop a common reference architecture that will eventually support a suite of common mission services, connectivity and interfaces that use existing government open, standards-based architecture compliant with OMS and UCI. When this technology is placed on a 5G space-based network, the backhaul for this connectivity would allow for increased capacity between users and applications.

The proliferation of Internet-connected devices in the consumer and commercial worlds has also now extended to the military. The so-called Internet of Battlefield Things (IoBT) will allow for a complex network of interconnected entities, or "things", in the military domain that continually communicate with each other to coordinate, learn, and interact with the physical environment to accomplish a broad range of activities in a more efficient and informed manner.

For this market, a Zero Trust overlay could be incorporated to provide secure communications transparent to the satcom infrastructure. The use of satcom for backhaul and the potential to incorporate optical or RF intersatellite links (ISLs) would increase security avoiding potentially suspect ground infrastructure (untrusted networks, equipment, etc.).

5G in space also allows for alternative communications paths enabled by space-based assets. One way this is occurring is through development of an interplanetary internet which would allow network nodes to communicate to one another through a 5G network. Network nodes can be integrated into satellites and all vehicles which go into space. Through this network communication model, there would be an ability for communication to occur in space and for data to be received at Earth ground stations.

With this type of communication network, it would be possible to execute more complex space missions and have a new terrestrial communication network with space vehicles. The technological advancement would allow the warfighter to have ubiquitous communication through seamless network connectivity. The overall architecture can prioritize users and permit those operating in contested or denied environments priority over users in an environment with stable connectivity.

Conclusion

Space is the ultimate high-ground and 5G, artificial intelligence, rapid technology insertion will all empower joint all-domain operations – which will help counter the rising threats we face today and tomorrow. In fact, speed is the key driver for winning in the 21st century battlespace: speed of resilience, speed of innovation and speed of connection. We believe Lockheed Martin is uniquely positioned, leveraging commercial best practices and the expertise of our leadership, to bring 5G connectivity and capabilities to the defense industry rapidly and affordably.