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5G could radically transform ship-to-shore, military logistics and battlefield communications. But with much of its development being spearheaded by the civilian telecoms sector, defence needs to better articulate its needs if the technology is to truly deliver for them.

By Anita Hawser

5G was meant to revolutionise telecommunications. Greater bandwidth, lower latency and the ability to more easily share video and other forms of data from multiple sensors and devices are just some of the many-touted benefits of the fifth-generation cellular wireless standard.

However, the reality hasn't quite lived up to expectations. This is due to several factors, say experts. Firstly, 5G — or offerings purporting to be 5G — have been rolled out on existing 4G towers which don't fully support the speeds or full spectrum band to deliver on 5G's real promise.

The complete transformation of the underlying telecommunications architecture that 5G promised hasn't been fully realised yet as the infrastructure required is expensive which has dampened telco providers' enthusiasm for the heavy investment needed. "The infrastructure changes needed for 5G are the biggest hurdle," says Gregg Melanson, former executive Vice President and Chief Growth Officer at Illuminate, which provides communications and data surveillance technologies to government and military customers around the world.

But these hurdles haven't stopped the military from experimenting with 5G-enabled networks and communications on and off the battlefield. "The military is really at the forefront of exploring how to deploy 5G to its advantage because they realise it gives them a tactical and strategic edge if they can master it," observes Stefan Pracht, senior Vice President of product marketing at Axellio, which provides network intelligence platforms for the Department of Defense and intelligence communities.

5G'S MULTI-LAYER ENCRYPTION IS MORE SECURE

5G is often thought of as just another evolution of 3G and 4G mobile access technology, but Pracht says it provides an end-to-end network that delivers a much faster, lower latency, and a more secure network for a much higher density of

A 5G mobile test station sits on the flight line at Hill Air Force Base, Utah, Feb. 25, 2022
(*US Air Force photo by R. Nial Bradshaw*)

end devices, even embracing the needs of applications hosted in the cloud. 5G can also work across a wide spectrum from below 1GHz to 300 GHz. "With this, you can build vast broadcast networks that cover a wide area while you can also create extreme short-range networks, which are important on the battlefield because they don't leave much of a footprint that adversaries can monitor," Pracht explains. Another aspect is about making networks more secure. "When you think about how other wireless technologies have been compromised, 5G provides more advanced and multi-layer encryption. It has the most secure end-to-end encryption that's available on the market, which so far is unbreakable. On top of that, you can layer additional end-to-end encryption on top of those connections as well."

5G also incorporates technology for reliably accessing applications in the cloud, unlike previous wireless mobile technologies that narrowly focused on wireless connectivity. One of the challenges the military has when they're on the battlefield in the middle of a desert, says Pracht, is they may not have the network connectivity that they're used to. "And when you need to calculate, let's say massive amounts of weather data, and you don't have the connectivity to shuttle that back to a supercomputer in the United States, you want computing power at the edge. 5G is so much more than just wireless network connectivity, creating really an end-to-end delivery platform that considers different end devices and use models including edge computing."

Illuminate, which provides communications and data surveillance technologies to government and military organisations around the world, says it is talking with military base officials in the US about setting up private 5G networks, primarily for the secure transfer of data. Some of these bases are still using old 2G and 3G networks, which are not secure and extremely slow.

5G allows for the quick and efficient sharing of data across networks in multiple different locations. "In a contested battlespace making that successful connection is tantamount to success," says Melanson. "It enables more things including the sharing of information that can help soldiers achieve success and give them situational awareness at greater speed and scale."

US Marine Corps Lance Cpl. Jesse Rushing, a transmission systems operator with Headquarters Battalion, Marine Air Ground Task Force Training Command, Marine Corps Air Ground Combat Center (MCAGCC) installs a 5G antenna for a 5G network demonstration. (*US Marine Corps photo by Pfc. Ryan Kennelly*)

SHIP-TO-SHORE 5G

Using a 5G mesh network supports different devices and sensors which could give soldiers a better understanding of what's going on inside the battlespace, says Melanson. And because of its lower latency, soldiers can receive information in as good as real-time. Although the military is still experimenting with 5G, he points to several promising projects, including "smart warehouse" applications for the Department of Defense's Naval Base Coronado in San Diego.

The US Department of Defense (DOD) selected AT&T as the primary 5G networking services provider for two of four US military test sites where it is testing 5G capabilities. AT&T says its 5G spectrum and private 5G Core and Radio Access Network (RAN) demonstrated data throughput speeds greater than four gigabits per second with less than 10 milliseconds of latency.

According to AT&T, delivering 5G across the 120,000 square foot Naval Base Coronado warehouse will securely connect smart warehouse application infrastructure to provide high-speed, low latency 5G connectivity for autonomous mobile robots, video cameras, Internet of Things (IoT), and AR/VR systems that will enable inventory tracking.

The tests at Coronado Naval Base support the development of a 5G-enabled Smart Warehouse focused on transhipment between shore facilities and naval units, to increase the efficiency and fidelity of naval logistic operations, including identification, recording, organisation, storage, retrieval, and transportation of materiel and supplies. Additionally, the project will create a proving ground for testing, refining, and validating emerging 5G-enabled technologies.

The US Army is also experimenting with 5G for secure connectivity on training devices, specifically the Instrumentable Multiple Integrated Laser Engagement System (I-MILES) and the Army's Integrated Visual Augmentation System (IVAS).

Communications in contested environments are also a promising use case. In 2021, Lockheed Martin was awarded a contract by the Under Secretary of Defense for Research and Engineering's (OUSD R&E) FutureG & 5G Office and the USMC to deliver the final Phase 1 Initial Prototype 5G testbed variant for the Open Systems Interoperable and Reconfigurable Infrastructure Solution (OSIRIS) to the Marine Corps programme management team at USMC Base Camp Pendleton, California.

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OSIRIS is a 5G communications network infrastructure testbed for expeditionary operations. Specific mission applications (a trailer-mounted 5G Nomadic Tower, ATV Mounted 5G Relay and deployable 5G operations facility) will be integrated on the testbed for experimentation. The objective is to increase bandwidth while also maximising virtualisation of shared resources like radios to provide increased bandwidth for Marines operating in contested environments.

Across the pond, in the EU, Ministry of Defence representatives from France, Germany, Hungary, Italy, Latvia, Spain, and Sweden recently met for their first workshop with the 5G Communications for Peacekeeping and Defence (5G COMPAD) project to discuss and agree on 5G use cases and the operational use of 5G military communication systems in the land, naval, and air domains. The participants also addressed associated system requirements and expected benefits and challenges of the 5G COMPAD project.

5G COMPAD, which includes partners from European telecom and defence industries, aims to reduce hurdles faced by European armed forces, which currently rely on expensive, hardware-locked communication systems with limited data rates and interoperability. The project, which is funded by the European Defence Fund, will provide a reference architecture for a 5G-based communications system for Forward Operating Bases, and deployed and homeland quarters that is compatible with existing systems and platforms. Validation is expected in 2025.

RISK BENEFIT TRADE-OFFS

Meanwhile, UK defence is taking more of a measured approach to 5G. "The technologies that underpin 5G, which are delivering significant advances in civil telecommunications, will form part of our future military systems whether badged '5G' or not," says Richard Leigh, Communications and Networks Research Programme Manager at Dstl. Leigh says it is essential that defence understands these technical developments and benefits from the billions of pounds in research, development and infrastructure deployment in the civil sector. However, 5G covers a huge spectrum of possibilities, he adds, each with a complex set of risk-benefit trade-offs.

"The business drivers behind the development of 5G are geared towards capacity and availability, not towards

US Air Force Tech. Sgt. Ron Richards, 86th Communications Squadron non-commissioned officer in charge of cable operations, stands by a recently activated 5G cell tower at Ramstein Air Base, Germany. (*US Air Force photo by Airman Jared Lovett*)

military use," he explains, adding that the defence opportunities of 5G need to be carefully weighed against the challenges associated with these applications, especially in circumstances such as a contested environment in the presence of a capable adversary.

Dstl is assessing the applicability of 5G across a variety of defence use cases, says Leigh, and is working with customers and industry partners to fully explore the potential of 5G capabilities and its vulnerabilities before adoption into service. Despite 5G's considerable benefits, Pracht of Axellio says the 3rd Generation Partnership Project, which defined what 5G is, is geared more towards mobile carriers than the military and their unique use models, especially on the battlefield in adverse conditions. "That makes it fairly complicated for defence vendors to implement," he explains, "because the standards aren't as detailed in these areas as we need for all those specialised applications, which can lead to compartmentalised stovepipe solutions, which can be very limiting for military applications."

A drone system on its own may work great on 5G, but if you then try to operate it simultaneously with other sensor networks you may run into interoperability issues, says Pracht. "That is where the military has a role to play in guiding the industry to build interoperable solutions that address the unique needs and applications the military require. " While enhanced 5G end-to-end encryption makes the data safe, it also makes it difficult to monitor, he adds. "When you think about firewalls and intrusion detection systems, they're all looking into the packet to inspect for potential threats or misuse. But now, with more sophisticated encryption, you lose this vital visibility, making your environment more vulnerable for adversaries to breach."

Then when you start to think about connecting different devices from vendors using 5G, that too will be challenging for the military, explains Pracht. "These vendors may be experts in building drones, but they're not experts in building a reliable communication channel to

the drone to control what it does and to feed down the sensory data that the drone is collecting. So, by interconnecting these different devices through a single network, you introduce vulnerabilities and weaknesses into that delivery chain."

If 5G is to develop in ways that are useful to the military, Pracht says they need to drive its development, not industry. "The military need to step up and bring the industry with them to say, 'This is what we need,' and not just rely on industry to say, 'We can build all of that.'" While there are plenty of ongoing 5G trials, Pracht says they're occurring in pockets. "You run the danger of building the perfect solution for that pocket whether it's ship-to-shore 5G or battlefield drone 5G. But then when you want to roll it out in a conflict working with your allies, how is that working together?"

He says it is not about building the perfect drone or wearable sensor network, but a universal joint forces network that cuts across the US military and all its allies. "The industry has built the individual technology components and standards that are necessary to build such a system," says Pracht. "Now, how do you take all of that and build a military wide, globally interoperable network? That requires someone who has not just commercial interests, but more operational and deployment defence experience."

5G has fundamentally changed the playing field, not just by defining a new wireless access technology, but thinking through how you deliver applications from many end devices in various environments, all the way to the application itself, reliably at speed, and securely. "Mobile carriers have developed, integrated and operated mobile wireless technologies for decades, which is new to the military. So that's where we're up against a pretty steep learning curve that requires mobile carriers, vendors, and the military, to work closely together to take advantage of this tactical and strategic edge 5G can provide." ∎