ULTRA | Intelligence & Communications

Achieving Technological Overmatch using Artificial Intelligence and Machine Learning

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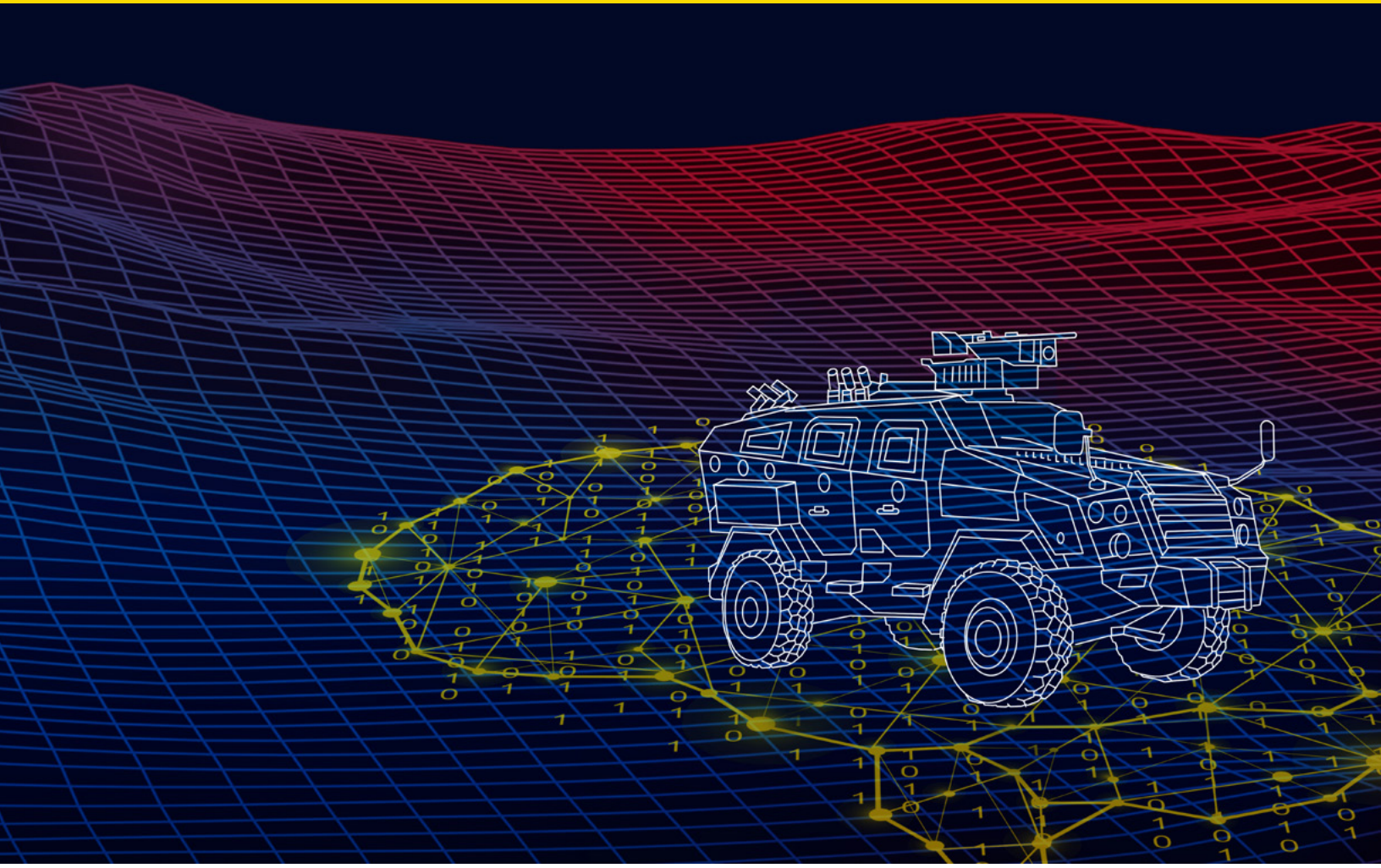


Introduction

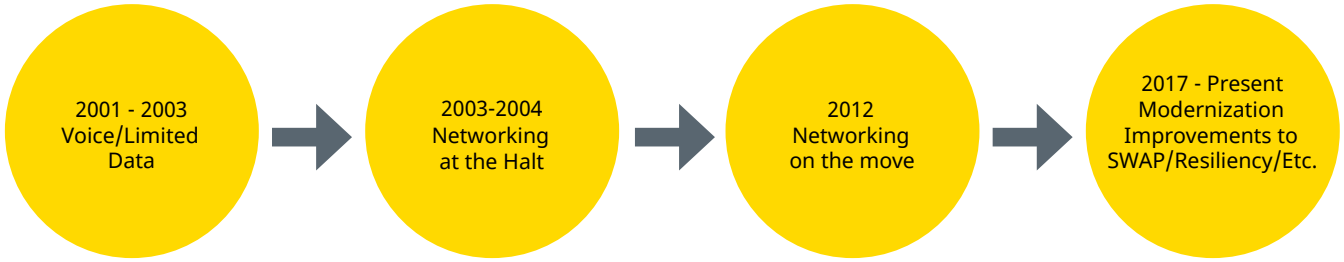
Creating and maintaining robust and resilient communications links during a conflict is absolutely essential on the front lines of the modern battlefield. During the first wave of the global war on terror in Iraq and Afghanistan, coalition forces were fighting a counterinsurgency war against an enemy that lacked the technological sophistication to jam communications within the operating theatre.

Those days are gone. As military forces globally face the growing reality of peer and near-peer threats, they must accept that in future conflicts they will be operating in a heavily congested and contested communications environment. This evolution in the threat landscape is forcing the military to re-examine its network resiliency and mobility on a fundamental level to maintain critical lines of communication.

It is not enough to count on a "network at rest" as the chief model for communications. Military forces must master networking on the move to increase survivability under any conditions. Achieving resiliency against such attacks requires a completely new approach: cognitive networking that automates various time-sensitive aspects of networking and responds with agility to rapidly changing conditions across multiple domains.

In this paper, we will examine not only the danger involved in maintaining the status quo, but also look to the future and the application of artificial intelligence (AI) and machine learning (ML) for networking topologies.

Chapter One: The Status Quo Cannot Stand



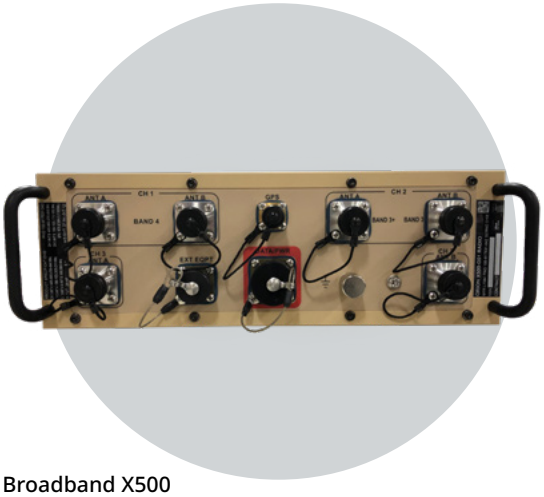
Circa 2003, during conflicts in Iraq and Afghanistan, network connectivity was limited based on a number of factors. Soldiers relied on a tactical network of mostly voice communications and limited data. Broadband satellite communications were only sporadically available. In such a scenario, that kind of networking was largely sufficient.

Just as the world continues its quest to be ever more connected, so too does the military. With so much data available, being able to access it and convey it effectively becomes a necessity. As forces become increasingly mobile and dispersed, networking on the move (NOTM) in turn became a top priority.

However, the path to fully integrated NOTM had several issues: networking devices tended to have a large size, weight and power (SWAP) requirement; they were deployed on lightweight unarmored Humvees; and they were assigned primarily to infantry brigade combat teams. Lower echelons seldom have a soldier assigned who has the technological expertise to effectively deploy and manage these radios, leading to frequent connectivity issues. Furthermore, the attempt to support every operational need with mesh networking proved short sighted given the data transport inefficiencies of mesh waveforms and the challenges of employing them in high threat environments.

In addition, the power required to boost and maintain connectivity led to a higher spectral signature, giving adversaries a way to pinpoint locations with greater accuracy.

NOTM can and will overcome those challenges through innovations in equipment, connectivity and networking.



ORION Broadband X500

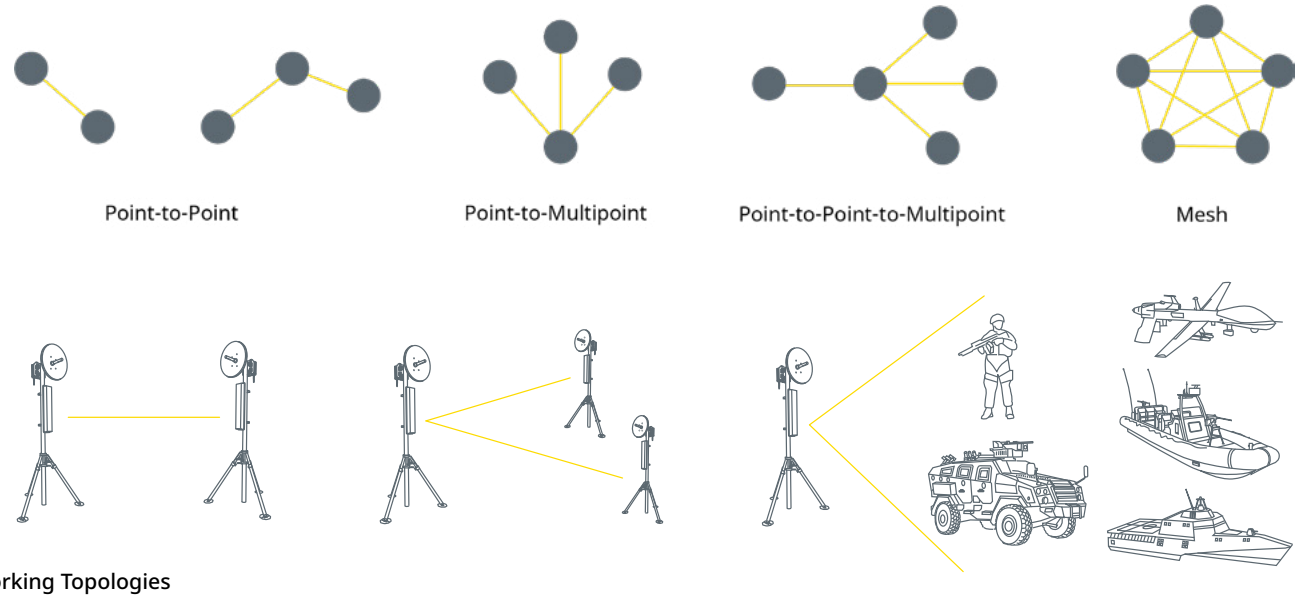
ORION X510 with parabolic antenna
Mast Configuration

Enter Small SWAP Solutions with Big Functionality

Producing radios that are smaller, lighter and less power-hungry was a solid first step. This allowed radios, utilized as tactical backhaul radios, to be mounted on a variety of platforms in the field. Backhaul radios were also much faster and easier to set up. Someone with little specialized training could use a GUI interface to simplify deployment and get connected in a fraction of the time. Today, tactical Line of Sight (LOS) radios can weigh as little as seven pounds and enable non-technical personnel to establish backhaul and mesh communications networks in minutes rather than hours.

With that clarified, it's also important to understand how these radios work. Typically, they offer a variety of networking topologies. A Point-to-Point (PTP) connection connects two radios in direct line of sight: for example, a command post to a forward operating base. A Point to Multipoint (PMP) setup allows one radio (typically at headquarters) to transmit to many other tactical radios. A mesh network interconnects all tactical radios in range together.

Modern tactical radio networks can also effectively link to satellite communications, providing 'always on' access to connect no matter the topography or conditions on the ground. Maintaining connectivity is always the goal.



Networking Topologies

Smarter, Faster, More Dispersed – The Modern Command Post

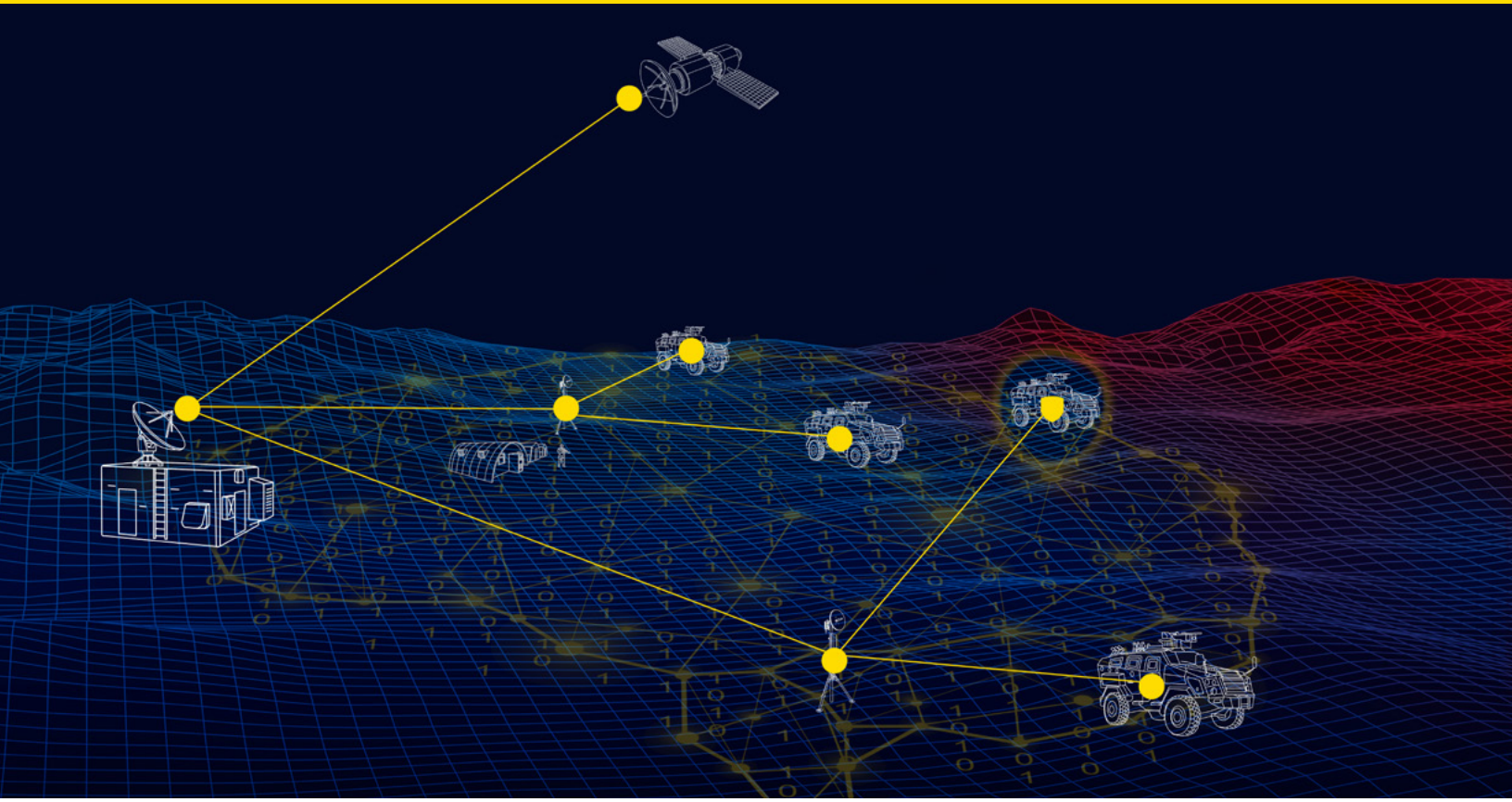
The inherent communications network vulnerability of a large command post – some of which take several days to set up, tear down and move – is obvious. As the operational footprint expands outward, outposts further and further from the central command post become increasingly vulnerable.

With the added proliferation of network connectivity and availability comes several additional risks. Command posts project a huge presence in the electromagnetic spectrum, meaning that they are more visible than ever for a peer adversary. In addition, unlike our previous experiences in Iraq and Afghanistan, as adversaries improve their networking technologies the spectrum becomes ever more crowded. Congested and contested networks must be overcome to protect not only command posts but mobile units as well.

Congested, Contested and Contentious

The proliferation of wireless systems, the growth of connected things and the need for joint operations and coalitions lead to highly congested networks. There are two issues at play in congested networks. One is the difficulty to find available frequency channels in sufficient quantity, and the other is to find channels of sufficient bandwidth. More channels mean you can deploy more nodes in higher density and can deploy more efficient ECCM strategies. Greater bandwidths mean you can transmit more data or make use of more robust waveforms. With life and death decision making on the line, network congestion becomes a critical priority.

In actual operations, network managers can expect their spectrum to become both congested and contested. A contested network is one in which adversaries are actively trying to disrupt our communications to create confusion, sow misinformation or simply deny your use of the spectrum. Jamming is one such method, but jamming comes in many flavors and there are several EW tactics that will be employed. Networks must be able to navigate congestion, but also defeat jamming – a trait called resiliency.



Building a Resilient Network

Making an intelligent use of a diversity of frequency bands, network topologies, channels, routes and waveforms enhances connectivity and makes the work of the jammer much more difficult. But what if we could not just defeat jamming attacks and take it one step farther? With AI/ML powered spectrum awareness and cognitive ECCM, military forces can learn jammer behavior and hide their ECCM waveform adaptation capabilities from the opponent. That's just one other example of how resiliency can be achieved when facing more sophisticated adversaries.

The imminent application of AI/ML into military networking will allow for even deeper levels of resiliency. Networks can become self-healing, with advanced waveform hopping and adaptive networks to stay ahead of jammers and other forms of EA (Electronic Attack). Assisted automation means that, although there is always a human in the loop, the network can automatically self-correct to use the best available link at any given moment based on preset parameters. More importantly, AI/ML is the one key to achieving faster decision-making and greater speed of action in an increasingly complex environment.

Uniquely Ultra

Ultra is in an advantageous position when it comes to deploying resilient networks. Our tactical radios are software-defined, meaning they can accept new software without necessarily requiring hardware upgrades. The radio systems also support multiple frequency bands and networking waveforms, providing the required flexibility for the AI/ML algorithms to operate on. Ultra's history in deploying tactical radios across multiple domains – land, sea, air defense and special operations forces - means consistent connectivity and resiliency wherever it is required.

Join us for future chapters where we will examine the immense impact AI/ML will have when it comes to ensuring survivability and mission success no matter how contested and congested a network might become.

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