# MILITARY COMMUNICATIONS AND NETWORKS


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Making good decisions in a timely manner is intrinsic to the success of military operations. Critical decisions need to be reliably communicated and executed, and may depend on efficient processing of information from multiple sources. Thus, there are tough requirements on military communications and networks, such as tactical networks, operating in the face of adversaries toward the limits imposed by physics. In this context, the articles in this issue cover important topics of cloud processing at the tactical edge, resistance to jamming, and radio communication beyond line of sight.

The article "Game-Theoretic Learning Anti-Jamming Approaches in Wireless Networks" investigates the anti-jamming communication problem and proposes a new anti-jamming paradigm, namely game-theoretic learning anti-jamming (GTLAJ) communication, to improve anti-jamming performance. The aim of GTLAJ is to design effective intelligent anti-jamming communication approaches. The performance of three cases, Stackelberg anti-jamming game, Markov anti-jamming game, and hypergraph-based antijamming game, are evaluated and compared to different algorithms.

In another article, "Long-Range Microwave Links Guided by Evaporation Ducts," the authors propose a communication technique through the atmospheric duct, an approach that can be beneficial for long-distance communication. They provide some insights on how this approach can support beyond line-of-sight (BLoS) communication, which is a desirable property in many use cases. The authors have performed theoretical evaluations, and validated their findings through experiments in the South China Sea. The work shows the feasibility of communication across distances in excess of 100 km with this approach using microwave links. We find the topic timely and relevant, and think our readers will enjoy reading about this work. We are also hoping to spark interest in the community so that we will see future papers building more elaborate and complete communication concepts on underlying principles like the ones explored here.

Kubernetes is a de facto industry standard for orchestrating containerized applications across multiple nodes in cloud environments. Typically, the performance of Kubernetes is analyzed in resource-rich environments on the enterprise or data center level. However, deployments of Kubernetes in tactical networks must overcome network resource limitations compared to deployments in enterprise networks or data centers. The last article, "Quantifying the Performance of Cloud-Oriented Container Orchestrators on Emulated Tactical Networks," provides an experimental approach to study and analyze the performance of various Kubernetes distributions under a relevant tactical network emulation environment. This analysis produces findings and recommendations for running a Kubernetes-based cloud in a resource-limited tactical domain.

We expect that the articles in this edition provide insight into current communications and network research for current and future military operations. It is our hope that these articles continue to inspire new thoughts, lead to innovative research, and produce exciting articles for this Series.

This edition serves as a transition period for our editorial group. Dr. Frank Trethan Johnsen dutifully led the Series since 2017 and has ended his term as a Series Editor. Many thanks to Frank for his dedication and service to *IEEE Communications Magazine* and the Military and Communications Networks Series. Subsequently, we also welcome a new editor, Dr. Nils Agne Nordbotten, who is currently a product manager at Thales Norway and an adjunct associate professor at the University of Oslo, Norway.

## BIOGRAPHIES

KEVIN S. CHAN (kevin.s.chan.civ@mail.mil) is a research scientist with the Computational and Information Sciences Directorate at the U.S. Combat Capabilities Development Command Army Research Laboratory (DEVCOM ARL), Adelphi, Maryland. Prior to joining ARL, he received a Ph.D. in electrical and computer engineering (ECE) and an M.S.E.C.E. from Georgia Institute of Technology. He also received a B.S. in ECE/EPP from Carnegie Mellon University. His research is in the area of network science and cybersecurity for tactical networks.

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