"From Autonomous Vehicles to Ship-to-Shore to: Designing 60 GHz Networks for Tactical Applications"

- Nadine Hatto | Senior Director of Product Marketing, Peraso Inc.

Today's defense operations are defined by mobility, speed and data. Whether coordinating ship-to-shore logistics, maneuvering ground forces, or enabling autonomous and semi-autonomous systems at the tactical edge, reliable communications are no longer a support function – they are mission-critical.

Defense forces must operate across fixed and mobile environments while maintaining secure, high-bandwidth connectivity amid interference, jamming, and limited spectrum availability. Legacy approaches, typically optimized for either static infrastructure or limited mobility, struggle to meet these combined requirements.

This is where 60 GHz millimeter-wave (mmWave) technology redefines what's possible. Operating in unlicensed spectrum, with up to 14 GHz of available bandwidth, 60 GHz enables rapid deployment without the delay, coordination, or regulatory friction associated with licensed bands. Command elements can establish high-capacity communications immediately, without spectrum dependency or external approvals—an essential advantage when speed and autonomy matter.

Equally important, no physical cabling is required. Traditional command posts often rely on cable runs between shelters, vehicles, and sensors, creating both setup burden and physical vulnerability. A fully wireless architecture eliminates these constraints, allowing command posts to be established, relocated, or reconfigured in minutes rather than hours, with no exposed cables to cut, trace, or compromise.

Perhaps most critically, 60 GHz removes the need for a fixed point-of-presence (PoP) altogether. Instead of anchoring communications to a centralized node, Peraso's equipment supports pop-up tactical point-to-multipoint networks, where any node can act as a hub, relay, or edge endpoint. Command posts, vehicles, sensors, and forward units form a distributed, self-contained network that adapts dynamically as the mission evolves.

This approach delivers multi-gigabit bandwidth across the tactical area while maintaining an inherently low observable RF profile. Highly directional beams and rapid signal attenuation confine transmissions to the intended recipients, minimizing RF spillover and reducing the probability of detection or interception. The result is a network that is not only fast and flexible, but also stealthy by design.

At Peraso, we have spent years developing and field-proving 60 GHz solutions that deliver multi-gigabit performance with inherent security advantages. Once used primarily for high-capacity fixed wireless links, 60 GHz is now evolving into a tactical, mobile communications fabric, supporting ship-to-shore operations, convoy networks, and autonomous vehicle ecosystems through a single, adaptable architecture.

Why 60 GHz for the Tactical Edge?
The 60 GHz band offers a unique set of characteristics that align naturally with defense and tactical requirements.

High bandwidth - With multiple gigahertz of available spectrum, 60 GHz enables multi-gigabit throughput for data-intensive mission-critical applications such as drone surveillance, sensor fusion, real-time video, edge AI processing and command-and-control systems.

Inherent discretion - Unlike lower-frequency bands, 60 GHz signals attenuate rapidly over distance and rely on highly directional, adaptive beams. This limits unintended signal propagation and reduces the probability of detection or interception, providing an inherent LPD/LPI advantage in challenged environments.

Interference resilience – Ultra-narrow beams and short wavelengths allow 60 GHz networks to operate effectively in dense RF conditions with minimum mutual interference. This makes them well-suited for scenarios involving multiple vehicles, units, or platforms operating in close proximity.

Historically, these attributes made 60 GHz ideal for fixed point-to-point or point-to-multipoint links. The challenge – and opportunity – has been extending those same benefits to dynamic, mobile operations.

Bridging Fixed and Mobile: Ship-to-Shore Connectivity
Ship-to-shore communications remain a foundational use case for tactical mobility networks. Naval vessels, expeditionary units and port operations depend on high-capacity links to move data between maritime and terrestrial assets in real time.

Traditional ship-to-shore solutions often require complex RF planning, large antennas and trade-offs between bandwidth and reliability. Environmental motion, including waves, vessel pitch and roll and changing line-of-sight conditions further complicates connectivity.

Peraso's 60 GHz systems are designed to maintain stable links up to 1-2 km range despite constant movement. Advanced beamforming and adaptive beam management continuously monitor link conditions and dynamically adjust beam direction as platforms move.

The result is a ship-to-shore architecture that delivers fiber-like performance with the flexibility of wireless, supporting logistics coordination, situational awareness and mission planning without sacrificing mobility.

Maintaining Connectivity at Speed: Convoys and Maneuvering Forces
Beyond maritime operations, modern tactical missions increasingly rely on mobile ground forces operating in distributed formations. Convoys, forward operating bases, and maneuvering units must share data continuously under dynamic conditions, without performance degrading every time a vehicle turns, accelerates, or changes formation.

Peraso's approach to mobile 60 GHz networking is built around three core capabilities:

Adaptive Beam Management - Maintaining alignment at 60 GHz is critical. Peraso's systems use fast beam training and real-time beam tracking to sustain connectivity as vehicles move relative to one another, even during rapid maneuvers or temporary obstructions.

Seamless Network Handover - Mobile units frequently transition between network nodes. Peraso's products support smooth handover between access points and relay nodes, enabling uninterrupted connectivity for live video, voice and mission-critical data streams.

Reliability Under Motion - Vehicle vibration, terrain variability, and environmental conditions all impact wireless performance. Peraso designs for robustness, incorporating link redundancy, intelligent path selection and resilience mechanisms that help maintain uptime under demanding conditions.

Together, these capabilities transform 60 GHz from a static backhaul technology into a true mobile tactical network fabric.

Enabling Autonomous and Semi-Autonomous Systems
Autonomous ground vehicles and unmanned systems represent some of the most demanding use cases for tactical wireless networks. Effective autonomy at the edge depends on ultra-low-latency data exchange, deterministic reliability, and robust security.

Peraso's 60 GHz solutions enable vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications through resilient mesh and relay networks that adapt dynamically as platforms move. Ultra-low latency supports real-time decision-making, while high throughput enables sensor fusion and edge AI workloads. Highly directional links further reduce RF visibility, allowing autonomous systems to operate effectively even in disconnected or denied environments.

Security by Design: LPD/LPI and Anti-Jam Resilience

In contested environments, performance and security are inseparable. Communications networks must operate reliably without drawing attention or becoming easy targets for electronic warfare.

The physical characteristics of 60 GHz naturally support this objective. Highly directional beams limit signal leakage, while rapid attenuation reduces effective interception range. Combined with Peraso's advanced beamforming and adaptive beam steering, these attributes make links difficult to detect, track, or jam.

Designing for the Future
While the applications are cutting-edge, the foundation is proven. Peraso's 60 GHz technology is already deployed in demanding real-world environments, delivering consistent performance, reliability, and operational confidence.

As defense operations evolve, the line between fixed and mobile infrastructure continues to blur. Networks must scale, adapt and reconfigure in real time, without sacrificing security, resilience, or performance at the tactical edge.

Discover how Peraso's 60 GHz solutions can help you design agile, secure networks for the future battlespace.