



Advances in Military Wireless Communication Systems

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Modern warfare necessitates coordinated operations of air, land, and naval forces for active intelligence collection and fusion to enhance their operational capacities and agility to respond to a threat rapidly. Software defined radio (SDR) based communication technology provides mission-adaptive networking with simultaneous exchange of voice, data and video messages in dynamic and mobile operating conditions. Digitization of domains like communication and surveillance/reconnaissance, play a vital role in the integrated operations of the modern battlefield. The SDR technology has seen rapid advancement in the last two decades. With tremendous progress in device technology, the SDR front-ends have become digital front-ends with digitization very close to the antenna. The high-end processing devices have embedded multi-giga bit serial interconnect peripherals which allow implementation of switched-fabric for high throughput data exchange among front-end and hardware modules for digital processing.

Modern soldier-centric portable SDRs provide dual channel connectivity across multi-octave frequency bands from 30 MHz to 2500 MHz. These SDRs are available in three variants of single channel personal radio, two channel handheld leader radio and 2-3 channel manpack SDR configuration having multiple antenna interfaces for LOS and BLOS satcom connectivity. Further advancements are being carried out by embedding artificial intelligence for better performance and communication reliability in dynamic battlefield conditions. MIMO technology is being integrated in portable SDRs for special operations in urban scenarios.

Modern tactical operations require on the move satcom capability which can be easily integrated on vehicles, naval vessels and aircrafts. Distributed aperture based satcom solutions are being explored on combat platforms due to high maneuverability and requirement of all time connectivity in harsh channel conditions. Low profile beam forming satcom antenna and miniaturized signal processing hardware enables dismounted soldiers to remain connected while on the move. Full-Duplex military radios is a new technology where extensive research is going on to simultaneously allow transmission while reception on the same frequency band. It uses advanced signal processing and hardware isolation/transmitter cancellation methods to achieve the same. This technology enables cancellation of incoming jamming noise on the same frequency and allows successful communication with friendly nodes. There are promising results in the design of RF Self-interference Cancellation Circuit for 100-W Full-Duplex Radio at 225–400 MHz, reported recently.

Dependable communication links for unmanned air vehicles (UAV) are crucial for operational reliability and mission success. The data link is one of the most essential flight-critical sub-systems of UAVs. Command & Telemetry along with multi-sensor data transmission and an accurate tracking system are the part of the data link system. Internationally UAV data links are available at L-band, S-band, C-Band, X band & Ku-Band frequency. LOS upto 300 Km and BLOS using GEO satcom provide data rate 200 Kbps to 274 Mbps with omni- and directional antenna. Shared apertures with multiband propagation are highly suited for simultaneously integrating functionality of multiband data link operations in a single antenna system. The shared aperture antenna (SAA) concept focuses on the simultaneous sharing of common aperture directivity towards the same footprint and is well suited for UAV platforms.

Convergence of wireline and wireless communication capacity is being explored through secure short range sub terahertz communication for connecting convoys of mobile military platforms to the backhaul communication setup (Fibre optical). Airborne/submarine military platforms and missiles are being reduced in weight for enhancing range through replacement of data cables with intra-avionics wireless networks using TeraHertz (THz) communication systems. Next generation radio relays are being augmented in higher frequency band of Ku/Ka frequencies with beam forming antenna to provide secure adaptive high data rate (upto 1 Gbps) directional ad hoc networks for agile and dynamic requirements of mobile communication.