Training in the DDIL Environment

Building nuanced tactical proficiency

by Maj Spencer S. Waters

> *The Marine Corps is currently not organized, trained, and equipped to meet the demands of a future operating environment characterized by complex terrain, technology proliferation, information warfare, the need to shield and exploit signatures, and an increasingly non-permissive maritime domain.* [1]
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> —*Gen Robert Neller,*
> **Marine Corps Operating Concept, 2016**

From Operation DESERT STORM in the early 1990s to Operation IRAQI FREEDOM in 2001–2003, the United States has moved from moderate satellite usage to nearly total reliance on Global Positioning System (GPS) satellites for reconnaissance, navigation, and precision-guided munitions.[2] Russia sees America's over-reliance on space and the satellite-based system as the Achilles' heel of the U.S. military.[3] The goal of space warfare in the People's Liberation Army (PLA) is "destroying, damaging, and interfering with the enemy's reconnaissance and communications satellites" to "blind and deafen the enemy."[4] Concerning the prospect of a stand-in force in the First Island Chain, the People's Republic of China deliberately jams, spoofs, and intercepts GPS receivers from its position in the Spratly Islands.[5] In the current era of strategic competition, with pacing threats and everchanging characteristics of warfare, it is vital that our maritime force can train and operate in the denied, degraded, intermittent and limited (bandwidth) (DDIL)environment

in order to gain tactical proficiency and awareness of emerging enemy capabilities.[6] The maritime force's effectiveness in the next fight will rely on well-trained individual actions in the DDIL environment across all levels of warfare.

Replicating DDIL conditions for training the MAGTF is complex and arduous. The force must consider the whole DDIL spectrum in preparation for thin connectivity: from continuous connectivity to entirely disconnected. The Naval Tactical Grid, or naval mesh network, connects warfighters via aerial platforms, satellites, low-earth orbit platforms, landlines, and developing modular networks.[7] Because of the self-healing mesh network and variations in GPS jamming, training in DDIL is much more nuanced than simply asserting

communications are "up" or "down."[8] In addition to positioning, navigation, and timing, GPS jamming has a trickledown effect that negates timing information, secure communications, and the health of Joint Direct Attack Munitions. Also, proliferated low-Earth orbit satellites will make the DDIL environment less severe as the positioning, navigation, and timing architecture expands and becomes more resilient to antisatellite attacks and electronic warfare.[9] Peer competitors, rogue states, and non-state actors have varying degrees of access to GPS jamming capabilities, affecting aircraft and ground equipment in numerous ways. The complexity of enemy jamming capabilities further complicates MAGTF training.

Innovative technologies, such as directional GPS jammers, will improve DDIL training in the far-term, but what can be done with existing capabilities in the near future to improve resiliency in DDIL environments?[10] First, training and readiness (T&R) manuals need to require exposure to the DDIL spectrum in both ground and aviation training. Secondly, because of the restrictions associated with using GPS jammers for training, T&R requirements for DDIL ought to expand virtual training capabilities. Lastly, MAWs should facilitate regular virtual large force exercises (LFEs) to enable cross-training

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Booster Landing. Two reusable rocket boosters land after the successful launch of the SpaceX Falcon heavy rocket carrying a communications satellite at Kennedy Space Center, FL, 12 April 2019. (Photo by James Rainier.)

with space operations officers (8866s), special technical operations planners (8016s), and cyberspace officers (1702s).

Requiring the Training

Current manuals and publications contain few requirements for training within the DDIL spectrum. For instance, tiltrotor and rotary-wing aircrew train to navigate without the aid of GPS in fundamental low-level sorties.[11] The F/A-18 Hornet T&R calls for the contested environment or "Link-16 denial, GPS denial, or communication degraded" training in its more advanced Forward Air Controller-Airborne (FAC-A) syllabus.[12] Flying sorties or conducting land navigation without GPS is valuable, but how do Marine aircrew understand the indications of spoofing verse jamming? How does a Marine using GPS for positioning, navigation, and timing recognize the insidious spoofing indication and decide *not to* trust their instruments? Our current training mindset is on the GPS-denied environment; however, GPS jamming is incremental,

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intermittent, and produces temporarily degraded systems.[13] An Army artillery unit noted this training to be "critical" and "being able to fight under degraded conditions is an extremely perishable skill and should be trained as a regu-

lar part of annual cyclic training and certifications."[14] Unless a squadron or battalion has spare time and resourceful training officers, Marines are unlikely to regularly train in the DDIL environment with the current T&R manuals.

Perils of Reality

Secondly, because live DDIL training is expensive, uncommon, and complex, developing virtual training options should be expanded. Also, because GPS satellites are low-powered and distant from the Earth's surface, GPS receivers are vulnerable to jamming. In order to organize a training event in which GPS is degraded, detailed coordination with the Federal Aviation Administration (FAA), local emergency services, and agricultural agencies are required.[15] Because of lower commercial and civilian air traffic, these training events typically occur on exclusive West Coast ranges. Despite deconfliction, the FAA is known to call and request a "stop buzzer" in the middle of training.[16] Unsurprisingly, range control operators are hesitant to allow GPS and communications training and often lack the experience and know-how of jamming effects. Also, depending on the range boundaries and size, GPS jammers are often constrained in power, gain, and time.

To emphasize electromagnetic spectrum training, Marine Aviation Weapons and Tactics Squadron One stood up its Spectrum Warfare Department in 2014 to facilitate jamming to deny communications, GPS, satellite communication, and tactical data link.[17] Spectrum Warfare Departments mobile training capabilities should be used to the maximum extent possible to expose Marines to the most realistic DDIL conditions to develop strategies and techniques. However, despite Spectrum Warfare Department's effort, the aforementioned civilian constraints misrepresented and trivialized GPS jamming training. This is precisely where virtual training can fill in the gaps. By using the improved worldwide database, aviation units can replicate near-peer integrated air defenses to include multiple GPS jamming systems. In the air, the training is intrinsically constrained, but in the virtual training realm, the gloves can come off.

Simulator training offers realistic threat systems, adaptable aircraft and equipment indications, low cost, and a low-risk DDIL training environment. In a recent podcast, Gen David Berger charged the Corps to take risks, to shutting off or denying GPS equipment and ultimately offering incomplete DDIL training. Improving realism in the simulator or war game improves the lethality of Marines in the DDIL.

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wargame, and think through challenging problems in a dynamic way.[18] Training in the simulator is a low-risk, high-reward solution. The constraining range restrictions, lengthy GPS jamming approval timelines, West Coast range exclusivity, and airline safety concerns are all mitigated. However, threat representations in simulators *must* be improved to reflect reality. The necessary modeling of traditional surface-to-air threats in the simulator is somewhat developed, yet the virtual GPS threat systems do not replicate threat capabilities and aircraft indications. Because the electromagnetic spectrum representation is rife with issues in simulators, training officers resort

Virtual LFEs

Virtual large-force exercises (LFEs), such as 2d MAW's Cope Javelin, provide a prime venue for educating, planning, and cross-training to ensure quality training in the DDIL environment.[19] One of the current problems in Marine space operations is its "multiplicity of participants" among military and civilian personnel.[20] To alleviate the multiplicity and space knowledge disparity, cross-training with space operations officers (8866s), special technical operations planners (8016s), and cyberspace officers (1702s) is critical. As a result of limited understanding, space-enabled capabilities and degradations are often

misrepresented or not considered in aviation Offensive Air Support (OAS) training events. By incorporating 8866s, 8016s, and 1702s into LFE planning, aviators and wing intel officers can establish the rapport required to utilize useful web-based products, deter against the isolation of space planners, and employ emerging MAGTF capabilities into collective readiness events.[21] Several obstacles exist to executing virtual LFEs: the siloed focus on aircraft-specific mission essential tasks, independent F-35 security protocols, and—most notably—interoperability between all aircraft simulators and Joint Tactical Air Controller simulators. Virtual LFEs are not a panacea to the challenge of DDIL training, but the events can provide Marines with a closed-air venue for knowledge sharing to keep pace with the progressing technological moment.

The Way Forward

In the *38th Commandant's Planning Guidance,* the current CMC aligns with Gen Robert Neller's statement from 2016: the Corps "is currently not organized, trained, and equipped to meet the demands of a future operating environment."[22] The work of TECOM and CD&I, improved T&R manuals, wargaming, realistic simulators, and virtual LFEs can aid the development of new operational concepts and enhanced lethality in the DDIL environment. Not training to DDIL induces unnecessary risks and provides the enemy with an avoidable seam. This problem will require a resource-intensive solution, but DDIL training is essential for success in strategic competition. As Sir Michael Howard famously stated, "the advantage goes to the side which can most quickly adjust itself to the new and unfamiliar environment and learn from its mistakes."[23] The recasting of the Corps' service culture must include Marines who are savvy and survivable, not unfamiliar, in the electromagnetic spectrum and training solely to GPS-denial omits the ambiguities of degraded, intermittent, and latent environments.

Marines employ long range communications in a distributed maritime environment and part of demonstrating expeditionary advanced basing capabilities. (Photo by Cpl. Josue Marquez.)

Notes

1. Headquarters Marine Corps, *Marine Corps*

LCpl William Coward (left), a digital wideband technician, and LCpl Robert Murphy, a satellite operator, both of 3rd Marine Regiment, test a very small aperture terminal satellite system during Island Marauder 21 on 9 August at Marine Corps Base Hawaii. Island Marauder is an annual, Marine Corps Systems Command-led exercise enabling Marines to assess and familiarize themselves with communications gear. This year's exercise was nested under the Navy's Large Scale Exercise 21. (Photo by Samantha Bates.)

Operating Concept: How an Expeditionary Force Operates in the 21st Century, (Washington, DC: September 2016).

2. Stephan Lapic et al., "The 18th ICCRTS: C2 in Underdeveloped, Denied, and Degraded Operational Environments," (San Diego: Spawar Systems Center Pacific, June 2013),

3. Staff, "This is the Achilles' Heel of Washington's Military Power," *SPUTNIK*, January 30, 2016, https://sputniknews.com/20160130/us-space-satellites-1033971479.html.

4. Bill Gertz, "China Outlines Space War Plans," *Washington Free Beacon*, July 26, 2019, https://freebeacon.com/national-security/china-outlines-space-war-plans.

5. FORUM Staff, "PRC Jamming and Spoofing Endanger Shipping, Threaten Civilian Air Navigation," *Indo-Pacific Defense*, December 16, 201 https://ipdefenseforum.com/2021/12/prc-jamming-and-spoofing-endanger-shipping-threaten-civilian-air-navigation/.

6. Also referred to as the Contested Degraded Operationally limited environment and the Denied, Degraded and Disrupted Space Operational Environment.

7. Department of the Navy: *Information Superiority Vision*, (Washington, DC: February 2020).

8. " The 18th ICCRTS: C2 in Underdeveloped, Denied, and Degraded Operational Environments."

9. A. Hallex Matthew and S. Cottom Travis, "Proliferated Commercial Satellite Constellations," *Joint Force Quarterly* 97, no. 2 (2020).

10. For more on directional GPS jammers, see Editorial Team, "US Air Force Selects Electronic Warfare Jamming Solution that Operates at Ranges Exceeding 35km." *everythingRF*, November 17, 2021. https://www.everythingrf.com/news/details/13496-us-air-force-selects-electronic-warfare-jamming-solution-that-operates-at-ranges-exceeding-35km.

11. Department of the Navy, *UH-1Y Training and Readiness Manual*, (Washington DC: 2013).

12. Department of the Navy, *FA-18 Training and Readiness Manual*, (Washington DC: 2019).

13. Ryan J. Tuttle, "A GPS-Denied Environment," *Marine Corps Gazette* 100, no. 1 (2016).

14. Thomas C. Powell et al., *Operating in a Denied, Degraded and Disrupted Space Operational Environment (D3SOE)*, No 18-28, (Fort Leavenworth: Center for Army Lessons Learned, 2018).

15. Staf, "Air Force Training Could Jam GPS Devices in Mountain Home Area," *Idaho Farm Bureau Federation*, January 25, 2021, http://www.idahofb.org/News-Media/2021/01/air-force-training-could-jam.

16. Mark Harris, "FAA Fumbled its Response to a Surge in GPS Jamming: Confusion Over Stopping Military Tests had Flight Controllers Fuming," *IEEE Spectrum*, October 7, 2021, https://spectrum.ieee.org/gps-jamming.

17. Deputy Commandant of Aviation, *FY2019 AvPlan*, (Washington, DC: 2019).

18. Staff, "Gen. David H. Berger on the Marine Corps of the Future," *War on the Rocks*, January 4, 2022, https://warontherocks.com/2022/01/general-berger-on-the-marine-corps-of-the-future.

19. Michael Curtis, "Marine Aviators Use Online Gaming Concept to Enhance Training," *Marines*, April 28, 2021, https://www.marines.mil/News/News-Display/Article/2589537/marine-aviators-use-online-gaming-concept-to-enhance-training/.

20. Office of the Joint Chiefs of Staff, *JCS Joint Publication 3-14 Change 1 Space Operations*, (Washington, DC: October 2020).

21. For more on the culture and general isolation of space planners, see Paul Szymanski, "Issues with Integration of Space and Terrestrial Military Operations," *Wild Blue Yonder*, June 22, 2020, https://www.airuniversity.af.edu/Wild-Blue-Yonder/Article-Display/Article/2226268/issues-with-the-integration-of-space-and-terrestrial-military-operations/.

22. Gen David H. Berger, *38th Commandant's Planning Guidance*, (Washington, DC: July 2019).

23. Michael Howard, "Military Science in an Age of Peace," *The RUSI Journal* 119, no. 1 (1974).

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