Combat SkySat

A solution to Marine Corps long-range radio communications limitations

by Capt Kevin Soeder

The long-range radio communications capability is as important to the Marine Corps now as ever. As Marines continue to operate within disaggregated command structures in austere environments, long-range radio communications is required to enable redundant and reliable command and control (C^2). Currently, there are few solutions readily available Marine Corps-wide to bridge the existing gaps in long-range radio communications, each of which present access, availability, resource, operator, and monetary challenges. One military tried and tested resource for expanding traditional long-range radio communications networks to operate over hundreds of miles is Combat SkySat (SkySat), which utilizes hydrogen or helium-filled balloon technology to relay ultra-high frequency (UHF) radio waves.[1] SkySat technology should be leveraged Marine Corps-wide to augment currently existing long-range radio communications capabilities and facilitate C^2 in the expeditionary environment.

Presently the U.S. military and the Marine Corps, in particular, have a tremendous reliance on long-range, beyond line of sight (BLOS) radio communications capabilities. BLOS refers to a greater distance than what a groundbased, non-amplified radio can communicate—normally around 12 miles in flat, open terrain. The most reliable method of achieving BLOS radio communications continues to be UHF SATCOM (satellite communications);[2] however, this method of communications has its drawbacks. UHF SATCOM is a limited resource with availability that cannot meet current or forecasted future demand requests. Since the technology first supported military operations during Operation Desert Storm, UHF SATCOM requests have increased over 75 percent,[3] with unit demand continuing to increase. The long-range radio communications need continues to remain valid within the Marine Corps. An example of the requirement's importance was validat-

15th MEU Marine during training with SkySat at Camp Pendleton. *(Photo courtesy Space Data Corporation.)*

>Capt Soeder previously served as the 26th MEU S-6A (assistant communications officer) 2009–11, and used Combat SkySat extensively during the predeployment training program and the deployment.

ed with a recent 1,100 mile proof-of-concept experiment by Marine Corps MV-22 Osprey that transported Marine Corps Base Quantico Infantry Officer Course students, which successfully supported "a long-range operation from Twentynine Palms, California to Fort Hood, Texas."[4] The few Marine Corps units fortunate enough to have readily available access to UHF SATCOM have other issues to contemplate. Overreliance on existing UHF SATCOM networks is setting a dangerous precedent because of the potential of adversarial attack on actual satellite systems in orbit.[5] Also, even though UHF SATCOM satellite coverage areas extend across the globe, network availability is often limited as there are a finite number of channels available. Although UHF SATCOM is an effective means for accomplishing BLOS communications, doing so while on the move is extremely difficult, and more often than not results in unreliable or at best intermittent communications.[6] Adding to these issues is the fact that UHF SATCOM on the move antennas are not a program of record in the Marine Corps, requiring all units that are interested in the capability to purchase the necessary antennas via organic procurement means.

The U.S. Senate Armed Services Committee has been briefed on UHF SATCOM availability problems, most notably by U.S. Army GEN John Abizaid, USA(Ret), the former Deputy Commander, U.S. Central Command during Operation Iraqi Freedom.[7] GEN Abizaid's testimony made all Services aware of their obligation to "aggressively pursue new technologies and system designs that take into account this limited critical resource."[8] Furthermore, the *Expeditionary Force 21 (EF 21)* concept, the Marine Corps' plan for readying the Service for future maritime requirements, places an even greater reliance on BLOS communications capabilities. *EF 21* identifies that "landing forces and support craft will require beyond line of sight, over the horizon, and networked on the move systems capable of operating in a degraded communications environment."[9]

The SkySat concept encompasses technology that can be applied to meet current and future Marine Corps-wide long-range radio communications requirements. SkySat was developed in 2006 by Space Data Corporation, a commercial communications company based in Chandler, AZ.[10] "This system solves the problems faced by troops on the ground where mission requirements place them in situations where distances exceed terrestrial line-of-sight and where satellite and airborne communications aren't available."[11] Available in both low- and high-altitude versions, SkySat utilizes tactical repeater technology to extend traditional UHFs. High-altitude SkySat augments current UHF SATCOM radio communications capabilities, while the low-altitude variant effectively doubles current ground coverage distance capabilities of UHF non-amplified radio sets.

High-altitude SkySat is a relatively compact package that includes the following: a 2,000-gram balloon, an attached 6-pound payload system, and an 8-foot ribbon antenna that receives and transmits the UHF signal by way of radio relay.[12] Onboard GPS processing allows for the real time tracking and control of the balloon platform once airborne. Using GPS data and a flight computer control mechanical flight control systems, the SkySat platform maintains its operational altitude via

SkySat training in March 2012. *(Photo courtesy of Space Data Corporation.)*

the release of lift gas and ballast as appropriate. The SkySat platform can also be used to "truck" other payload capabilities to high altitude for experimental and operational applications. More specifically:

> The SkySat Platform provides a short range two-way communication link between itself and the suspended payload to support command and control of, and low-rate telemetry from, the lower payload, all through the SkySat Platform's command and control link with its standard ground station.[13]

The high-altitude SkySat system can be launched and tracked from ground- and shipbased environments when and where it is needed, making it ideal to support Marines in the expeditionary environment.

The high-altitude SkySat system is capable of up to 16 hours of flight at a cruising altitude of 60,000 to 85,000 feet above sea level, creating a UHF radio communications coverage diameter in excess of 500 miles.[14] The SkySat system is "compatible with standard tactical radios including the PRC-148, PRC-152, PRC-117, ARC-210, and other FM-capable military radios, supporting both encrypted and non-encrypted communications."[15] No part of the high-altitude SkySat system contains classified material or sensitive electronics, so there are no security or technology transfer concerns if the payload is not recovered after use. All encryption and decryption is applied within the groundbased UHF user radio sets only. Low-altitude SkySat has similar application benefits and associated technology as the high-altitude version, and likewise benefits traditional BLOS Marine Corps communications capabilities. The software defined radio system has a software wipe capability that removes all functionality from the payload at the completion of the mission so it is useless to anyone who finds it.[16]

Low-altitude SkySat uses the same components as the high-altitude variant, minus GPS tracking technology. This tethered method is reliant on the ability to raise and lower the balloon and communications elements, which is typically accomplished most expediently via a winch system to elevate and retrieve the balloon. The low-altitude SkySat system's winch is typically mated to a vehicle that allows for both timely transport as well as the ability to consolidate the storage of spare helium tanks and balloons for future application. Capabilities of existing groundbased UHF radio communications equipment extend network coverage to line of sight capabilities, which are limited to antenna elevation and terrain considerations. By duplicating the extreme elevation normally associated

Marines at WTI 2-12 during SkySat payload launch. *(Photo courtesy Space Data Corporation.)*

with aerial radio relay capabilities by aircraft, low-altitude SkySat provides a better, more adaptable option to ground forces. However, most tethered systems are limited to elevations of a few thousand feet, cannot be used with surface winds exceeding 20 miles per hour, and require restricted operating zone approval.

SkySat is a combat-proven capability that has been successfully utilized by select Air Force, Army, and Marine Corps units. Both low- and high-altitude SkySat systems have and continue to fill the void created by oversaturated UHF SATCOM networks and associated resource non-availability. Five MEUs self-procured and used SkySat technology in training and real-world applications during multiple deployments.[17] In 2011, the 26th MEU's battalion landing team from 3d Bn, 8th Mar used low-altitude SkySat during combat operations in support of Operation Enduring Freedom in Afghanistan.[18] Later in the same year, the 26th MEU command element utilized high-altitude SkySat to provide radio communications redundancy in support of Operation Odyssey Dawn, specifically during a tactical recovery of aircraft and personnel mission that resulted in the rescue of a downed U.S. Air Force pilot in Libya. Col Mark J. Desens, the 26th MEU Commander, remarked on the versatility of SkySat in supporting the unit's wide-range of exercises and operations stating, "SkySat fills a great niche. It's a simple retransmitter on a balloon; it works."[19]

Marine Aviation Weapons and Tactics Squadron One, the aviation development and doctrine lead within the Marine Corps, has also both experimented with SkySat and used the system to enhance instructional scenarios since 2010. After-action reports from Weapons and Tactics Instructor training has shown that SkySat technology "provides an important capability set to any agency or platform that is limited by line of sight communication issues."[20] Currently, multiple U.S. Army units are utilizing SkySat systems, to include the 25th Infantry Division's 4th Brigade Combat Team [21] and elements of the 7th Special Forces Group.[22] The successes that select U.S. military units have had with SkySat prove that the system has the potential for Marine Corps-wide application.

SkySat is a more effective Marine Corps-wide means to expanding long-range radio communications than UHF SATCOM for many reasons. Although routinely planned for, in reality, the use of aircraft for radio relay purposes is a difficult process. Utilizing valuable aircraft, often in short supply and high demand, for this purpose is not cost effective and potentially impacts other mission requirements. Using aircraft for radio relay puts pilots and their crews in danger, and adverse weather conditions and unplanned maintenance requirements provide additional impacts to the feasibility of radio relay by way of aircraft. Instead, high-altitude SkySat is a more efficient and cost-effective option that provides a similar long-haul radio communications capability to all elements of the MAGTF.

SkySat training is another concern that must be addressed ...

Perhaps the most readily available and tenured BLOS communications means within the Marine Corps is high-frequency (HF) radio communications. The military use of HF radios in long-range communications dates back more than 80 years.[23] However, HF radio communications is oftentimes unreliable, is subject to unpredictable changes in the ionosphere, and requires a high degree of training and continued practice to maintain proficiency. Also true of UHF SATCOM, HF radio communications are extremely difficult to achieve while on the move and cannot be relied upon to communicate effectively in this manner.

Critics argue that widespread adaptation of SkySat technology by Marine Corps units will take a sizeable cost and training effort. Both high-altitude and low-altitude SkySat variants will cost in excess of $100,000 each for all required systems, and the expendable nature of balloon technology and helium gas will require the frequent reordering of items. The long-term benefits of SkySat outweigh cost concerns, with initial and sustainment costs to invest in the technology far less than relying on currently existing methods for BLOS radio communications networks. The approximately $12,000 per high-altitude platform cost provides otherwise unavailable BLOS communications for less than $1,000 per hour.

SkySat training is another concern that must be addressed as the system does require education to properly utilize. SkySat training methodology exists and can easily be adapted to Marine Corps training and readiness standards at both formal Marine Corps communications training institutions: the Marine Corps Communication-Electronics School and regional Communications Training Centers. Proficiency requires minimal SkySat training for both high-altitude and low-altitude variants; typical initial training is five days in length, emphasizing hands-on experience. A formal training curriculum is ideal and would facilitate future "train the trainer" methods, allowing Marines who have completed the formal training version to then train and educate their subordinates to become proficient with SkySat.

SkySat is a combat-proven technology capable of augmenting currently existing long-range radio communications shortfalls that plague the majority of Marine Corps units. Through the use of SkySat, the Marine Corps can better achieve C^2 with secure, reliable, and redundant long-range radio communications between dispersed forces operating within an expeditionary environment. In an operational environment that continues to rely heavily on expensive and technically advanced communications systems that remain in short supply, SkySat is a tangible option that provides both added flexibility and realized cost savings to UHF SATCOM and other long-range radio communications methods. Leveraging SkySat for long-range radio communications will bridge the long-range BLOS communications gaps that currently exist across the Service and better posture

Marines with BLT 3/8, RLT 8, launch the lofted communications balloon in Helmand Province, Afghanistan, February 2011. *(Official Marine Corps photo.)*

the Marine Corps to support future C^2 requirements.

Notes

1. For information go to: Space Data, http://www.spacedata.net.

2. Timothy Shroyer, "Satcom-On-The-Move: Why One Size Doesn't Fit All," accessed at http://www.gdsatcom.com.

3. U.S. Senate, Statement of VADM James D. McArthur, Jr., Commander, Naval Network Warfare Command before the Strategic Forces Subcommittee of the Senate Armed Services Committee on Fiscal Year 2008 Defense Authorization Budget Request for Space Activities, 2007 (Washington, DC: Government Printing Office, 2007), 10.

4. SGT Tyler Main, "Marine Infantry Officer Students Conduct 1,100 Mile Raid," accessed at https://www.dvidshub.net.

5. Capt Christopher S. Tsirlis, "Overreliance on SatCom," *Marine Corps Gazette,* (Quantico, VA: September 2011), accessed at http://www.mca-marines.org.

6. Mission Need Statement for a UHF Surrogate Satellite Relay System, 1 September 1992, accessed at http://www.fas.org.

7. U.S. Senate, then-LTG Abizaid Senate Confirmation Hearing Questions and Answers, 2003 (Washington, DC: Government Printing Office, 2003), 12.

8. Ibid.

9. Headquarters Marine Corps, *Expeditionary Force 21* (*EF 21*), (Washington, DC: March 2014), 34.

10. Space Data.

11. Ibid.

12. Space Data: SkySat, accessed at http://www.spacedata.net.

13. D.J. Montoya, "SkySat Balloon, Payload Launch Impresses Army Officials," last modified 16 October 2012, accessed at http://www.army.mil.

14. Space Data: SkySat UHF Retrans System, accessed at http://www.spacedata.net.

15. Ibid.

16. Jerry Quenneville (Space Data Corporation), email message to author, 7 December 2014.

17. Ibid.

18. Headquarters Marine Corps, *26th Marine Expeditionary Unit (26 MEU) After-Action Report*, (Quantico, VA: Marine Corps Center for Lessons Learned, 2012), 12.

19. Ibid., 17–18.

20. Headquarters Marine Corps, *Combat SkySat Demonstration (TACDEMO) Final Report*, (Yuma, AZ: Marine Aviation Weapons and Tactics Squadron One, 2010), 10.

21. D. Lafontaine, "RDECOM facilitates technology discussions at Alaska exercise, *Army Technology*, army.mil, 22 April 2014.

22. DOD Fiscal Year 2016 President's Budget submission, (Washington, DC: February 2015), Exhibit R-2A.

23. *Radio Communications in the Digital Age*, accessed at http://rf.harris.com.