

The Greatest Mesh Network

Ground based solutions for SOF

by SSgt Franklin W. Baker

Mesh networking has been studied for decades and employed by various organizations since the 1990s. Iridium Satellites and other large-scale technical successes of mesh networking have ultimately eliminated physical obstacles to better communicate between nodes (devices).

Our case should be no different. We can eliminate some obstacles in a three-dimensional world by the mere creation of a mesh network—enabling data transmission from one node to another by going through another node to get to the desired destination. For special operations forces (SOF) operators, “some” obstacles refer to things at ground level that is relatively easily defeated using a ground-based mesh networking solution. Person A needs

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to send a message to Person B, who is on the opposite side of an obstacle that radio transmissions cannot penetrate (concrete building, dense foliage, undulating terrain). Therefore, a ground-

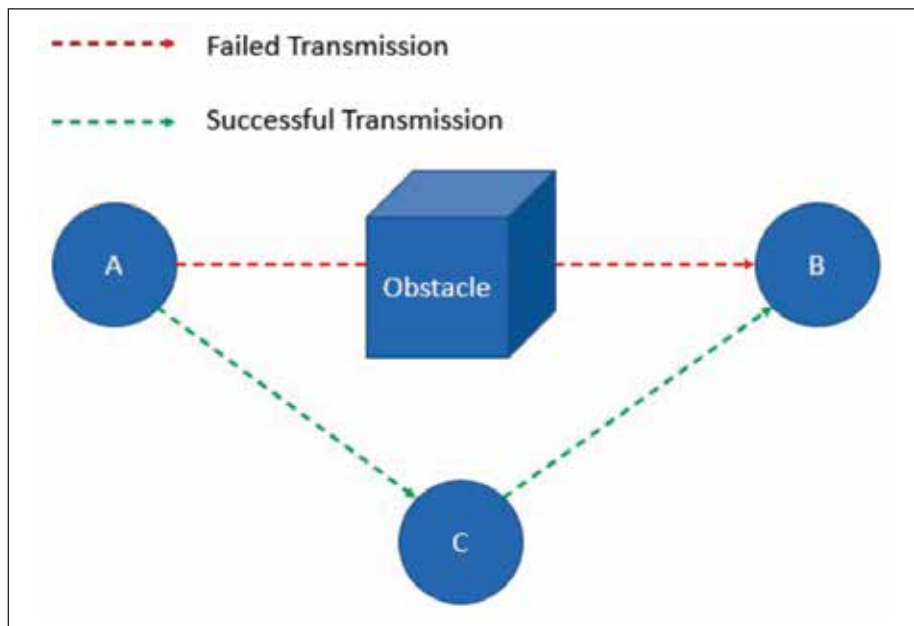
based mesh networking solution is employed to transmit data from Person A to Person B through Person C’s node.

While this technique provides a logical method to defeat some obstacles, it is not always realistic to expect “Person C” to naturally be in this adjacent position at all times. Additionally, some obstacles (i.e., an extensive mountain range) are so tall and so vast that merely flanking the object is impractical or impossible to maintain line of sight (LOS) communications. Therefore, creating a solution that can defeat obstacles of varying height and width is needed. An aerial mesh networking solution is an answer here. By equipping an aerial asset (i.e., a drone) with a node within the mesh network, defeating LOS obstacles of nearly any height or width becomes an achievable endeavor. Whether the barriers are concrete urban buildings, tall vast mountains, or densely vegetated canopy, an aerial mesh networking solution can prevail.

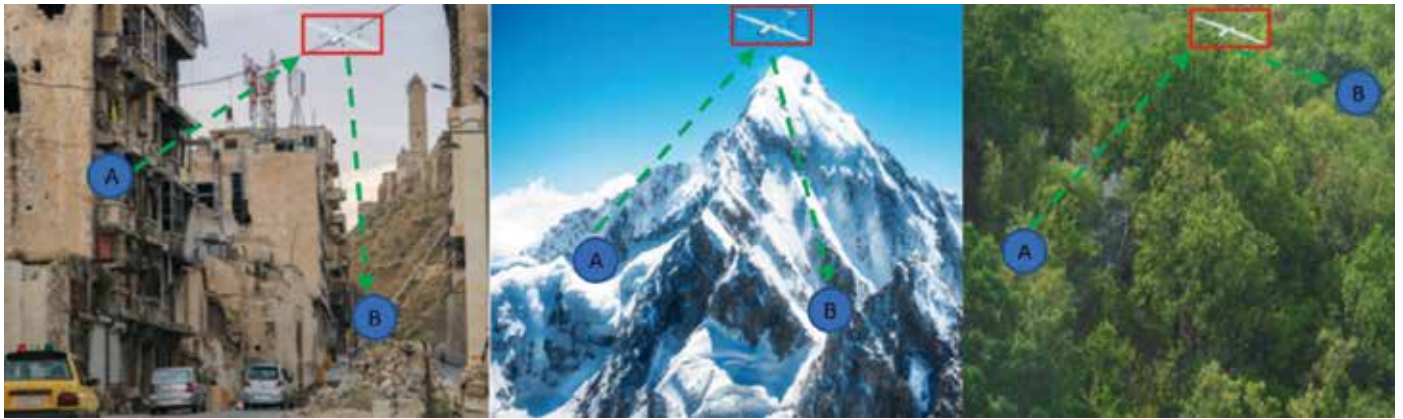
GoTenna Pro X

GoTenna Pro X is a mesh networking solution for both military and non-military applications:

The world’s smallest, lightest, most cost-effective tactical mesh networking device pairs with our native iOS/Android mobile application as well as third-party apps like ATAK to enable off-grid communications.¹



Above is a graphic depiction of how mesh networking can defeat line of sight (LOS) obstacles. (Graphic provided by author.)



Above are examples of a sUAS platform (acting as an aerial communications relay node) used in various operational environments to defeat LOS obstacles. (Photo provided by author.)



Above is a picture of an individual employing ATAK in a rural environment via goTenna's ATAK plugin and mesh network (goTenna, Inc., 2021). (Photo provided by author.)

GoTenna Pro X antennas are small, approximately 3oz per device, and 5.5" x 1.2," so it stores discreetly on a person or platform.²

"The goTenna Pro X ATAK plugin supports critical, short-burst data communications for mapping, messaging, and personnel tracking in comms-denied environments."³ The big takeaway for this device is its ability to create networks in areas where traditional cellular networks are not available, are degraded, or denied to the SOF

operator—a situation most SOF operators encounter while deployed. A must-have to accompany the goTenna Pro X purchase is a goTenna Tether sold by Juggernaut Defense LLC successfully pairing an ATAK device (smartphone) through a cabled connection to a goTenna Pro X rather than relying upon a Bluetooth connection. GoTenna Pro X's mesh networking solution is a better bang for your buck than other known military solutions (L3 Harris 152A, Silvus Technologies) for two reasons.

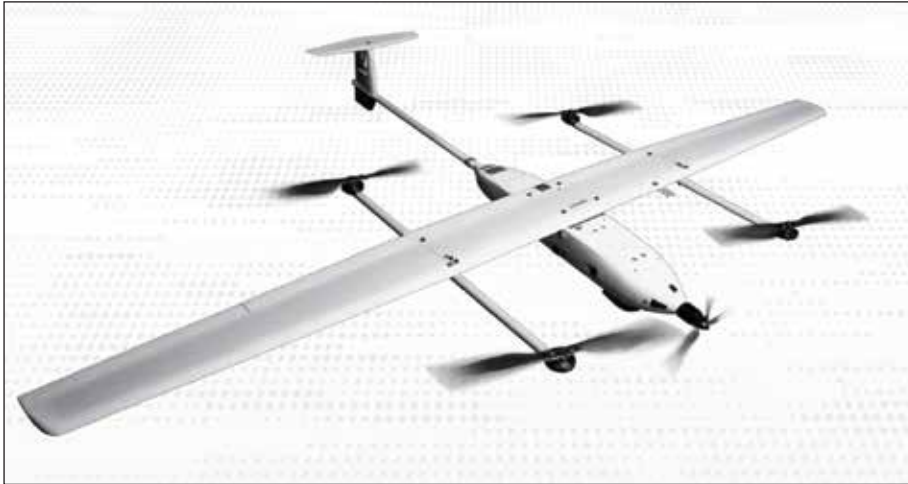
Firstly, the unit cost for such solutions is exponentially higher than the goTenna Pro X solution. Secondly, the goTenna Pro X weighs a fraction (three ounces) of the weight of a handheld radio solution—permitting the outfitting of a goTenna Pro X on organic sUAS platforms for a mesh networking solution far beyond simple ground-based mesh networks.

Stalker VXE VTOL Suite

"Stalker VXE is an operationally proven small, silent, Unmanned Aerial System (UAS) that provides unprecedented long-endurance imaging capability in a variety of environments. Optionally powered by a ruggedized Solid Oxide Fuel Cell, Stalker VXE uses propane to achieve 8+ hours of operation. The system can be reconfigured in the field to a battery-powered option that provides 4 hours of endurance."⁴

Specific unique capabilities of the Stalker VXE Vertical Take-Off and Landing (VTOL) are:

- Up to eight hours flight time with fuel cell configuration.
- Electro-Optical/Infra-Red imagers, Thermal Imagers (Long Wavelength Infra-Red and Medium Wavelength Infra-Red), and Laser Designator.
- Ranges over 100km with various antenna configurations.
- Small Footprint: Complete Mission Capability Fits in a Small SUV, Sedan, or Rolling Duffel Bag.
- Quiet Operation: Silent > 800 ft.
- Operating Altitude 300 ft above ground level up to 12,000 ft.



Above is an image of a Stalker XE sUAS system with a vertical take-off and landing (VTOL) capability. (Photo provided by author.)

- Bungee, Rail, or VTOL Launch Options.
- Autonomous Mission Operation: Launch, Flight, and Landing.
- Waypoint Navigation.
- Cursor-on-Target Compliant.
- Integrated Tracker Provides Scene Lock Moving, Target Track, Auto Track, and Follow Navigation.
- Hand-off capable between ground control stations.
- Communication relay through additional Stalker platforms.
- Multi-UAS Operation from a single ground control station.

This platform’s key takeaway is its substantial loiter time, various imaging options, the adjustable antenna footprint per mission, and its payload capacity.

Android Team Awareness Kit (ATAK)

“[ATAK] uses GPS and maps to give the user a real-time view of the AO. This new situational awareness capability includes ‘Blue Force Tracking’ to see where team members are (which reduces friendly fire incidents and helps with coordinating movements), ‘Red Force Tracking’ to see where the bad guys are, as well as terrain, weather, and other topographical elements. Additionally, the app enables multiple types of encrypted data communication such as text and file sharing (including photos and video). These communications can be set for user-to-user, user-to-select teams, user-to-command post, or user-to-entire force (even if they are from different agencies).



Above is an image of an Android Phone with the Android Tactical Awareness Kit (ATAK) software depicted on the screen being worn on an operator’s plate carrier for quick access. (Photo provided by author.)



10,000 mah DXPPOWER Power Bank already purchased by multiple Marine Special Operations Teams (MSOTs). (Photo provided by author.)

This level of integrated communications was unavailable before ATAK.”⁵

ATAK—and MARSOC’s current employment modality via the Field Computing Device-Wearable (FCD-W)—has been increasingly employed in the last few years; thus, laboring on its capabilities is not necessary. It is worth noting, however, a few essential features to takeaway for the purposes herein:

- Collaborative mapping, including points, drawings, locations of interest. Extensive and customizable set of icons.
- Overlay Manager, which allows the import and display of overlays and maps, including online sources.
- Location marking, sharing, history.
- Chat, file sharing, photo sharing, video sharing, streaming.
- Navigation-walking/hiking, driving, also practical flying and air-ground coordination.
- Elevation Tools, heat maps, computed contour maps, viewsheds, routes with digital terrain elevation data, Shuttle Radar Topography Mission, including dynamic profiling.
- Range, bearing, and other measurement tools.
- Network-aware geofences with triggers.
- “Bloodhound” destination tracking, including on moving objects.
- Radio controls and Integration.
- Casualty evacuation (9-Line and Z-MIST) tool.

- Air-Ground and indirect fire integration.⁶

Power Banks

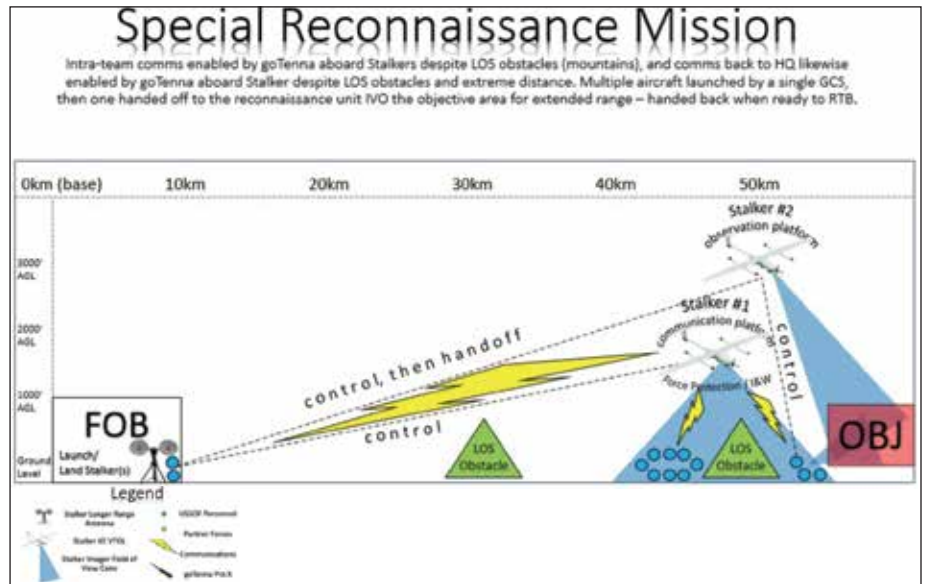
As SOF operators become increasingly reliant upon electronic devices, so does their need for power increase. Such devices' battery life is continuously sapped when operating at maximum capacity and is typically employed in less than optimal environmental conditions. Portable power banks have increased their portability and capacity as battery technology advancements accelerate faster than their various applications can be discovered.

This portable power bank, the DXPower power bank shown on page 20, comes with a substantial 10,000 mah capacity (equal to two complete Samsung S7 charges), weighs less than half pound, and in the small footprint of 4" x 2.5" x 1."⁷ It has a USB and micro-USB port which can charge at a 5V/2.1A output. This power bank is rated IP67, which means it is shockproof, dustproof, and protected in 1m of water for up to 30 minutes.⁸ Overall, the big takeaway for this power bank (and any like-power bank) is the capacity in milliamp hours, the nominal size/weight, and its ability to withstand the harsh environment.

Integration of Technologies

Imagine the Stalker VXE VTOL with the goTenna Pro X and DXPower power bank mounted onboard exponentially, furthering the mesh network capability for all forces nearby. All of this without burdening higher headquarters (HHQ) with requests for multi-million-dollar intelligence, surveillance, and reconnaissance platforms to create the same thing. Couple this new tactic, technique, and procedure with SOF operators who likewise have ATAK devices mounted on their chest-rigs with that device paired with a goTenna Pro X mounted on their back and each device supported with their DXPower power bank. This new hyper-enabled operator will have a plethora of enhanced capabilities. A list of specific benefits are as follows:

- ATAK devices have longer endurance (24–48 hours with one DXPower) while employing the ATAK



Vignette #1. A Special Reconnaissance Mission made possible by the use of this mesh networking solution. (Graphic provided by author.)

application (high-battery-usage application).

- Thus, SOF operators do not have to compromise their ATAK ping rates (frequency of position updates) to conserve battery life.

This new hyper-enabled operator will have a plethora of enhanced capabilities.

- ATAK now functions in an area where cellular networks are denied, degraded, or do not exist because the goTenna Pro X mesh networking.
- A worn goTenna Pro X has a longer endurance than the advertised maximum battery life of 9 hours (well over 48 hours when supported by one DXPower power bank).
 - GoTenna Pro X internal battery is about 450 mah and is advertised to last 9 hours (goTenna, Inc. 2021). A DXPower Power Bank provides an additional 10,000 mah; this device could last many days without issue.⁹
- Stalker VXE VTOL can carry a single or dual goTenna Pro X configuration and DXPower power bank for

extended maximum endurance (an estimated thirteen ounces of additional payload). Together, these provide supplemental unimpeded LOS for an aerial mesh networking solution in mountainous terrain, around urban developments, and during thick jungle operations.

- Stalker VXE VTOL can be handed off from an operator far from the objective area to a SOF operator near the objective area, increasing situational awareness for the team on the ground via a resident sUAS operator viewing and controlling live feed. All of this can happen without having to carry out the equipment or launch/land the drone.
 - To receive a Stalker hand-off, an operator must only pack out a single laptop and handheld radio (only twelve pounds in gear).
- Multiple Stalker VXE VTOL aircraft can be outfitted with a fuel cell configuration (enabling eight hours of loiter time per aircraft), equipped with goTenna Pro Xs and DXPower power banks.
 - Since multiple Stalker aircraft can be launched and controlled by a single GCS, the pilot can successively launch two-four aircraft. Then, the Stalker pilot can create a “relay” of Stalker aircraft with goTenna Pro Xs onboard, illuminating a large area with an unmatched aerial mesh

network to further enable SOF operators. This solution also provides extended aircraft range and can defeat LOS obstacles (mountains, buildings, dense jungle).

Here are a few vignettes to better illustrate these hyper-enabled operators in action.

Vignette 1: Special Reconnaissance

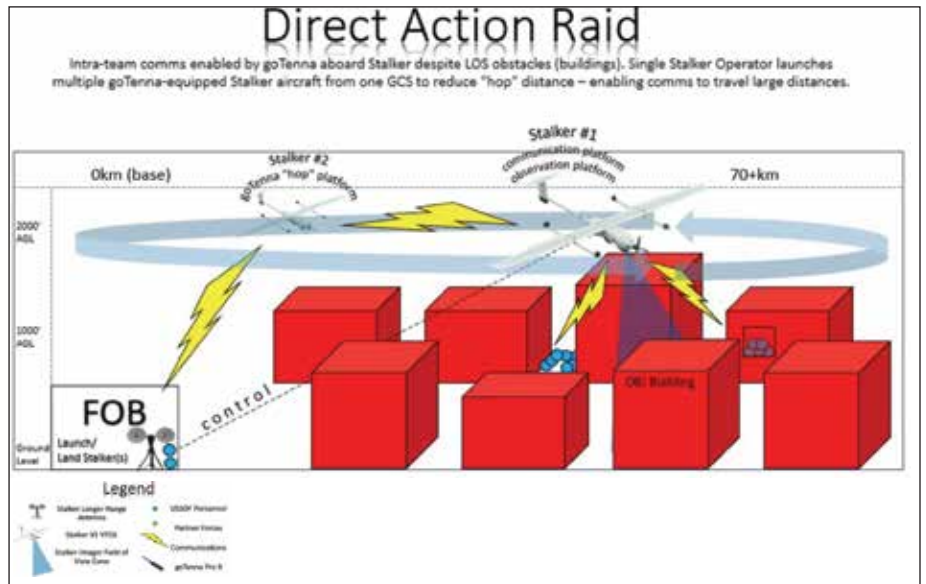
An MSOT is tasked with surveilling an objective area to gather pattern of life over 24 hours. The objective is 50 km from the nearest forward operating base (FOB), and terrain prevents standard LOS comms from working. Stalker pilots from the FOB launch dual Stalkers from a single GCS equipped with goTenna Pro Xs. Stalker #1 provides ATAK communications between team members and back to HQ via its attached goTenna Pro Xs. Stalker #1 also provides indications and warnings for the MSOT. Stalker #2 is handed off to the MSOT’s organic Stalker pilot, who is located forward with the MSOT to conduct special reconnaissance (SR) in the objective area. This stalker pilot is closer to the objective and therefore has a unique understanding of what is and what is not essential or noteworthy for investigation.

Vignette 2: Direct Action Raid

Like the SR vignette, the objective area is within LOS for Stalker #1 via the long-range antenna configuration. The goTenna Pro X’s range, however, is in question (cannot range in a single hop—case study test range 23.1 miles).¹⁰ Therefore, FOB Stalker pilots launch Stalker #2 equipped with goTenna Pro Xs to orbit halfway between the FOB and the objective area, extending the mesh network back to HQ. Stalker #1’s goTenna attachments enable ATAK comms throughout dense urban areas in addition to providing I&W for the MSOT.

Vignette 3: Clearing Operation

The clearing operation occurs in an enemy-controlled mountain range over an extended period (24–48 hours). FOB Stalker pilots have three Stalker platforms equipped with the fuel cell configuration—permitting eight-hour

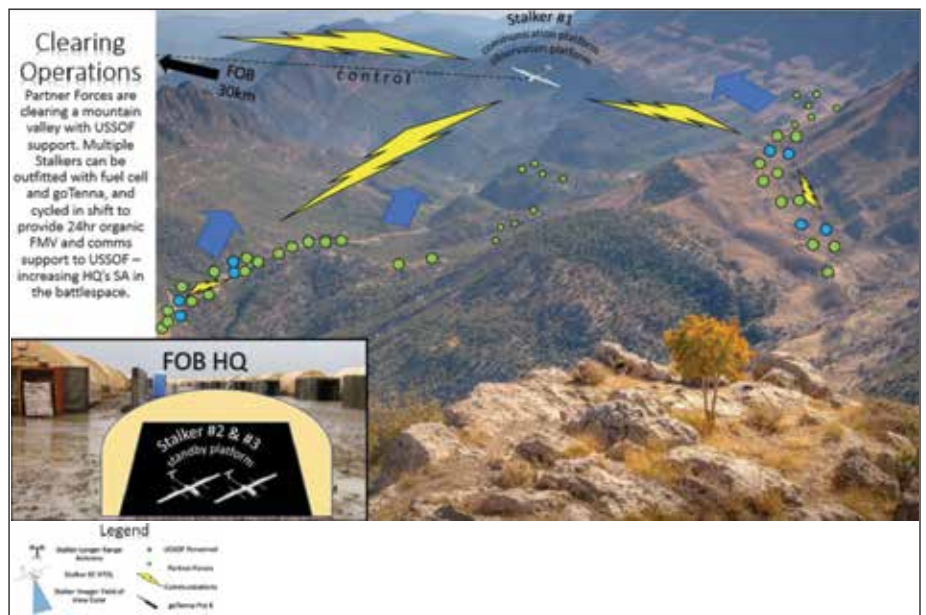


Vignette #2. A Direct Action Raid with internal and external communications greatly enhanced by the use of this mesh networking solution. (Graphic provided by author.)

The clearing operation occurs in an enemy-controlled mountain range over an extended period (24–48 hours).

coverage per launch—and with goTenna Pro Xs for an extended mesh network intra-team and back to HQ. Each Stalker is additionally fitted with a DXPower power bank to extend goTenna endurance to well beyond 24-hours

each. The constant Stalker coverage eliminates minor intra-team lapses in coverage. Stalkers rotate shifts to enable 24-hour operational support from the FOB. Each wear DXPower power banks to extend goTenna Pro X endurance.



Vignette #3. Partner Force Clearing Operations greatly supported and facilitated by the use of this mesh networking solution. (Graphic provided by author.)

Cost Analysis per MSOT

Purchase Items	Unit Cost	Quantity to Purchase	Total Cost
GoTenna Pro X Deployment Kit (20 UHF or VHF units) https://www.gsaadvantage.gov/advantage/ws/catalog/product_detail?gsin=11000066104634	\$24,558.21 (GSA price)	1 (1 per MSOT)	\$24,558
Stalker XE VTOL Suite (3 A/C bodies w/ all accessories) Procured at a higher organizational level	\$3.1M	0 (owned by MRR)	\$0
***Field Computing Device - Wearable (wearable ATAK device) Procured at a higher organizational level	\$11,156.11	14 (1 per MSOT's CSO)	\$156,186
DXPower Power Bank (10,000 mah, IP67-rated, 4.5"x2.5"x1", 7 ounces) https://www.altatac.com/dxpower-armor-outdoor-emergency-portable-power-bank-external-battery-charger/	\$20 (OPR)	28 (2 per MSOT's CSO)	\$560
Juggernaut goTenna Tether (eliminate Bluetooth need from goTenna to FCD-W) https://shop.juggernautcase.com/products/gotenna-tether.html	\$350 (OPR) (not yet on GSA)	14 (1 per MSOT's CSO)	\$4,900
Juggernaut Mount (to mount device to Operator's chest rig) https://www.gsaadvantage.gov/advantage/ws/catalog/product_detail?gsin=11000048332706	\$115 (GSA price)	14 (1 per MSOT's CSO)	\$1,610
		***TOTAL	\$187,814

*Taxes, shipping, and other various fees are not computed into this figure.

**Many Marine Special Operations Command units currently own and employ various items in the list above in multiple capacities. The total cost to outfit any MSOT will vary by MSOT, MSOC, and MRB based upon their current inventories. Because of this fact, the total cost to fit any MSOT is expected to be substantially less than quoted above.

*** FCD-Ws currently comes with a dated phone (Samsung Galaxy S6 or S7) to employ ATAK-MIL. This phone may be becoming obsolete or less-than-optimal in comparison to newer models. An assessment should be made into the longevity of such a device in our technologically progressive world.

ance and ATAK device endurance to last throughout the 48-hour mission.

In summary, what has been described is an example of a ground & aerial mesh networking solution. This example utilizes the Stalker VXE sUAS platform, goTenna Pro X, ATAK-capable device with Juggernaut Phone Mount and Tether, and DXPower Power Banks. Any one of these elements described can be substituted for a more capable, versatile, or viable solution if necessary—it all depends on the operational environment. What is most important here is the concept—defeating LOS obstacles using mesh networking in conjunction with an aerial component to relay communications.

We here at MARSOC have an exclusive opportunity to demonstrate every pillar of MARSOF 2030 through the pursuit of this concept: The Cognitive Raider, MARSOF as a Connector, Combined Arms for the Combined Arena, and—by the rapid employment of this concept—Enterprise Level

Agility. If we can all come together to understand the value of this idea for MARSOC, if we can all come together to make this a reality for MARSOC, then we would become the premier, future, fighting force in USSOCOM.

Notes

1. Information on DXPower Power Banks can be found at <https://www.techadvisor.co.uk>.
2. Information on the goTenna Pro Case Study in Puerto Rico can be found at <https://gotennapro.com>.
3. Information on the goTenna Pro X can be found at <https://gotennapro.com>.
4. Information on Stalker UAS is available at <https://www.lockheedmartin.com>.
5. Staff, "Snapshot: ATAK Increases Situational Awareness, Communication and Alters Understanding of Actions Across Agencies," Department of Homeland Security, (November 2017), available at <https://www.dhs.gov>.

6. Information on ATAK / CivTAK is available at <https://www.civtak.org>.

7. Marie Black, "DXPower Armor DX0001 10,000mAh Power Bank Review," *Tech Advisor*, (January 2017), available at <https://www.techadvisor.co.uk>.

8. Ibid.

10. Ibid.

