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GOTENNA PRO AFTER ACTION REVIEW – MARWORKS SITUATIONAL AWARENESS

Executive Summary

During initial capability trials, the GoTenna Pro has the potential to fulfil multiple concepts for use within the Royal Navy/Royal Marines and wider MoD, providing a primary bearer for in-service and CoTS user devices that are Bluetooth and Micro USB compatible (HADR, Surveillance and Reconnaissance), and an alternate bearer within a communications PACE model[1]. The GoTenna Pro also has the potential to provide tactical range extension via a linear and MESH network, for the use of ATAK or via the GoTenna application within benign and non-combative operating environments (Safety, training and security). The waveform and characteristics of the GoTenna Pro, inherently reduces a user's signature within a controlled emission environment, that is significantly less compared to current in-service radios. This is due to narrow band propagation and frequency hopping. To thoroughly investigate the GoTenna Pro's utility for use, it is recommended that user trials are conducted within a realistic operational training environment to exploit the use of ATAK over a small form factor MESH network.

Introduction

1. To fulfil the current capability gap for Dismounted Situational Awareness (DSA) at the tactical level and mitigate the future delivery of long-term projects, MarWorks have been investigating and developing an interim solution that can deliver collaborative C2[2], PLI[3], shared targets and Points of Interest (PoI) for the Royal Navy. DSA requires 3 key components; a bearer, end user device and Battlefield Management Application (BMA). MarWorks are utilising bearers and end user devices that are currently fielded within the Royal Navy[4], alongside the GoTenna Mesh and GoTenna Pro as a primary and alternate bearer, and the Android Tactical Assault Kit (ATAK) BMA. A key requirement to the success of this project is interoperability at all levels and the secure passage of information.

[1] Primary, Alternate, Contingency and Emergency.
[2] Command and Control
[3] Personal Location Information
[4] Harris RF-7800-S SPR and Samsung Note 4

GoTenna Pro Overview

2. The GoTenna Pro provides a secure mesh network within a small SWaP[5] form factor, enabling Shared Situational Awareness (SSA), group and peer-to-peer chat messaging and PoI via ATAK or the GoTenna Pro application (Android and IOS)[6]. The GoTenna Pro is tuneable to operate in the 142 – 175 MHz (VHF) and 445 – 480 MHz (UHF) frequency ranges, and has scalable power options up to 5 Watts. GoTenna units are configurable via a management portal that provides central ownership and control of the communications plan, currently hosted remotely on a cloud based server. The option also exists to configure the units in the field directly within the software application without any interfacing with an external management system. GoTenna also provides a deployment unit that provides a central charging point for up to 30 GoTenna units and locally hosted application server[7]. Indicative costing for single GoTenna Pro units are $499 and the baseline GoKit priced at $20,000 (including 20 Pro radios).

3. GoTenna Pro operates on a baseline channel bandwidth of 11.8 kHz, resulting in Narrow Band (NB) propagation for small packets of data at low burst rates. The channel bandwidth options are 4.54, 7.28 and 11.8 kHz; however, it is ill advised to go any lower than 11.8 kHz to ensure optimal throughput. The maximum number of hops within a network is currently 3. Initial trials were conducted at 4.54 kHz bandwidth to trial the capability at the lowest rate. GoTenna also executes frequency hopping within the NB channel; with a hop set of 1 – 16. Encryption for the GoTenna pro is performed at the application layer, utilising 384-bit ECC encryption within the GoTenna Pro application and 256-bit AES encryption within ATAK. All keys are generated, exchanged and controlled within the GoTenna Pro application and are non-user definable; however, ATAK allows the user to self-generate multiple encryption keys and exchange these manually or physically and remotely via QR codes.

Concept of Employment

4. MarWorks SA (MSA) is being developed to fulfil a multitude of use cases that require a robust and resilient mechanism for SSA and collaborative C2. GoTenna has proven to be effective in maintaining a robust data link in both the rural and urban environments, achieving impressive ranges within a linear network, meshed network and for extended range via the use of HeliKite and fixed mast systems. The GoTenna Pro can be employed within a tactical role as a primary bearer for MSA, an alternate bearer to compliment current capability as part of a PACE model, or pared back to fulfil non-tactical roles such as small Short-Term Training Teams (STTT), boarding parties, humanitarian aid and disaster relief. The interoperability of the GoTenna Pro with third party BMA's, proprietary applications and end user devices provides multiple use cases:

a. **Expeditionary role.** GoTenna has the potential to provide SSA and passage of information within a secure and non-centralised mesh network for expeditionary forces that have a requirement to interoperate with partnered forces and allies. GoTenna also provides an Ad-Hoc bearer in the absence of CNR.

b. **Conventional roles.** GoTenna has the potential to act as a primary and secondary bearer for MSA, providing a reduced emission signature and non-linear network within conventional operating environments[8]

c. **Non-permissive GSM environments.** GoTenna provides a scalable and secure mesh network for SSA, chat messaging and limited PoI where GSM is denied, degraded or unavailable.

[5] Size, Weight and Power
[6] https://www.gotenna.com/pages/gotenna-pro-technology
[7] https://www.gotenna.com/pages/gotenna-pro-deployment-kit
[8] Close Quarter Combat (CQC), Fighting in Woods and Forests (FIWAF), Operating in Built Up Areas (OBUA), Deliberate Actions (DA) and Emergency Response (ER).

d. **Humanitarian Aid and Disaster Relief (HADR).** GoTenna has the potential to provide a bearer of opportunity at very high readiness for HADR operations, where little or no communications infrastructure exists. The GoTenna units and Go-Kit are capable of being pre-programmed, pre-charged and pre-encrypted as part of a rapid deployment package for HADR teams.

e. **Maritime boarding teams.** There is potential utility for the use of GoTenna Pro for boarding teams, however the concept for use requires further investigation. The inability to accurately report PLI within a ships structure prevents friendly force tracking, consequently reducing SSA. Pairing ATAK with a GPS-denied personnel tracker (various vendors) and goTenna may solve these issues - although chat, COT, and manual position updates would still function without it.

f. **STTT's.** Utilising GoTenna alongside ATAK and the GoTenna Pro application within STTT's, may provide a mechanism for internal security and safety within teams via the use of PLI, and providing interoperability with indigenous and partnered forces. The ability to compartmentalise information via the use of encryption and separate networks, enables users to restrict and allow access where appropriate.

Conduct

5. The GoTenna Pro was trialled in conjunction with MSA, as part of Exercise Information Warrior 18 and Exercise Joint Warrior 18 within the UK. GoTenna was predominantly trialled on the Dartmoor Training Area, providing rural and undulating terrain for trials and the Plymouth area for trials within an urban environment. Maritime, air and fielded trials were out of scope due to unavailability of assets and exercise limitations.

a. **Dartmoor Training Area.** The GoTenna Pro was trialled as a linear network for range extension as a point-to-point and relayed link between 2 users. The aim of this trial was to investigate the feasibility for GoTenna to act as a range extension node for SSA (PLI and messaging), via the use of ATAK, for a pre-landing force and/or reconnaissance screen. This was achieved both on-the-man and via elevated mast systems (HeliKite and in-service antenna masts). Due to poor weather conditions, the HeliKite was limited to 250 feet; however, elevation up to 2000 Ft is an advertised capability.

b. **Plymouth Area.** To replicate operations within an urban environment, GoTenna was trialled within a static, mobile and elevated mission profile. The GoTenna Pro was elevated at a static location to a height of 200 feet, providing elevated Line-of-Sight (LOS) coverage to a mobile vehicle callsign, providing a tri-mesh network of 3 nodes for 3 users. GoTenna was also trialled as a mesh network within separate multi-floor buildings, comprising of 20-inch stone walls, and rooms that are above and below surface.

6. **Concept of Communications**. Enabling the GoTenna Pro network requires initial access to the GoTenna Portal to establish frequencies for use, bandwidth and assign users[9]. Set up via a QR code or a GoKit is also possible if access to the Portal is not available. Once all parameters and users are assigned, GoTenna Pro units are programmed using the user accounts on the GoTenna Pro application. Multiple GoTenna Pros can be programmed from a single user account, negating the need for multiple user accounts for each GoTenna unit. Access to the GoTenna Pro Portal is cloud based, hosted by Amazon Web Services and managed by GoTenna. Channel bandwidth was initially set at 4.54 kHz to enable local testing and increased to 11.8 kHz for later trials. All frequency sets were pre-defined at the planning level and cascaded to users via the GoTenna Pro application. It is possible to delegate permissions to users via the GoTenna Portal for frequency

[9] User - Access to the GoTenna Pro App and updating of firmware – network coordinator.

and bandwidth changes by assigning service users within a group. The GoTenna Portal is intuitive, requiring little or no prior knowledge or training to generate a communications plan.

Results

7. **Initial Trials.** Upon receipt of the units and access to the GoTenna Portal, local trials were conducted to investigate interoperability with ATAK, MSA and operation alongside current in-service radios (figure 1). There were discrepancies with the battery usage (remaining on 9 percent) and CoTS messaging. However, these were identified faults within the current ATAK Plug-in and GoTenna have rectified this under version control. The GoTenna Pro connected seamlessly to the devices via Bluetooth. The adoption of Bluetooth Low Energy (BLE) requires the device and the GoTenna to remain within close proximity (approx. 2m), mitigating the risk of interception via Bluetooth and potentially reducing the impact on security of information, as the information is encrypted on the device and not the GoTenna Pro. It was quickly identified that the GoTenna Pro and ATAK application could be pared back to provide a less tactical and ruggedized option for different mission profiles, utilising an android device and GoTenna pro as standalone devices. The GoTenna Plug-in version trialled with ATAK provided the following functionality:

a. Limited CoTS information (Broadcast only). It was identified that PoI's disappeared after a period on endpoint devices.

b. Blue and Green force tracking (PLI) at changeable refresh rates (30 – 180 seconds).

c. Chat messaging within the GoTenna plug-in and broadcast chat messaging within the ATAK chat application.

d. Drawing tools, supporting squares, and the polygon tool up to 8 points.

Figure 1

8. **Dartmoor Training Area.** The GoTenna pro was trialled utilising HeliKites for elevating the network for increased LOS as a mechanism for range extension, resulting in a point-to-point range of approx.16km, with clear and diffracted LOS (figure 2a). The HeliKite was elevated at a static location to approx. 300 ft. (Point A, figure 2b), providing a LOS link to a GoTenna Pro unit on-the-man (Point B, figure 2b). The link was established throughout, providing PLI and messaging at a refresh rate of 30 seconds. The signal pathway was lost at certain points within the low terrain, improving as elevation was gained and LOS improved; which was to be expected. The GoTenna unit was also successfully trialled on-the-man over undulating ground, providing ranges of approx. 3 km dependant on terrain.

Figure 2a

Figure 2b

9. **Plymouth Area.** The GoTenna Pro was elevated to 8m within a static location (point A, figure 3) as a receiving station for 2 mobile vehicle callsigns at approx. 30 km. PLI information and messaging was received at 6.8 km (point B, figure 3a), maintaining a robust link whilst manoeuvring thorough the city (see figure 3b for LOS path at 6.8 Km). To investigate the resilience of the link, vehicle callsigns screened themselves between buildings and bridges whilst closing in to the static location (Area C, figure 3). The link remained established throughout, outperforming PLI from current in-service radios.

Figure 3a

Figure 3b

Opportunities

10. The GoTenna Pro units trialled were pre-production models, along with the goTenna Pro App and portal which are currently Beta versions. GoTenna Pro is currently forecasted to be FOC on 2 June 18, to include essential patches to firmware for the ATAK GoTenna plug-in and upgrades in functionality. The current roadmap for capability enhancements, provides greater utility and functionality without the need for new hardware, also allowing the GoTenna Pro exploited further across all concepts for use. The roadmap is to include the following functionalities within the next 3 – 6 months and sooner:

a. Unicast and group messaging within the ATAK (potentially delivered before 2 June 18).

b. Downloadable mission packages via the TAK Server hosted on GoKit.

c. GoTenna support for Fires and CASEVAC 9 Liner within ATAK.

d. Network merging. The ability to join multiple GoTennas to single handset as a requirement by SOCOM, that is achievable through Bluetooth Low Energy (BLE) technology, enabling users to bridge multiple networks on the same device.

e. Ability to 'push' and 'pull' mission information (PLI and PoI) between the GoKit and GoTenna devices.

f. Stealth functionality to allow GoTenna units to adopt receive only mode, rendering the GoTenna unit a silent receiver with no emission signature.

g. Asynchronous audio clips of approx. 3 seconds in length (short acknowledgements).

h. Biometrics. Passage of biometric information within ATAK via the GoTenna plug-in, using Samsung/Android based Smart watches and Apple Smart watches; providing average heart rate of the user and enabling parameters to be defined that identify cause for concern.

11. The trial also identified the ability to separate, merge and bridge networks via the use of encryption keys via the GoTenna ATAK plug-in. This enables the user(s) to operate within a closed user group, also allowing interoperability with allies, partnered or indigenous forces. The ability to segregate networks via crypto ensures that no information stored within the GoTenna device is susceptible to compromise and no third party can access the information via ATAK (see figure 4). Although networks are separated by encryption, the frequency and net pre-sets remains the same; therefore, network latency and hop limitations remain extant. The GoTenna's ability to store and forward data and manage encryption keys, may provide a potential concept of use for discreet operations.

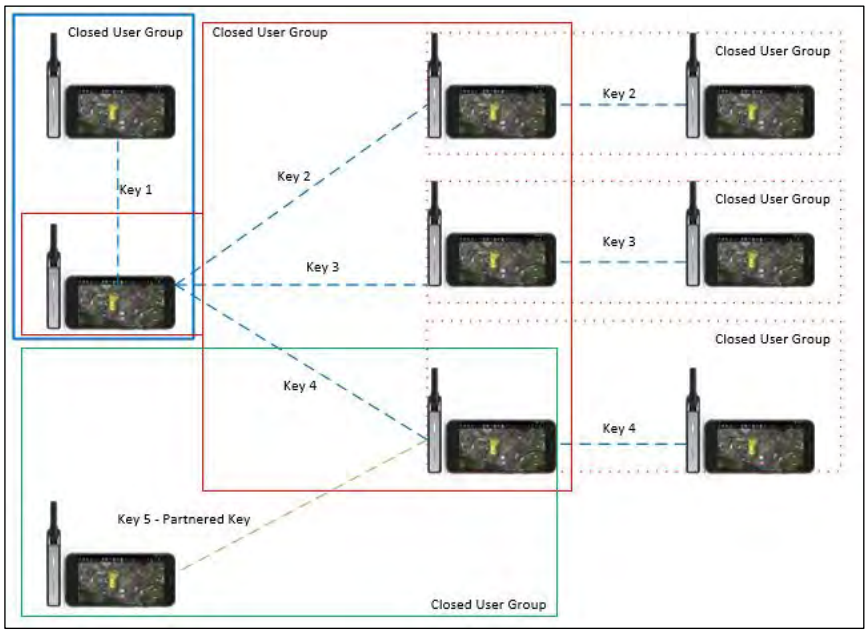

Figure 4

Recommendations

12. The initial trials for GoTenna as a primary and alternate bearer for MSA, and a standalone capability proved highly effective in maintaining a robust and resilient MESH and linear network. Purchasing of a GoKit is highly recommended to further exploit the GoTenna Pro within an expeditionary and HADR mission profile. This would provide 20 GoTenna Pro units for further user trials within the Royal Navy/Royal Marines.

Summary

13. The initial trial of the GoTenna Pro was a resounding success, regardless of issues contained within the current plug-in release and beta versions of the GoTenna application. The GoTenna Pro has the potential to address current shortfalls in capability for a communications capability at high readiness for HADR, expeditionary operations and inform/influence current and future projects within the wider MoD. The employability and feasibility for use requires further in-depth trial and discussion with the user community to establish definitive concepts for use.

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