Multi-Channel Link 16 Terminal

For Size, Weight, and Power Constrained Platforms

01. Introduction

While there have been significant improvements in today's battlespace with the range, speed, and lethality of kinetic weapons, the increased ability to engage has far outpaced the ability to identify friend from foe. This competing dynamic has contributed to slower progress in expansion of Situational Awareness (SA) and understanding reflective of the long-standing challenges associated with the "fog of war" concept described by Carl Philipp Gottfried von Clausewitz.

As the effective size of the battlespace gets reduced due to the enhanced effects of kinetic weapons (longer vs. shorter engagement distances), it becomes increasingly more important to arm individual platforms with multiple sources of communications pathways to obtain the SA that is necessary for increased lethality and survivability.

However, even with force modernization efforts, budget realities and the urgency of ongoing operations have placed more emphasis on enhancements to existing platforms. As a result, many existing air, ground, and sea platforms are seeking improvements to communications to achieve the required SA provided by Link 16 (the predominant line-of-sight waveform for tactical data links), but internal trades must be made to existing systems especially in the areas of Size, Weight, Power, and Cost (SWaP-C). The need to "network" joint forces only makes this demand more urgent, but it does not remove the requirement for legacy communications pathways already on the platform.

Developed by ViaSat and Harris, the Small Tactical Terminal (STT) KOR-24A is a two-channel radio designed to meet the needs of users who have SWaP-C constraints, but also need simultaneous access to Link 16 and either wideband waveforms or legacy communications pathways, including Very High Frequency and Ultra-High Frequency (VHF/UHF). With the STT, it is now possible to consume tactical information from a ground network and pass that information over to Link 16 and vice versa, creating seamless SA and a Common Operational Picture (COP) between air and ground forces. It also affords SWaP constrained platforms outfitted with a legacy VHF/UHF radio with an upgrade path to Link 16 (while maintaining its legacy capability), without having to impact platform SWaP.

FIGURE 1. Lightweight, software programmable radio meets military space and size demands in a small package.

02. Product Development

In 1997, the U.S. Department of Defense (DoD) began its quest for the perfect family of radios that were software defined and could be reprogrammed for different missions and could communicate and interoperate with existing U.S. military systems. The U.S. DoD's Joint Tactical Radio System (JTRS) program aimed to solve this problem and evolved from a loosely associated group of radio replacement programs to an integrated effort to network multiple platforms and users where it mattered most – at the last tactical mile.[1]

When making the decision to develop the STT, ViaSat and Harris not only looked at the most critical requirements of the JTRS Airborne & Maritime/Fixed Station (AMF) program, but also the communications needs of the warfighter in the adjacent space of the primary Link 16 network. This led to the development of a more SWaP efficient and economical product that could also meet the needs of other disadvantaged users at the tactical edge.

It was also important to leverage as much of the practical hardware, software and information assurance technology of the participating companies as well as the software-defined waveforms currently implemented in other products. This not only assured interoperability with existing/legacy and next-generation radios, but it also minimized the cost of development.

1 https://en.wikipedia.org/wiki/Joint_Tactical_Radio_System#JTRS_Program_of_Record

In addition, key trades were made to streamline design and development, resulting in a product that was well-suited for SWaP-constrained environments:

- Single input power source (28 VDC)
- Integrated RF power amplifiers for each channel in a single Line Replaceable Unit (LRU) design
- Optimized power levels (63 W for Link 16 and 5 W for VHF/UHF)
- Simplified Information Assurance (IA) architecture
- Use of standardized digital interfaces (Ethernet and serial) for use with multiple computers in a wide range of applications

03. Real-World Applications

Evolution of Link 16 Technology

As with many system solutions, SWaP-C has traditionally limited Link 16's application to high value, large operational platforms. Since the 1990s, Link 16 has proliferated from small numbers on capital ships and Command and Control (C2) aircraft to over 10,000 platforms deployed worldwide. However, even with the further reduction of SWaP-C to a 55 pound terminal, there are still many front line and tactical edge platforms that need to be accounted for in the COP that cannot afford even half of that weight and size.

FIGURE 2. Reduced size of the STT provides SWaP-constrained platforms with the same Link 16 access as legacy Link 16 terminals, but at 1/3 the size and weight with an added capability of simultaneous VHF/UHF LOS networking.

Designed for flexibility, the STT KOR-24A meets the needs of users who have SWaP constraints, but need the information available on Link 16 networks and either wideband UHF or legacy VHF/UHF. Helicopters, Unmanned Aerial Vehicles (UAVs), ground vehicles, small boats, and small aircraft now have access to both air and ground (friendly and enemy) situational data and can provide secure and reliable target data to the network.

This flexibility recently helped the U.S. Army upgrade the latest version of its AH-64E Apache helicopter. The STT KOR-24A enables the AH-64E Apaches to switch waveforms and network connections on the fly (Link 16 on one channel; SRW on the second channel), merge disparate networks, and deliver SA as the mission unfolds.

FIGURE 3. The AH-64E Apache is the world's most advanced multi-role combat helicopter. While in flight, the STT will provide simultaneous communication, voice or data, on two key waveforms for the battlefield of the future: Link 16 and SRW.

While it is unlikely that a mission will change waveform requirements during the course of a mission, it is entirely likely that a platform may have differing communication requirements based on its particular role. The flexibility of waveform configuration also means that the STT can provide a logistically common solution for Link 16 needs across multiple applications.

Another key requirement for SWaP-constrained platforms is the need for multiple sources of communications pathways. The increased SA/C2 provided by two-channels of communications can address specific mission requirements such as:

- Direct communications with ground networks for SA of friendly locations to significantly decrease the likelihood of fratricide incidents
- Link 16 data that can be linked via satellite uplinks and downlinks (like UHF Demand Assigned Multiple Access TACSAT) to transmit information across continental distances from a variety of air and ground platforms
- The ability to carry civilian voice and digital radio frequencies, allowing the U.S. National Guard to communicate with local agencies and organizations during disaster response and other homeland defense and security situations

With the STT KOR-24A, the two channels operate simultaneously and are security isolated. This allows SECRET Link 16 SA/C2 to be constantly monitored while the second channel can operate on UNCLASS APCO-25 for Civilian Police and Fire Services, SECRET Advanced Networking Wideband Waveform (ANW2C) for U.S. Marine Corps Operators, CONFIDENTIAL Ground SA Net or Clear Voice for Civil Air Traffic Control.

Beyond meeting the need for simultaneous voice and data communications, the STT also solves the U.S. DoD’s long-standing space problem on legacy platforms. When new communications equipment is installed, it must fit where the older systems were installed. This can cause weight and power issues when the replacement gear is heavier and more power-hungry than its predecessor, especially when there is limited onboard space. Now with a single radio with two channels, this effectively allows the DoD to remove an existing radio and have additional networking capability at no extra power and weight costs.

FIGURE 4. Weighing approximately 16 pounds and having a volume of approximately 300 cubic inches, the STT is designed to fit into a variety of platforms with tight space and power needs.

Other platforms have found that they can satisfy their need for Link 16 participation with the STT KOR-24A with minimal installation effort (and cost) and defer the activation of the second channel until the next communications need arises. Then the next phase of integration is much faster and cheaper since the STT KOR-24A is already installed and qualified on the platform and it is now a matter of integrating and testing the functions of the second channel.

When considering all of the major costs associated with an equipment upgrade, it is not the expense of radio hardware or software, but the effort involved to integrate the system onto a platform. The AH-64E Apache used a similar, two-phase approach to significantly reduce the integration cost of SRW, saving the U.S. Government nearly $250M over the life of the program. Having two channels capable of accessing a variety of military networks and waveforms allows integrators to do more at once. This is especially important for SWaP-constrained platforms that have multi-mission, multi-role requirements.

04. Conclusion

The key to successful employment of the STT KOR-24A on SWaP-constrained platforms is two-fold.

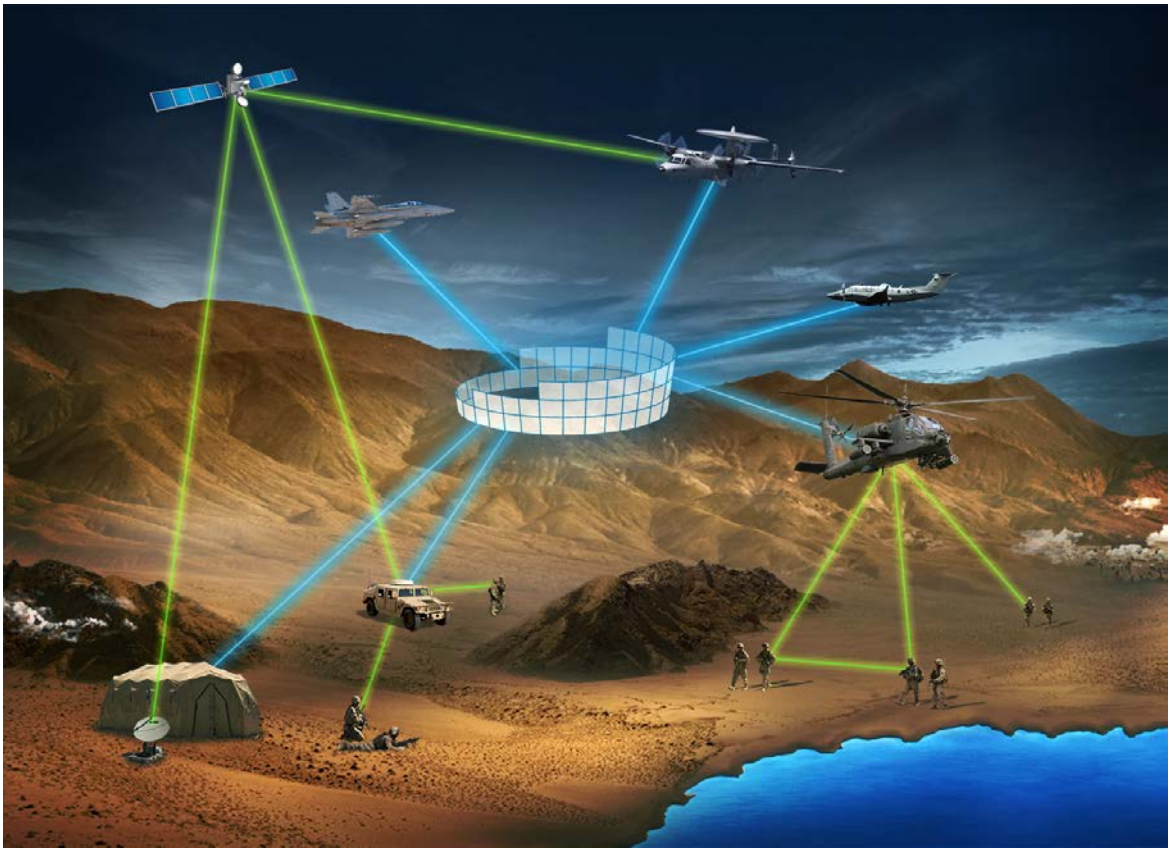

FIGURE 5. The STT is currently in service on a wide variety of fixed and rotary wing aircraft across all military services and has exceeded 1,000,000 operational flight hours in Link 16 networks to date.

Leveraging commercial innovation for defense needs

While the STT was developed to carefully meet the DoD's needs for a multi-channel radio, it was not developed as part of a formal program. The radio is centered on a commercial model and best practices can be adapted to meet strict performance and environmental requirements, while simultaneously ensuring a cost-effective development and support structure. Customer, or rather, warfighter feedback, allows for quick modifications to match the military services' needs. Terminals in the field can also be upgraded at a substantially faster rate than the normal acquisition process.

Flexibility and future proofing with a software-defined radio

As new features are developed, the technical baseline of the radio is adaptable and switching to additional waveforms and networks can quickly be accomplished – as simply as if one were changing the channel on the television.

Other customer driven enhancements include upgrades to support new BLOS waveforms such as UHF DAMA SATCOM as well as a variety of new Link 16 capabilities enabling broader operations on protected participation group nets, adding another layer of security.

With government cryptographic modernization efforts, security enhancements will have a programmable approach and will be certified and accomplished via software download as well.

With the STT KOR-24A, SWaP-constrained platforms that have traditionally lacked Link 16 access can now see a complete air/ground COP with all operators and assets accounted for – helping to remove the fog of war and significantly reducing the risk of blue-on-blue engagements.

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