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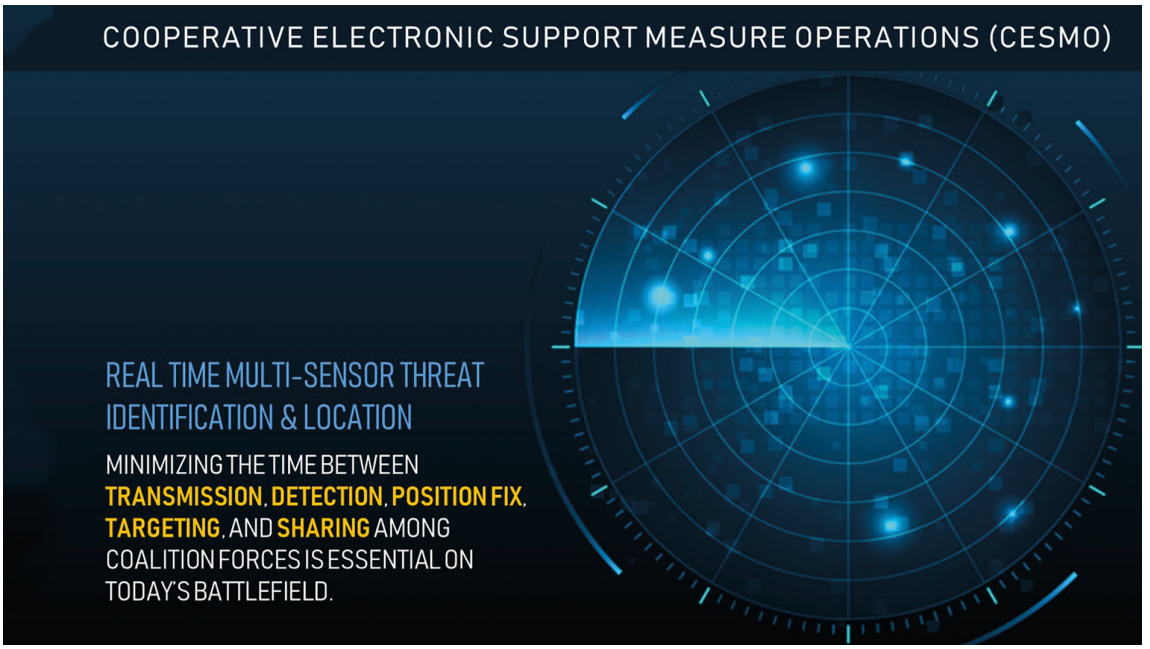
Strength in Numbers

CESMO and the Power of EW Interoperability



◁ *The image shows the concept of CESMO in action. (All images via Curtiss-Wright Defense Solutions)*

Knowing the precise location of threats and friendly forces is essential to increasing warfighter survivability. Previously, detection of threats was typically a task performed by a single surveillance aircraft, flying over battlefields to capture RF signals and use basic triangulation methods to determine threat locations and types. Warfighters in the field would receive details about the threats, such as the locations of missile launchers and radar systems, in a spreadsheet, often hours or even days after the signals were collected. These reports were manually generated, and often contained errors and duplicate or ambiguous data. On today's modern battlefield our adversaries have developed smaller, more sophisticated, and more mobile communications equipment and weapons. Because of this, threats are constantly moving, and RF emissions often occur in very short bursts, which presents a challenge to detection and renders the legacy methods obsolete. As a result, technology and tactical data networks have evolved considerably to offer new battlefield tactics, completely changing the game for NATO when it comes to Electronic Support Measures (ESM) and Electronic Intelligence (ELINT).

To be effective on today's battlefield, the time between transmission of an RF signal and subsequent detection, position fix, and targeting must be as close to real-time as possible, and the digital sharing of that Electronic Warfare (EW) data must be interoperable between coalition forces. Cooperative Electronic Support Measure Operations (CESMO), a new NATO tactical data link (TDL) standard for exchanging high fidelity EW information, provides NATO coalition forces with the visibility for this critical task. Our adversaries have invested much effort and expense to research and develop technologies to dominate the EW spectrum. CESMO provides a powerful tool, available today, to help manage the EW spectrum and offset progress made by adversaries.

CESMO is adopted in STANAG 4658 and Allied Engineering Documentation Publication 13 (AEDP-13) to support EW and Electromagnetic Operations (EMO). It involves platforms equipped with sensors capable of detecting RF emissions from all types of ground, air, and sea platforms – hostile and friendly. Friendly platforms in the area can use the protocol and exchange collected data within seconds, allowing a real-time position fix of these signal sources.

While its potential remains greatly underutilized, CESMO has begun to play an increasingly important role in NATO EW and EMO. The protocol is continuously enhanced through use by a growing community of NATO member countries, including Germany, the United Kingdom, France, Spain, Italy, Norway, the Czech Republic, Greece, Turkey, and the Netherlands, that are actively exchanging CESMO information today. In fact, the protocol was successfully used in more than 20 trials and campaigns in 2020 and 2021.

CESMO As a Force Multiplier

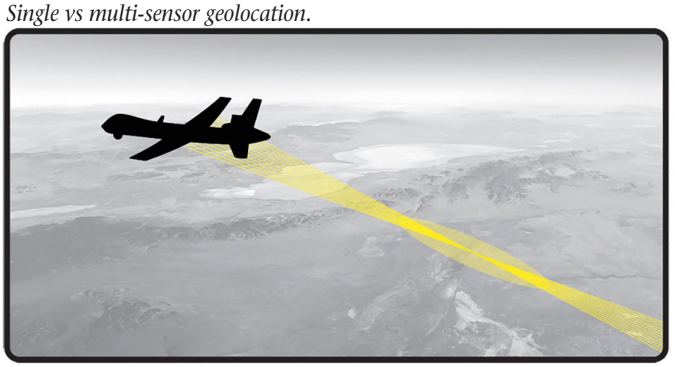
To date, no US airborne or naval platform currently deploys this powerful technology, yet CESMO can significantly enhance TDL capabilities for EW by providing much better information on US Air Force and Navy platforms. What's more, the power of CESMO increases dramatically as the number of participants increases, which means that both US and coalition partners will benefit from implementing the protocol on as many platforms as possible.

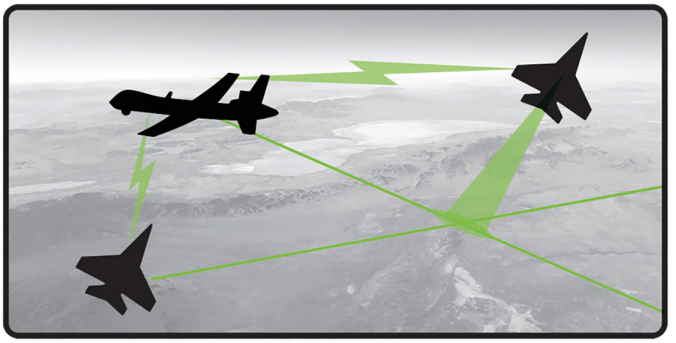
CESMO is based on the principle that multi-sensor geolocation increases accuracy of detection, positioning, and identification, compared to current triangulation practices, while at the same time reducing the time and manual effort required to do so. Sharing CESMO information gives warfighters a consistent and cohesive view of threats and friendly forces, resulting in a more complete and accurate common operating picture (COP). This knowledge increases cooperative opportunities among joint forces to make time-sensitive targeting decisions, and helps to avoid accidental targeting of friendly forces. Without a cohesive COP, each participant has a different, and far smaller, window into the overall battlefield situation, increasing risks for all.

Low Barrier to Entry to Communication

Because CESMO is much less costly to implement compared to Link 16, Link 11, or Link 22, it can be used on more platforms and deployed more rapidly. One advantage of CESMO, in contrast to other data links, is that it is IP-based and can be exchanged between coalition platforms using commonly available UHF/VHF radios. Ground troops, for example, already carry radios that can send and receive encrypted data to support CESMO.

Single vs multi-sensor geolocation.





In situations with no access to Link 16, CESMO enables the use of much more inexpensive processing software, making the barrier of entry to communication very low. For example, an airborne participant with just a laptop and a walkie-talkie can connect digitally, with no need for any sensor integration to participate in information sharing. At the most basic level, a person might be looking out the window of a civilian aircraft, see something of interest in a particular direction, and simply type it manually into the system and send it out. At the other end of the spectrum, CESMO can be implemented as a fully integrated system. In one example, the German Tornado has had Link 16 onboard for some time, but the additional coordination of CESMO enabled the platform to greatly augment its capabilities.

Another advantage of CESMO is its simplicity. CESMO uses a dedicated network whose only function is the coordination of EW information. Other than the ability to chat and send position data, the bulk of the data carried on the CESMO network is dedicated to exchanging lines of bearing, geolocation and emissions. In comparison, Link 16 must support many different roles simultaneously and cannot always be relied upon to support high rates of EW information exchange.

To help drive widespread adoption, the CESMO protocol is designed from the ground up for ease of integration, ease of use, low cost, and broad applicability across a wide range of electromagnetic operations.

- CESMO procedures are developed in a way that ensures minimal disruption of the warfighters' normal mode of operation.
- CESMO can operate on low-bandwidth, bearer-agnostic radio networks by employing the same variable message principles as the Variable Message Format (VMF) protocol to minimize message size.
- CESMO can be easy to implement on existing (in service) ground, air, and sea platform using existing radios in a peer-to-peer architecture.

Getting the Big Picture

While every NATO member country has its own threat detection and geolocation technologies, it is a challenge for any single country to gather enough information to enable a complete tactical picture that covers large areas. The only way to resolve this challenge is the rapid exchange of standardized information about emissions on the battlefield. While U.S. forces already use TDLs, such as Link 16, Link 11, and soon Link 22, to securely share information across platforms and EW assets, many platforms and EW assets used in ESM operations don't support Link 16 communications. That's because Link 16 (and even Link 22) is simply too time-consuming, complex, and expensive to implement across all EW assets.

By using CESMO in combination with other TDL types, the U.S. Navy and Air Force can extend situational awareness and enhance time-sensitive targeting decisions. For example, in addition to improving tactical situational awareness and survivability, CESMO enables naval forces to increase their exploitation of the electromagnetic spectrum by contributing to the Electronic Order of Battle (EOB) and Joint Intelligence, Surveillance, and Reconnaissance (JISR).

How CESMO Operates

The CESMO Fusion and Coordination (CFC) function shares details about threat location and type. In general, the CFC operator periodically sends a request list to every CESMO Collector Asset (CCA) on the network containing emitters of interest on which to report when detected. When a CCA detects an RF signal of interest, it sends a message to the CFC indicating the identification, line of bearing, and parameters of the signal. The CFC fuses the signal information from many collector assets (unlike triangulation approaches that use just one or two assets), determines a high precision location, identifies the emitter based on predefined EW parameters, and then shares that information with everyone on the CESMO network. If a CCA detects a signal not requested by the CFC, the CCA can send the signal information to the CFC. The CFC may update the request list if the signal is of interest.

With its ability to almost instantly geolocate RF-emitting assets, CESMO can be used to detect a variety of EW threats, including:

- Radar: geolocating surface-to-air missile sites
- Navigational warfare: geolocating GPS jammers
- Communications: geolocating VHF and UHF radio signals
- Electro-optical and infrared (EO/IR): geolocating infrared target illuminators

CESMO and Link 16 Working Together

Because Link 16 is also often used to enhance situational awareness in US and joint missions, it's particularly important to share the CESMO information about these threats on the Link 16 network. CESMO and Link 16 can be used together (Figure 1) to increase situational awareness. The platforms receiving both message types have precise geolocation information from the CESMO network as well as EW product information, parameters, and land point or track information from the Link 16 network.

When CESMO information is translated and provided to EW systems on platforms that use Link 16, those systems automatically display the details of the detected tracks including the presence and positions of hostile and friendly forces the aircrew did not know about. The crew can now quickly and precisely evade threats, make more informed decisions, and more effectively interoperate with coalition forces on the CESMO network. Similarly, warfighters from ground vehicles are also now aware of friendly and hostile threat positions they could not see or detect due to topography or other physical barriers.

The Benefits of a TDL Gateway for CESMO

As US Forces evaluate CESMO solutions, it's important to understand the full value that CESMO provides and how that value can be enhanced and extended through use of an intelligent gateway that can translate between CESMO and Link 16 and other TDL types. An intelligent gateway provides warfighters with access to information that comes in on all communications networks so that all networks behave like one. The warfighter does not need to know that some of the assets and information may not be native to their employed data link. Without

◁ *The TCG HUNTR is an intelligent translation gateway for multiple datalinks.*

the gateway, someone has to manually share the critical CESMO information with these warfighters, delaying the data, creating unnecessary distractions, and introducing the risk of errors on each end of the communications.

Today, Curtiss-Wright's TCG HUNTR TDL Hub and Network Translator is the only fielded and operationally-tested CESMO data link gateway available on the market. The process of translating information to and from Link 16 networks and CESMO networks is a complex task. Other gateways implement only certain aspects of the Link 16 and CESMO standards. However, these partial implementations severely limit interoperability. For a cohesive COP, the gateway must provide full, bidirectional interoperability with Link 16 and CESMO networks and devices. Unfortunately, most legacy TDL gateways are a challenge to connect, configure, and use, with some requiring at least half a day to connect and configure, and also require expert assistance from the gateway vendor to set up.

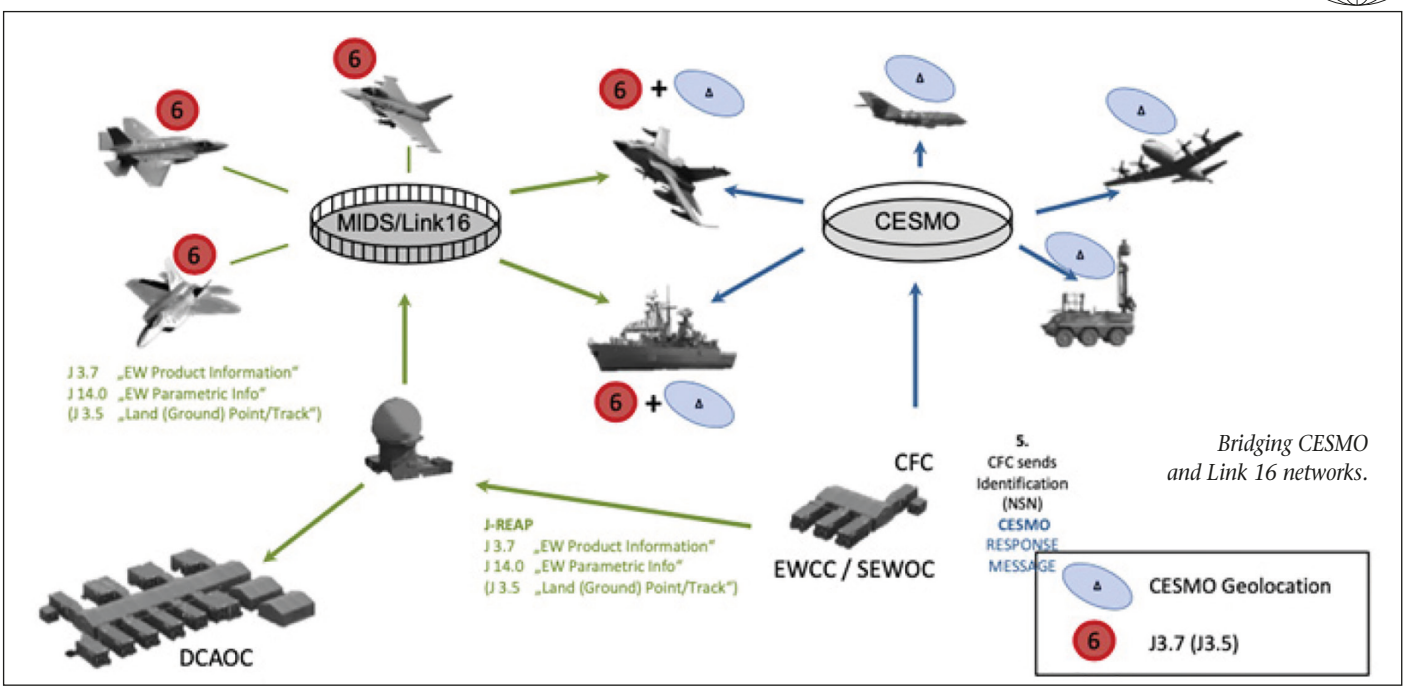
To meet warfighters' needs on the battlefield, TDL gateways must be designed much like an appliance would be, hiding the complexity of TDLs and data translation behind the scenes. The gateway should provide push-button startup so the system is operational within a few seconds and automatically connects to all TDL types. Radios must be automatically configured with no expert input. Even error messages must be easy to understand. This ease of use must carry through all aspects of TDL gateway operation to ensure warfighters can focus on mission tasks rather than the enabling technologies.

Also extremely important is the way data translations are presented to warfighters. Warfighters don't care that communications equipment is sending a CESMO message to a device that communicates using Link 16. They care that the information exchange is successful, fast, and gives them the information they need in an easy-to-understand format. To provide trustworthy translated information that's easy for warfighters to understand, TDL gateways must translate the concepts being communicated rather than the individual TDL messages. These conceptual translations must be automated, supported across multiple TDL types, and provided in context. That means the TDL gateway must fuse information from all data links with previously received information and then send the appropriate information, in context, to the other TDLs.

Finally, TDL gateways must be provided in a form factor that is suitable for any location on the tactical edge of the battlefield. For example, a warfighter in the field should be able to run the software on a standard laptop or remotely operate it without a user interface on an unmanned aerial vehicle (UAV) that can be put in an advantageous position in line-of-sight of the participants for an extended period.

Example of a TDL Gateway

While the CESMO standard is written by NATO member countries and government agencies, Curtiss-Wright has been invited as an expert contributor to the standard and is heavily involved in testing hypotheses and different aspects of the protocol to ensure they function as defined. Curtiss-Wright's TCG HUNTR is an intelligent translation gateway for multiple TDLs, including CESMO, Link 16, VMF, CoT, GPS, Situational Awareness Data Link (SADL), and Joint Range Extension Applications Protocol (JREAP). TCG HUNTR is extremely fast and easy to set up and use at the tactical edge of the battlefield and other military environments with minimal personnel and training, and almost no expertise. This simplicity allows warfighters to reliably communicate and access data in a natural and intuitive way across CESMO, Link 16, and other networks with no need for expert knowledge of the technologies or complexity behind the scenes. It provides every participant with instant access to critical information, at their fingertips, that helps to increase survivability.



Bridging CESMO and Link 16 networks.