

Tactical Data Link Translation Made Easy - What It Takes to Get It Right

Introduction

Military organizations around the world rely heavily on tactical data links (TDLs) to securely and reliably share mission-critical information among air, ground, and sea platforms. Because different devices use different TDL types for communications, a highly sophisticated TDL gateway is needed to translate information across all of the various link types. But, there's a huge disconnect between historical TDL gateway designs and modern military requirements. As a result, TDL gateways that were designed for the way the military operated years ago are an extremely poor fit on present-day, technologically advanced battlefields.

TDL gateways are notoriously difficult and time-consuming to set up and configure. They're also extremely complicated to operate. These legacy gateways were intended to be used behind the scenes at Air Operations Centers (AOC) and Control and Reporting Centers (CRCs) by teams of highly experienced experts working in a quiet environment. They were not designed to be used by warfighters who are actively engaged in mission activities at the tactical edge of the battlefield.

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Today's warfighters are digital natives who grew up surrounded by technology. They expect ready access to easy-to-use technologies in all aspects of mission activities. These warfighters were trained to execute on their role-related tasks and mission objectives, not to operate ultra-complex radio and computer equipment. And, they cannot possibly operate such equipment while simultaneously engaging in mission activities.

If equipment is not fast and easy to set up and operate in the field, there's a good chance warfighters will simply leave it behind when they head out on missions. Executing missions without access to vital equipment such as a TDL gateway puts warfighters' lives and mission success at risk. So does taking the time to try and operate convoluted and difficult equipment at the tactical edge of the battlefield. It seems like an impossible choice to make. But, in the end, warfighters have no choice at all. It simply doesn't make sense for warfighters to carry the weight of equipment they don't have the knowledge, skills, or time to operate.

Modern TDL Gateways Must Resolve Multiple Issues

When military equipment is so difficult and time-consuming to operate that it gets left behind, the design problems are typically addressed far more quickly than they have been with TDL gateways. The primary challenge in this case is that Link 16 and other TDL formats are extremely complex to work with. Most gateway vendors have not even attempted to address the many complexity issues with TDL translation. Some simply recommend that highly trained personnel accompany the gateway into the field. Other vendors have taken the opposite approach and have focused only on addressing very narrow and specific issues. Or, they've oversimplified TDL gateways to the point where they've restricted interoperability among link types.

Near-Instant Operation Is the First Steps

Today, it can take at least half a day to connect and configure a TDL gateway. Some systems require three or four days of effort. Any solution that requires this level of time and effort to become operational is unusable in busy field environments.

Warfighters need a TDL gateway that is so easy to start up that anyone with any level of training can simply push a button to start the gateway and have the system become fully operational within a few seconds. The gateway must automatically set up connections to any and all data links, including management of radio configuration settings, with no additional effort or input by experts.

Usability and Flexibility Must Be Improved

The ease of use that push-button startup and automated configuration enable must carry through all aspects of TDL gateway operation. One of the main reasons TDL gateways are so extremely difficult to use is because all of the complexity associated with connecting and configuring TDLs and reading translated messages is exposed to end users. And it's exposed in a way that's very difficult to understand and navigate.

TDL gateways must be designed much like an appliance would be, hiding the complexity of TDLs and data translation to deliver information to warfighters in a clear and easy-to-understand format. This is the only approach that will ensure TDL gateways can be easily used by warfighters who are not experts in

TDLs, communications protocols, or communications equipment. The design must also include an intuitive graphic user interface (GUI) that presents the pertinent mission-specific information in a highly visible and simplified way, similar to the user-friendly apps that warfighters are so familiar with.

TDL gateways must also be developed in a form factor that is suitable for any location on the tactical edge of the battlefield. This requirement includes the ability to operate in unmanned aerial vehicles (UAVs) with line-of-site and reasonable proximity to ground, air, and sea platforms.

Complete, Accurate, and Up-To-Date Translations Are Essential

Once the TDL gateway is operational, it must provide complete, accurate, and up-to-date translations between multiple link types. With the complexity and variety of TDL types in use, this is not an easy requirement to meet.

While link types such as Variable Message Format (VMF), global positioning system (GPS), and Cursor on Target (CoT) are relatively straightforward and don't require extensive understanding of military standards, Link 16 TDLs are the exact opposite. These extremely complex TDLs are based on military standards that are thousands of pages long and include numerous rigid rules for implementation. But, Link 16 is the most prominently used TDL type in the world, so the way the TDL gateway supports the high-speed digital link and the data it carries is extremely important to warfighters.

While it can be tempting to deal with Link 16 complexity by implementing only certain aspects of the communication standard, partial implementations severely limit interoperability with other link types. Full interoperability with as many TDL types and devices as possible is necessary to avoid stove-pipe, or point, solutions that only address a few TDL gateway challenges.

Context Is Everything

The way data translations are presented to warfighters is also extremely important. Warfighters don't care that communications equipment is sending a VMF message that will be received on 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.

For example, it takes too much valuable time to decipher information that's presented as a single, long text string separated by slashes. It's also very difficult to establish context for the information when it's translated literally, word-for-word. It's the same problem people have when someone is speaking in a foreign language and each word is translated exactly as it is spoken. At best, literal, word-for-word translations are very difficult to understand. In many cases, they don't make any sense at all.

To ensure translated information is easily understandable, TDL gateways must translate the

concepts being communicated rather than the individual words. These conceptual translations must be automated, they must be supported across multiple TDL types, and they must be provided in context. The TDL gateway must listen to incoming information on all TDLs, put the information into context with previously received information as well as information provided on the other TDL types, then send the appropriate information, in context, on outgoing TDLs.

Taking TDL translations to this level requires significant TDL expertise on the part of the TDL gateway developer because there is no standard that fully defines how this should be done.

A Holistic Approach to TDL Gateway

Development Is the Only Way to Address All Issues

To resolve technical and operational challenges of the magnitude described in the previous section, TDL gateway developers must adopt a very broad and open-minded approach that considers the entire system, not just specific functions. They must be very careful they don't predetermine what the appropriate solution to an issue is, or is likely to be, before exploration begins. With a holistic approach, TDL gateway developers can stimulate out-of-the-box thinking that reveals unique and unexpected approaches and solutions that could not have been preconceived.

Imagine a group of car designers thinking their ultimate goal is to design a faster, more efficient car, but discovering along the way they actually need to design an airplane to meet their end users' needs. This is the type of possibility and change of direction that TDL gateway developers must open their minds to.

To get TDL gateway design right, developers must focus on human-centered design principles that include the end user in the design process. They must step into the warfighter's world, understand the tasks they need to execute in the field, observe their actions in military exercises, and talk to them at length and in depth about the challenges they face on a daily basis. Gateway developers also need to conduct extensive consultations with warfighters to determine exactly what they need the technology to do for them and the best way for the information to be presented to them.

Once developers fully understand warfighters' challenges and requirements for TDL gateways, an iterative process that is based on agile development methodologies and includes prototypes is needed to ensure the gateway resolves every key technical challenge and provides the level of usability required. Testing prototypes with end users in real-world environments is the best way to validate functionality and usability during development. To get the design right, this iterative design and redesign process will likely take several years of effort.

A Full Link 16 Implementation Is a Must

TDL gateway developers must have expertise in all of the commonly used TDL types. But, Link 16 expertise is the most valuable when developing a TDL gateway for the modern military. It's also the most difficult to obtain and cannot be acquired in a short period of time. Link 16 experts with the knowledge level needed for TDL gateway development have studied and implemented the technology for years, often decades.

The TDL gateway must implement all Link 16 messages, not just a subset, despite the difficulty of the task and the time required to do it properly.

To fully implement Link 16 and ensure accurate and up-to-date data translation between Link 16 and other TDL types, the gateway developer must understand the details of Link 16 operation as well as the associated military standards. The military standard for Link 16 is more than 10,000 pages long. There is complicated interplay between Link 16 messages that must be understood and implemented, and very rigid rules that must be precisely followed.

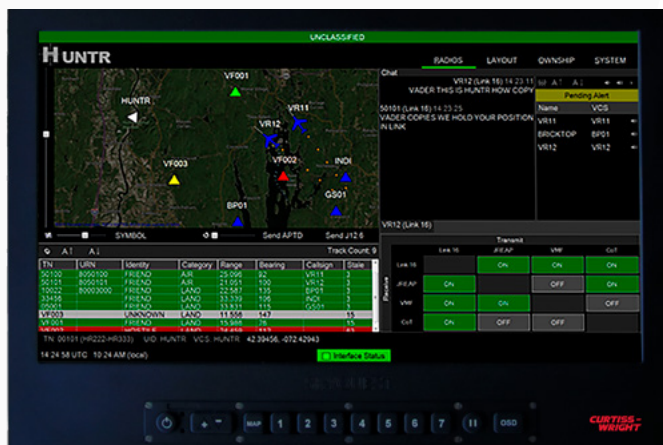
Understanding Link 16 in-depth is worth the effort. With a full Link 16 implementation, TDL gateway developers can make communications across different TDLs far more user-friendly than they would otherwise be. This capability has significant benefits for warfighters.

Consider a VMF K02.33, or 9-line, message that a Joint Terminal Attack Controller (JTAC) would send as part of communications with an air support crew.

The 9-line message includes logistical information that's critical to the success of the mission and the safety of the air crew. However, because there is no direct translation from VMF K02.33 to Link 16, most TDL gateways simply send a free text message of the entire K02.33 message on Link 16, using slashes to delineate specific pieces of information. This simplistic format means the air crew has to comb through the entire text message then manually enter the information into their onboard computer. This requirement takes time and focus away from the mission and could lead to input errors.

With a full Link 16 implementation, the VMF K02.33 message can be broken up and translated into multiple Link 16 messages, such as a J3.5 Land Point or Track message, a J12.0 Mission Assignment message, a J12.4 Controlling Unit Change message, and other messages as needed to fully communicate the message intent. Because the information is now in Link 16 format, it goes directly to the onboard computer. The air crew no longer has to think about the message format or take the time to manually reenter information. They can focus fully on the message content and what it means to their mission activities.

An Automated, User-Friendly TDL Gateway Is Available



The HUNTR TDL Hub and Network Translator is an intelligent translation gateway for multiple TDLs. It took years of extensive research and effort to develop, and it leverages almost two decades of knowledge and expertise in Link 16 technology and messages. It is the only TDL gateway on the market that delivers all of the capabilities and benefits warfighters need:

- Single-button startup, including automated link connections, in seconds
- A highly intuitive graphical user interface that clearly indicates connectivity information flow and filtering of traffic
- Up-to-date and accurate contextual translations of relevant link data that take bandwidth limitations into account rather than awkward and cumbersome word-by-word translations that can consume high amounts of bandwidth and result in information overload
- Support for a wide variety of link types, including Link 16, VMF, CoT, Cooperative Electronic Support Measures Operations (CESMO), GPS, Situational Awareness Data Link (SADL), Joint Range Extension Applications Protocol (JREAP), Serial-J, and Socket-J
- A complete Link 16 implementation

The simplicity and automation the HUNTR TDL Hub and Network Translator provides means it is the only TDL gateway that can be successfully used at the tactical edge of the battlefield and other military environments with minimal personnel, minimal training, and almost no expertise required. Curtiss-Wright's unique understanding of warfighter requirements, deep technology expertise, and long history of industry leadership and innovation have made our company the trusted, proven leader in defense and aerospace. With the HUNTR TDL Hub and Network Translator, we're continuing to demonstrate our commitment to resolving the most difficult challenges warfighters face today and tomorrow.

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