

Simplifying TDL Integration on Naval Platforms

More Efficient and Cost-Effective TDL Integration Is Needed

The need for increasingly integrated communications networks has become a key objective of most navies over the past few years. The rationale being that more integrated networks will make it easier for all naval assets to share tactical intelligence with each other and with other branches of the military during any operation.

As noted by the commander of the United States Marine Corps Combat Development Command, “If you look at intelligence, if you look at the threat, if you look at budgets that will be flat or declining, there really is only one way you can go — a truly integrated naval force in support of the joint force.”¹

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Interoperable tactical data link (TDL) systems are essential components of fully integrated communications on both manned and unmanned naval platforms. All naval command, control, and communications (C3) systems rely on TDL systems and standards to either transmit, relay, or receive critical tactical data that will contribute to a common, mission-critical view of surface, subsurface, air, and space environments. These systems enable tactical data to be shared between operators in real time on manned platforms and they enable data from unmanned platforms to be integrated into the data stream to command and control stations. With so many crewed ships, submarines, unmanned underwater vehicles (UUVs), and aircraft in their fleets, navies need a multitude of varying TDL gateways, translators, and support systems to enable interoperable communications between personnel on each ship, with other assets, and with command and control centers.

Given the critical importance of TDL systems in naval operations, it's not surprising that the integration of TDL gateways and translators on every naval platform is a key consideration in naval commissioning, building, deployment, and maintenance programs. Unfortunately, the integration of TDL systems has typically been a lengthy, costly, and resource-intensive custom process. There are multiple TDL hardware and software solutions from multiple vendors and many different TDL versions that must be integrated on each platform. This increases the complexity of the integration process and creates interoperability challenges that require additional engineering time and effort. As a result, the lengthy TDL integration process for each naval program has often left naval assets lagging behind the most advanced TDL standards and struggling with interoperability issues long after platforms have been deployed.

As navies move to build out their fleets with more assets that can operate seamlessly with air force and army command centers, as well as joint international task forces, the integration and deployment of TDL systems will need to be more efficient and cost-effective. But this can only be achieved by leveraging the advantages of truly interoperable TDL solutions built from commercial off-the-shelf (COTS) components that reduce the need for custom engineering during the integration process.

Complex TDL Requirements Create Interoperability Challenges

Two things have contributed to the complexity of TDL systems on naval platforms:

- The increasing use of sensors that collect and transmit a variety of mission data.
- The sheer volume of information that needs to be shared.

Since every naval asset needs to have access to all of the available sensor data, naval programs need to keep pace with the evolution of TDL standards to support the real-time sharing of mission-critical information.

Early in the TDL evolution process, Link 11 enabled the exchange of digital data, such as radar tracking information beyond line of sight (BLOS) with either high frequency (HF) or ultrahigh frequency (UHF) radio systems. But, although Link 11 allowed information to be disseminated more quickly, it didn't have the capacity needed to enable operators to share the increasingly large volumes of information collected by more sophisticated sensor and surveillance systems.

Link 16 emerged to address the requirement for more bandwidth, speed, and jam resistance for encrypted communications. With two channels of digital voice, and support for text messages and image data, Link 16 allows users to share tactical data in near-real time. Today, Link 16 is the main standard used by most naval communications systems. It is one of the digital services of the Joint Tactical Information Distribution System/ Multifunctional Information Distribution System (JTIDS/MIDS) in NATO's Standardization Agreement (NATO STANAG 5516/MIL-STD 6016). And it is a key communications standard used by all branches of the U.S. military.

Meanwhile, Link 22 has emerged to complement Link 16 and will eventually replace Link 11 for BLOS communications in the HF and UHF bands. It offers automated and simple management processes that make it easier to use than both Link 11 and Link 16.

But, given its flexibility and widespread use, Link 16 is the backbone of multi-TDL networks (MTNs), which aggregate similar and dissimilar TDLs together through gateways, translators, and correlators to enable interoperable communications by systems built around different TDL standards. Complex MTNs may include a variety of TDLs, as well as additional interfaces for other data link standards, such as the Situation Awareness Data Link, the Army Tactical Data Link, and NATO Link 1.

Multiple TDL Standards Make Integration Difficult

While each new or revised TDL standard has brought more advanced capabilities to address the tsunami of tactical data collected by sensors, systems built on previous standards are still in use. Therefore, it is not unusual for naval platforms to have multiple TDL systems on board, each based on a different standard. For example, an aircraft carrier will have multiple TDL systems to support a variety of communication requirements:

- Link 11 and Link 22 systems for situational awareness
- Link 16 systems for electronic warfare, imagery, free text, mission management, voice, friendly ID, and command and control
- Link 16 for fighter-to-fighter exchanges
- Variable Message Format (VMF) systems for communication with fighters

New revisions to a standard such as VMF bring additional complexities. For example, previous versions of the VMF standard are incompatible with other versions. So, not only are there multiple standards, there are multiple, possibly incompatible, versions of each standard.

The systems that support all these TDL standards must interoperate with each other, as well as other vessels, command and control operations, other branches of the military, and joint international task forces. This has created significant integration challenges because the integrator must contend with multiple components within each data link system, which may include radios, data terminal sets, crypto devices, antennas, connection cabling, and user interfaces. The integration challenge is exacerbated by the fact that TDL components and systems are usually supplied by different vendors.

With many different types of on-board TDL systems supplied by different vendors, the typical TDL system integrator does not have the depth of knowledge, experience, and expertise needed to deliver a custom integration of all the TDL systems into a cohesive, interoperable whole. To get it right, the integrator must have extremely deep expertise in each of the TDL technologies. This is highly unlikely given the complexity of each TDL standard.

For example, the military standard for Link 16 alone is more than 10,000 pages long, there is complicated interplay between Link 16 messages that must be taken into consideration, and very rigid rules that must be precisely followed to create an interoperable Link 16 product.

Given the high level of complexity involved, most vendors have either not attempted to address all the communications challenges with their systems or have addressed specific challenges in a very narrow way that limits key capabilities, such as interoperability. As a result, the need to ensure all TDL systems are interoperable falls on the naval platform integrator. In an attempt to address the challenge, the integrator must add engineering time and resources to enable a custom TDL integration that supports all the disparate TDL systems and standards.

Unfortunately, because of the complexity of the process it can take years to integrate a fully interoperable TDL system on an aircraft carrier. And creating a viable communications network that supports all TDL standards and disparate systems can take even longer. Obviously, the costs and risks associated with this level of custom engineering and integration increase time to deployment and are no longer viable.

Training Requirements Increase Costs

Program risk, cost, and time to deployment are further increased because personnel also must be trained on the use of all the systems. With so many disparate systems, training times can balloon out of proportion because of the different types of training needed. For example, for a single TDL:

- Electronic technicians have to learn how to work with TDL data from sensors.
- IT technicians have to learn how to manage TDLs that support intership networks.
- Communications personnel have to learn how to use TDL radios.
- Operations specialists have to learn how to operate the data link.

These requirements are compounded when multiple different TDLs are in use, increasing the training and operator knowledge requirements.

In most cases, personnel don't train together. This complicates the interoperability challenge because personnel are trained as specialists in one type of TDL standard or system and are often not aware of how the other systems operate or how they are supposed to interact. When they finally do get on the ship and train together, they go through near sight exercises and over-the-shoulder training that does not provide the in-depth, hands-on knowledge needed to enable seamless TDL communications. Ultimately, this causes confusion for everyone involved, complicates fleet operations, and hampers joint operations.

Custom Integration Complicates Maintenance Processes

Beyond deployment and training, the custom TDL integration process also has an impact on ongoing maintenance.

Information sharing requirements continue to evolve and TDL standards change every year or two to address those requirements. With every new change or update, the software that enables TDL-based communication on all platforms must be updated. At the same time, personnel must be trained on the updates to the standards. And in some cases, hardware updates may be needed to ensure systems can support the updated standards.

But because onboard TDL infrastructures were created through a custom integration process of multiple disparate components from different suppliers, ongoing maintenance can be a complex and costly process. Maintenance personnel usually don't have insights into how the individual components that make up the whole interact with each other and may find themselves creating problems, rather than fixing them with each subsequent update. Often this leaves the naval operations team hostage to the original system integrator and the increasing costs associated with simple maintenance operations.



Interoperable TDL Systems Reduce Custom Integration Requirements

As navies move towards greater interoperability in the fleet and with other branches of the military, the current custom integration of TDL solutions for each navy program is no longer tenable. Custom integration increases costs and risk. It makes time to deploy and time to full operation a moving target because it is so complex. Beyond the program itself, custom integration makes efforts to create a single, unified, communication infrastructure extremely challenging.

Although some level of system engineering will always be needed to fully integrate interoperable TDL systems in all naval platforms, risk, cost, and time to deployment can be significantly reduced by introducing interoperable, plug-and-play solutions into the mix. The ideal approach is to opt for COTS-based TDL solutions and testing, evaluation, and support systems that have been field proven to reduce integration time, deliver ease of use, and enable full interoperability with all TDL standards.

However, even a COTS-based approach can be a challenge because all COTS-based TDL solutions are not created equal. While some vendors may claim their COTS-based TDL offering can integrate easily, these systems are typically not engineered to support the most recent standards. And they are usually not engineered to communicate and interoperate with other TDL-based systems.

Plug-And-Play Systems Simplify Integration and Ensure Interoperability

Truly interoperable COTS TDL systems eliminate the need for intensive and extensive custom software development at the integration stage. They provide the latest and greatest TDL compatibility and interoperability out of the box. Ideally, they are developed by specialists with extremely deep expertise in communications technologies, TDL standards, and military operational requirements, as well as a vested interest in staying current with all TDL standards to ensure their products are plug-and-play. Most importantly, the solution should be field-tested and proven through deployments in similar applications.

Obviously, eliminating the need for extensive custom software development at the integration stage removes the associated costs from the program budget.

Time-to-deployment is also significantly reduced. Where a custom TDL integration may take many years to complete, integrating a field-proven, COTS TDL system could be achieved in months rather than years.

The training challenges are also minimized. Training programs for field-proven, COTS TDL systems leverage all the lessons learned by the supplier from previous applications. As a result, the supplier can provide truly complete training for all personnel that will be operating the system. Structured properly, the training will address the operational requirements of the system itself and ensure that personnel understand how the system interoperates with systems based on other TDL standards.



Truly Interoperable, COTS TDL Systems Are Available

Curtiss-Wright Defense Solutions understands the changing needs of navies around the world and the communications integration challenges they face. We offer truly interoperable, standards-based COTS and Non-Developmental Item (NDI) TDL products that can reduce the complexity of the TDL integration process.

Curtiss-Wright's TCG HUNTR™ TDL Hub and Network Translator is an intelligent translation gateway for multiple TDLs. This patented TDL gateway was developed following a holistic and user-centric approach to the many issues in legacy TDL gateways and the many struggles those issues create for users. It delivers all 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
- Automatic radio configuration, initialization, control, and monitoring for Multifunctional Information Distribution System (MIDS), Low Volume Terminal (LVT), MIDS Joint Tactical Radio System (JTRS), and combat net radios (CNR)
- A complete Link 16 implementation

For testing and evaluation, Curtiss-Wright offers TCG BOSS® (Battlefield Operations Support System), which is used by military test, evaluation, and certification organizations around the world to:

- Test and verify tactical data link (TDL) implementations
- Ensure interoperability across TDL solutions
- Validate conformance with military standards

Our TCG GTS® (Ground TDL System) is a multi-tactical data link hardware and software solution for training warfighters in the use of tactical data links with both simulation and live, virtual, and constructive (LVC) capabilities. It is also a portable network-in-a-box for Link 16. The complete system includes all the hardware and software needed to create a fully functional Link 16 network: Just add a terminal, we handle the rest.

Curtiss-Wright's TCG LinkPRO® software provides an advanced, embedded multi-tactical data link processing engine for any TDL requirement. TCG LinkPRO is standards-based and optimized for TDL processing, integration, and communication while lowering life cycle maintenance costs. It includes terminal and interface support to a variety of terminals and communication protocols and ensures reliable communication in and across multiple data links.

Rounding out our TDL portfolio are the Curtiss-Wright TCG Terminal Housing Cases. These multi-function, mobile, and affordable rugged cases support all MIDS-JTRS and MIDS-LVT1 Link 16 terminals. They also contain all required control modules, power supplies, and cable sets.

All Curtiss-Wright TDL systems enable near real-time dissemination of mission-critical situational information from multiple sources between personnel onboard a vessel, as well as deployed warfighters, aircrews, and maritime commanders to facilitate command and control decisions. And these systems have been proven in naval air platforms such as the P-3 and P-8 aircraft.

In addition to products, Curtiss-Wright offers a variety of high-level and fully detailed training sessions for all personnel who will be interacting with TDL systems. We offer complete training options, including training packages such as 101-level TDL introduction training, highly detailed operator-level training, JICO-level training, and custom mission specific training.

Curtiss-Wright's TDL solutions, integration services, and ongoing support for fully interoperable systems simplify the TDL integration process on manned and unmanned naval platforms. With our truly interoperable COTS-based TDL systems, any non-recurring engineering (NRE) is usually only needed for very specific integration efforts. So, navies that choose Curtiss-Wright's trusted and proven TDL offerings can reduce integration time and costs and get to deployment faster with fully integrated and interoperable TDL networks.

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References

> ¹ Lieutenant General Eric M. Smith, U.S. Marine Corps, Commander, Marine Corps Combat Development Command during a discussion on The Movement Toward Greater Integration in Naval Warfare, hosted by the Centre for Strategic and International Studies (CSIS) and the U.S. Naval Institute (USNI) on October 29, 2020.