White Paper
On
Using the Ground Tactical Data Link System

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INTRODUCTION

WHAT IS A GTS?

The Ground Tactical Data Link System (GTS) is a fully functional Tactical Data Link ground station that supports Command and Control (C2) operations, training and live-fly exercising of data link networks and data link system implementations. GTS provides a robust operational capability with a full set of Command and Control as well as Non-Command and Control message sets that are easy to operate including TCG's world-class support. A robust simulation engine supports a sophisticated, built-in training capability to support off-line basic, intermediate, and advanced individual and group data link training to include mission rehearsal, war gaming, and post mission debrief and analysis. In live operations, GTS supports full situational awareness, flight following, safety of flight, and a command and control capability.

GTS can also provide a Live, Virtual and Constructive (LVC) training capability by broadcasting fully interactive simulated tracks. The realities of shrinking national and allied budgets have created an urgent need for Live-Virtual-Constructive (LVC) operational training of the complex challenges that cannot be replicated in a live environment. This deficiency is further exacerbated by a drastic curtailment of flying hours and major exercises world-wide. GTS answers this difficult challenge by broadcasting fully interactive "virtual/constructive" tracks into the Link-16 network and—with a radio—real time voice inputs that replicate the virtual platform, e.g., a Rivet Joint, AWACS, JSTARS, Patriot, AEGIS, etc. This capability is absolutely critical for effective training and operational readiness, enabling the warfighter to train as they would in real-world combat situations – with ground, air and maritime assets fully integrated. For example, a simulated AWACS can be controlled from GTS with the full transmit and receive library of a live asset including the full complement of C2 messages. This allows the simulated AWACS to take control of aircraft, transmit mission assignments, intercept tasking, etc. C2 messages can be pre-scripted and interactively activated by the operator, providing a robust organic training capability at the squadron or unit level. Cost savings are further realized through reduced flight hours (assigning friendly forces to enemy roles), efficient operations, and reduced maintenance costs.

The addition of TCG's Link-16 Wide Area Network (WAN) implementation on a secure network supports forces at multiple geographically dispersed locations and allows them to collectively participate in a combat training exercises supported by a WAN connected GTS operator at distant locations.

GTS also provides a Range Training Officer (RTO) capability that provides an exercise controller a significant ability to follow and evaluate exercise operations in real time, control exercise engagements, and record and replay the Link 16 picture for post mission analysis and debrief. The portability of the system allows GTS to be quickly deployed to support exercises as well as real world contingencies.

GTS offers a user-friendly human machine interface (HMI) and an advanced map display which allows operators to customize their tactical display to accommodate their immediate mission.

Available in a variety of configurations, GTS is transportable and able to operate in either fixed facilities or forward operating locations, enabling TDL operations anywhere in the world. GTS inherently supports localized TDL training, facilitating understanding and fostering confidence, ultimately resulting in the development of a skill set critical to mission accomplishment. Not limited to Link 16, GTS processes data over JREAP (A&C), Link 11, SADL, SIMPLE, and DIS networks as well.

Over the years, TDLs have been recognized more and more as a force multiplier, enabling commanders at all echelons to effectively employ their limited assets while accomplishing more mission-related objectives. With its up-to-date implementation of MIL-STD's (such as 2525B, 3011, 6011C, 6016 B/C/D/E, 6020, etc.) and STANAG's (such as 5516, 5511, 5602, etc.), and various associated ICP's, GTS ensures Command and Control and Mission Assignment directives are transmitted, understood, and executed exactly as designed leaving no doubt as to the commander's objectives.

Product Support

From on-site installation and training to on-call technical and operational support, TCG is client-focused. Our teams of operations specialists, data link trainers, and JICOs have decades of military tactical data link experience. Most of our engineers are also involved in technical support. Our annual, international Users Group meeting allows our clients to see what's new and to see how our products are used by others.

Internally, our Configuration Control Board (CCB) meets weekly to review all new client-reported issues. Our Engineering team and Technical Support team track all issues from entry through resolution. We provide annual (and typically more frequent) software releases that incorporate reported issues, integration testing updates, and enhancements. Recent enhancements include MIL-STD-6016E, STANAG 5516, next generation tactical display mapping, line-of-sight calculations, JREAP-A, Link 11B, etc.)

GTS is constantly being upgraded to meet current US and international military standards and change requests. We also have significant (and growing) support for classified and proprietary messages. By incorporating changes to our baseline releases, all of our clients can benefit from updates and enhancements to GTS software and hardware.

Basic GTS Components

GTS includes a tactical data link server, a transportable housing case for many different terminal types, a UHF L-band antenna, and optional client workstations. The transportable case is pre-configured to house power (US and international) and cooling components designed for use with the customer-identified terminal type. All connecting cables are provided. Note: Link 16 terminals are Government Furnished Equipment (GFE) and not provided by TCG. Figure 1 shows a typical GTS with an LVT (1) and desktop server.

Figure 1 – TCG's Ground Tactical Data Link System (GTS)

Ancillary Components

Ancillary components enhance the operational utility of the base GTS. The most common options include the Client Workstation and External Time Reference (ETR) kit.

Client Workstation

The addition of client workstations, shown in Figure 2, to GTS allows a user to remotely operate GTS. The client communicates to the server over Ethernet, so the operator does not have to be co-located with the Link 16 terminal. Additional workstations may be added to GTS to allow the possibility of multiple users at multiple locations to share the Link 16 terminal and associated situational awareness, as well as command message transmission and simulated data injection capability.

Figure 2 – Client Workstation

External Time Reference (ETR) Kit

Operational requirements may dictate the need to employ ETR capabilities. To accommodate users with this need, an ETR kit built specifically for GTS has been developed. Commercial-off-the-shelf (COTS) hardware includes a GPS antenna, 50' cable, receiver and a Trimble Resolution T GPS receiver. A proprietary pulse shaper/signal conditioner receives the one pulse per second (1PPS) signal from the GPS receiver and creates the requisite 1PPS signal required by the terminal.

Interfaces

GTS supports numerous interfaces. A single-link GTS contains either Link 16 or Link 11 whereas a multiple link GTS contains both. All other interface options can be added based on operational requirements.

Link 16

GTS Link 16 interfaces support the following Link 16 terminal types:

- MIDS LVT (1) and its variants for Platforms A, D, and I. Support for Platform D includes a built-in RARP server to facilitate communication with the terminal.
- MIDS LVT (2), LVT (11), ViaSat's Small Tactical Terminal (STT), and Rockwell's TacNet Tactical Radio (TTR) for Platform J
- MIDS LVT (3)/FDL for F-15 Platform types A/B/C/D and E
- Class II terminal types F-15, E8C/JSTARS, E3/AWACS, USN Air, and USN Ship MIDS JTRS for Platform type A

GTS supports current Link 16 standards such as MIL-STD-6016 B, C, D, and E and ICPs associated with each, STANAG 5516, MIL-STD-3011 (JREAP), MIL-STD-2525B (Symbology), STANAG-5602 (SIMPLE), etc.

GTS can be configured to **control up to 20 terminals simultaneously** in one or more Link 16 networks. In addition to providing the user interface to initialize and monitor these multiple connections, GTS also solves the problem of line of sight overlap through intelligent addressed message routing, redundant message rejection, and the provision of unique filtering for each terminal connection.

Link 11A and Link 11B

M-series message protocols (format, transmission and reception rules) are processed IAW MIL-STD-6011C. GTS supports Naval Tactical Data System (NTDS) and Airborne Tactical Data System (ATDS) interfaces for transmission of Link 11A message data. In addition to Link 11A, GTS supports Link 11B, a full-duplex, two-way, point-to-point link that provides for the serial transfer of data. GTS also provides a user interface for initialization, monitoring and overall control of the Link 11A and B interfaces.

Situational Awareness Data Link (SADL)

GTS supports the transmission and reception of data over a Situational Awareness Data Link (SADL) interface using the Enhanced Position Location Reporting System (EPLRS) radio with embedded gateway firmware version 11.xy or higher. GTS can be configured to operate in Gateway mode on the SADL network and can act as a forwarder or router between a SADL network and a Link 16 network, enhancing the surveillance picture for participants on each network.

Joint Range Extension Application Protocol – Appendix C (JREAP-C)

The IP-based beyond line of site (BLOS) transmission protocol for Link 16, known as JREAP-C, is the most requested optional interface for GTS. GTS implements MIL-STD-3011, revision A for JREAP, Appendix C, using both Transmission Control Protocol (TCP) and Universal Datagram Protocol (UDP) Internet Protocols (IP) as the means of communication. Support for 3011 revision B will be added to the GTS in 2015. GTS can operate as either a client or server, supporting up to 20 connections, when using TCP/IP. When using UDP, both unicast and multicast connections are supported.

Joint Range Extension Application Protocol – Appendix A (JREAP-A)

GTS can operate as a Network Controller, Alternate Network Controller, Network Participant, or Network Listener on a JREAP-A network, communicating with other network participants over a DAMA satellite connection. This allows GTS to exchange Link 16 data between its JREAP-A interface and any/all other Link 16 interfaces thereby providing the operator with another option for communicating beyond line of sight. GTS currently supports communication via synchronous serial interface with the ARC-210, PRC-117, and PSC-5 DAMA radios.

Serial J

GTS supports an interface to a remote, Serial J-capable system over an asynchronous serial line via a null modem setup or attached to a Secure Terminal Equipment (STE) data modem connected to a Public Switched Telephone Network (PSTN). This interface is frequently used to exchange J-series messages.

Socket J

An interface to an external socket J-capable system over an Ethernet connection using TCP/IP is supported with GTS. This interface may be used to exchange J-series messages using the MTDS/MTC protocol. It is able to establish and maintain a socket J connection as either a client or server.

Distributed Interactive Simulation (DIS)

GTS supports a Distributed Interactive Simulation (DIS) interface to exchange Link 16 data between one or more Link 16 networks and a DIS network to support Live, Virtual, and Constructive (LVC) simulation and training needs. With this capability, Link 16 network participants are able to interact with the DIS entities. Likewise, DIS participants will be able to interact with the Link 16 network participants. Optimal configurations allow for connectivity between flight simulators, Air Combat Maneuver Instrumentation (ACMI) training ranges, and live Link 16 participants. GTS uses either the IEEE

Standard 1278.1-1995 protocol or SISO-STD-002 protocol to allow for maximum compatibility with other DIS applications. GTS supports Entity State, Transmitter, and Signal Protocol Data Units (PDU) and allows for connections to be made as Broadcast, Multicast, or Unicast. GTS supports nomination of Link 16 PPLIs, Tracks, and Targets to Entity State PDUs; and supports nomination of Entity State PDUs to Link 16 Surveillance Tracks. GTS also supports the generation of PPLI messages from reported DIS entities.

Standard Interface for Multiple Platform Link Evaluation (SIMPLE)

Standard Interface for Multiple Platform Link Evaluation (SIMPLE) is a NATO Standardization Agreement (STANAG) specifying a standard for interfacing test rigs for the purpose of TDL interoperability testing. Adding a SIMPLE interface enables GTS to interface with other SIMPLE compliant sites using an Ethernet connection for the purpose of exchanging Link 11 and Link 16 messages. The implementation is in accordance with STANAG 5602.

Message Routing

GTS provides a graphical user interface to define the routing of J-series messages between its external interfaces, such as Link 16 terminals, JREAP IP and satellite connections, DIS, SADL, and SIMPLE. The operator may use this graphical interface to provide, inhibit, or filter the message data provided to or from any interface. In this way, information can be provided in one direction only, or filtered based on message type (label/sublabel) and/or TN Source.

Message Processing

GTS goes beyond just message routing and forwarding. GTS includes a full-featured Message Processor that handles message management, track management and correlation, automatic message responses, etc. The Message Processor can be configured to process any of the supported US or international military standards. GTS software has an outstanding heritage of fully supporting all message fields and message processing rules.

Track Management

In order to be an acceptable network participant, GTS adheres to the strict surveillance track management rules established in MIL-STD-6016 and MIL-STD-6011. GTS supports the Drop Track, Difference Reports, Change Data Orders, Emergency and Force Tell indicator changes, Strength changes and Exercise Status Order functions. GTS also provides the capability for the operator to manually assign surveillance Track Numbers or request GTS to assign track numbers to new local surveillance objects based on a track block of Track Numbers.

Network and Mission Management

GTS supports the creation, scripting, transmission and reception of various types of network management messages and mission management message in accordance with the appropriate MIL-STDs. Network management messages include time slot assignment, communications control, time slot reallocation (TSR), and over-the-air rekeying (OTAR). Mission management messages include engagement status, pairing, association, DMPI association, controlling unit status, platform status, target sorting, correlation, airfield status, threat warning, GARS, mission correlator, weather over target, EA engagement, free text, image transfer, and pointers.

Link Forwarding

GTS provides data link forwarding between Link 11 and Link 16. GTS also supports forwarding from one Link 16 network to another, including JREAP networks. The data store-and-forward model is based on the rules in MIL-STD-6020. GTS normalizes data for track and mission objects to a precision and resolution meeting or exceeding the link requirements. When a track is nominated for forwarding, GTS builds and sends the correctly formatted data link message.

Automation

The operator can define how GTS will perform and respond to real-time events. The operator is provided with many controls that allow for the definition and automation of typical data link events, such as transmission or omission of a drop track message when a drop is selected for removal or canned responses to receipt-compliable messages. Examples include drop track transmission, automatic message exchange (ex. Link 16 Handover using J12.4 and J10.3), terminal status definition, terminal transmission buffer definition, loopback ID definition and monitoring, latitude/longitude and speed display format, receipt compliance responses, etc.

Target/Track Correlation

GTS supports the transmission and reception of Link 11 and Link 16 Correlation messages and will correlate the tracks according to algorithms and parameters established the MIL-STD-6011 and MIL-STD-6016 and will generate the appropriate messages. GTS fully supports the J12.5 Target/Track Correlation message, non-C2 JU automatic message updates, and the J12.6 Local Simulated Target messages. Remote Targets can also be correlated in real-time. The GTS Target Sorting capability allows definition of the target parameters, status, fusion parameters, kinematics, ambiguity, sensor data, accuracy information, as well as future event and precision information.

GTS IN USE WORLD-WIDE

GTS has been selected through competitive procurements for numerous US and international armed forces. Since its initial competitive procurement, the US Air Force (USAF) has continued to purchase additional systems for wings and squadrons in the US, Europe, the Pacific, and Central Command. Widely used by the USAF, multiple systems are also in use by the Air National Guard (ANG), the US Navy (USN), and the US Army.

International users include Saudi Arabia, the UAE, Finland, Hungary, Greece, Pakistan, Morocco, Oman, Chile, and was procured sole-source by Singapore.

REQUIREMENTS BACKGROUND

Prior to the first Gulf War, aircraft would fly in protected areas called Military Operating Areas (MOA) and, as such, pilots would not be overly concerned with unauthorized aircraft breaking into their airspace. In such a "sanitized" environment, the pilots' focus could be on flying the plane and learning unit and service-level tactics, techniques and procedures.

After the onset of the first Gulf War, the USAF and USN embarked on major platform upgrade programs to field Link 16 in C2 and fighter aircraft. Little consideration was given to ground infrastructure or localized unit training. However, in a warzone with dozens of aircraft all around, pilots quickly recognized the true value of TDLs. They could receive C2 directives, mission assignment changes, aircraft and target identification, and friendly and enemy positions well beyond their radar detection range. TDLs, when employed effectively and efficiently, became a "force multiplier."

GTS REQUIREMENTS FORMULATION

Initial Link 16 theory and technology dates back to the early 1970's; employment concepts were only developed for air and ground C2 nodes. With the advent of Link 16 on fighter aircraft, the need to develop employment training became apparent, however, individual squadrons were required to develop their own training programs. As more aircraft became upgraded, the need for a ground-based training tool that could be used by all Link 16-capable units became apparent. Initial GTS requirements were developed by the USAF's Air Combat Command's Director of Requirements, the Realistic Training Review Board (RTRB), and the Weapons and Tactics Conferences (WEPTAC). Based on these initial requirements, the TDL program office at the Electronic System Center (ESC), Hanscom Air Force Base developed a detailed Ground Support System (GSS) Technical Requirements Document (TRD) for Foreign Military Sales (FMS) customers. GTS is the only product that meets both sets of requirements.

GTS CAPABILITIES FORMULATION

GTS continues to improve and evolve; as technologies, network architectures, and operational applications emerge. GTS keeps pace with its infusion of interfaces supporting various protocols. The embedded Data Link Processor is constantly updated to incorporate the latest MIL-STD Interim Change Proposals (ICPs). Users suggested enhancements are captured during an annual user-group forum, site visits, and exercises and joint training events. Applications such as the cockpit situation display and Range Training Officer (RTO) function were developed in response to requests from pilots to enhance their training and debrief capabilities. In addition, the Terminal Control Wizard, context-sensitive help, C2 and non-C2 control panels, and line-of-sight calculations were recently added in response to GTS operator requests.

EMPLOYMENT OF GTS

GTS is an extremely versatile system with wide-ranging applications and features anchoring any of three TDL focus areas: operations, training and testing. GTS is not dependent on any one specific configuration for optimal performance; it may be used independently of, or in conjunction with, other TDL and GTS systems. When equipped with the available interfaces, GTS performs as a ground-based C2 node.

GTS EMPLOYMENT IN AN OPERATIONAL ENVIRONMENT

Flight Safety

The situational awareness provided by Link 16 greatly enhances the pilot's ability to see and avoid aircraft transiting through airspaces. GTS is able to receive and forward surveillance data, including imagery, to the cockpit, enabling pilots to see the same air picture monitored by ground C2 nodes. Similarly, Commanders, Operations Officers and Supervisors of Flying can monitor data provided through the platform's J2.2 message to determine mission assignments, refueling priorities, whether or not to recall aircraft, or to divert aircraft to another location. A significant benefit of monitoring aircraft operations with GTS is in the event of a bail out. GTS will recognize and alert operators to this emergency condition enabling them to insert an emergency point at the exact location, allowing for the expeditious rescue of the pilot. Additionally, the GTS playback function can be used to augment flight data recorders and other sensors in an aircraft accident/incident investigation.

Establishing NTR/ETR

Achieving fine synchronous timing is a prerequisite for all platforms operating in a Link 16 network. When operating as an independent network node, GTS can establish timing either in Net Time Reference (NTR) or Extended Time Reference (ETR) mode ensuring pilots enter the network within a minute after takeoff. The major benefits of ETR operations – increased network geographical span and consistent timing source – offer significant advantages over NTR operations. ETR eliminates the requirement to exit one network then enter another, reduces data drop-out rates, and increases platform participation. All these advantages lead to increased pilot situational awareness and reduce pilot workload.

Terminal Control Wizard (TCW)

GTS contains TCG's Terminal Control Wizard (TCW). TCW provides operators and easy "6 clicks to the net" intuitive user interface that uses automated decision making to facilitate the often complex task of Link 16 network entry. TCW simplifies terminal initialization by allowing the operator to create an "optimized" initialization data file. This optimized file is created by starting with a network load file from a network design facility and adding the site's own parameters (position, track number, voice call sign, and stacked net numbers). Once created, these site specific parameters are stored and applied to any initialization data file. Using the optimized data file as its first step, TCW walks the operator through a series of windows to define mission-specific parameters such as date, time source, and time reference setting before sending the data to the terminal.

Control Panels (C2 and Non-C2)

GTS provides information for Link 16 Command and Control (C2) and non-Command and Control (non-C2) entities (simulated or live) in a single, concise window. These displays are created by collecting, summarizing, and presenting information for various tactical messages associated with each

entity. For any C2 unit, the C2 Control Panel provides rapid access to information and control of an entity. The panel allows easy control over the C2 unit's interaction with any non-C2 unit by offering simplified controls for J-series message exchange with the non-C2 unit. Like the C2 Control Panel, the non-C2 Control Panel provides a summarized view and control of the interaction of a non-C2 unit with the Link 16 network.

Line-of-Sight Visualizer (LOS)

The LOS Visualizer provides a graphic display of the terrain obstructions that may exist between and 2 points on the map and may be used to assist with network planning. GTS graphically displays the data in two formats, a map obstruction view and a vertical terrain view.

Mission Playback and Debrief

All Link 16 J-series and Link 11 M-series message data received by GTS is recorded. This data may be replayed for mission debrief or used to augment any other debriefing system available (e.g., air combat maneuvering instrumentation (ACMI)). The playback controls provide numerous options resulting in a significant degree of flexibility for debriefing. There are controls to pause/resume, fast forward, and control speed (faster or slower). The advantage of the playback feature is that it captures data for all network participants without requiring a special pod.

GTS playback may be viewed on multiple displays and backgrounds, and zoomed in or out depending on the area of interest. Various map overlays may be used depending on the needs of the pilots during debrief. An optional cockpit situation display provides a dual screen view of both the entire tactical situation and an emulation of the cockpit display from any selected participating aircraft. It is range scalable and allows for dynamic operator interaction. The display may be centered on any object within the field of view.

GTS EMPLOYMENT IN A TRAINING ENVIRONMENT

Scenario Generation and Scripting

Link 16 operations without a ground station barely touch the capabilities provided by today's robust network architectures. Fighter-to-fighter operations serve to familiarize pilots with basic actions such as verifying crypto loads, entering and maintaining the net, locating friendly forces including C2, ISR, and refueling platforms, and performing basic air combat maneuvers. GTS provides the means to insert simulated ground targets, hostile airborne forces, imagery, and mission assignment messages that the pilots will likely encounter in real-world operations.

With GTS' easy-to-use scripting tools, any data link mission scenario can be planned and developed in simulation mode, then played back into the live network. Each scenario can provide virtual air, ground or surface entities depending on the mission or training event. The scenario may be adjusted real-time as well, furthering the learning curve when pop-up targets and simulated emergencies occur. Scripts may be saved and played over and over again, or they may be developed in layers allowing progression through the training syllabus.

Real Time Kill Removal

A powerful capability of GTS is to mine data already available in the Link 16 network and present it in a format usable by a Range Training Officer (RTO) to conduct kill assessment and removal. The RTO display is an embedded GTS application that receives positional and engagement data from the Link 16 network. Track data is formatted and displayed according to the network settings chosen by the operator

along with corresponding shots fired data, which are displayed in separate windows. Screen captures of the RTO display can be sent to the mission lead to be used in the mission debrief. The RTO function may also be run in playback mode and shown during debrief.

The RTO function is enhanced further by employing Blue Air/Red Air operation functions. This capability requires a specific net design load that splits the network and allows Red Air to operate on Link 16 unseen to Blue Air; however GTS can see all participants. If an operator desires, he can designate the Red Air tracks via pseudo local tracks then transmit them to Blue Air participants who will use their radar to confirm the Link 16-reported Red Air aircraft. This creates a much more realistic training event as pilots are acting or reacting to live objects.

GTS FIELDING CONSIDERATIONS

LINK 16 TERMINAL, ANTENNA, AND WORKSTATION LOCATIONS

Placement of the Link 16 terminal is critical to successful Link 16 operations. Terminal specifications mandate its location within 300 feet of the antenna. Optimally, antenna placement is on top of a building overlooking the flight line, preferably without topographical impediments (mountains, tall buildings, etc.) which affect line of sight to the working area. Additional factors which also should be taken under consideration include the location of local air traffic control beacons.

Identifying the location of GTS and any client workstations including display only workstations will be the installation team's next priority. Depending on the type of Link 16 terminal used and the system configuration, the GTS main server workstation is placed within close proximity to the Link 16 terminal. If the terminal has either a Platform D or J (Ethernet) interface, a connection may be made over a secure Ethernet LAN from virtually anywhere on the installation; however, if a 1553 connection is being used then the workstation must be co-located with the terminal.

Depending on the base infrastructure, it may be possible to locate GTS in the Wing or Squadron operations building. If placement of the antenna and terminal do not allow for this, a GTS client workstation can be added and connected through a secure Ethernet LAN to the main server workstation. This is a powerful capability as it can provide full control of the terminal and situational awareness picture of TDL participants for the supervisor of flying, and the wing and squadron leadership. A client workstation may be placed anywhere there is secure network connectivity with the main server workstation.

TERMINAL TYPES

Live network operations require a Link 16 terminal. GTS can operate with all currently used terminal types, including MIDS, STT, and TTR terminals. Link 16 terminals are controlled COMSEC items due to the embedded cryptographic technology. Proper consideration and planning must be made for location and security of the terminal. Furthermore, loading the crypto keys must be planned and processes put in place to ensure the proper keys are always loaded. The operator must ensure that the proper crypto needed to support the desired network is available. The operator should also establish procedures to facilitate line maintenance and spare batteries.

NETWORK DESIGN LOAD

A proper network design load (NDL) optimized with requisite data (antenna location, antenna cable length, antenna transmit port, etc.) is required for GTS operations. TCG's Terminal Control Wizard (TCW) can be used to create and save an optimized NDL. Once an optimized load file has been developed, TCW will step the operator through net entry procedures in just six mouse clicks. Note: If the antenna or the entire GTS is ever moved, this file is easily updated through the TCW to reflect the changes made to these parameters. Finally, to fully exploit the RTO function the operator must ensure that the NDL supports network participation group (NPG) 19 and both blue and red shot data.

MULTIPLE TERMINALS (MULTI-MIDS)

Ground-to-Ground MIDS terminal connectivity typically requires airborne relays. These relays add to timeslot usage, delay, complexity, and the need for continuous airborne relay operation. While using JREAP can help, the MIL-STD-3011 is written for multi-network, not to extend the range of one common Link 16 network. To achieve full ground-based coverage without the use of airborne relays is the goal of Multi-MIDS. However adding MIDS (or other Link 16) terminals can result in coverage overlap, duplicate messages, and multi-path issues.

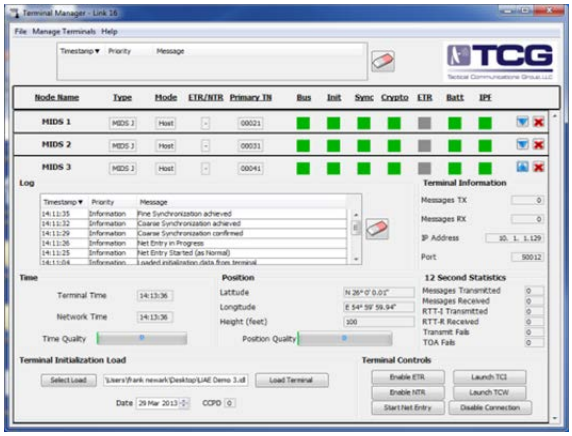
Solving the Multi-MIDS Challenges

GTS with the Multi-MIDS option can solve these challenges. GTS can control up to 20 Link 16 terminals from a single operator station. These terminals can be local, within a few hundred feet, or can be at remote sites with Ethernet connectivity.

The automatic message processing handles many of the complications that can occur when terminals are positioned within line of sight of each other, such as redundant message processing, addressed message routing to a single terminal, and separate geographic filters for each terminal.

GTS provides a simplified User Interface for the initialization, control, and monitoring of each terminal, thereby reducing operator workload.

Multi-MIDS Terminal Manager

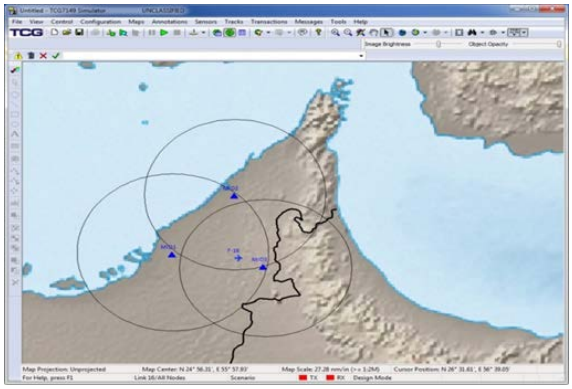


The GTS terminal manager allows operators to connect to and configure up to 20 terminal interfaces. A summary view provides status of all terminals. An expanded view, modeled after the TCW, is also available. Operators may load all terminals simultaneously. GTS allows both distributed and central control. Distributed control requires that the terminal interface be co-located with the MIDS terminal. Central control does not require co-location.

Smart Message Routing

For each received PPLI, the data link processor notes the terminal from which it was received. The most recent reception represents the best line of sight connectivity. Addressed messages are automatically routed; however, the operator may override the algorithm by specifying the transmitting terminal.

Redundant Message Processing



The Multi-MIDS data link processor discards redundant J-series messages usage a 3 second (operator modifiable) message comparison algorithm. All messages are compared to the maintained messages. They are logged and discarded if a match is found. The operator may disable the algorithm.

Geographic Filters

Geographic filters can reduce the clutter outside of an area of interest and minimize duplication on the network. These flexible, user defined flow control filters apply to surveillance messages.

SUMMARY

GTS is an affordable solution to improve daily data link operations and training. The system leverages existing unit assets and capabilities and helps minimize training costs by maximizing the efficiency and effectiveness of the training. The fusion of live and simulated Link 16 traffic allows the pilots to train with assets not normally available, enhancing their skills and proficiency.

GTS may be operated as an independent stand-alone ground C2 station or in an architectural scheme comprised of many ground stations. The user friendly interface and map display provide an intuitive interface for data link operators at all levels of proficiency. The record and playback capabilities can be utilized to augment and enhance mission debriefs and assist with safety investigations.

GTS is in use worldwide as a force multiplier supporting the warfighter and as a foundation for initial and proficiency-level TDL training. It is interoperable with existing TDL equipment and easily transportable for deployed operations and training events and exercises.

Every GTS is backed by a comprehensive product support team of engineers, technicians, and operations personnel. On-site installation, system checkout, and comprehensive training are part of the GTS experience. Our first-line and senior engineering technical support team deftly handles questions from the field as well as issue tracking and resolution. If you have questions, TCG has the answers.

Glossary of Abbreviations and Acronyms

Term	Definition
ACMI	Air Combat Maneuvering Instrumentation
AEW	Airborne Early Warning
ATDS	Airborne Tactical Data System
AWACS	Airborne Warning and Control System
BLOS	Beyond Line of Sight
C2	Command and Control
CCB	Configuration Control Board
COMSEC	Communications Security
COTS	Commercial-Off-The-Shelf
DAMA	Demand Assigned Multiple Access
DIS	Distributed Interactive Simulation
DLP	Data Link Processor
DMPI	Designated Mean Point of Impact
EPLRS	Enhanced Position Location Reporting System
ESC	Electronic Systems Center
ETR	External Time Reference
FMS	Foreign Military Sales
GARS	Global Area Reference System
GFE	Government Furnished Equipment
GPS	Global Positioning System
GSS	Ground Support System
GTS	Ground Tactical Data Link System
HMI	Human Machine Interface
IP	Internet Protocol
ISR	Intelligence, Surveillance and Reconnaissance
JREAP	Joint Range Extension Application Protocol
JSTARS	Joint Surveillance and Target Attack Radar System
LVC	Live, Virtual, and Constructive
LVT	Low Volume Terminal
MIDS	Multifunctional Information Distribution System
MIL-STD	Military Standard
MOA	Military Operating Area
NDL	Network Design Load
NPG	Network Participation Group
NTDS	Naval Tactical Data System
NTR	Network Time Reference
OTAR	Over-The-Air Rekeying
PDU	Protocol Data Units
PPLI	Precise Participant Location and Identification
PSTN	Public Switched Telephone Network
RTO	Range Training Officer
RTRB	Realistic Training Review Board
SADL	Situational Awareness Data Link
SIMPLE	Standard Interface for Multiple Platform Link Evaluation
STANAG	Standardization Agreement
STE	Secure Terminal Equipment
STT	Small Tactical Terminal
TCG	Tactical Communications Group
TCW	Terminal Control Wizard
TCP	Transmission Communication Protocol
TDL	Tactical Data Link
TN	Track Number
TRD	Technical Requirements Document
TSR	Time Slot Reallocation
TTR	TacNet Tactical Radio
UDP	Universal Datagram Protocol
UHF	Ultra High Frequency
US	United States
USAF	United States Air Force
USN	United States Navy
WAN	Wide Area Network
WEPTAC	Weapons and Tactics Conference