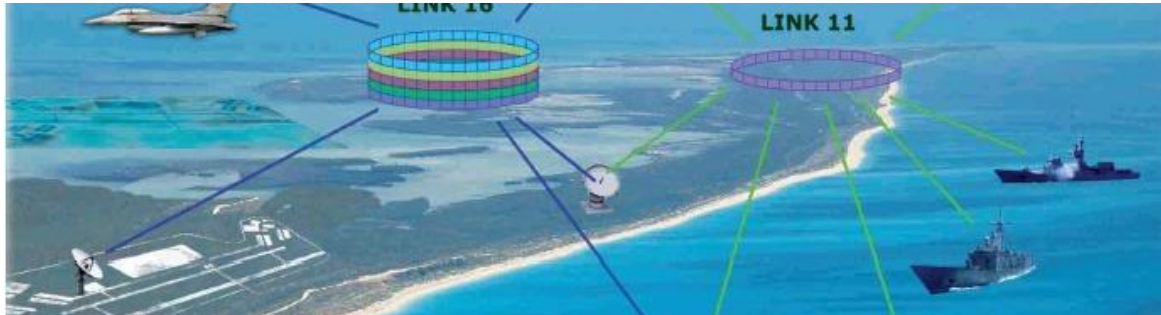


Link 16 Tutorial - Tonex Training

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Link 16 Tutorial

Link 16 Tutorial, Learn about Tactical Data Links (TDL)

Link 16 tutorial is designed by TONEX to give you a general overview about various aspects of link-16. This tutorial will serve you as an overall guideline to what you need to learn in regards to tactical data, Link-16. This tutorial is particularly useful to you if you are just starting to learn about link-16, or if you know enough but simply need to brush up your knowledge of link-16.

TDLs and Link 16 Buzzwords:

What is a TDL?

Tactical data links (TDLs) are highly structured standardized and interoperable communication links used by the military organizations. TDLs such as TDL-based solutions offer a means of secure communications via networks such as Link 16, Link 11, Link 22, SADL, JREAP, VMF, MADL, CDL, TTNT and SIMPLE are used for transmission and exchange of tactical data among US joint and coalition partners.

Tactical data link communications are also at the center of all military command and control systems today. TDL standards are highly complex and constantly evolving, and TDL solutions need to interoperate across platforms, service branches, and even international boundaries.

What is TADIL?

TADIL-J or “Tactical Digital Information Link” (TADIL) J refers to the series of standardized J-series message used in Link 16 TDL. Link 16 and TADIL-J are used by the U.S. Navy, U.S. Army, U.S. Marine Corps, U.S. Air Force, U.S. Coast Guard, NSA, NATO countries, and Japan as part of the Multi-Tactical Data Link Network (MTN). TADIL-J messages are described in U.S. military standard MIL-STD-6016.

TADIL-A, TADIL-B, and TADIL-C are equivalent to NATO Link 11, Link 11B, and Link 4 respectively.

J-series messages exchanges over IP-based bearers are defined by the NATO SIMPLE protocol. JREAP via satellite is referred to S-TADIL J.

What frequencies does Link 16 use?

Link 16 tactical data link standard operates in the portion of the UHF spectrum, L-band (969 – 1206 MHz) excluding the 1030/1090 frequencies as these are used for Identification, friend or foe (IFF)

Is Link 16 secure? Can link 16 be jammed?

Link 16 communication is secure and jam resistant. Link 16 enables real-time transfer of tactical and combat data, voice communications, imagery, and navigation information in the battlespace, using multiple layers of data encryption and frequency hopping.

About J-series Messages

Link 16 tactical information is presented as J-series messages. J messages are binary data words grouped in functional areas, and allocated to Network Participation Groups (NPG) (virtual networks). Example of important NPGs are:

- Network Management (J0 and J1 series)
 - J0.0 Initial Entry
 - J0.1 Test
 - J0.2 Network Time Update
 - J0.3 Time Slot Assignment
 - J0.4 Radio Relay Control
 - J0.5 Repromulgation Relay
 - J0.6 Communication Control
 - J0.7 Time Slot Reallocation
 - J1.0 Connectivity Interrogation
 - J1.1 Connectivity Status
 - J1.2 Route Establishment
 - J1.3 Acknowledgment
 - J1.4 Communication Status
 - J1.5 Net Control Initialization
 - J1.6 Needline Participation Group Assignment

- PPLI, or Precise Participant Location and Identification (network participation groups 5 and 6):
 - J2.0 Indirect Interface Unit PPLI
 - J2.2 Air PPLI
 - J2.3 Surface PPLI
 - J2.4 Subsurface PPLI
 - J2.5 Land Point PPLI
 - J2.6 Land Track PPLI
- Surveillance (network participation group 7)
- Command (Mission Management/Weapons Coordination) (network participation group 8)
- Aircraft Control (network participation group 9),
- Electronic Warfare (EW) & Coordination (network participation group 10).

What kind of platforms use link 16?

- Aircrafts
- Ground vehicles
- Missile defense systems
- Networked Weapons
- Ships

Example of Link-16 enabled platforms are:

- Arrow
- ATR-72MP
- Boeing RC-135 Rivet Joint
- Dassault Mirage 2000
- Dassault Mirage 2000D
- Dassault Rafale
- E-2C Hawkeye
- E-3 Sentry
- E-8 Joint STARS
- EA-18G Growler
- EA-6B Prowler
- EP-3C Aries
- Eurofighter Typhoon
- F/A-18 Hornet
- F-15 Eagle
- F-16 Fighting Falcon
- F-18 Super Hornet
- F-35 (in addition to multi-function advanced datalink or MADL)
- Joint Land Attack/Cruise Missile Defense Elevated Netted Sensors (JLENS)
- JSOW-C1
- JTAGS

- MH-60S/R NavalHawk family helicopters
- P-3C Orion
- Panavia Tornado
- Patriot ICC and Battery Command Post (BCP)
- Royal Navy Ships, French, Italian, Spanish, Norwegian, Netherlands and German frigates
- Saab 340 AEW&C
- Saab Gripen
- SDB II
- SHORAD
- THAAD
- VESTA

What are the differences and similarities between Link 11, link 16 and link 22?

Link-11 is a legacy communication capability is about to be removed from operational service in the coming years. Link-22 will be the eventual replacement.

Link 11 is a secure half-duplex tactical data radio link operating with HF or UHF band> link 11 is used for digital information transmission among airborne, land-based, and ship-board tactical data systems.

Link-22 is a secure beyond-line-of-sight (BLOS) communication capability for joint and coalition communications in the surface, sub-surface, land, and air domains. Link- 22 is a network with self-healing capability, increased user availability, longer range, and interoperability with Link-11 and Link-16.

What is JREAP?

The **Joint Range Extension Applications Protocol (“JREAP”)** as defined by MIL-STD-3011 (JREAP A, JREAP B and JREAP C) and STANAG 5518 extends the range of Tactical Data Link such as Link 16. It allows tactical data messages to be transmitted over long-distance networks and beyond Line of Sight (LOS), e.g. satellite links.

- JREAP A: encrypted satellite link with a serial data interface to exchange information in a broadcast mode or half-duplex.
- JREAP B: a secure synchronous or asynchronous point-to-point serial data interface (full-duplex data-transparent mode).
- JREAP C: a secure data link interface that encapsulates JREAP over TCP/IP protocols and encapsulation using IP-based networks for the exchange of information.

What is MADL?

Multifunction Advanced Data Link (MADL) is a modern data link used in F-35 platforms. The MADL is a high-data-rate, X-band, directional communications link used in the 5th Generation F-35 aircraft. F-35 shares its tactical and sensor fusion data (The integrated and fused sensor suite) with other aircrafts, surface and ground-based platforms. F-35's communication, navigation and identification (CNI) suite has over 27 different waveforms including MADL.

What is SADL?

Situation Awareness Data Link (SADL) is a secure, robust, jam-resistant, and contentious free provides fighter-to-fighter, air-to-ground and ground-to-air data communications.

SADL integrates US Air Force close air support (CAS) aircraft with the digitized battlefield via the US Army's Enhanced Position Location Reporting System (EPLRS).

What is TTNT?

Tactical Targeting Network Technology (TTNT) is a secure and robust IP-based waveform that delivers the fastest ad hoc mesh network to the tactical edge. TTNT's low latency and on-demand ad hoc IP networking allows aircraft, UAVs, ships and ground vehicles to automatically enter and exit the network without pre-planning. The masterless self-healing networking capability ensures that even if a platform node is lost or leaves the area, the network remains active for all the other users.

What is VMF?

Variable message format (VMF) is a tactical data link (TDL) supporting whatever environment is desired.

VMF is well suited for communications bandwidth constrained situations when Combat Net Radio (CNR) networks are deployed and used. VMF and the Joint Range Extension Applications Protocol (JREAP) enable the exchange of voice, mission and tactical data and imagery by connecting to a network of various participant nodes, platforms and units, both vertically and horizontally.

Link 16 and TDL Training Courses by Tonex

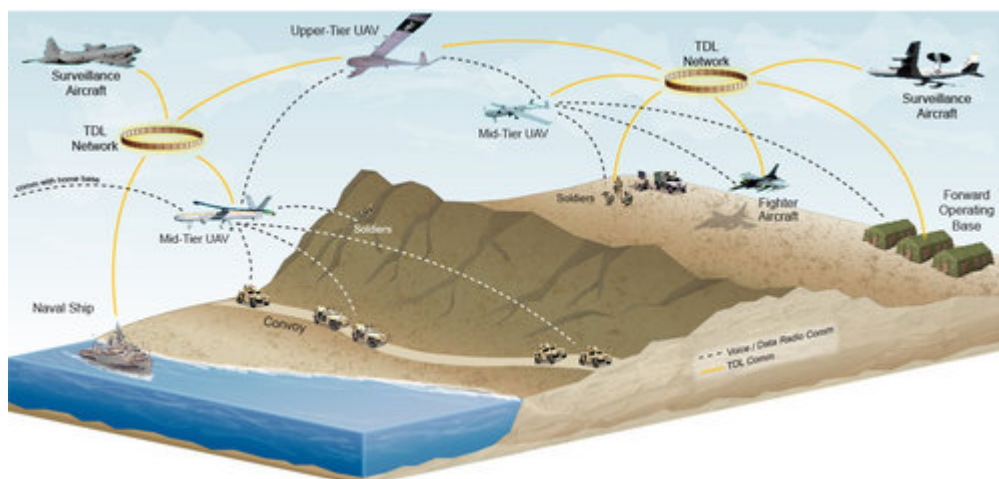
COURSE NAME	LENGTH
Advanced Link 16 Training	3 days
Joint Range Extension Applications Protocol Training JREAP Training Bootcamp	4 days
Link 16 Advanced Training Network Enabled Weapons Bootcamp	4 days

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Link 16 and MIDS Training Bootcamp	5 days
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Tactical Data Links (TDL) Testing Training Bootcamp	4 days
Variable Message Format (VMF) Training Bootcamp	4 days

MIL-STD-6016 is the official Tactical Data Link (TDL) 16 Message Standard used in DoD.

Introduction to Tactical Data Links (TDL)

Tactical Data Links (TDL) offers important communications routes between forces to help interoperability. The application of thorough, established standards certifies that tactical information is informed securely and sustainably to all force components and thus is a crucial enabler to Battlespace Management (BM) and Shared Situational Awareness (SSA) in operations.



The most common TDL for National, NATO and Coalition forces is the Multifunctional Information Distribution System (MIDS) Link 16, being the lead of the latest NATO and coalition operations in Bosnia, Iraq, Libya and Afghanistan.

However, the advantages of Link 16 cannot be understood without the use of complicated tools, well-trained staff, and good association.

Tactical Data Links support tools to distribute data processed from RADAR, SONAR, Identification Friend or Foe (IFF), Electronic Warfare, Self-Reporting, and visual observation. Each TDL applies a specific data link standard to deliver communications through radio waves or data cables. Such Military Standards (MIL-STD) establish the message standards for data link interoperability. During the Battle of Britain, RADAR enabled the allied forces to identify enemy bombers and fighters, through tracking “pieces of metals” in the sky, initiating from different positions across Europe. Distribution of these footprints at the time was performed by voice communications, which was very complicated and slow.

Over time, airplanes started to fly faster and thus the speed of disseminating the tactical data became vital. By the late 1950s, the Tactical Digital Information Link (TADIL) was invented, which today we know them by as TDL.

Link 16 Descriptions

MIDS Link 16 is positioned on air, land, and marine stages and enables the trade of data in the form of standard message:

- Situational Awareness
- C2 to C2 Battle Management
- C2 to Fighter mission assignments
- Fighter to Fighter information exchange
- Imagery
- Voice communications

Regardless if the battlespace is conducted from a single C2 center or a disseminated C2 atmosphere, Link 16 enables the trade of sensor data to facilitate the C2 center to create and sustain the Common Operating Picture (COP) and assists effective mission performance by permitting the Link 16 enabled platforms to be implemented with the highest efficiency.

Link 16 adopts the Joint Tactical Information Distribution System (JTIDS) and Multifunctional Information Distribution System (MIDS) data link terminals. ^[1]_{SEP} Link 16 is a frequency-hopping, jam-resistant, high-capacity data link. Functioning on the base of Time Division Multiple Access (TDMA), where 128 time slots per second are assigned among contributing JTIDS Units (JUs), time slots are prepared into numerous operational Network Participation Groups (NPGs). Link 16 consists of components of Link 11/Link 11B and Link 4A/Link 4C, whereas supporting several original or upgraded competences, including voice.

The Link 16 also delivers crucial exchange of Situational Awareness data between Link 16 enabled properties, making Link 16 an essential influence for military administrators to make wise decisions inside the battlespace.

Link 16 is usually swapped across a Radio Frequency (RF) bearer, though can be exchanged among landlines, satellite and serial links. Data encryption and frequency hopping tools certify that Link 16 is both jam resistant and secure.

Link 16 works at UHF frequencies; thus straight communications is solely practical when the transmitter and receiver are in line of vision. Link 16 procedures so let data to be “relayed” through other stages, but this still needs the C2 staff to make sure properties are geographically placed to secure the communications network consistently. As a substitute, Link 16 messages can be transported through reliable landlines, satellites or other data links, applying, for example, Joint Range Extension qualities to improve the Link 16 structure.

Link 16 functions at frequencies that have the possibilities to obstruct with the operation of Navigational Aids. Hence, during the peace, the applications of Link 16 require precise monitoring to secure obedience with national flight safety legislation. Network Management and Monitoring Systems adherence to these rules and standards and allow the Link 16 Network Manager/JICO to sustain flight safety.

Lifecycle of Link-16

The TDL lifecycle will allow the generation of an effective vigorous TDL network. The lifecycle includes five phases together guarantee that the TDL enhances the inter-functionality among contributing platforms leading to effective combination at both angles of physical and data. The lifecycle brings in a range of organizational units that need to be incorporated into the overall Battlespace Management course. Hence, each nation might adopt various approaches and diverse organizational units conducting the tasks explained below:

Phase 1- Planning

Link 16 is a systematic network, which uses data of the mission and mission members to enhance the network and sustain the security. With the line of vision restrictions of Link 16 it is obviously crucial to arrange the network so that interactions can always be upheld.

A) Long Range Planning

To design the planning, long-range architecture procedures require to occur at least 6 months before training events/operations and the following facts need to be taken into considerations:

- Planning Conferences
- Types of Platforms
- Locations/Ranges
- FCA Requirements
- Primary Link
- Platform/Site Clearances to Radiate Link 16

- Multi Link Architecture, Data Forwarding – Link 11, Link 16

B) Short Range Planning

Unlike the long range, short range planning adopts the weekly/daily criteria of the Link 16 network and the platforms contributing in it. The following facts need to be taken into considerations:

- Opt Ask Link (OAL) message production
- JTIDS forecast report
- Cross border liaison
- Daily mission planning

Phase 2- Design

Network Designs include all the noticeable data about the Link 16 network and are applied to prepare each of the Terminals relevant with every network user.

Network Designers construct the Link 16 networks. They are compelled by criteria put down in national Frequency Clearance Agreements (FCA), Individual Equipment Requirements (IER), crypto and platform types and numbers. Such data is acquired from the long range planning data obtained by the DLOC. The Link 16 Designer key considerations are:

- Link 16 Design Authority
- Convert Foreign Designs
- Distribution of Designs
- Fault Evaluation & Support to Link 16 Operators
- IER Database

Phase 3- Initialization

This phase is to oversee and regulate the L16 Network linked together with ground terminals through interfaces and national WANs. The establishing of a Link 16 network is launched by a Link 16 Network Management System (NMS) imposing their own ground terminals to get into the network, either by functioning as the Network Time Reference or by synchronizing with an External Network Time Reference.

Phase 4- Monitor and Manage Network

Monitoring

- FCA Compliance Monitoring
- Platform Connectivity
- Timeslot Utilization Monitoring
- Network Health And Performance
- TSDF Calculations

Managing

- Over-the-Air Assignment and De-Assignment of Timeslots
- Relay Assignment
- Re-Assign Id Loads to Platforms Over-the-Air
- Functionary Role

Phase 5- Analysis

This phase allows the Battlespace Executives via the Network Manager to enhance, upgrade, and consider lessons that have been determined over a period of functions. Pretty frequently, there is interoperability issues that inhibits platforms functioning in Link 16 networks and thus restrict the platforms application while a mission is undergoing. This can impact the overall mission goals, too. The documentation of FCA and JTIDS Activity Reports confirm that nations have evidence to provide incident investigations by CAA. The recording and replay operations upkeep the general network data evaluation and can furthermore give support to educating the operators.

How Can You Learn More?

TONEX offers comprehensive, hands-on training courses on Link-16:

Link 16 Systems Engineering and Operation

COURSE NAME	LENGTH
Advanced Link 16 Training	3 days
Joint Range Extension Applications Protocol Training JREAP Training Bootcamp	4 days
Link 16 Advanced Training Network Enabled Weapons Bootcamp	4 days
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