Today's Complex & Interwoven Multi-Link Environment

Tactical Data Links (TDLs) have been developed, purchased and brought into service in a piecemeal way and so there has, until recently, been no overall implementation plan to ensure interoperability of TDLs fitted to various platforms. Consequently, many platforms have been fitted with more than one TDL so that they are able to operate with a range of other platforms.

The result is that it is very rare to operate only one TDL in one theatre of operations. Usually there are wide ranges of TDLs operating simultaneously and this can be a problem if it is not planned for very carefully.

Four-Dimensional Environment

In planning TDL operations it is essential to remember that the operation occurs in a four-dimensional environment. Rather than defining our space in terms of length, height and width, we should define a TDL operating volume in terms of range, area, altitude and time. Each of these dimensions must be considered in initial planning and during on-line management if successful connections are to be obtained.

Range

The range at which TDL operations are going to be carried out is one of the main factors in determining the type of TDLs which will be used and the media which must support them. For example, Line-of-Sight (LOS) ranges between surface units are very short, of the order of 30 nautical miles (NMI), so the use of an Ultra High Frequency (UHF) TDL such as a Link 16 Radio Frequency (RF) network is likely to cause connectivity problems between surface units which are unable to maintain LOS with each other. So, if we wish to establish and maintain TDL connectivity beyond LOS ranges, the use of a High Frequency (HF) or Satellite Communications (SATCOM) capable TDL or UHF relay will be essential.

Some TDLs have range limitations built-into their architecture. For example, the Multifunctional Information Distribution System (MIDS) is limited by its Time Division Multiple Access (TDMA) architecture to a maximum range of 500 NMI between communicating units.

Area

Whilst the range at which we wish to maintain connectivity may determine the type of TDLs we use, the area within which we want to maintain TDL coverage will often determine the TDL configuration.

Ground-to-air information exchanges centred on a single fixed ground site might allow a TDL configuration with direct LOS UHF communications. However, if we wish to combine local connectivity with long range early warning of hostile targets we would be likely to use a combination of UHF and Joint Range Extension Application Protocol (JREAP) / SATCOM / HF TDLs, possibly with data being forwarded from one TDL into another.

Altitude

Clearly, the altitude of a transmitter or receiver has a significant influence on its LOS range - the higher it is (and the corresponding receiver / transmitter), the further is its LOS. For example, a TDL-equipped fighter, if sufficiently low, may suffer from terrain masking, which can interfere with air-to-air connectivity.

Time

The last of the four dimensions is time. TDLs often operate 24 hours a day and for some units, such as ground sites, or ships at sea, this is not a problem. However, aircraft fly sorties of limited duration and, where an airborne platform is an essential part of the TDL plan, that aircraft must be replaced, or its duties passed to another unit.

TECHNICAL ARTICLE

The Plan

The TDL plan is designed to meet the Commander's intentions. It must be flexible and adaptable, but its sole purpose is to enable the data and information flow required by the battle plan. Nevertheless, it is almost inevitable that the plan is a compromise between many priorities. The following are just a few of the aspects to be addressed:

TDL Assets Available

The first element of a plan is to assess the TDL capabilities of the platforms taking part in the operation. This will be done at the highest level – Link 11, Link 16, etc., but must also consider how the implementation of each TDL limits the capabilities of the platforms in question.

Geographical and Time Constraints

The location of platforms, operating areas, height/range relationships, LOS considerations and endurance of airborne platforms are all matters of importance which must be taken into account.

Task Allocation

TDL related tasks must be allocated to participating units, Data Network Control Station (DNCS) for Link 11, Network Time Reference (NTR) and Initial Entry JTIDS Unit (IEJU) for Link 16 networks and relay assignments. In addition, TDL functions such as management, surveillance areas and Weapons Control responsibilities must all be allocated to appropriate units.

Details

Detailed planning includes items such as allocation of Participating Unit (PU) / Joint Tactical Information Distribution System (JTIDS) Unit (PU / JU) Numbers, Track Number assignments, frequencies, crypto and the network design to be used.

Data Forwarding - Data Looping

Most current TDL scenarios involve the use of numerous data forwarders operating on a variety of TDLs. This can be a major problem for planners because of the high risk of data looping and this occurs when data from an originating unit goes out and then comes back to the same unit on another TDL after being forwarded. The result is a huge number of duplicate tracks and trying to sort out the real tracks from the 'looped' tracks ranges from being difficult to impossible! Careful planning can stop this from occurring, or at least minimise the instances of it.

Procedures

Having planned the operation, all participating units must be notified accurately and in good time of the details of the multi-link plan. This will normally be carried out via the Operational Tasking (OPTASK) Link. However, dissemination of Link 16 network design files is generally via email, while some nations may have a server / website where designs are stored and are available for download by the user.

In operation, single TDL system procedures will normally be in accordance with the relevant Allied Tactical Data Link Publication (ATDLP) if it is a NATO context, possibly modified by local or system specific procedures. Multi-TDL operations are described in ATDLP-7.33 and controlled by the Data Link Manager / Interface Control Officer (DLM / ICO). This function is known as the Joint Interface Control Officer (JICO) in the United States (US); with TDLs designed to operate in the Land environment almost exclusively there is often a Ground ICO (GICO) reporting to the JICO. This single point of control is essential if things are to progress smoothly and with minimal trouble.

In the last analysis, the ability of TDLs to meet the needs of operational commanders' rests at least as much on the ability of the personnel charged with operating the systems as it does on the capability of the systems themselves.

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