REAL-TIME EXCHANGE OF TACTICAL DATA

Joint Doctrine Pamphlet
2/01

JOINT DOCTRINE PAMPHLET 2/01

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Joint Doctrine Pamphlet 2/01 (JDP 2/01), October 2001 edition
is promulgated
as directed by the Chiefs of Staff

Director General
Joint Doctrine and Concepts Centre

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PREFACE

SCOPE

1. **Purpose**. This JDP is intended to convey understanding, and to inform and guide those most likely to be involved in the study, planning and conduct of exchanging tactical data in real-time/near real-time in UK Joint and UK-led multinational operations.

2. **Context**. The real-time/near real-time exchange of tactical data via a network of Tactical Data Links (TDL) has been a fundamental part of operations for many years, particularly in the maritime and air environments. Force assets such as Airborne Warning and Control System (AWACS), Airborne Stand-Off Radar (ASTOR) and Nimrod MR2/MRA4 can provide TDL information which may be of benefit throughout a Joint Operations Area (JOA). However, it is constrained both by the equipment level of participating forces and by the manner in which the TDL capability has been implemented in platforms. It is therefore essential that all personnel, particularly those responsible for procurement, take an holistic view of data exchange across the battlespace and, rather than focus narrowly on platform or role-specific issues and discrete Tactical Data Links they should aim to create Tactical Information Exchange Network Systems (TIENS). Nationally, guidance should always be sought from the Director Equipment Capability (Command, Control and Information Infrastructure) (DEC(CCII)), the Core DEC for TDLs, on this issue. Thus, for all existing or new platforms implementing or making significant changes to TDLs, Capability Managers must ensure that the needs and aspirations of all other UK TDL users are addressed within the User and System Requirement Documents. The principle objectives of this approach are to underpin the goals of MOD's Smart Procurement Initiative and to ensure interoperability amongst all UK TDL platforms.

3. **Structure**. This document consists of four main chapters. Chapter 1 aims to provide an overview of the need for and factors affecting TDLs. Chapter 2 provides information on the use and management of TDLs for those involved in the planning of TDL operations or their integration in platforms. Chapter 3 describes the Command relationships and responsibilities of those involved in the TDL planning process. Finally Chapter 4 provides a guide to Operational Staffs and Components on the conduct of link operations.

LINKAGES

4. This publication is subordinate to JWP 3-00 '*Joint Operations*', draws upon other related allied, joint and single service doctrine, and endeavours to illuminate common subjects where current differences in single Service terminology can cause confusion,

but does not seek to change extant NATO doctrine. A key enabler, TDL doctrine supports Joint Operations in all environments but in particular should be read in conjunction with, JWP 6-00 '*Communications and Information Systems*', JWP 2-00 '*Intelligence*' and JDP XX-01 '*Intelligence, Surveillance and Reconnaissance*' (ISR).

UK JOINT DOCTRINE FOR TACTICAL DATA LINK OPERATIONS

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Glossary of Terms and Definitions

Glossary of Abbreviations

JOINT WARFARE PUBLICATIONS

The successful prosecution of joint operations requires a clearly understood doctrine that is acceptable to all nations and Services concerned. It is UK policy that national doctrine should be consistent with NATO doctrine and, by implication, its terminology and procedures (other than those exceptional circumstances when the UK has elected not to ratify NATO doctrine). Notwithstanding, the requirement exists to develop national doctrine to address those areas not adequately covered, or at all, by NATO doctrine, and to influence the development of NATO doctrine. This is met by the development of a hierarchy of Joint Warfare Publications (JWPs).

As a general rule, JWPs of principal interest to Joint Force Commanders/National Contingent Commanders and their staffs are situated 'above the line' in the hierarchy; while more detailed operational and tactical doctrine including Joint Tactics, Techniques and Procedures (JTTPs) are positioned below.

Joint Doctrine Pamphlets (JDPs) are published as necessary to meet those occasions when a particular aspect of joint doctrine needs to be agreed, usually in a foreshortened timescale, either in association with a planned exercise or operation, or to enable another aspect of doctrinal work to be developed. This will often occur when a more comprehensive 'parent' publication is under development, but normally well in advance of its planned publication.

The Joint Doctrine Development Process and associated hierarchy of JWPs is explained in DCI JS 117/00.

RECORD OF AMENDMENTS

Amendment No	Date of Insertion	Initials

CHAPTER 1 – THE FUNDAMENTALS

101. The timely exchange and dissemination of battlespace information is fundamental to effective Command and Control (C2). It is a key enabler of the ability to control, monitor and evaluate operational activity in all battle environments. The goal must be to develop situational awareness (SA)[1] by presenting commanders with a harmonised common real-time tactical picture; this will require fusion of intelligence, surveillance and reconnaissance (ISR) and raw data at a number of stages of production.

102. The real-time communications architecture to support this activity should have high capacity, security, jam resistance and survivability, coupled with low data latency. There should be seamless connectivity from sensors to weapon systems, overlaid with C2 directives; this will require at the very least compatibility of data transmission media. These factors militate towards digital data exchange formats. Tactical Data Links (TDL) have therefore been designed for use in the exchange of real-time or near real-time tactical information between computerised tactical data systems such as mission systems in aircraft and command systems in ships or in land HQs.

SECTION I - ASSUMPTIONS

103. UK doctrine recognises the need for interoperability in combined and multinational operations with allies and coalition partners. It is therefore assumed that UK TDL systems will continue to be based on NATO standards wherever applicable. For the foreseeable future, these will be based on digital, bit-oriented message formats.[2]

104. It is assumed that the Command and Battlespace Management (CBM) initiative[3] will further underline the need for digital data exchange in support of the production of a common real-time tactical picture. However, notwithstanding CBM, there will be a continuing need for information exchange with and amongst legacy Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems.

105. Despite the prevalence of digital data formats, it is assumed that there will continue to be a need for traditional formatted messages, using character-oriented[4] standards (such as those contained in Allied Data Publication 3 (ADatP-3). However,

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[1] The understanding of the operational environment in the context of a commander's (or staff officer's) mission (or task). (JWP 0-01.1)

[2] A bit-oriented message format enables the transmission of data which is not inherently man readable but can be processed for display by other means(eg track symbology).

[3] Formerly known as Joint Battlespace Digitisation (JBD).

[4] A character oriented messge format enables the transmission of data which is inherently man readable and displayed in a textual format.(eg, OPTASK LINK).

other than in the developing use of Variable Message Formats (VMF), the use of these non real-time message standards falls outside the scope of this JWP.

SECTION II – OBJECTIVES

106. TDLs will be used for exchanging tactical information throughout the full potential spectrum of military operations. The objectives of TDL networks are prioritised as follows:

a. **First Priority**. To support C2 by providing the commander with real-time Operational Intelligence (OPINTEL), surveillance, reconnaissance, engagement and weapon status information, together with a means of disseminating real-time tactical instructions.

b. **Second Priority**. To support mission execution by providing real-time exchange of sensor and platform information overlaid with tactical orders.

c. **Third Priority**. To enable the exchange of tactical data between co-operating forces and nations.

d. **Fourth Priority**. To act as an aid to the positive identification of friendly forces, thereby aiding Combat ID.

Providing the TDL facilities necessary to achieve the lower priority objectives will usually ensure that the higher priority requirements are realised, but this may not always be the case and so care must be taken in managing TDL inter-connectivity to ensure that priority requirements are fulfilled.

SECTION III - FACTORS AFFECTING OPERATIONS

107. The demand for TDLs to provide information exchange across the entire spectrum and geographical area of operations is likely to be high. However, several factors may affect and limit TDL operations. Whilst the bearer media for individual TDLs may vary, all rely on establishing and maintaining connectivity amongst Link participants. If landline or microwave bearers are used then a suitable telecommunications infrastructure must either already exist or be created. Radio frequency bearers will have the advantages and limitations of their operating bands; ie, UHF will be limited to line-of-sight (unless relays are available) and HF will suffer from interference and ionospheric effects. Satcom bearers will be subject to satellite field of view and channel availability pressures, but these should only have a marginal effect on TDL operations. The requirement for continuous exchange of data makes all transmitting units subject to Direction Finding (DF), thereby providing an enemy the opportunity to use signal analysis to gain information on Force composition and disposition.

108. The scope and intensity of the predicted Electronic Warfare (EW) threat will have a major bearing on the use of TDLs in any particular operation, as it will influence the choice of TDLs used together with their data handling capacity.

109. Bandwidth, and thus data bearing capacity, on all TDLs is limited to a greater or lesser degree. Achieving a balance of timeliness, capacity, survivability and security to meet operational needs will therefore require careful and detailed planning. The relative importance of these elements will need to be prioritised on a case-by-case basis for each operation.[5]

110. Operations may be constrained by procedural restrictions in the use of bearer radio frequencies, especially during peacetime and low intensity operations. For example, Electronic Protective Measures (EPM) features, such as frequency diversity, might be restricted, or limits may be placed on total network capacity utilisation, particularly where there is a risk that the TDL might interfere with civilian navigation systems.

111. Data link operations may also be constrained by the requirement to exchange data between different Link networks, some of which may operate formats and protocols which do not allow automatic transfer of data without an interface being established. This interface can be provided by a suitably fitted link C2 platform, fixed or mobile buffer site or mobile ground station. Furthermore, TDL planning must provide for a back up capability within the interface configuration to ensure information flow does not cease if a single platform becomes a casualty. Further details on this aspect are given in Chap 4 Sect IV.

112. **Training**. Well-prepared and rehearsed plans, implemented by properly trained personnel, allow forces to react swiftly across the range of military operations. All military forces should therefore conduct Joint and Combined training in the use of TDLs. The complex nature of TDL operations means that, for information exchange to be complete and effective, training must be conducted in a holistic manner; it should, therefore, address all aspects of the planning, operation and management of TDL networks. TDL capabilities and procedures will continually evolve and so all formations, units and personnel who are involved in the use of TDLs must regularly participate in scheduled formal training. Tier1 (tactical level) training is the responsibility of the single Services. However, TDL training should always involve units from as many Services and Nations as possible to ensure that common operating procedures are developed and practised in a joint environment, and to allow interoperability issues to be identified as soon as possible. This should then help to ensure that maximum benefit is obtained from Tier 2 (component level) and Tier 3 (operational level) training. PJHQ will normally develop and manage all Tier 2 and

[5] Data update rates, capacity, ECM-resistance and security can be varied by network design. The mission objectives and the assessed enemy threat may influence the design selected or produced.

Tier 3 exercises, but responsibility for some Tier 2 exercises may be delegated to the single-Services. All Tier 2 and 3 exercises will, however, be co-ordinated through the Joint Exercise Co-ordination Group (JXCG) located at PJHQ.

CHAPTER 2 – PRINCIPLES OF TACTICAL DATA LINK PLANNING AND OPERATIONS

SECTION I - THE USE OF TACTICAL DATA LINKS

201. **Concept**. The conduct of joint operations requires the exchange of tactical information between the participants on a real-time or near real-time basis. The exchange of real-time tactical information between Command and Control (C2) systems, weapons systems, and Intelligence, Surveillance and Reconnaissance (ISR) systems[1] provides the basis for a common operating picture. A common operating picture will enhance the ability to provide mutual support, allow co-ordinated action, and prevent interference between forces thus enabling the efficient and effective application of military force.

202. **Information Exchange**. Tactical Data Link (TDL) operations provide for the continuous exchange of information concerning friendly, hostile, neutral and unidentified space,[2] air, land, surface and subsurface contacts. In addition, information on friendly units, the status of weapons and engagements, and other tactical data may be exchanged. If necessary, and if connectivity allows, information on the tactical situation for the entire tactical area of operations under the surveillance of the systems involved may be provided to the Joint Task Force Commander (JTFC) as well as Component Commanders (CCs). TDLs also provide commanders with the ability to digitally transmit certain orders to subordinates and requests to other agencies.

203. **Functions**. Whilst individual Links vary in capability and may not in isolation be capable of meeting all of the requirements below, TDLs should be used to support the following functions:

a. Participant position and identification.

b. Space surveillance.

c. Air surveillance.

d. Land surveillance.

e. Surface (Sea) surveillance.

f. Subsurface surveillance.

g. Electronic Warfare (EW).

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[1] For the purposes of this document, this embeds the target acquisition function (ISTAR/RISTA).
[2] Including ballistic missiles.

h. OPINTEL.

i. Mission management.

j. Weapons co-ordination and management.

k. Command and Control.

l. Information management.

m. System information exchange and network management.

n. Secure voice communications (implemented in certain TDLs).

o. Special Information Systems (SIS) Support.[3]

204. **Integration**. TDLs are Command, Control, Communications, Computers and Intelligence (C4I) systems; they exist to support C2 and ISR functionality. As such, they should be fully integrated to provide seamless, transparent exchange of data with the primary C4I or other systems used by each platform. Since the information that TDLs bear is required to be both timely and accurate, the manual transfer of information between links across an air gap is fundamentally unacceptable. Integration of TDL nets with other Wide Area Networks also needs to be considered.

205. **Control of Data**. A number of different TDLs are currently available to UK forces and more are expected to become available in the future (an overview of these Links is included at Annex 2C). Wherever possible, the most capable Link appropriate to the mission being planned or conducted should be used; for example Link 11 is used to exchange information on air, surface and subsurface tracks in the maritime environment whilst Link 16 is the preferred TDL for air operations. However, for a number of reasons, a particular Link might not always be available to all those requiring information and a combination of Links will be required, particularly by C2 units. If this is the case, every attempt should be made to achieve commonality of information across all Links, notwithstanding that the depth of information may be fuller on some Links than others. Most critically, ambiguity of reporting must be avoided. It will therefore be necessary for suitably equipped participants to:

a. Take responsibility for controlling the content of each Link in real-time.

b. Data Forward (translate data between Links without the host system applying any processing).

[3] SIS can interface with C2 and weapon systems via tactical data links and therefore need to be tasked through Essential Elements of Information (EEI) requests.

c. Gateway (translate selected data between Links having been subject to onboard processing by the host system).

206. **Network Planning and Design**. The complexity of Joint Force TDL requirements means that effective networks cannot be set up on an ad hoc basis. Similarly, single standing plans are unlikely to be able to meet the needs for the uncertain variety of scenarios in which UK forces may find themselves operating. There is, therefore, a need for both long-term and dynamic planning to be carried out in support of TDL operations, both at JTFHQ and Component levels. In general terms, the more capable the Link, the greater the need will be for specialised network planning and design tools. Details of the Network Design Process are given in Annex 2A.

SECTION II - ELEMENTS OF TACTICAL DATA LINK PLANNING AND OPERATIONS

207. **Interoperability**. The term Interoperability, in the context of information exchange, means that a system, unit or forces of any service or nation can transmit data to and receive data from any system, unit or forces of another service or nation unambiguously and the exchanged data can be used to operate effectively together. Without interoperability, there is no point in having a communication system; consideration of interoperability is hence the key to the entire TDL integration process. The level of interoperability achieved can be considered in a number of different layers. A large number of different aspects of the system must fit together in order that all the levels of interoperability are achieved. In addition to achieving the physical transfer of messages between platforms (Radio Frequency (RF) Interoperability), it is essential that the messages sent over the Link contain the data necessary to achieve the IER (Data Interoperability) and that they conform with the protocols defined for Link operation (Protocol Interoperability). The information contained in the messages must also complement the operational procedures defined for conducting the mission, task or battle. Finally, on reception, the information must be displayed and interpreted correctly by the receiving operators (Human Computer Interface (HCI) & 'Brain-to-Brain' Interoperability) and, if appropriate, forwarded onto other TDLs in a correct and timely manner so that an entire force can share the same tactical information.

208. **Standardisation and Documentation**. To achieve interoperability, it is essential that agreed standards are laid down and followed. TDL documentation comprises a suite of NATO, national and individual platform documents which define those standards. However, subscribing to standards does not, of itself, guarantee interoperability because dissimilar platforms have different capabilities and they may not implement the agreed standards in the same way or to the same degree.

209. **Platform Integration**. The integration of TDLs into a platform is a complex process, requiring changes to the host system that will allow it to initialise the Link terminal, to collect, format and pass information to the Link terminal, to process and display the data received and to generate appropriate alerts. If a modern TDL such as Link 16 is being retrofitted to an in-service platform, this will require, for example, an upgrade of the platform's software, the provision of a mechanism for controlling the terminal and cryptographic equipment, the installation of initialisation/loading devices and a change in the display system. In the case of a small manned aircraft, this often leads to cockpit space problems, and in a very small vehicle, such as an Unmanned Air Vehicle (UAV), will impose significant payload and power supply challenges. A properly integrated TDL can dramatically increase a platform's effectiveness, but, if the integration is poor, there is a high risk that operators will be swamped with information, increasing their workload and decreasing their effectiveness.

210. **Platform Implementation**. Each TDL has a specified set of messages for the exchange of data. Not all platforms will need to be able to read all of these messages; for example, an air defence fighter aircraft is unlikely to need the ability to read Link 16 messages pertaining to ASW track information. The decision on which messages to implement in each individual platform is, however, fundamental to successful TDL operations and this decision must be supported by sound operational analysis, guided by MOD policy. In order to understand and allow for the varying degrees of interoperability between participating platforms, the Theatre Systems Group (TSG), part of the UK Defence Procurement Agency (DPA) Integration Authority, conducts interoperability assessments for the majority of UK, and many US, platform implementations. However, it is the responsibility of the Central Customer for each platform, actioned through the appropriate Integrated Project Team (IPT), to implement the full range of messages relevant to each platform's role; this will be particularly crucial for C2 units.[4] All platform implementations must be living entities and must be amended in response to changes in standardisation agreements and the operational environment.

211. **Multi-TDL Network Management**. It is unlikely that future operations and training will be conducted in anything other than a multi-TDL environment. The purpose of multi-TDL network management is to ensure that forces can exploit the inherent flexibility and capacity of the Links available to extract the maximum operational benefit. Successful operation of TDL networks requires that the terminals of all participating units are provided with parameters which ensure a common definition of network characteristics, allocation of transmission time slots (where

[4] Any TDL participant responsible for the formulation, dissemination, data forwarding/gateway of C2 data and instructions should be considered as part of the C2 chain and should thus be considered, in TDL terms, a C2 entity, with TDL functionality implemented accordingly. This is a separate issue to C2 authority and will apply whether or not the participant is a C2 unit in its own right.

applicable), and co-ordination of crypto-variable usage on secure Links. Network management should have the following aims:

a. The network configuration and operation should support the planned tactical operations.

b. Network operation should, wherever practical, be common in peacetime training and in low and high intensity operations.

c. The network should be robust and, where possible, non-nodal (ie, the loss of one element should have minimal impact on the remaining network).

d. Network operation should place minimum constraints on operational deployments.

e. Participants joining or leaving the network should cause minimal disruption to operations.

f. Non-C2 units should be excluded from real time network management responsibilities.

g. The network management plan and its means of dissemination should minimise the need for routine dynamic management.

212. **Dynamic Network Management**. Correct platform implementation, effective participant preparation and adherence to agreed procedures should ensure that TDL operations are largely transparent to end-users. Unfortunately, however, this situation rarely occurs and so dynamic network management is needed to identify and correct problems as they occur. Facilities are therefore required to monitor the conduct of TDL operations, to recognise abnormal data exchanges, to identify the source of any errors and to implement timely corrective measures. The integrity of the network as a whole must always take priority over the needs of a single participant and, if a workable solution cannot be found, all non-compliant platforms should be excluded from the network.

213. **Multinational Operations**. In any operation where US forces are committed, they are likely to have the preponderance of TDL-equipped assets, as well as the most capable systems. Whilst US doctrine emphasises the need for interoperability, especially with NATO, this requirement needs to work in both directions. UK TDL systems and standards must, therefore, be established, designed and maintained to ensure compatibility with the US and NATO at all times.

214. **Planning Documents and Link Capabilities.** Details of the various publications which deal with these elements of Tactical Data Link planning and operations are given at Annex 2B. At Annex 2C is a brief description of the

capabilities and limitations of the main UK/US and NATO Tactical Data Link systems in use.

ANNEX 2A – TACTICAL DATA LINK NETWORK DESIGN PROCESS

2A1. Network design is the process of specifying the information exchange or communication requirements in support of planned tactical operations, and then translating those requirements into sets of terminal initialisation data for use by intended network participants.

2A2. **Initialisation Data**. Data link terminals can be fitted to many types of platform and can be used in a number of different roles. The terminal therefore incorporates in its software a number of changeable parameters that tailor the terminal's operation to its platform's configuration and role in any operation. Many of the parameters can only be changed by recompiling the software and so it would not be feasible to change these between missions. However, some of the parameters may be changed each time the terminal is to be operated; these are termed 'initialisation parameters'. Initialisation parameters may be divided into two categories as follows:

a. **Network Dependent Parameters**. Network Dependent parameters define a platform's participation in a particular network. The most obvious example is the time slot assignments to be used by a particular platform in a Link 16 network.

b. **Network Independent Parameters**. Network Independent parameters do not need to be changed whenever a new network is to be operated. Examples of these are cable delays, which compensate for different cable lengths between aerials and the terminal.

A small number of these parameters can only be set immediately before operating in the network; for instance, the voice callsign of an aircraft may not be assigned until shortly before the mission is due to be flown.

2A3. **Centralised Production**. If a large number of parameters is to be provided to a large number of platforms, there will be a need for a centralised, automated system to produce the initialisation data; this is particularly true for the more advanced and complex TDLs such as Link 16. This centralised production of network designs and initialisation data is intended to keep the initialisation procedure at unit level as simple as possible. Network design is a complicated process in which errors can easily be made; it must therefore take place well in advance of operations if the network is to support them adequately.

2A4. **Network Design Requirements**. The first step in the network design process will be to analyse the anticipated operational environment and to arrive at a set of communications requirements. The general requirements will include the following:

a. Overall operational environment (peace/exercise/war).

b. Number and type of participants.

c. Participant platform dispositions (particularly in terms of relay requirements).

d. The data (including voice) to be transmitted and received by each participant and its characterisation in terms of:

(1) Type/function; eg. surveillance.

(2) Amount (per period).

(3) Priority/availability.

(4) Security, including any integrity/confidentiality requirements.

(5) Electronic Counter Measures (ECM)-resistance.

2A5. **Network Design Management**. Normally, a Joint (or Combined when appropriate) Network Steering Group (NSG) should be formed to decide on network requirements. This group should comprise of single service and J3/J6 representatives and should meet at regular intervals to define communications requirements in operational terms. However, technical experts who can translate these operational requirements into link-specific network design decisions should support the NSG. The NSG should be responsible for the direction and prioritisation of the production, validation and distribution of network designs.

2A6. **Network Design Library**. Standing network plans should be designed for wartime, exercise and peacetime operations. These will be subject to change as the number of TDL-fitted platforms increases, particularly during the early years of bringing NATO Multifunctional Information Distribution System (MIDS) into service. These standing designs will often meet the needs of other (perhaps more limited) scenarios. The aim should therefore be to establish a library of network designs. Whilst there will be a potentially infinite number of detailed variations on the operational scenarios that might be encountered, in many cases it will be feasible to adapt an existing design rather than plan an entirely new network. The number of designs maintained should, however, be commensurate with the logistics of production, distribution, local handling and, in particular, overall configuration control. Designs held in the library should have been validated and approved for general operational use, which will normally be achieved by limited operational use and feedback from other operations. Arriving at a library of designs known to work successfully will be an iterative process, with design improvements to reflect current operational thinking being incorporated progressively. The network library should

contain sufficient information, including background information, instructions and network descriptions, to allow the network manager to quickly select the most appropriate design to meet the specific operational requirements. The selection may be computer-assisted or based solely on paper descriptions (the number of networks in the library will probably determine which method is adopted).

2A7. **Network Planning**. Network planning is the process of preparing for specific TDL operations at a particular time. It includes the selection of the network design to be used, the production of the OPTASK LINK message, the designation of the bearers and cryptovariables to be used, together with other planning details which will enable all participants to operate in the network in a co-ordinated manner.

2A8. **Selection of Network Design**. Selection of the network design will be based on the operational environment and its communications requirements. More than one design may be selected (eg. for fallback purposes). The choice of network design, and any modifications required to tailor it for use, will be promulgated in the OPTASK LINK. Where there is no existing design that can be employed without the need for extensive ad-hoc modifications, the network manager must initiate a request for a new design. The criteria for selecting a network design will include the following:

a. The design must contain at least as many of each platform type as required.

b. The design must support the required data exchange between platforms and C2 units in terms of capacity and participants supported (including voice).

c. The design must support the required connectivity.

d. The network must support security and survivability requirements.

e. The network design must be appropriate for the environment and conform to any relevant frequency clearance rules.

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ANNEX 2B – TACTICAL DATA LINK STANDARDS DOCUMENTATION

2B1. This Annex gives details of the documents and publications issued by NATO, the UK or the US, which govern the standards to be used to assure TDL interoperability. In principle, NATO documentation will have primacy; UK documentation is primarily produced to ensure national implementation of NATO standards. US documentation is included for completeness, since it covers a number of areas that have yet to be addressed authoritatively by the other sources. Details of the relationships between these documents are given in Figure 2B.1.

2B2. **NATO Publications**. The extant NATO publications relating to TDLs are as follows:

a. STANAG 5501 (Point-to-Point Digital Link – Link 1).

b. STANAG 5511 (Tactical Data Exchange – Link 11 and Link 11B).

c. STANAG 5514 (Tactical Data Broadcasting – Link 14).

d. STANAG 5516 (Tactical Data Exchange – Link 16).

e. STANAG 5616 (Standards for Data Forwarding between Tactical Data Systems Employing Link 11/11B and Tactical Data Systems Employing Link 16).

f. STANAG 5522 (Tactical Data Exchange – Link 22).

g. STANAG 5601 (Standards for Interface of Data Links 1, 11, 11B and 14 through a Buffer).

h. ADatP 4 (SOPs for Link 4).

i. ADatP 11 (SOPs for NATO Link 11).

j. ADatP 12 (SOPs for the Ship-Shore-Ship Buffer).

k. ADatP 14 (SOPs for Link 14).

l. ADatP 16 (SOPs for NATO Link 16).

m. ADatP 22 (Draft) (SOPs for Link 22).

n. ADatP 31 (SOPs for Link 1).

o. ADatP 33 (Draft) (Multi-Link SOP (MLSOP) based on the US JMTOP B – see below).

2B3. **UK Publications**. The extant UK publications relating to joint doctrine and TDLs are as follows:

a. OPS for the Employment of MIDS/Link 16 in the RAF (ACAS.71377 dated Oct 93).

b. RN/RAF Concept of Employment for the use of Link 16 in Support of Air Defence Operations (D/D Air Def/114/17/16/1 dated Dec 94).

c. RN/RAF CONOPS for the use of Link 16 in Support of UK Air Defence Operations (11G/310/6/5/2/GE dated 1994).

d. RN Data links CONOPS (D/DOR(Sea)/34/31 dated Feb 1997).

e. SOPs for Units using MIDS Within the UK FIR in Peacetime (11/18 Gp/BP/360/6/6/1/OPS dated Mar 97).

f. RN Link SOPs (LSOP).

g. APP-11 (NATO Message Catalogue) – contains OPTASK LINK format.

h. UK Multi TDL Management Requirement Specification (C309230/R-01/67 issue 1 dated June 2000)

2B4. **US Publications**. The extant US publications relating to TDLs are as follows:

a. Joint Tactical Data Link Management Plan.

b. Joint Multi-link Tactical Operating Procedures (JMTOP B). The purpose of the JMTOP is to provide planning guidance and operating procedures for the deployment of Joint Tactical Data Link C4I Systems.

c. Variable Message Format (VMF) Technical Interface Design Plan (TIDP).

d. USN TADIL SOPs.

e. USAF Concept of Link Employment (COLE).

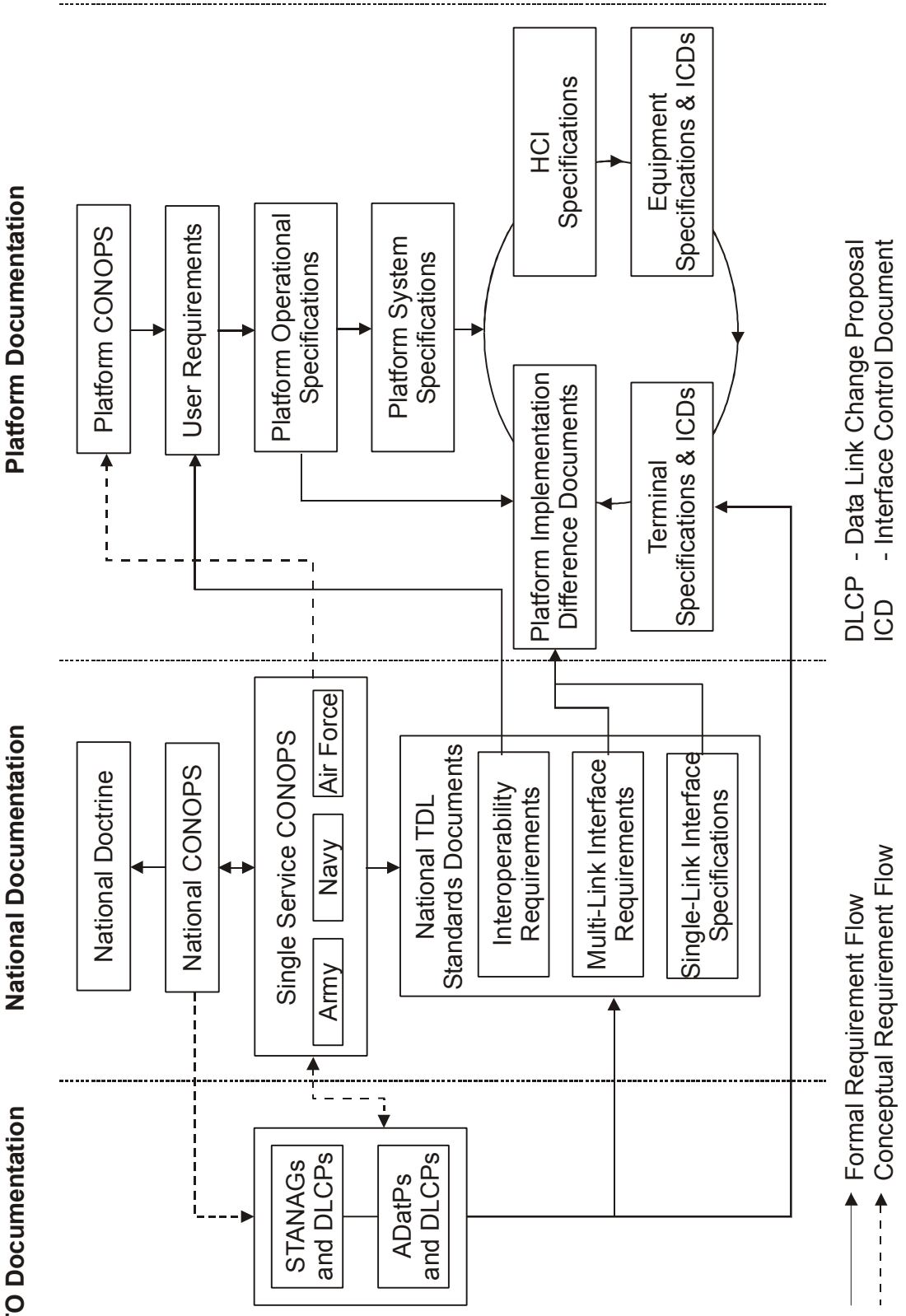

Figure 2B.1 - TDL Standards Documentation Flowchart

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ANNEX 2C – TACTICAL DATA LINK CAPABILITIES

SECTION I - CURRENT DATA LINKS

2C1. **Link 1**. Link 1 is used in NATO Air Defence (AD) systems. Designed in the late 1950s, it is a fixed point-to-point data link system used between ground elements of the Air Surveillance And Control System (ASACS). The link is of low capacity and is effectively limited to passing air tracks. It is not secure, although it could be subject to standard landline encryption, and only has such Electronic Counter-Measure (ECM)-resistance as is inherent in a buried cable or a microwave link. Fixed or mobile buffer sites, such as the NATO Ship-Shore-Ship Buffers (SSSB), can provide an interface between Link 1 and other tactical data links, however only air track data can be forwarded.

2C2. **Link 11**. Link 11, which is the most commonly fitted TDL in NATO and is also widely used in the rest of the world, was developed as a naval data link. Link 11 is based on 1960s technology and is a relatively slow link (rates of 2250 or 1364 bps are available). It normally operates on a polling system with a Net Control Station polling each participant in turn for their data (polling is a system whereby a central unit, known as the Data Net Control Station (DNCS), communicates with each user in turn authorising the transmission, or reception of data). In addition to this 'Roll Call' mode, Link 11 may be operated in partial roll call where only selected units are polled in a sequence with remaining units in a receive only mode. A broadcast mode, in which a single data transmission or a series of single transmissions, is made by one participant is also available. It is secure but not ECM-resistant. Link 11 supports the exchange of air, surface and subsurface tracks, EW data and limited command data among C2 units. Its nodal nature makes it vulnerable to the loss of a participating unit and the lack of ECM-resistance means that it is vulnerable to jamming in an EW environment. Link 11 is designed for operation on High Frequency (HF) ground wave and thus has a beyond line of sight (BLOS) capability (to a theoretical range of approximately 300 nm although reliable communications are rarely achievable beyond 150nm). However, this range can be extended considerably by exploiting Link 11's sky-wave capability, typically achieving reliable ranges in excess of 600 nm. Link 11 can also operate in the UHF band but is then limited to LOS ranges (approximately 15nm surface-to-surface or 150 nm surface-to-air). EMCON considerations may often make this the preferred mode of operations where force disposition allows. It is very widely fitted throughout NATO and beyond and will remain in service until at least 2015. UK fits include CVS, T42 Destroyers, T22 and 23 Frigates, ALES, LPH (HMS Ocean), UK ASACS, Sentry AEW 1, and future fits include Nimrod MRA 4, Landing Platform Dock (LPD) replacement (HM Ships Albion and Bulwark), Merlin Helicopter, SSNs and T45 Destroyer.

2C3. **Link 11B**. Link 11B is a ground-to-ground implementation of the Link 11 message catalogue (To differentiate from Link 11B, Link 11 is sometimes unofficially referred to as Link 11A). The implementation differs slightly to that on Link 11; for instance Link 11B includes a unique message to monitor the status of a point-to-point data link and Link 11B does not implement some messages concerned with ASW data. Whereas Link 11 is a netted system employing parallel transmission characteristics, Link 11B is a point-to-point system employing serial transmission of the data. Link 11B is used by the UK for ground-to-ground communications with the Iceland Air Defence System (IADS).

2C4. **Link 14**. Link 14 is a broadcast HF, UHF, and SHF Satcom data link for maritime units designed to transfer surveillance information from CVS/T42 to non-TDL fitted units using Teletype transmission, which allows reception over very long ranges. Reception can be to teleprinter or to Autoplot VDU in pictorial form. However, at 75 bps, the data rate is very slow, with plots being updated approximately every 6 minutes. Link 14 is therefore used primarily to provide a High Interest Track Broadcast (HITB) to supplement other real-time data links and voice reports. Although it was discontinued as a NATO TDL from 2000, it is still likely to remain in service for several years and remains useful for provision of a maritme surface picture to NATO ASACS units which have no access to this data over Link 11.

2C5. **NATO Multifunctional Information Distribution System**. NATO's Multifunctional Information Distribution System (MIDS), originally known as Joint Tactical Information Distribution System (JTIDS) and based on Time Division Multiple Access (TDMA) technology, is a high capacity, ECM-resistant communications link designed for all environments (space, air, surface and land) and all platform types. The requirement for high capacity constrained the link to a UHF solution, thereby limiting the range of the system to direct LOS (300 nm or 500 nm depending on range mode selected, normal or extended) and so relay is designed into the system to achieve BLOS performance. There are two message standards that may be used:

a. **Interim Joint Tactical Information Distribution System Message Specification**. An Interim JTIDS Message Specification (IJMS) came into existence because the hardware for JTIDS was available before the US TADIL-J message standard (on which Link 16 is based) was agreed. IJMS was therefore developed to provide an initial JTIDS operating capability for the USAF and was also implemented in the NATO E-3A. It is based on Link 11 messages packaged to fit into the JTIDS architecture and transmitted at speeds of up to 28800 bps. Consequently, it has the same functionality as Link 11, but with a greater capacity and ECM-resistance; however, it is not optimised for the JTIDS architecture and cannot use the enhanced JTIDS features which increase data throughput. IJMS is implemented in the

UK/NATO ASACS for commonality with NATO E-3As and can be used by Link 16 capable units as a fallback when full Link 16 functionality is unavailable or they are working with less capable units. IJMS does not however meet the UK's requirements for expeditionary operations because the surveillance capacity is not sufficient and it has limitations in the C2 function.

b. **NATO Multifunctional Information Distribution System/Link 16**. MIDS/Link 16 has been designed to optimise the use of the MIDS architecture and can carry at least four times the surveillance information of MIDS/IJMS; transmission speeds of 57600 bps or better can be achieved. It completely meets the requirements for C2 functionality and aircraft control. Link 16 has been developed to meet the information exchange requirements of all tactical units, supporting the exchange of surveillance data, EW data, mission tasking, weapons assignments and control data.

2C6. **Other Links**. Link 3 is used within the NATO Early Warning System for sending general situation reports from the Allied Command Europe (ACE) Evaluation Centres to SHAPE. It uses both landlines and tropospheric forward scatter. Link 4 is a ground-to-air and air-to-air tactical fighter direction link. It is fitted to the E-3D, but has not been maintained and is not used. Link 4 is not installed in any other UK system, but is still used by certain US platforms not yet converted to Link 16. UK forces may also be involved in operations in which other TDLs are in use, primarily by the US, such as Army Tactical Data Link-1 (ATDL-1), which is used for controlling and co-ordinating Surface to Air Missile (SAM) operations.

2C7. **Fighter Data Link**. Not a link in its own right (the term fighter data link normally refers to the terminal fitted in the aircraft) Fighter Data Link (FDL) will be fitted to US F15 C/D and F15E aircraft. The FDL terminal will use only a subset of Link 16 and will be lower powered than other MIDS terminals; in particular, it will have little or no MIDS voice, navigational or relay capabilities.

SECTION II - FUTURE DATA LINKS

2C8. **Satellite Tactical Data Link (16)**. Link 16 is being developed in a number of ways beyond the basic concept of integrating a MIDS terminal on a platform and using Link 16 as the language of that terminal. The RN investigated the use of the Link 16 message standard on a satellite bearer to overcome the LOS limitations of MIDS. The Satellite Tactical Data Link (16) (STDL) is now part of the RN Ship System requirement and is to be implemented at the same time as MIDS/Link 16. The intended fitting programme includes CVS, T42 Destroyers, T45 Destroyers, Type 23 Frigates and SSNs. The US Navy are also investing in satellite Link 16 known as Satellite Link 16 (S-Link 16). However, the solution chosen is not the same as that of the RN, thus the two systems are not compatible.

2C9. **Link 22**. NATO has designed a new data link, Link 22, which uses Link 16 elements in a TDMA architecture using either fixed frequency or frequency agility in the UHF (225- 400 MHz) and HF (3-30 MHz) bands. This programme was initially known as NATO Improved Link Eleven (NILE) and this name is still widely used. It is intended that Link 22 will eventually replace Link 11 and will work in harmony with Link 16 to provide secure, ECM-resistant data communications for LOS and BLOS operations. In January 1996 it was announced that 7 nations - Canada, France, Germany, Italy, the Netherlands, UK and USA - were to issue a joint Request for Proposals (RFP) for the development of the software for Link 22. This development should be completed in the year 2001. The aim is to use the data processing systems and radio equipment that are already installed in the candidate platforms and for nations to procure new terminal and cryptographic equipment, the latter from the USA under bilateral agreements. Link 22 will introduce a new level of complexity into the planning and conduct of TDL operations because a single Link 22 Super Network[1] can consist of up to 4 (possibly 8) Mission Area Sub-Networks.

2C10. **Common Data Link/Tactical Common Data Link**. This link consists of a secure, jam resistant uplink/downlink system operating at different data speeds and bandwidths. CDL permits the remote operation and exploitation of sensors carried by CDL fitted platforms at long range via satellite. The US Defence Advanced Research Projects Agency (DARPA) is in the second phase of the procurement programme for a CDL-compliant Tactical Common Data Link (TCDL). The TCDL programme is to provide a family of interoperable, secure, digital data links for use with both manned and unmanned airborne reconnaissance platforms. It will transmit radar, imagery, video and other sensor information at rates from 1.544Mbps to at least 10.7 Mbps over ranges of 200km. It is also intended that TCDL will soon support the required higher CDL rates of 45, 137 and 274 Mbps. The UK is evaluating a High Integrity Data Link (HIDL) for UAVs sponsored by the NATO Naval Armaments Group's Projects Group 35. This link will consist of airborne and surface-based terminals with a full-duplex narrow-band jam-resistant data link operating in broadcast mode to control at least two UAVs simultaneously to ranges of 200 km. It is a requirement that this link must be able to operate with the US wideband TCDL.

2C11. **Surveillance and Control Data Link**. Surveillance and Control Data Link (SCDL) is a narrow-band used by the E-8C JSTARS for promulgating its Moving Target Indicator (MTI) radar picture to dedicated ground stations. It is intended that SCDL will also be implemented within the Airborne Stand-off Radar (ASTOR). SCDL relies on its own dedicated ground station.

2C12. **Variable Message Format**. Variable Message Format (VMF), also known as Joint VMF (JVMF), is a media-independent data message set that can operate over any digital-capable radio frequency (RF) broadcast or point-to-point system. It achieves

[1] Link 22 allows multi-network operation. When these networks are interconnected they are known as super networks.

higher effective data flow by more efficient use of message space compared to other types of TDL. Almost any type of data can be exchanged, including binary or hexadecimal data, ASCII text, video, voice or fixed format messages (similar to other TDLs). It has its origins in a 1970s US Army requirement for a variable message extension to Link 16 and is primarily aimed at ground operations fire support. It will also support general information exchange; intelligence; air, land, maritime and special operations; combat service support; and airspace control. However, it is not intended as a surveillance picture compilation link. Effective data throughput varies according to the medium being used: 2,400 bps, 4,800 bps or 9,600 bps using various generations of VHF SINCGARS radios; or 16,000 bps using landline. Whilst these rates may be slower than systems such as MIDS, VMF's greater message efficiency means that more actual information may be exchanged than by other TDLs. It will be widely used by the US Army and the USMC but not by the USAF, who intend to develop a Link 16/JVMF gateway. It may be used by the UK in Jaguar and Apache aircraft in conjunction with the Improved Data Modem (IDM) that will provide a limited networking capability.

2C13. **Co-operative Engagement Capability/Joint Composite Tracking Network**. The US Navy began developing the Co-operative Engagement Capability (CEC) system in the 1980s as part of general research on battle group self-defence, but converted it to a regular acquisition programme in 1993. The CEC programme originated as an improvement in ship self-defence capabilities in an open ocean environment, but migrated to a self-defence capability for engagement in areas close to land. The CEC programme allows US Navy Surface Action Groups (SAGs) or Battle Force surface ships and airborne elements to exchange sensor plot (measurement) data that is integrated within identical fusion engines in each platform to provide high fidelity fire control quality information in real time as both an electronic warfare counter-measure and an enhanced operating capability. The involvement of USAF and other agencies has led to the use of the alternative name of Joint Composite Tracking Network (JCTN). CEC is a 'data fusion' system with extremely high data rates of 2-5 Mbps (to be enhanced to 10 Mbps) and provides the means for sharing assets among multiple AAW units in a counter-measures environment to perform SAG/BF AAW detection or surveillance, control and engagement functions. CEC makes co-operative use of all participants track measurements to produce a single, shared picture. Co-operating Units (CUs) are equipped with omni-directional beacon antennas, which allow for directed Line Of Sight (LOS) data exchange at ranges of approximately 50-60 km. The CEC network will not replace Link 11 or Link 16 in the integrated battle area, although plans exist for further implementation and development. For the foreseeable future, CEC and traditional TDLs will continue to complement each other. CEC is planned for integration into most USN aircraft carriers, AEGIS cruisers and destroyers, Kidd and Spruance Class destroyers and other surface vessels. It will also be fitted to USN P-3 and E-2C aircraft, US Army Patriot and probably THAAD. Fitment to USAF E-3

aircraft and the USMC AN/TPS-59 radars is also likely. The UK is participating in CEC and a number of other NATO nations have shown interest in the project.

2C14. **Air Command and Control System-Wide Common Information Exchange Standard**. The Air Command and Control System- Wide Exchange Standard (AWCIES) was introduced as part of the NATO Air Command and Control System (ACCS). AWCIES will provide a far more capable and secure replacement for Link

2C15. **Tactical Data Link Summary**. A summary/comparison of the features of the primary TDLs is given in Table 2C.1.

	Link 14	Link 11	MIDS
Operating Frequency	HF/UHF/SHF	HF/UHF Fixed Frequency	UHF 969-1206 MHz
Data Rate (Nominal)	0.075 kbps	2.25 kbps	57.6 kbps (Packed 2)
Max. No. of Participants	Broadcast	24 active PUs unlimited receive only	Unlimited (Practical limit 250)
Throughput Measure - Nominal	5 Tracks per 10 seconds	21 Tracks per 10 sec. Net Cycle per user	80 Tracks per 12 sec. (Packed 2) per user
Coverage - Range	HF: variable 300 nm nom. UHF: LOS (up to 200nm) SHF: Worldwide	HF: variable 300 nm nom. UHF: LOS (up to 200nm)	LOS - max 300/500nm
Nodal	Yes	Yes	No
Jam Resistance	UHF/HF – Zero SHF - Good	Zero	Excellent
Error Resistance	Poor	Poor. Bit Error Rate $1x10^{-3}$	Excellent. Bit Error Rate $1x10^{-6}$
Robustness	Poor - Single Broadcast Unit	Poor - Nodal Polled System	Excellent - Non Nodal. Relay Available
Message Structure	Character based	M-Series. Little scope for growth.	J-Series. Good Granular Accuracy
Max Track Accuracy Reportable[2]	± 1 dm	Air ± 3.5 dm Surface ± 1 dm	± 0.003 dm (± 20 ft)
Major Weaknesses	Intended for RATT transmissions only, Low data rate, No jam-resistance. High Probability of intercept and Exploitation	Nodal, Old technology, No jam-resistance. High Probability of intercept and Exploitation	Line of Sight[3] Frequency Clearance Restrictions.
Major Strengths	Simple data transfer to Non TDS platforms	In service with all NATO nations	High capacity. ECM resistant. Low Probability of intercept. Low Probability of Exploitation Fitted to Fighter ac.
Platforms[4]	CVS, *T45,* T42, T22, LPD, E-3D, UKASACS, *LPD(R), LPH, AOR, SSSB*	CVS, *T45,* T42, T23, T22, LPD, E-3D, JFAC HQ, UKASACS, ALES EH101 (Merlin), *TACC,* Nimrod MR2*, Nimrod MRA4, SSN, LPD(R), LPH, SSSB*	*CVS, T45, T42, SKW, FA 2, EF2000* E-3D, F3, *TJF*, JAPNMS, *TKR, Nimrod MRA4, ASTOR*

[2] Based on best reportable track quality.
[3] If no airborne relay available.
[4] Future fits are shown in italics.

	STDL	Link 22
Operating Frequency	SHF	HF/UHF Fixed Freq / Freq. Agile
Data Rate (Nominal)	19.2 kbps	1.4 or 4 kbps (HF) 12.7 kbps (UHF)
Max. No. of Participants	16 Transmit 32 Receive	128
Throughput Measure - Nominal	34 Tracks per 12 seconds per user	35 or 53 Tracks per 10 seconds per user ??
Coverage - Range	Near-world-wide Satellite Footprint	HF: variable 300 nm nom. UHF: LOS (up to 200nm)
Nodal	Yes. (Requires Ground Station)	No
Jam Resistance	Excellent	Reasonable
Error Resistance	Excellent. Bit Error Rate $1x10^{-6}$	Good. Bit Error Rate Goal of $1x10^{-5}$
Robustness	Medium - Reliant on satellite resources	Good - Non Nodal. Relay Available
Message Structure	J-Series. Good Granular Accuracy	F-series (based on J-Series)
Max Track Accuracy Reportable[5]	± 0.003 dm (± 20 ft)	± 0.003 dm (± 20 ft)
Major Weaknesses	Competition for satellite resources. High Probability of intercept.	Limitations of HF Radio Communications. Medium Probability of intercept.
Major Strengths	Long Range. ECM resistant. Potential of 2Mbps Data Rate. Low Probability of Exploitation	Modern Networking Techniques. Simple radio technology. Low Probability of Exploitation
Platforms[6]	*CVS, T45, T42, T23, SSN*	*tbc*

Table 2C.1 – Comparison of Major TDL Capabilities

[5] Based on best reportable track quality.
[6] Future fits are shown in italics.

CHAPTER 3 - COMMAND RESPONSIBILITIES AND RELATIONSHIPS

SECTION I - JOINT ORGANISATION

301. **The Joint Commander**. The Joint Commander (Jt Comd) is responsible for the planning and execution of joint, potentially joint, combined and multinational operations led by the UK, and for exercising operational command (OPCOM) of UK forces assigned to combined and multinational operations led by others. As such, the Jt Comd is responsible for the overall planning and provision of Tactical Data Links (TDLs), but responsibility for their usage and day-to-day control will normally be delegated through the Joint Task Force Commander (JTFC) to the most appropriate Component Commander (CC) capable of acting as TDL Co-ordinating Authority (TDLCA). The Permanent Joint Headquarters (PJHQ) J6 staff will, nevertheless, remain responsible for ensuring that the JTFC's in-theatre requirements are met. In particular, the PJHQ should ensure that advanced planning and preparation for the deployment of appropriate TDL assets is undertaken; normally, this task will be delegated to the Supporting Command[1] best equipped to carry out this task.

302. **The Joint Task Force Commander**. The JTFC is the commander authorised to exercise operational control (OPCON) over a joint force. The JTFC will normally operate from an operational HQ close to or within the Joint Operations Area (JOA). The JTFC should issue a concept of operations (CONOPS) that specifies the objectives to be met and provide guidance for the employment of TDLs. Air Defence (AD) operations are often of primary concern in drawing up a TDL CONOPS. However, all aspects, particularly Intelligence, Surveillance and Reconnaissance (ISR), should be taken into account. The CONOPS should include:

a. Specific guidance and objectives for TDL operations, including apportionment of surveillance assets (eg Airborne Warning and Control System (AWACS) or Airborne Early Warning (AEW), Airborne Stand-Off Radar (ASTOR), Maritime Patrol Aircraft(MPA)) and prioritisation of missions.

b. Requirements to develop, co-ordinate and de-conflict plans for TDL operations.

c. Nomination of the Tactical Data Link Co-ordinating Authority(TDLCA) (if responsibility delegated) and guidance for co-ordinating with allies.

[1] The 3 single-Service Commanders in Chief (CinCs) (ie, CINCFLEET, CINCLAND and CINCSTC) are responsible for providing forces for joint and multinational operations (British Defence Doctrine). In as much that these forces will be placed under the OPCOM of the nominated Jt Comd, the CinCs are considered to be acting in a supporting capacity, hence the terms Supporting Command and Supporting Commander. (JWP 0-10).

303. **The Joint Task Force Commander's Staff**. Elements of the JTFC's staff should be responsible for the following:

a. **Joint Intelligence Staff**. J2 staff should identify to J3 the requirements for TDL support to real-time OPINTEL and ISR collection and dissemination, including the support of Special Information Systems.

b. **Joint Operations Staff**. J3 staff should establish and prioritise TDL objectives with input from, and in co-ordination with, the CCs' staffs.

c. **Joint Logistics Staff**. J4 staff should identify deployment and support requirements for all non platform-embedded TDL equipment (eg. RAF Tactical Communications Wing (TCW) equipment).

d. **Joint Planning Staff**. J5 staff should plan for the deployment of appropriate TDL assets needed to support Joint Force and Component operational requirements.

e. **Joint Communications and Information Systems Staff**. J6 staff should ensure that TDL systems are integrated into the strategic deployed Command, Control, Communications, Computers and Intelligence (C4I) networks. They should assist in establishing and providing connectivity requirements where these are not integral to the operational participants. They should also review, in conjunction with J3 staff, through the Battlespace Spectrum Management (BSM) organisation any in-theatre frequency clearance issues that may affect TDL operations (this is particularly important for Link 16 operations) and also liase with the TDLCA regarding tactical frequency management at component level.

304. **The Tactical Data Link Co-ordinating Authority**. Once nominated by the JTFC, the TDLCA will take Co-ordinating Authority responsibility for the immediate planning and conduct of TDL operations across the Components. Since the preponderance of UK Joint TDL operations can be expected to be in support of Air Defence operations, this responsibility will normally fall to the Air Defence Commander[2] (ADC). The TDLCA will normally form a TDL Planning and Co-ordination cell, led by a Data Link Manager (DLM)[3], also known as the Joint Interface Control Officer (JICO)[4] by the US to exercise this responsibility. The DLM/JICO will

[2] The task of ADC will normally be vested in the CC with the preponderance of air assets and possessing the means to command and control them. This will usually, but not exclusively be the JFACC.

[3] The TDLCA is the CC who has overall responsibility for co-ordinating TDL operations, but the DLM is the officer on the staff of the TDLCA (typically of SO1 rank) who actually implements that obligation.

[4] A full description of the responsibilities of the JICO is contained in the draft of ADatP-33. From a UK perspective, the JICO responsibilities, as described in AdatP-33, do not adequately define the actions required of a network manager. The UK Data Link Operations Cell is presently making strenuous efforts, on behalf of a formal NATO Committee, to improve the Link 16 Network Manager SOPs as defined within ADATP-16.

be responsible for the production and dissemination of the Operational Tasking Data Links message (OPTASK LINK), which promulgates interface details and responsibilities to all TDL participants, and for monitoring the status of TDL operations in real-time to ensure that appropriate connectivity is maintained between co-operating forces.

305. **The Component Commanders**. The CCs will ensure that the forces under their command conduct TDL operations in accordance with the JTFC's requirements, as co-ordinated by the DLM. As a minimum, the CCs will:

a. Ensure that the platforms and systems employed in the operation use compatible and interoperable TDLs.

b. Provide materiel and manpower resources to support the TDLCA in the planning, conduct and co-ordination of joint TDL operations.

c. Co-ordinate component requirements and/or capabilities with the TDLCA and report to the JTFC any deficiencies that may affect the conduct of joint operations.

d. Manage component-unique TDL operations, issuing supplementary OPTASK LINK orders as necessary.

306. **The Supporting Commands**. The Commanders in Chief (Cs in C) Supporting Commands furnish forces, equipment, logistics or support to the PJHQ, and may be tasked to develop a supporting plan for a deployed operation. The Jt Comd may therefore nominate a Supporting Command[5] to take responsibility for the longer-term planning and design of TDL networks. This Commander will have access to the necessary staff and operations expertise, together with the required planning tools. These should be drawn together to form a TDL Planning and Co-ordination Cell (TDLPCC), initially to act in support of the JTFC, but later, after operations commence, control of the cell may be transferred to the TDLCA. At this stage different Supporting Commanders may be given responsibility for various links but, if this occurs, one should be nominated as the overall lead for co-ordination purposes. The Supporting Commander in charge of the TDLPCC will be responsible for the following activities:

a. Reviewing the Supported Commanders' objectives and their information flow and connectivity requirements (ie, their Information Exchange Requirements (IERs)).

[5] The Supporting Commander in this context is a single-Service CinC and should not be confused with the JTFC's requirement to express cross-component support at the tactical level by designated CCs as supported or supporting (JWP 0-10).

b. Identifying the TDL-equipped platforms that are participants in the operation, as well as the communication capabilities of each platform.

c. Documenting the locations and planned movements of the participants in the operation.

d. Developing a viable TDL interface design.

e. Reviewing standing plans to determine whether existing network designs will support the planned operation, and selecting an appropriate design or conducting the necessary activity to produce a new design.

SECTION II - MULTINATIONAL OPERATIONS

307. TDL operations may be required within the context of an alliance, multinational coalition, or other international arrangement as follows:

a. In operations where the UK is the framework nation, the JTFC's staff, in consultation with subordinate command staff, must determine the level of multinational interoperability required. In particular, consideration must be given to aspects such as: force capabilities and disparities, differences in equipment and standards, information and security requirements, and procedural and organisational variations.

b. In operations frameworked by another nation or conducted by a standing alliance (such as NATO), that nation's or alliance's staff will bear the responsibilities detailed above. However, the staff of the UK National Contingent Commander (NCC) will need to liaise with these lead staffs to ensure that UK capabilities are exploited to best meet operational requirements and that UK platform TDL requirements are included in combined TDL plans.[6]

[6] A lesson identified from Operation *Allied Force* was that national representation at multi-national TDL planning activities was vital for all participant requirements to be met. Furthermore, if the framework nation staffs were less experienced than UK personnel, then UK expertise should be offered to assist in the TDL management process. Some nations may have access to their own TDL planning tools.

CHAPTER 4 - TACTICAL DATA LINK OPERATIONS

SECTION I – INTRODUCTION

401. **General**. Successful multi-link Tactical Data Link (TDL) operations are essential for the provision of timely Command and Control (C2) support to the Joint Task Force Commander (JTFC) and Component Commanders (CCs). However, in order to establish TDL connectivity as soon as operations commence, a considerable amount of network planning and design must be completed, well before the initiation of the operation. Nevertheless, it is not always possible to take all factors into account in such preparation (eg, in-theatre geographic considerations and platform unserviceabilities) and so TDL participants must be able to identify and resolve likely link problems whilst operating. The overall process for multi-TDL management is described in detail in the UK Multi-TDL Management Requirement Specification (MRS), and is summarised at Annex 4A, but the specific activities that must be undertaken by command staffs and TDL participants are detailed in the following sections.

402. **Analysis**. Interoperability is key to effective TDL operations. This is a complex issue and attempts to resolve it in an ad hoc manner are most likely to fail; at best, it will provide limited capability and distract participants from undertaking the operational task at hand. Many TDL systems possess integral recording equipment which can be used to conduct dynamic analysis of the performance of a TDL Network. Regular technical and operational analysis of platform implementation and network performance should therefore be carried out in order to prove interoperability among and between all platform types.

SECTION II - MILITARY STRATEGIC PLANNING

403. The planning process at the military strategic and operational levels is described in JWP 0-10, with further expansion in JWP 3-00. Consideration of joint TDL operations will be but one element of that planning process and must be considered as a fundamental element of CIS planning.

404. Once the Chief of the Defence Staff (CDS)'s Planning Directive is issued, the Strategic Estimate is begun and the Supporting Commands will become involved in the estimate process. Joint TDL requirements must be addressed at this early stage to ensure that the holistic needs of the potential Joint Task Force (JTF) are considered, particularly those that do not fall neatly within the immediate remit of the various environmental/functional commanders. If neither the PJHQ nor the Joint Force Headquarters (JFHQ) staffs have the specialist expertise to carry out the joint TDL planning process, then lead agent responsibility should be assigned to the most

appropriate Supporting Command, based upon the likely level of requirement for each of the participating components.

405. The joint TDL planning process should aim to achieve the highest degree of TDL integration and co-ordination through liaison and consultation with the staffs at PJHQ, Joint Force Headquarters (JFHQ), and the CC and Supporting Command HQ. In order to ensure that the JTFC is assigned the appropriate TDL capabilities to meet his allocated mission, joint TDL requirements, in terms of information needs and data distribution constraints, should be considered in the Directives of both CDS and the Jt Comd, and in the JTFC's Estimate. An important issue that may need to be addressed early in the planning process is obtaining relaxation of peacetime frequency agreements.[1] Consideration must also be given to crypto-variable requirements and an initial OPTASK LINK message promulgated by the appropriate authority if a TDL Co-ordinating Authority (TDLCA) has not been nominated at that stage. The J6 Cell within PJHQ will need to contact the single-Service COMSEC officers who will grant authority to the UK National Distribution Authority at Corsham to issue crypto to the units earmarked for the operation if necessary. The initial joint TDL framework can then be reflected in the JTFC's Guidance and Apportionment planning, for use by the CCs as they are nominated.

SECTION III - OPERATIONAL AND TACTICAL PLANNING

406. CCs will undertake their own estimate/planning process in which they will understandably tend to focus primarily on their own component's environmental area. Hence, the formulation of TDL plans would be facilitated by the early nomination of the TDLCA (normally the Air Defence Commander (ADC)), together with the CCs' liaison officers. The TDLCA can then provide objectives and guidance to his staff, review the TDL elements and capabilities available and, after joint liaison/consultation, formulate the joint OPTASK LINK parallel to, and in concert with, the work of the other CCs.

407. As Force Protection is likely to be a prime consideration for commanders, TDL requirements in support of Intelligence, Surveillance and Reconnaissance (ISR), Air Defence (AD), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW), Electronic Warfare (EW) and other protective operations will need to feature in the planning for the initial deployment and establishment of the JTF.

408. Once in theatre, joint TDL planning will continue to be an iterative process. If the ADC is nominated as TDLCA, and is dual-hatted as the Joint Force Air Component Commander (JFACC), he will establish a TDL Planning and Co-

[1] This is particularly important for MIDS operations, which uses the UHF frequency band that is also used by civil aeronautical radio-navigation systems. Use of the band for military purposes in peacetime is only authorised by agreement with the appropriate national aviation authorities; failure to obtain a relaxation to the current rules could impose considerable constraint on MIDS TDL operations.

ordination Cell (TDLPCC). This cell will be established within the Joint/Combined Air Operations Centre (JAOC/CAOC) to plan joint TDL operations. Liaison staffs provided by the Air Operations Co-ordination Cells (Maritime) and (Land) (AOCC(M) and AOCC(L) respectively), and the military and naval liaison staffs in the JFAC HQ (respectively the Battlefield Co-ordination Detachment (BCD) and the Maritime Liaison Element (MLE)), will be fundamental to ensuring that effective liaison is undertaken. In particular, they will co-ordinate their parent CC's TDL requirements and recommendations, and identify their ability to support the other components and the ADC.

410. The TDLPCC will produce, disseminate and, where necessary, update the joint OPTASK LINK message so that interface details and responsibilities (including changes to the crypto plan) are re-promulgated to all participants. The OPTASK LINK addresses elements of TDL planning such as frequency planning(primary and secondary/day and night frequencies), force disposition and mutual interference considerations. Whilst CCs are at liberty to issue their own supplementary OPTASK LINK instructions covering these aspects if required, they must ensure that changes to their own environmental TDL networks which affect joint network operations are not undertaken without prior consultation with the TDLPCC. Changes made in isolation may have catastrophic effects on the overall architecture and may result in the failure to meet the JTFC's operational directives. Once the change has been authorised by the TDLCA the joint OPTASK LINK can be amended.

411. Where the ADC is not nominated as TDLCA, the TDLCA will need to establish a mechanism, similar to that described above, for co-ordinating and planning TDL operations, and allocate responsibility to a suitable Commander for the production and dissemination of the OPTASK LINK.

SECTION IV - TACTICAL DATA LINK OPERATIONS

412. The overall purpose of TDL operations is the exchange of real-time tactical data among units of the Joint Force. The overall Link picture should therefore be complete, clear, unambiguous and timely; maintenance of these facets will be a continuous task. The TDLCA oversees the proper functioning of TDL operations. This activity will normally be conducted through the Combat Operations section of the JAOC/CAOC, which will be responsible for:

a. Ensuring co-ordinated, accurate and timely TDL operations.

b. Ensuring effective data flow and clarity of the tactical picture within and between the Links.

c. Delegating appropriate tactical C2 functions to subordinate TDL users.

d. Monitoring and ensuring that the TDL network complies with the JTFC's Emission Control (EMCON) policy and any appropriate civil transmission or frequency restrictions.

413. **Data Forwarding and Gateways**. The desired objective is for all units to share a common tactical picture. This is most easily achieved if all units operate on the same TDL, preferably MIDS/Link 16, but it may be necessary to use a less capable Link in order to achieve the required inter-connectivity. When a common TDL is not available data must be passed between different TDLs. However, care must be taken to avoid creating ambiguity, especially in the form of multiple reporting[2] or data looping[3]. Direct re-transmission of information may not be possible because the protocols used by some links are incompatible. There are, therefore, two basic options for transferring data from one link to another: a straightforward translation of common elements, commonly referred to as 'Data Forwarding', or a more intelligent transformation of all processed data by a specially-equipped unit, known as a 'Gateway'. Some platforms operate on a number of links simultaneously without exchanging data between the links. Known as 'concurrent operations', this process does not forward information maintained by third parties. As a result, unique information that is reported on one link may not be made available to users operating on other links. Therefore, where possible, Data Forwarding or Gateways should be used. Simultaneous use of Concurrent Users and Data Forwarders/Gateway carries the greatest risk of data looping and should only be conducted after careful consideration and under the strictest supervision.

414. **Identity and Status Reporting**. TDLs primarily provide a real-time mechanism for keeping participants in an operation informed of each other's location, identity and activity. Usually generated automatically by onboard systems, TDLs allow units to report their own positions and movements, identifying information, and platform and weapons status information (the actual quantity and degree of detail depending on the TDL being used). Of great importance in supporting the Identification (ID) process, particularly in the field of combat ID, TDLs provide an assured source of friendly ID dissemination, and carry a wide range of data to support other ID declarations.

415. **Intelligence, Surveillance and Reconnaissance Operations**. The exchange of surveillance reports on air, land, surface, subsurface and space (ballistic) objects represent, by far, the predominant use of TDLs. The ultimate aim is to provide a clear tactical picture for all participants, so each object should be reported as a discrete point, plot or track.[4] Although complex fusion techniques may be used to combine

[2] Different units report the same object on different links, each with different levels of accuracy.
[3] Information reported on one link is forwarded onto one or more other links, which in turn forward that data to other links, such that the information is back told to the original link, where it appears as new information.
[4] The ability to achieve this will depend upon sensor discrimination and TDL capacity limits; if necessary, several discrete objects may need to be grouped together and told as a single track.

disparate reports of different accuracy, timeliness and reliability, track picture compilation will normally be achieved using straightforward link/sensor correlation techniques[5] and the allocation of Reporting Responsibility[6] (R2). OPINTEL information, particularly Electronic Intelligence (ELINT) and Signals Intelligence (SIGINT), should be added to a surveillance track by any unit that possesses it. Other OPINTEL information, including Communications Intelligence (COMINT) reports, may also be passed. However, unless specifically designated otherwise, OPINTELdata exchanged on TDLs should not automatically be accepted as evaluated information[7]. Appropriate protective measures must be taken for all intelligence information.

416. **Command and Control Operations**. As well as providing commanders with the tactical picture, some TDLs have the ability to carry commands and requests. The majority of this capability is in the area of weapons management; for example: weapons control orders, engagement status and duty instructions. Only those units with specific command authority should issue such messages and recipients should validate this authority before complying. Emergency orders such as 'Hold Fire' and 'Clear Aircraft' are, however, employed to prevent fratricide and may be issued by any C2 unit. As a matter of course, weapon systems should report their engagement status over the Link to enable commanders to monitor the situation and make real-time re-allocation decisions if required.

SECTION V - LINK MANAGEMENT

417. **Tactical Data Link Co-ordination**. Although TDLs will be the primary means of exchanging real-time tactical information, one or more voice nets will be required to manage and co-ordinate individual Links and multi-Link interfaces. It may also be possible to use these nets for co-ordinating the employment of certain tactical weapons.

418. **Relay Requirements and Platforms**. Many TDLs are carried on UHF bearers and are thus constrained by radio horizon and line-of-sight (LOS) limitations, typically around 15 nm surface to surface and 150nm surface to air. NATO Multifunctional Information Distribution System (MIDS)/Link 16 can, however, achieve air-to-air ranges of 500nm in extended range mode, but only at a cost to data capacity and ECM-resistance. Surface-to-surface and surface-to-air ranges will be much shorter. In most cases, these ranges will not be sufficient to meet JOA-wide operational needs and consequently TDL relays will be required or operation at HF considered. Suitable

[5] The matching of a track's position and behaviour, as reported on a TDL, against information derived from a unit's own sensor (s).
[6] A unit assumes responsibility for reporting a track on a TDL based either on its allocated area of responsibility, or on how the unit assesses the quality of the information it has in comparison to that reported by other units on the link.
[7] Unless real-time intelligence information is available, it is often very difficult to associate intelligence reports with particular tracks.

airborne platforms must, therefore, be tasked to carry out the relay mission throughout the expected period of TDL operation. These platforms will be those with multiple radio capability and long endurance and, as such, are currently likely to be large, high value assets which, to meet the needs of relay, may need to be positioned in sub-optimal locations for their primary role (including in areas of increased threat).

419. **Emission Control**. Most TDL operations depend upon using electronic emissions. The EMCON policy for a JTF, which will be co-ordinated and promulgated by the JTFC, must therefore consider the requirements of TDL operations in order to establish a balance between the needs for surveillance/control and security/surprise. Procedures for the rapid change of EMCON state should be promulgated by the JTFC, along with the level of authority to order such changes.[8] TDLs can also be used to help to overcome limitations imposed by EMCON restrictions. For example, EMCON restrictions that compromise one element's organic surveillance and warning capability may be ameliorated by TDL information from another element operating under less restrictive EMCON (eg. air picture and AD warning information could be provided by an Airborne Warning and Control System (AWACS) or Airborne Early Warning (AEW) aircraft to a maritime unit operating under EMCON silence).

[8] NATO standard times for breaking radio silence are contained in ATP 1.

ANNEX 4A - UK MULTI-TACTICAL DATA LINK MANAGEMENT PROCESS

4A1. Figure 4A.1 sets out the model for the overall process of Multi-TDL management within the phases of Planning, Tasking, Execution and Assessment. During a military campaign, this cycle of phases may take place many times in order to support different operations and missions in each of the campaign stages. Those responsible for issuing, monitoring and executing Multi-TDL Network Management orders, data or instructions, must not only have the authority but also, must be sufficiently informed and supported with decision/planning aids to discharge their responsibilities.

4A2. The overall process is broken down into its twelve constituent processes, as annotated in Figure 4A .1 and the numbered notes below. Whilst most of the constituent processes fall into one of the phases, there are overlaps. The overall process of Multi-TDL management must form an integral part of the much wider process of CIS and ISR planning and management. Although TDL management is an operational activity, the processes described below are based on design engineering principles in order to ensure the delivery of a product that meets the operational requirement within the universal and inescapable constraints of bandwidth, frequency and time. At some stage of the production of the Multi-TDL Plan, design compromise is unavoidable. It is important that the stage at which this occurs is appropriate to the relevant level of command and that those responsible have sufficient training.

4A3. Many of the technical parameters of TDL operations are inherent to each TDL equipment, therefore it is not easy to construct a formal, structured decision flow chart that leads directly to the production of a Multi-TDL Plan. The demands of operational scenarios and requirements cannot be quantitatively compared with one another and directly translated into specific TDL parameters. Very few decisions in the processes can be made on a ‘black or white’ basis. In this sense, the engineering of a Multi-TDL Plan is an art. This must be realised by those involved in this process, so that they clearly identify the operational priorities to the Multi-TDL Planners, Designers and Managers in subsequent processes.

4A4. The TDL planning detail increases as one progresses down through the processes of Multi-TDL Operations and Tactical and Pre-mission planning (ie. 2, 4 and 6). Thus whilst those involved in processes 2 and 4 do not need to be aware of the technical detail required in process 6, they must be able to prioritise their requirements to enable those in process 6 to make the design compromises.

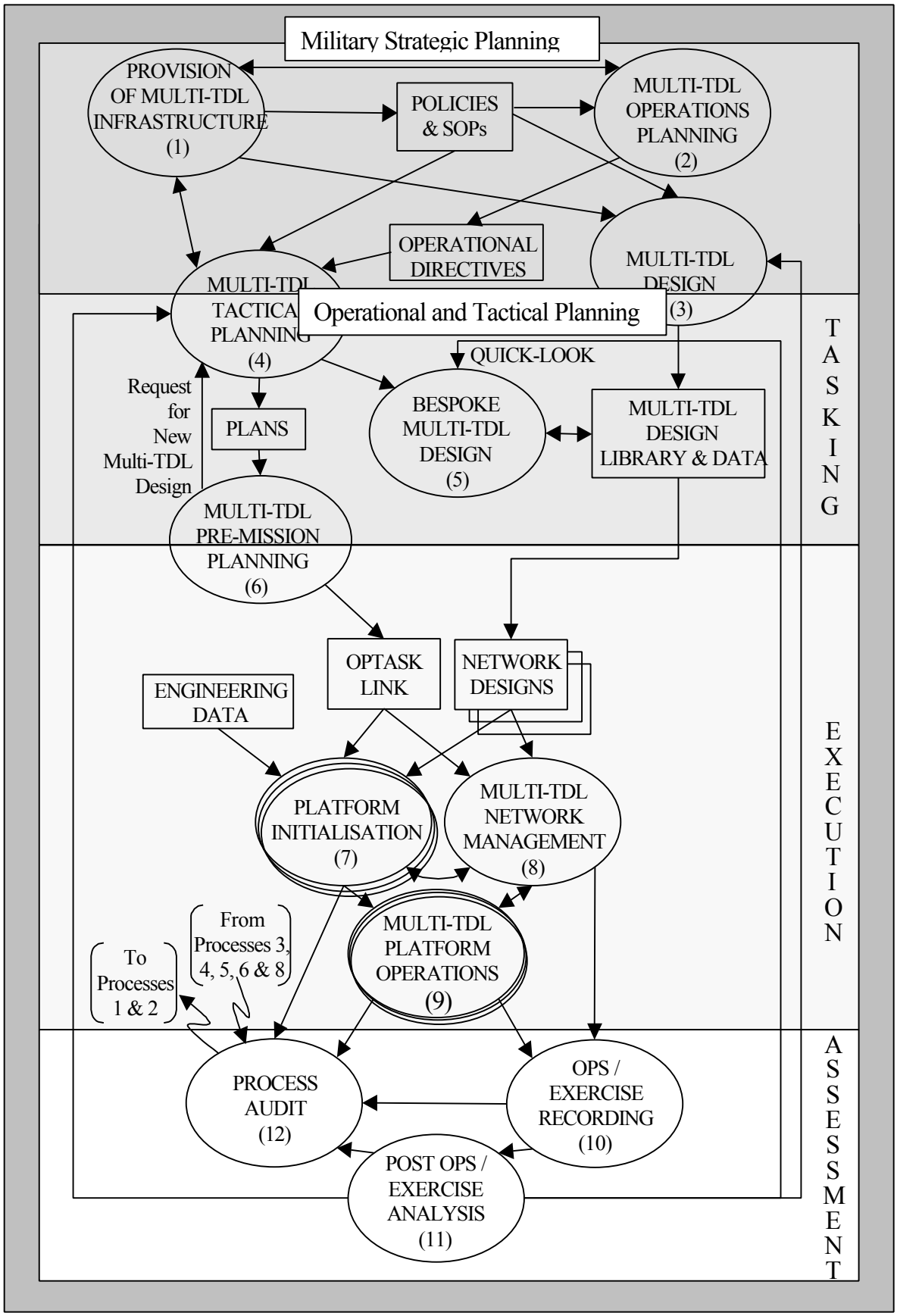

Figure 4A.1 - Multi-Tactical Data Link Management Phases and Process

4A5. Individual processes are not intended to reflect the responsibility boundaries of existing organisations. In any one process, individuals from several different organisations may be involved. This area of management is expected to create many challenges, particularly in Allied or Coalition operations. The allocation of responsibility for each process is likely to alter on a case-by-case basis. For some processes, there is a definite lowest level down to which responsibilities for multi-TDL management can be delegated. Further delegation would reduce interoperability and increase the workload of front-line users who may not be sufficiently enabled, either with training or authority, to conduct the tasks.

4A6. The processes described provide a basis for a balance of training investment to be conducted. Some areas of Multi-TDL management are highly complex and are complicated by the many-to-many interactions. Whilst all personnel involved are required to have an overview, it should be possible to target the necessary training at those responsible for the respective constituent processes.

4A7. **Multi-TDL Management Phases and Processes**. Figure 4A.1 illustrates the processes involved, their interactions and some of their primary products. It is not intended for the Figure to be interpreted as a rigorous data flow diagram. The depth to which each process is applied for each TDL varies and depends largely on the network management philosophy developed for that TDL. Hence MIDS and STDL make extensive use of initialisation data sets that can be automatically loaded into platform terminals. This enforces greater configuration management between platforms, but requires more careful forward planning. Link 11 on the other hand, does not have this concept and relies more heavily on manual settings at individual platform terminal equipment nearer to the time of operations.

4A8. **Provision of Multi-Tactical Data Link Infrastructure (1)**. This process provides the ‘glue’ by which all the remaining processes act together. This process ensures that the necessary military infrastructure and direction is provided for the efficient and effective execution of all the subsequent TDL Network management processes. The process encompasses the provision of policy direction, standardisation agreements and standard operating procedures, together with the necessary command structures (as outlined in Chapter 3) and specialist TDL agencies (like the Theatre Systems Group and the JFAC HQ TDL Planning and Co-ordination Cell).

4A9. **Multi-Tactical Data Link Design (2)**. This process provides the capability to design and support a range of logical Multi-TDL designs that are suitable for tailoring to satisfy the demands of a specific operational scenario. This is very much a long-term or strategic activity and is part of the support MOD infrastructure. A Joint Steering Group, led by an appropriate single-Service Supporting Commander, should normally be established to direct this activity.

4A10. **Multi-Tactical Data Link Operations Planning (3)**. This process provides campaign directives that, amongst other things, identify what part TDLs are expected to play in the theatre's C4ISR network integration. Staffs at the PJHQ, JTFC HQ, CC HQs and single-Service Supporting Commander HQs should all be involved in this activity.

4A11. **Multi-Tactical Data Link Tactical Planning (4)**. This process translates the operational directives into a set of options for a practical Multi-TDL Plan. It optimises the operational benefit offered by TDLs and must be consistent with other operational plans and orders. This activity is normally undertaken by the TDLCA on behalf of the JTFC and CCs.

4A12. **Bespoke Multi-Tactical Data Link Design (5)**. This process provides the capability to design and support specifically requested Multi-TDL Designs that satisfy the demands of specific operational scenarios. This is a short-term activity in response to comparatively urgent requirement. The degree of validation will not be as thorough as for Process 3. This task would be managed by the TDLCA.

4A13. **Multi-Tactical Data Link Pre-Mission Planning (6)**. This process identifies the broad configuration for the TDL equipment on each platform for initial operation within the selected Multi-TDL Plan and for dynamic re-configuration during a mission. Another TDLCA task, the primary output of this process is an OPTASK LINK message.

4A14. **Platform Initialisation (7)**. This process initialises all the TDL equipment, in all the platforms nominated as participants in the Multi-TDL Plan. This activity is normally carried out on the platform or at the platform's operating base.

4A15. **Multi-Tactical Data Link Network Management (8)**. This process involves the execution and on-line management of the Multi-TDL Plan within the operational environment, ensuring that the combination of all the TDLs continue to be used in a manner that maximises operational advantage. This activity would again be undertaken by the TDLCA.

4A16. **Multi-Tactical Data Link Platform Operations (9)**. This process ensures the individual platforms continue to support the operation of the Multi-TDL Network as directed by the Multi-TDL Network Manager. Every TDL platform operating in the network has some responsibility for this activity. One particular activity within this process is the requirement for TDL participants to maintain the fidelity of the tracks that they report. Typically, this is the remit of the Track Production Officer (TPO) in ASACS or the Force Track Coordinator (FTC) in the maritime environment.[1]

[1] NATO terminology may, in the future, adopt the US term Track Data Coordinator (TDC).

4A17. **Operations/Exercise Recording (10)**. This process records the Multi-TDL Network management activities that take place during the operations. The TDLCA would co-ordinate this process.

4A18. **Post Operations/Exercise Analysis (11)**. This process provides the data reduction and analysis functions for the presentation of results from the previous recording process. The TDLCA would undertake a quick-look in the immediate time frame, but a more detailed analysis would probably have to be undertaken by an appropriate Supporting Commander.

4A19. **Process Audit (12)**. This process involves the collation and review of all the activities involved with the overall Multi-TDL management process, for the purpose of improving its efficiency and effectiveness. This activity would need to be undertaken to different degrees of fidelity by all levels of command.

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GLOSSARY OF TERMS AND DEFINITIONS

Brain-to-Brain
The incorporation of human factors issues into information system design such that data is converted into information and then into knowledge. It recognises that the availability of information in a system, or its display at a terminal, does not ensure that it will be read by the operator or commander who is required to act on it, or that they will derive the understanding that the sender intended. (JDP 2/01)

Concept of Operations
A clear and concise statement of the line of action chosen by a commander in order to accomplish his mission. (AAP-6)

Concurrent Operations
TDL operations in which platforms fitted with multiple links operate simultaneously, as normal participants, in more than one TDL. A platform undertaking Concurrent Operations will receive data on its preferred TDL only (usually MIDS), and transmit on several TDLs, the data for which it has Reporting Responsibility, complying independently with all the protocols and procedures for each TDL in which it operates. Compare with 'Data Forwarding' and 'Simultaneous Operations'. (JDP 2/01)

Control
That authority exercised by a commander over part of the activities of subordinate organisations, or other organisations not normally under his command, which encompasses the responsibility for implementing orders or directions. All or part of this authority may be transferred or delegated. (AAP-6)

Co-ordinating Authority
The authority granted to a commander or individual assigned responsibility for co-ordinating specific functions or activities involving forces of two or more countries or commands, or two or more services, or two or more forces of the same service. He has the authority to require consultation between the agencies involved or their representatives, but does not have the authority to compel agreement. In case of disagreement between the agencies involved, he should attempt to obtain essential agreement by discussion. In the event he is unable to obtain essential agreement he shall refer the matter to the appropriate authority. (AAP-6)

Data Forwarding
Data Forwarding involves receiving data on one TDL, storing and then forwarding the data onto other TDLs, using the format and protocols of the other TDLs. The process of data forwarding should be transparent to operators on the platform effecting it. Compare with 'Concurrent Operations' and 'Simultaneous Operations'. (JDP 2/01)

Information
Unprocessed data of every description which may be used in the production of intelligence. (AAP-6)

Information Exchange Requirements
Those categories of information that must be exchanged between operational facilities in order to provide commanders with essential information for decision-making. (JDP 2/01)

Integration
The act of putting together as a final item various components of a system in such a way that the combination of separate systems, capabilities and functions can operate effectively singly or in concert and without adversely affecting the other elements.

Intelligence
The product resulting from the processing of information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations. The term is also applied to the activity which results in the product and to the organisation engaged in such activity. (AAP-6)

Joint Commander
The Joint Commander, appointed by CDS, exercises the highest level of OPCOM of forces assigned with specific responsibility for deployment, sustainment and recovery. (JWP 0-01.1)

Joint Operational Picture
A digital, map-backed graphical display, maintained by PJHQ on a 24 hour basis, comprising maritime, land and air activity within directed areas of operational responsibility and operational interest designated to PJHQ by DCDS(C). (JWP 0-01.1)

Joint Task Force Commander
A commander authorised to exercise command authority or OPCON over a joint force. (AJP-01(A))

Mission
A clear, concise statement of the task of the command and its purpose. (AAP-6)

Operation
A military action or the carrying out of a strategic, tactical, service, training, or administrative military mission; the process of carrying on combat, including movement, supply, attack, defence and manoeuvres needed to gain the objectives of any battle or campaign. (AAP-6)

Operational Command
The authority granted to a commander to assign missions or tasks to subordinate commanders, to deploy units, to reassign forces and to retain or delegate operational and/or tactical control as may be deemed necessary. It does not, of itself, include responsibility for administration or logistics. May also be used to denote the forces assigned to a commander. (AAP-6)

Operational Control
The authority delegated to a commander to direct forces assigned so that the commander may accomplish specific missions or tasks which are usually limited by function, time or location; to deploy units concerned, and to retain or assign tactical control of those units. It does not include authority to assign separate employments of components of the units concerned. Neither does it, of itself, include administrative or logistic control. (AAP-6)

Platform
The term 'platform' is used for all military assets which, by themselves, can participate in any of the TDLs. (JDP 2/01)

Platform-to-platform
The system architecture and procedures that encompass the exchange of tactical information between combat and combat-support platforms co-operating in the execution of a mission, including sensor information and track analysis, friendly force responsibilities and disposition, and target identification, allocation and engagement authority (compare with sensor-decision maker-shooter). (JDP 2/01)

Sensor-decision maker-shooter
The system architecture and procedures that encompass, in near real-time, the analysis of sensor information, the identification and dissemination of possible targets, the confirmation of command authority to intervene or engage selected targets, preparatory tactical manoeuvre by friendly forces and, finally, taking the appropriate action against the designated target(s) (compare with platform-to-platform). (JDP 2/01)

Simultaneous Operations
TDL operations in which one, and only one, multi-TDL equipped platform transmits all locally derived data on several TDLs. All the other platforms either remain silent or otherwise limit their output (eg. by the use of transmit filters). Compare with 'Concurrent Operations' and 'Data Forwarding'. (JDP 2/01)

Situational Awareness
The understanding of the operational environment in the context of a commander's (or staff officer's) mission (or task). (JWP 0-01.1)

Supported Commander
A commander having primary responsibility for all aspects of a task assigned by higher authority. (JWP 0-01.1)

Supporting Commander
A commander who provides a supported commander with forces or other support and/or develops a supporting plan. (JWP 0-01.1)

Tactical Command
The authority delegated to a commander to assign tasks to forces under his command for the accomplishment of the mission assigned by higher authority. (AAP-6)

Tactical Control
The detailed and, usually, local direction and control of movements or manoeuvres necessary to accomplish missions or tasks assigned. (AAP-6)

Tactical Data Link
A standardised information exchange system employing a formatted message set and communications infrastructure suitable for the transmission of digital information between two or more locations to interface dissimilar or identical computerised tactical data systems for C2 and weapon direction. (JDP 2/01)

GLOSSARY OF ABBREVIATIONS

ACCS	NATO Air Command and Control System
ACE	Allied Command Europe
ACO	Airspace Control Order
ADatP	Allied Data Publication
ADC	Air Defence Commander
AJP	Allied Joint Publication
AOCC(L)	Air Operations Co-ordination Centre (Land)
AOCC(M)	Air Operations Co-ordination Centre (Maritime)
AOI	Area of Operational Interest
ASACS	Air Surveillance And Control System
ASTOR	Airborne Stand-off Radar
ASW	Anti-Submarine Warfare
ATDL-1	US Army Tactical Data Link - 1
ATO	Air Tasking Order
AWCIES	ACCS-Wide Common Information Exchange Standard
BLOS	Beyond LOS
bps	Bits per second
BCD	Battlefield Co-ordination Detachment
C2	Command and Control (compare with CC)
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Combination of C4I and ISR
C4ISTAR	Combination of C4I and ISTAR
CA	Co-ordinating Authority
CAOC	Combined Air Operations Centre
CBM	Command and Battlespace Management (formerly JBD)
CC	Component Commander (compare with C2)
CDL	Common Data Link
CDS	Chief of the Defence Staff
CEC	Co-operative Engagement Capability
CJO	Chief of Joint Operations
COLE	Concept of Link Employment
CONOPS	Concept of Operations
DF	Direction Finding
DLM	Data Link Manager
DPA	Defence Procurement Agency

EMCON	Emission Control
EPM	Electronic Protective Measures
EW	Electronic Warfare or Early Warning
FTC	Force Track Coordinator
HCI	Human Computer Interface
HF	High Frequency
HIDL	High Integrity Data Link
IADS	Integrated Air Defence System
ID	Identification
IER	Information Exchange Requirement
IJMS	Interim JTIDS Message Specification
IO	Information Operations[1]
io	Interoperability[1]
ICO	Interface Control Officer (US Terminology)
IDM	Integrated Universal Data Modem
ISR	Intelligence, Surveillance and Reconnaissance
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance (also referred to as RISTA)
J-#	Joint Staff posts (#: 2 intelligence, 3 operations, 4 logistics, 5 planning and 6 CIS).
JACC	Joint Airspace Control Cell
JAOC	Joint Air Operations Centre
JCTN	Joint Composite Tracking Network
JFACC	Joint Force Air Component Commander
JICO	Joint Interface Control Officer (US Terminology)
JMTOP	Joint Multi-link Tactical Operating Procedures
JSTARS	Joint Surveillance and Target Attack Radar System
Jt Comd	Joint Commander
JTFC	Joint Task Force Commander
JTIDS	Joint Tactical Information Distribution System[2]
JVMF	Joint Variable Message Format
JWP	Joint Warfare Publication
LPD	Landing Platform Dock

[1] The abbreviation IO must be read in context. IO has long been used within the TDL community to mean Interoperability, but has never been formally agreed, hence its inclusion in this document as 'io'. Whilst JWP0-01.1 gives IO as 'Information Operations', the more accepted acronym is 'Info Ops', since IO has come to mean 'International Organisations.

[2] JTIDS is no longer accepted NATO terminology, but is now replaced by the term MIDS.

LOS	Line of Sight
LSOP	Link SOP
MIDS	NATO Multifunctional Information Distribution System
MLE	Maritime Liaison Element
MLSOP	Multi-Link Standard Operating Procedures
MTF	Message Text Format
MTI	Moving Target Indicator
NAEWF	NATO Airborne Early Warning Force
NCS	Network Control Station
NOD	NAEWF Operations Document
NSG	Network Steering Group
OPTASK LINK	Operational Tasking Data Links message
PJHQ	Permanent Joint Headquarters
R2	Reporting Responsibility
RAPTOR	Reconnaissance Airborne Pod for Tornado
RF	Radio Frequency
RISTA	Reconnaissance, Intelligence, Surveillance and Target Acquisition (referred to within the UK as ISTAR)
SAG	Surface Action Group
SCDL	Surveillance and Control Data Link
SIMOPS	Simultaneous Operations
SOP	Standard Operating Procedure
SPI	MOD Smart Procurement Initiative
SSSB	NATO Ship Shore Ship Buffer
STDL	Satellite Tactical Data Link
TCDL	Tactical Common Data Link
TDC	Track Data Coordinator
TDL	Tactical Data Link(s)
TDLCA	TDL Co-ordinating Authority
TDLPCC	TDL Planning and Co-ordination Cell
TDMA	Time Division Multiple Access
TIDP	Tactical Interface Design Plan
TCA	Track Continuity Area
TDL	Tactical Data Link
TPA	Track Production Area
TSG	Theatre Systems Group

UAV	Unmanned (Uninhabited) Air Vehicle
UHF	Ultra-High Frequency
VMF	Variable Message Format