



# The Real Cost of Link 16 Modernisation

Tactical Comms Forum – Salzburg

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# 3SDL Experience

- TDL Subject Matter Experts for over 14 years
- 3SDL founders all came from the TDL community (the 'DL' in 3SDL is Data Links)
- Supported the UK MoD in TDL acquisition, and a plethora of technical consultancy
- TDL Products
  - TacPlan
  - TacSig
- 60 staff
  - Retired Armed Forces (Royal Navy, Army and Royal Air Force)
  - Blend of TDL Technical excellence and Operator experience
  - Graduates and Apprentices

# My Experience

- 23 years Royal Navy Combat Systems and Data Links (ADAWS, Links 10, 11, 14 & 16) operator.
- One of the first qualified Royal Navy Link 16 Network Designers - trained at Hanscom AFB in the US.
- TNDS Project Leader and TDL consultant at EDS Defence (now DXC)
- Ultra Electronics ATS – UK, Europe & MENA ‘ADSI guy’ – Technical BD and provided operational support to various nations on shore and at sea.



# What is 'Link 16 Modernisation'?

## The biggest change to Link 16 in a generation

Incorporates the following:

- Crypto-Modernisation (CM)
- Frequency Remapping (FR)
- Link 16 Enhanced Throughput (LET)
- Concurrent Multi-Netting (CMN)
- Concurrent Contention Receive (CCR)
  
- **MIDS JTRS** – 4 x channel software defined radio with:
  - CMN 4 & CCR 4 (Concurrent Multi-Netting and Concurrent Contention Receive - four networks)
  - LET (L16 Enhanced Throughput)
  - Upgrade path to future waveforms e.g. TTNT.
- Crypto Modernisation (CM)
- Frequency Remapping (FR)
- **MIDS Block Upgrade 2 (BU2)** (no CMN/CCR)



# Why Modernisation?

- Restrictions on L-band (MIDS/Link 16) frequencies in US airspace
- Software defined radio architectures and future waveforms
- Changes to MIDS/Link 16 to increase bandwidth and to ease Network Management overheads
- Increasing complexity of MIDS/Link 16 networks to support UK, NATO and Coalition IERs

More importantly....

## US DoD (NSA & FAA) mandates & enhancements:

- Crypto Modernization (CM) – by **1 Jan 2022**
  - Joint Requirement Memorandum (JROCM 001-17)
- Frequency Remapping (FR) – by **1 Jan 2025**
  - MoA between the US DoD and DoT dated 31 Dec 2002

So what?

**If Link 16 nations wish to continue Link 16 operations and properly integrate into the coalition battlespace, then L16 modernisation is *essential*.**

# MIDS-LVT Block Upgrade 2 (BU2)

- MIDS-LVT is managed by the US MIDS Program Office (MPO)
- BU2 is a hardware and firmware upgrade to the existing MIDS-LVT BU1
- Can be procured new, or as a retrofit upgrade kit for BU1
- It incorporates a number of fixes, and newly introduces:
  - Crypto Modernisation (CM)
  - Frequency Remapping (FR)
  - Link 16 Enhanced Throughput (LET)
- BU2 will **not** support Concurrent Multi-Netting (CMN) and Concurrent Contention Receive (CCR) capabilities

# MIDS-LVT BU2: Pros and Cons

## Pros:

- BU2 retrofitting would provide a CM and FR modernisation capability
- Would also enable an ET enhancement capability
- Includes all the current MIDS Platform Type protocols...meaning less complex and less costly Host upgrades
- More likely for existing MIDS-LVT BU1 equipped platforms to migrate to BU2 and avoid a Link 16 capability gap from 1 Jan 2022 due to CM

## Cons:

- Will not support CMN-4, CCR and future advanced waveforms
- Interim step on inevitable migration to MIDS-JTRS



# MIDS Joint Tactical Radio System (MIDS-JTRS)

## MIDS-JTRS(4)

### MIDS JTRS Core

Additional channels to support other JTRS Waveforms



- JTRS Certified (SCA/API/JTRS Infosec)
- Potential Growth up to 3 channels
- NSA Type 1 Cert and IA Mod Ready
- Includes Freq. Remap (FR) and ET
- Includes Voice and TACAN
- Includes Link 16 Power Amplifier (PA)
- 325 Terminals

## MIDS-JTRS(5)

### MIDS JTRS CMN-4

Additional channels to support other JTRS Waveforms



- Includes MIDS JTRS Core functions
- Includes 4 Nets Concurrent MultiNetting/ Concurrent Contention Receive (CMN-4)
- Potential Growth up to 3 channels
- 1033 Terminals Planned\*

## MIDS-JTRS(5) AWF

### MIDS JTRS CMN-4/Advanced WF

Additional channel to support other JTRS Waveforms



- Includes MIDS JTRS CMN-4 functions
- Potential Growth up to 1 channel
- Includes Advanced Waveform PAs and/or High PAs

JTRS will provide 4 waveform channels: Channel 1 for Link 16, and Channels 2-4 for future waveform capabilities, e.g. TTNT

# MIDS-JTRS: Pros and Cons...

## Pros:

- Would provide a modernised capability for CM and FR mandates
- Would enable CMN-4, CCR and LET enhancements (1553 b/w limited ET)
- Would enable use of future Waveforms (Channels 2-4) in same form factor
- Software Defined Radio –increased reliability, maintainability and availability

## Cons...

- Does not support MIDS Platform Type B and Platform Type D Host interface protocols, hence ***will attract significant Host re-engineering and integration costs***
- Does not support **any** Ethernet MIDS Platform Host interface for Air and Maritime mobile, and fixed Land Ground platforms
- Significant technical risk, would be expensive
- Low likelihood of avoiding a Link 16 CM capability gap at 1 Jan 2022

# MIDS-LVT BU2 versus MIDS-JTRS -Summary

## Retrofit existing BU1 MIDS-LVT terminals to BU2 build configuration

Current estimates show BU2 retrofit is the least expensive option

## Procure new MIDS-LVT terminals at BU2 build configuration

- Unit costs estimated to be more than for BU2 retrofit
- Increased likelihood of meeting CM and FR implementation deadlines
- Life expectancy ~20+ years
- Replaces aging MIDS terminals

## Procure new MIDS-JTRS terminals

- Unit costs estimated to be greater than for MIDS-LVT BU2 retrofitting
- Future-proofed:
- Includes all updates/enhancements baselined for MIDS-LVT BU2
- Core already CM and FR capable
- Imminent capability to support CMN and CCR
- Capacity for further capability growth with additional waveforms
- Replaces aging MIDS terminals

# Crypto Modernisation (CM)

- Mandated for all Link 16 terminals for operation by **1 Jan 2022**
- More robust security includes new algorithms and greater capacity for holding crypto keys (1000 keys versus the current 8 keys)
- Field re-programmability enables implementation of changes that further improve information security
- Significant impacts relating to crypto key management and training; electronic key distribution and Loading; new system keys such as the Message Key Encryption Key (MKEK) and File Encryption Keys (FEK)
- Requires changes to IDL parameters
- **Will impact** Network Designs, TNDS, Platform IDPFs, certain TDL Host Systems, Key Fill/Load Devices etc.

# Frequency Remapping (FR)

- Provides flexibility to prevent Link 16 interference with US Dept. of Transport (DOT) controlled commercial aviation systems
- Mandated for operation in US airspace by **01 Jan 2025**
- Is not UK policy, but..... UK platforms will be mandated to enable FR when operating in US FAA controlled airspace
- Reduces authorised MIDS frequencies from the current 51 to 37
- FR-enabled MIDS terminals must only participate in a MIDS network with other FR-enabled MIDS terminals, all operating on the same “remapped” frequencies
- Requires new IDL parameters
- **Will impact Network Designs, TNDS and Platform IDPFs**; no impact to TDL Host systems

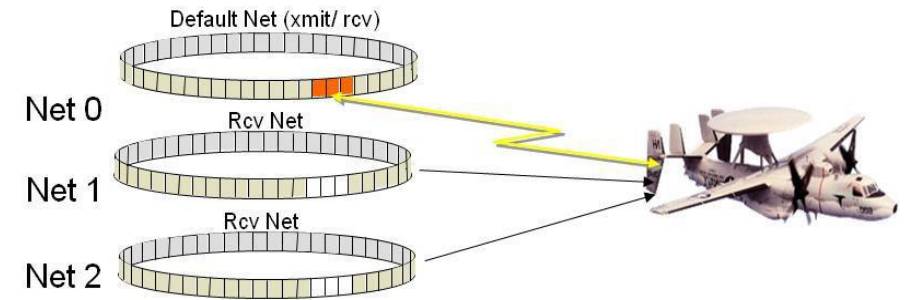
# Link 16 Enhanced Throughput (LET)

- LET is **not mandated** but an enhanced Link 16 capability
- MIDS-JTRS is already ET capable
- MIDS-LVT will implement ET in BU2 **from 2020**
- ET implements a new set of message packing structures that **provides 3x to 10x higher data throughput** than conventional P4SP, i.e. packing more data per time slot
- ET does not alter the spectral characteristics of MIDS, it just uses the available bandwidth more efficiently
- ET trades anti-jamming capabilities for increased data throughput
- **Will impact Network Designs, (TNDS), Platform IDPFs and certain Host Systems**

Link 16 ET Mode	Link 16 Words per time slot
P4SP	12
ET Mode 0	40
ET Mode 1	61
ET Mode 2	93
ET Mode 3	108
ET Mode 4	123

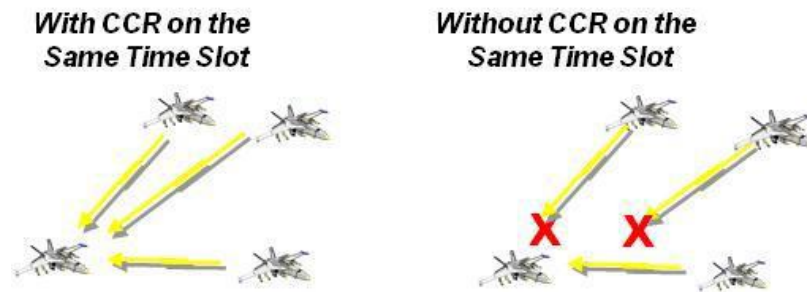
# Concurrent Multi-Netting (CMN)

- MIDS-JTRS only (not available with MIDS-LVT BU2)
- CMN-4 allows MIDS-JTRS to concurrently receive on up to 4 Nets and transmit on one Net
- Achieved using one JTRS waveform channel (Channel 1)
- Requires new IDL parameters (up to 384 TSBs)
- **Will impact Network Designs, (TNDS), platform IDPFs and certain Host systems**
- Increases data exchange capacity, reduces satellite TDL forwarding between different operational areas



# Concurrent Contention Receive (CCR)

- MIDS-JTRS only (not available with MIDS-LVT BU2)
- Employs 4 receivers to allow up to 4 data receptions in the same contention time slot
- Time slot contention pool size can be balanced against the probability of data reception; is useful for a Network Manager to optimise pool size to enable allocation of slots for other tactical purposes
- Requires new IDL parameters
- **Will impact Network Designs, (TNDS), platform IDPFs and certain Host systems**





# Sustainability of MIDS Test Equipment Capabilities

## MIDS Terminal / Link 16 software functions:

- Terminal initialisation, control, monitoring and recording
- New format, greater content IDL files for compilation and recording
- Data reduction and analysis
- Products must be compatible with new format IDL files and data recordings
- Ability to emulate new Link 16 terminal capabilities
- Network simulation
- Ability to emulate new Link 16 network capabilities, i.e. LET, CMN & CCR

## Physical hardware:

- Host equipment/LRU racks
- Host environmental requirements (prime power, cooling etc.)

***All such capabilities will be required to be upgraded!***

# So, what's the impact?

Link 16 Modernisation **WILL** Impact:

- Link 16 Network Design systems (TNDS, JNDA etc) and Link 16 Network Designs
- Platform Initialisation Data Preparation Facilities (IDPF)
- Platform Host systems
- Link 16 Communications Security (COMSEC) Key Fill Devices

Engineering Support Equipment:

- MIDS Interface Cables, Batteries and Test Support Equipment
- **A LOT of testing!!**

Link 16 Modernisation is *not* 'just replacing the terminal'

# What needs to change???

## Terminal

Crate/Terminal housing

Host software

GUI/HMI

Platform testing

IO testing

Crypto Load Device

Remote Crypto Distribution system

Network Design Tool

Network Management System

Multilink Planning Tool

Anything that ingests OTL

Policies, CONOPS, TTPs etc

Exercises etc, etc, etc

# Contact Details

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