

Practical & Pragmatic TDL Interoperability Management

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Why do we need Interoperability Management?

If you implement using the STANAG, what can go wrong?

TDL = Just another radio!

There is a Data Forwarder so we can be sure of seamless comms

He has MIDS, I have MIDS – we have Link 16



TDL solutions are often based on "high-level" operational requirements

• Integration of TDLs into platforms

- is complex
- is often led by industry
- is often developed from a single platform perspective

TDL Standards

- Have been historically ambiguous
- Are living and (by committee action) evolving documents

Platforms are developed

- To different Standard baselines
- Using different
 - integration approaches
 - Interpretations of the standards





Illustrative Example



STANAG Draft Revision 3 +DLCPs Early NRS Circa 1995 STANAG Ed 3 +DLCPs Supplier Imp Plan Circa 2001





STANAG Ed 6 +DLCPs iSMART PRS Circa 2011

STANAG Ed 1 +DLCPs Supplier Spec Circa 1998

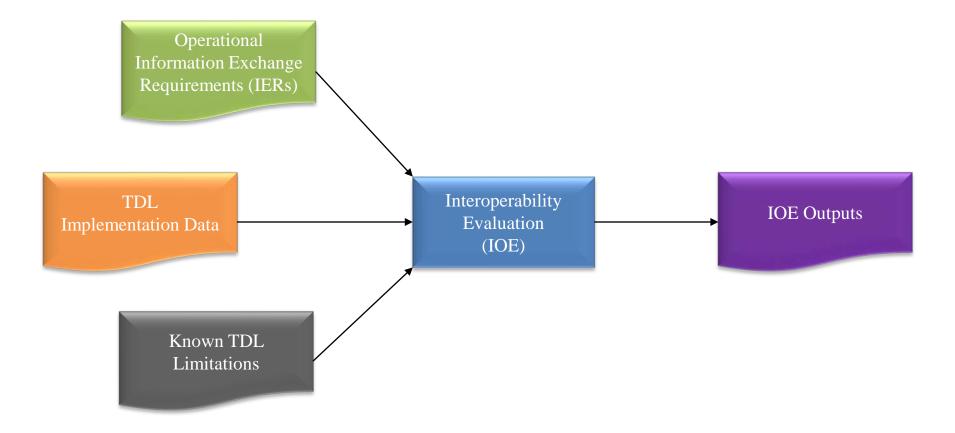




MIL-STD 6016C +DLCPs iSMART PRS Circa 2005



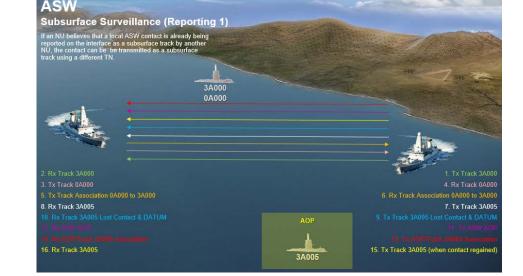
Key Components – IO Management





How do we define the Operational Context?

- Scenario/mission/role based Use Cases can assist in IER Capture
- IERs need to be:
 - Operationally focused
 - TDL agnostic



But mapped to TDL message structures to aid effective and efficient IO evaluation

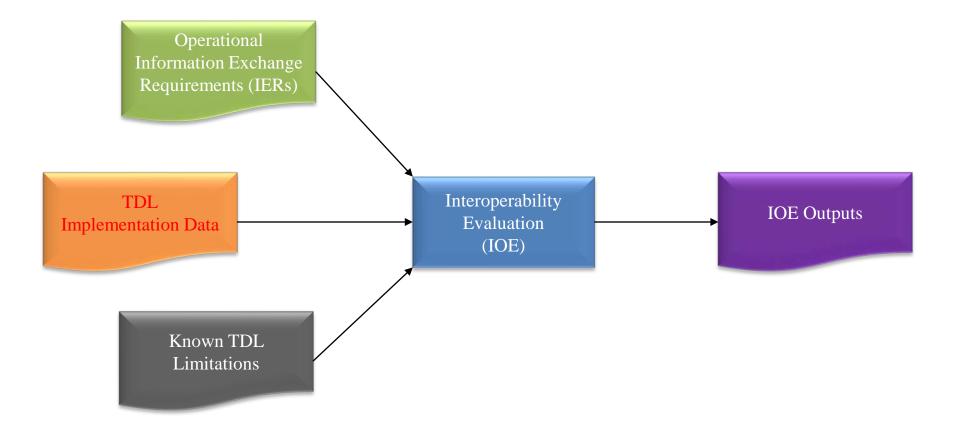


IERs – Scope for IOE

Project - Exercise "Protect" IER Editor Exercise "Protect" ×	nal Area	Rs - Destroyer and Combat Air ERs
Triangle		ERs
Friendly	T T T T T	
Subject Platform		Location and Identification data
Object Platforms	~	Basic Status information Fext Messages
		Air Tracks (Air Surveillance System to Combat Air)
		Land Tracks (Air Surveillance System to Combat Air)
		Threat Warnings (Air Surveillance System to Combat Air)
		Geographic Reference Points, Lines and Areas (Air Surveillance
Destroyer	•	System to Combat Air) Land Objects (Points) (Air Surveillance System to Combat Air)
Ground Based		Emergency Points (Air Surveillance System to Combat Air)
AWACS ASACS Combat Air		Data Update Request for Reference Point data (Combat Air to
Information Definition (IDF) T R T R T R	A	Air Surveillance System)
🕨 💦 Friendly Forces		
🖻 🦥 Situation Awareness - Tracks 🔹 🔳 🔳 🔳 🔳 🔲		
🕨 🂁 Situation Awareness - Geographic Entities 🔹 🔳 🔳 🔳 🔳	Table 2-2 - IERs Discounted from IOE - Destroyer and Combat Air	
A Situation Awareness - FW	Functional Area Situation Awareness – Track	Discounted IERs Surface Tracks
	Data	Space Tracks
		Subsurface Tracks
		Data Update Requests (Air Surveillance System to Combat Air) Force ID Change instructions (Air Surveillance System to
		Combat Air)
	Situation Awareness – Geographic Entities	Data Update Request for Reference Point data (Air Surveillance System to Combat Air)
EW Data Handling Attributes		Emergency Points
Simulated EW Line of Bearing		Pointers
	Battle Management Weapons Control	No requirement to exchange No requirement to exchange
🖉 🚍 Area of Probability - Passive	Local Target Data	No requirement to exchange
	Situation Awareness - EW	No requirement to exchange
🕨 📮 EW Picture Management 🖉 🗹 🗌 🔲 🗉	EW – Parametric Data	No requirement to exchange
Battle Management	Ballistic Missile Defence	No requirement to exchange
	Anti-Submarine Warfare	No requirement to exchange
🕑 🔨 Weapons Control	magery	No requirement to exchange



Key Components – IO Management





Often "Project Owned"

• Key issue for central TDL "authority"

Available in several forms

- Full iSMART Products
- Supplier specific documents
- Implementation Plan
 - Excel
 - Tool set "specific"
 - PDF

IOM Data



Implementation Data

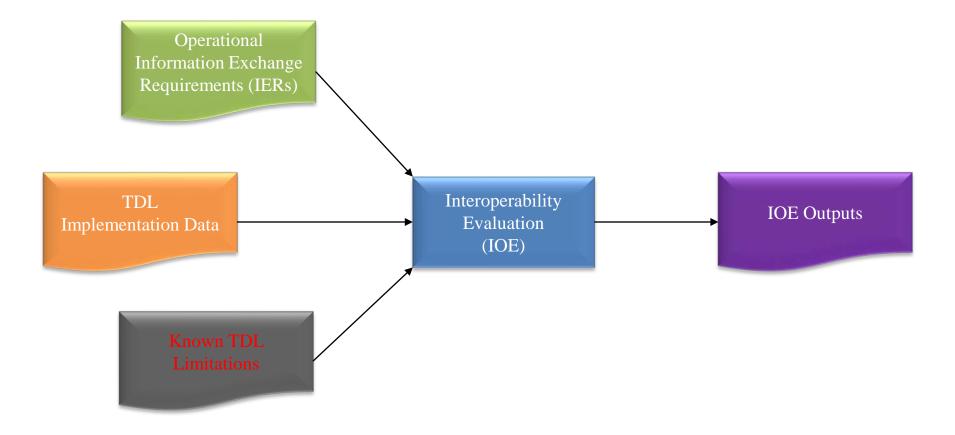
D.1.2 C ² TRACK TRANSMISSION								
D.1.2.1 C ² Track Transmission St	imulus							
D.1.2.1.1 <u>Transaction D.1.1</u> , C ² Prep (<u>Paragraph D.1.1.3.6.1</u>), upon prepar								
	Overlay IERs from Project		IDF Group	IDF Level	I		IDF Level	2
D.1.2.1.2 Periodically as defined	Demo Project 🗸	<all></all>	~	<all></all>		< All>		~
Paragraph D.1.2.3.3.12.c, for a Bal			TDL Element		Transmit	Transmit Issues	Receive	Receive Issues
repeated transmission. Not Used	▲ M J2.3 Surface PPLI				т		R	
	▲ W J2.3I SURFACE PI	LI INITIAL WORD			т		R	
D.1.2.1.3 <u>Transaction E.1.3</u> , Recep	▷ F 1550 001 WC	RD FORMAT			т		R	
Number (<u>Paragraph E.1.3.3.1</u> , <u>Paragr</u>	▷ F 270 004 LAB	L, J-SERIES			т		R	
<u>E.1.3.3.14</u>), on receipt of a data u	▷ F 271 005 SUB	ABEL, J-SERIES			т		R	
	F 800 001 MES	GAGE LENGTH INC	DICATOR		т		R	
D.1.2.1.4 Transaction P.3.3, C ² Red	▷ F 385 003 EXE	CISE INDICATOR			т		R	
P.3.3.3.5.a), upon automatic accept	F 756 001 SPAR	E			T=0		NP	
for which R^2 is held.	▷ F 354 002 FOR	E TELL INDICATO	R		т		R	
	▲ F 355 002 EME	RGENCY INDICATO	OR		Т=0		R	
	D O NO STA	EMENT			т	\bigcirc	R	
	D 1 EMERG	NCY STATUS			NT		R	
	▷ F 893 001 CON	MAND AND CON	ITROL INDICATOR		т		R	
	▷ F 1604 001 SIN	ULATION INDICA	TOR		т		R	
	▷ F 756 002 SPA	E			T=0		NP	



	F	latform	Details				-		<						
Add Platform	Export Platform Clone Platform Remove I	Platfor	n		Main Menu		Record	Editing abled							
TDL: Link 16 🔽	Platform: Navy Frigate		~				ODi	sabled							
Classification	NATO UNCLASSIFIED			-	tional Role										
Releasable to	APN(AUS, AUT, CHE, FIN, SWE)			ARTIFIC	IAL DATA										
Platform	Navy Frigate				y Frigate operates as a warship and is par It is able to provide Air Surveillance and w										
Country	Partner				nd Air Force assets using Link 16 and Link 2										
-															
Service	Navy														
SoftwareVersion	Combat System 5.1.5			Techn	ical Comments										
Operational SW?					the Link 16 message processing for LOS (N			le).							
Terminal	MIDS LVT 5- BU1		~		: 16 over JREAP, a reduced subset of messa ented (largely excluding J12.x series messa		ill be								
Terminal SW	BC7														
		Messi 🚽	Implementation Question	•		Plat A 🤤	Plat A 🚽	Plat A Responses 👻	Plat A Response 🔻	Plat B 🤤	Plat B 🖕	Plat A Response ▼	Plat A Responses	Plat A Comme 🚽	Plat B Comme 🖵 s
Base Spec' Doc'	5516 Edition7/ATDLP-5.16(A)(1)	J0.0	Initial Entry Message		Primarily used for network synchronisation. It is also possible to include a basic set of timeslots that a joining platform can then use to join a network without	т	R	-		т	R		-	No Comment	No Comment
Entry Type	5 - Full Responses (Planned Implementation)				a previously allocated timeslot load. Automatically generated by the Terminal in response										
Point of Contact	Lt Cdr Kirk	J0.1	Test Message		to a J0.6 Terminal Interrogation. Used to establish the presence of connectivity between two platforms. Facilitates a change to network time. Supports the	T	R	-	-	T	R	-	-	No Comment	No Comment
		J0.2	Network Time Update Message		promulgation of the change required to network time and the time of execution for the change.	т	R		-	т	R		-	No Comment	No Comment
		J0.3	Time Slot Assignment Message		Provides the Network Manager with the ability to dynamically assign or deassign Time Slot Assignments being used within the Network.	NT	R	NT	NP	NT	R	NT	NP	No Comment	No Comment
		J0.4	Radio Relay Control Message		Provides the Network Manager with the ability to dynamically assign or deassign Relay Functions being used within the Network in order to ensure effective	NT	R	NT	NP	NT	R	NT	NP	No Comment	No Comment
		J0.5	Repromulgation Relay Message		data propagation within the network. Used to identify particular messages within a specific timesiot that are to be relayed as part of the repromulgation relay function. A unit can either originate repromulgation relay or simply repromulgate messages that were originated by others.	NT	R	-	-	т	R	-	-	No Comment	No Comment
		J0.6	Communications Control Message		See Below Request that a remote unit responds with either a J0.1	NT	R	NT	NP	т	R	NT	NP	No Comment	No Comment
		J0.6	Action, Communication Control = 0 Interrogation)	(Terminal	(Test Message) or J2.x (PPLI Message). Used to establish connectivity.	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	No Comment	No Comment
		J0.6	Action, Communication Control = 3 Request)	(Control	Request from a unit to the Network Manager to request		tbd	tbd	tbd	tbd	tbd	tbd	tbd	No Comment	No Comment
		J0.6	Action, Communication Control = 3 Request)	(Control	Allows the appropriate authorised unit to effect a change of CVLL within a remote unit.	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	No Comment	No Comment
		J0.7	Time Slot Reallocation Message		Provides the capability for a JU to request a percentage of time slots from a shared Time Slot Reallocation (TSR) pool and disseminate the requests of other JUs.	т	R	-	-	NT	NP	-	-	No Comment	No Comment



Key Components – IO Management





Known TDL Limitations

1								Edit/R	eview/Report IO	ls norn	nal moi	ie.					
	- 20	54	L	Country:All		- Se	arch Titles :					Status :	Active		-	Record Editing	
10		597	list:	TDL:All		-	Impact :	-All		_	-	Short report	Reapply Filters		in Menu	 Enabled Disabled 	
				IOA No.		1000	Platform :	Any-			-	Full report	Reset Filters	Ma	in Menu		
•			6	Classification:	NATO UN	LASSIFI	D .		Release To			APN(AUS, A	UT, CHE, FIN, ST	NE)	-	1	
PI	4 1	12	3	The ALL						-					600	1.5	
PI		14	1	Title (NU):	Reception of	PPLI N	lessages -	Cont	inuation	Nor	d Se	quence					
P		15	2	Country:	Partner		- No	. 010	Issue No.	6	P	OA Status: Ac	tive	-	Dated:	12 January 20	10
PI		18	1	TDL:	Link 16		Msg: J2.2	2			•	Function:	Friendly Forces	Data			-
NN		51	1	Originator:	UK - IOM Custor	lian								I	mpact: Op	erator Level B	-
N	A 6	54	1	Source:	PTDLIOT IOI POO	87J, P06	92J, <mark>P08</mark> 03J	& NTD	LIOT IOI P11	21J							
N	A E	57	1	Operational	Summary Open	tional De	tails Techn	ical De	tails Further	Actio	on R	ationale for se	elected Status V	alidati	ion		
N	A 7	70	3 3 2	"Operation	al Summary" N/		LASSIFIED				1						
N	A 7	73	2	It is possible	that certain elen	ents from	n a platform	's PPLI	message ma	y not	be pr	ocessed (or th	he entire messag	e may	be comp	letely discarded	Ŋ.
N	A 7	74	2 2						<u> </u>				8	2		-	
N	A 7	76	4														

IER Summary Issue Table										
Issue		Summary		Originator No	Туре	IER Information				
Discard of Link 16 Threat Warnings	Comb	at Air cannot receive Threat Warnings via Link 16		Combat Air-15	Receive	Situation Awareness - Tracks				
Illegal Threat Warning Messages		t Warning messages should be transmitted with Threat Posture o No Statement" or "Unknown"	other	Destroyer-36	Receive	Situation Awareness - Tracks				
Emergency Entities	Comb	at Air does not display Emergency Entities		Combat Air-1	Receive	Friendly Forces Situation Awareness - Tracks Situation Awareness - Geographic Entities				
Incorrectly Displayed (Forwarded) PPLIs	Com			0.1110						
Discard of All Lines/Areas	Com	Name	Eme	ergency Entities						
High Precision Land Targeting	Com infor	Originator Number	Con	nbat Air-1						
0 Laser Designated Targeting	Com	Severity	() Significant							
Flight Control	Com									
0 Limited Text Message Display	Com	Security Marking	NAT	O Unclassified						
Setting Force/Emergency Tell on a Remote Entity	Dest	Releasability	NATO Only							
<u> </u>	entity	Operational Summary	Combat Air does not display Emergency Entities							
Problems with Land/Surface Targets as Mission Objectives The Destroyer Discards BDA Status from Fighters	The I agair The I from	Operational Description	The Combat Air system discards Emergency Points and will not interpret the Emergency Indicator for Tracks, PPLIs and other entities. This may prove problematic when undertaking Combat SAR missions.							
Transit Training - Simulated Entities	The	Workaround	Pointers and voice would need to be used to assist in coordinating CSAR (or a Reference Point used instead of an Emergency Point							
		Technical Description J3.1 Emergency Point message is discarded on reception. The Emergency Point message is not interpreted.								
		Further Action	Futu	ure upgrade						

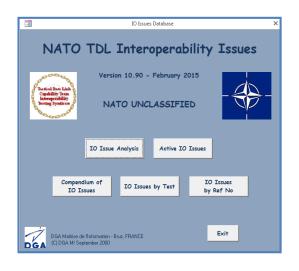
InvestigationComplete [Op Flt Prog 12.0]

INDICATOR

J2.3 Surface PPLI J2.3I SURFACE PPLI INITIAL WORD 355 002 EMERGENCY

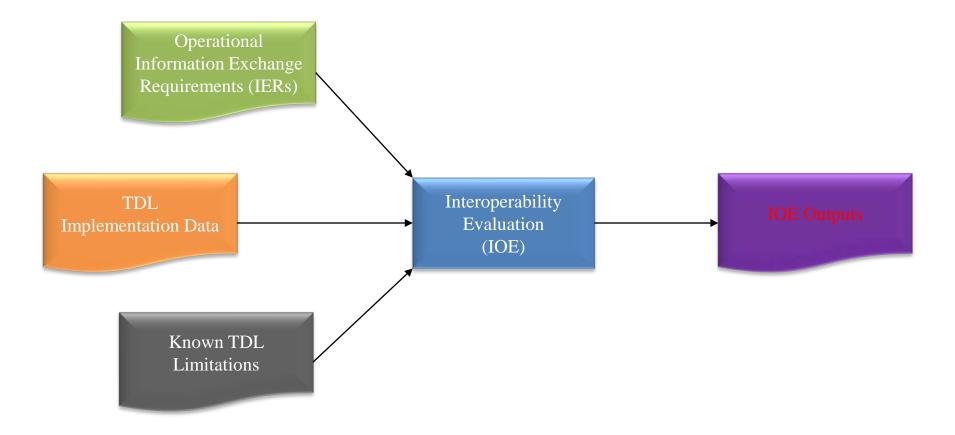
IOA Number IOI Numbers National Issue Numbers Issue Status

Issue Applies To





Key Components – IO Management





IOEs reports historically developed from a technical standpoint

- Overly focussed on technically derived issues
 - Little or no operational significance
 - Impacts not well identified
- As a consequence, front line were not benefiting
- IOE Reports:
 - "Bulky"
 - Static
 - Required SME knowledge to interpret
- A more operationally focussed output was needed
 - And more dynamic



IOE Outputs

Key Components of IOE Output

- Detailed Analysis
- Operational View
 - Representation of IERs
 - Capabilities & Limitations



Detailed Analysis

Project - Exercise "Protect" Destroyer v Combat Air ×									
Destroyer v Combat Air Switch Direction									
Rename Analysis		estroyer		nbat Air		Unabl	e to Assign - (Clear to Dro	op 🛙
TDL Element	Transmit	Transmit Issues	Receive	Receive Issues	IO Issues	Nar	me:	Una	ble to Assign - Clear to Drop
M J12.0 Mission Assignment W J12.0I MISSION ASSIGNMENT INITIAL WORD	T		R R				erity:		Minor
F 1550 001 WORD FORMAT	т		R			Sta	tus:	Inve	stigationComplete 🔹
F 270 004 LABEL, J-SERIES	т		R			Sec	urity Marking:		O Unclassified
F 271 005 SUBLABEL, J-SERIES	т		R				easability:		O Only
F 800 001 MESSAGE LENGTH INDICATOR	т		R				ginator Numb		troyer v Combat Air-3
F 769 006 TRACK NUMBER, ADDRESSEE	т		R*				ncerns DI Conf		troyer v combat Air-3
F 1626 001 MISSION ASSIGNMENT DISCRETE	Т		R*						
D 0 NO STATEMENT	NT		DM						Affects History
D 1 REFUEL	т		R			I I	Operational Su	immary:	Combat Air cannot be assigned a "Clear to Drop" Mission
D 2 ORBIT	т		R						
D 3 RECALL	т		R				Operational D	escription:	Combat Air cannot be assigned a "Clear to Drop" Mission via Link 16
D 4 RETURN TO BASE	т		R						(which could be transmitted by the Destroyer). This is not considered relevant to the Combat Air role.
D 5 ENGAGE	т		R						
D 6 PRIORITY KILL	т		R			1	Workaround:		Not required
D 7 BREAK ENGAGEMENT	т		R						
D 8 INVESTIGATE/INTERROGATE	т		R						
D 9 CLEAR TO DROP	т		DM		•	-		Can	cel Save
								Can	

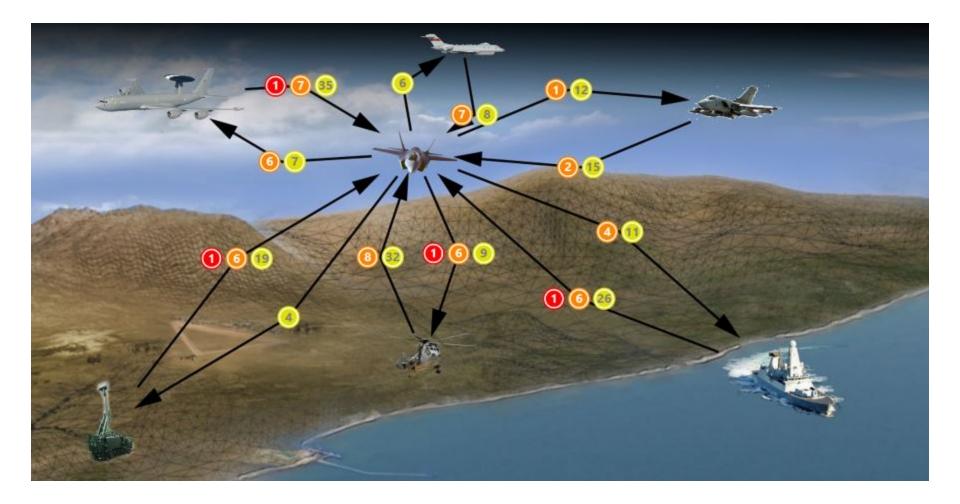


Operational View

s: Destroyer v × +		- 0	
	ebOutput/9ba7d893-6334-4507-b306-80cf872831ca.htm	□☆ = 2 4	
mary Issue Table			-
	Friendly Forces		
	Situation Awareness - Geographic Entities		
	Battle Management		
	Weapons Control		
	tocal Target Data		-
171	Friendly Forces	<u> </u>	,
Combat Air [Op Fit Prog 12.0]	Situation Awareness - 20	20 Destroyer	
	Situation Awareness - Geographic Entities	[Combat Mgmt Sys 3.3]	
	Battle Management		
	Weapons Control		
9	Situation Awareness - Geogra Geographic entities that are exchange	aphic Entities ged to provide additional SA or to report entities for which	direct sensor support is not available.
	Cocal Target Data Cocal Target Data Geographic entities that are exchange Reference Point - Hazard A geographic reference point that reports an entities	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces	
	Situation Awareness - Geogra Geographic entities that are exchange	aphic Entities ged to provide additional SA or to report entities for which	direct sensor support is not available. Operational Summary
	Local Target Data Local Target Data Situation Awareness - Geogra Geographic entities that are exchange Reference Point - Hazard A geographic reference point that reports an ent Information Type	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces Issue	Operational Summary
	Local Target Data Cocal Target Datata Cocal Target Datataa Cocal Target Data Cocal Target	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces ity that is a potential Hazard to friendly forces	Operational Summary The Combat Air system discards any Reference Point wh
	Local Target Data	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces ity that is a potential Hazard to friendly forces	Operational Summary The Combat Air system discards any Reference Point wh is slaved to another track or PPLI Operational Summary
	Local Target Data	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces ity that is a potential Hazard to friendly forces is successful to the second s	Operational Summary The Combat Air system discards any Reference Point wh is slaved to another track or PPLI
	Local Target Data	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces ity that is a potential Hazard to friendly forces issue ity that is a potential Hazard to friendly forces issue ity that is a potential Hazard to friendly forces ity that	Operational Summary The Combat Air system discards any Reference Point wh is slaved to another track or PPLI Operational Summary Combat Air does not interpret Land Objects with High Precision positional information correctly Combat Air displays all exercise tracks/points as if real
	Local Target Data	aphic Entities ged to provide additional SA or to report entities for which ity that is a potential Hazard to friendly forces Issue ON Known Issues ON Known Issues Ombat Air Discards All Slaved Reference Points s been derived from other than sensors Issue	Operational Summary The Combat Air system discards any Reference Point wh is slaved to another track or PPLI Operational Summary Combat Air does not interpret Land Objects with High Precision positional information correctly



Operational View





RF Interoperability

• Introduction of new technologies/waveforms etc

Multi-Link Interoperability

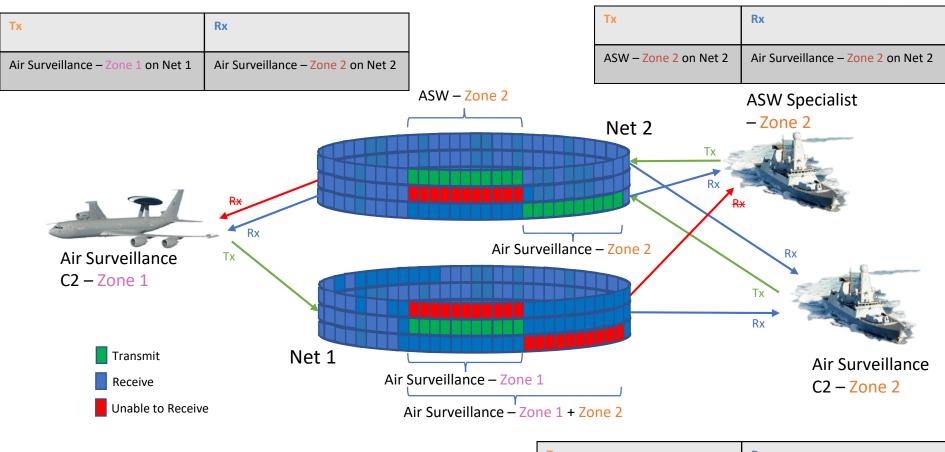
- Source TDL Issues;
- Destination TDL Issues; and
- Data Forwarder Issues, exacerbating the problems

Expanded functional use of TDLs

 Network Enabled Weapons, Ballistic Missile Defence, Imagery



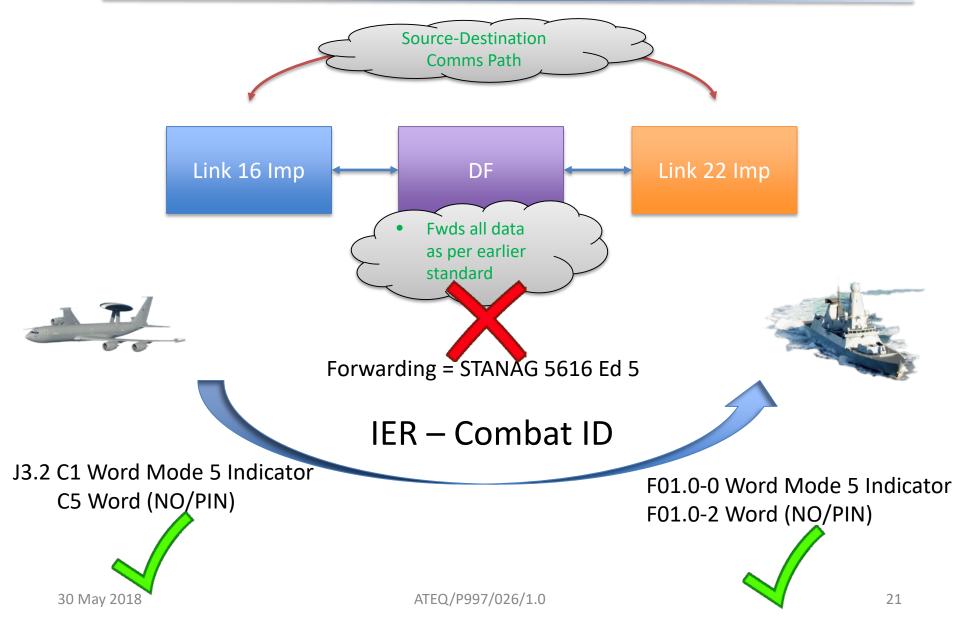
Example – RF Interoperability Planning



Тх	Rx
Air Surveillance – Zone 2 on Net 2	Air Surveillance – Zone 1 on Net 1
-	ASW – Zone 2 on Net 2

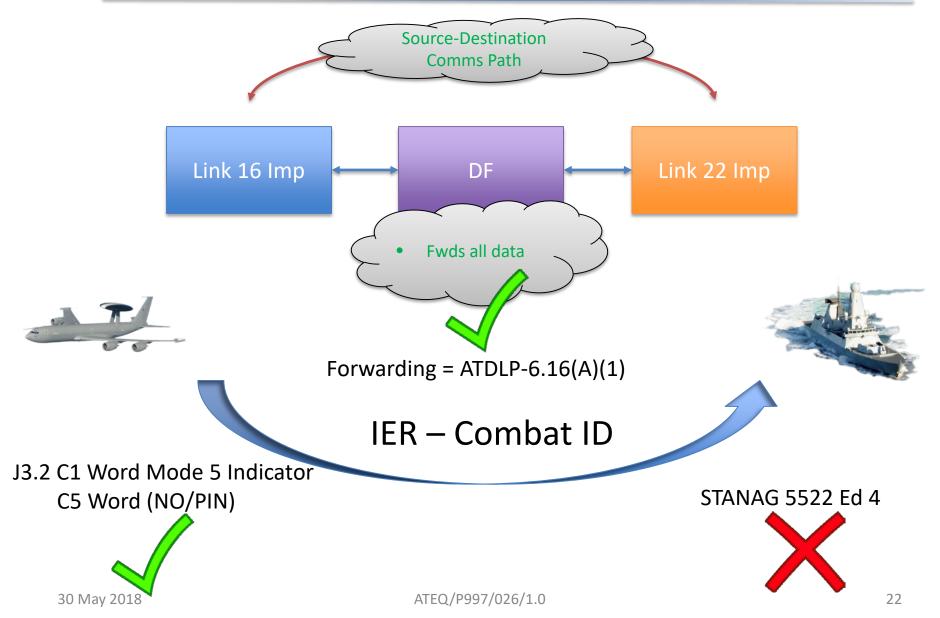


Example – Multi Link Interoperability



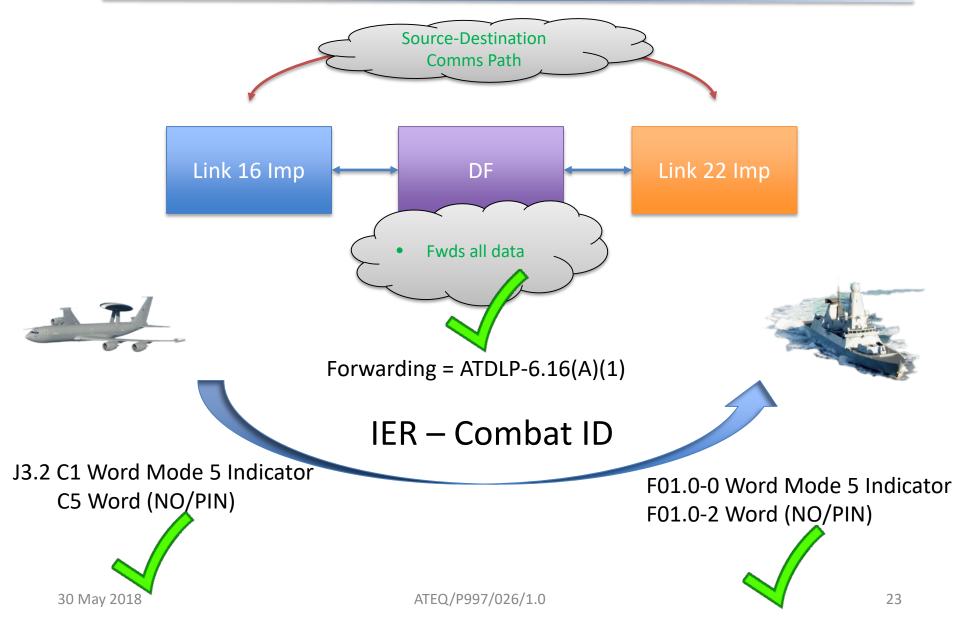


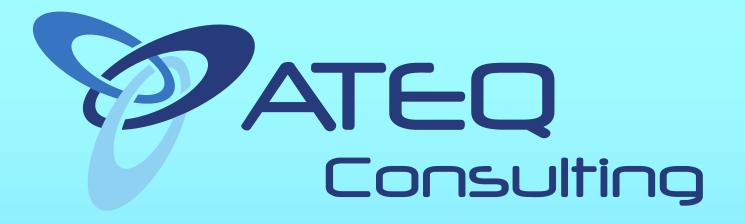
Example – Multi Link Interoperability





Example – Multi Link Interoperability





Questions?