

STANDARDS RELATED DOCUMENT

AEP-104.1

RATIFICATION BRIEF

EDITION A VERSION 1

JANUARY 2022



NORTH ATLANTIC TREATY ORGANIZATION

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NATO LETTER OF PROMULGATION

31 January 2022

1. The enclosed Standards Related Document, AEP-104.1, Edition A, Version 1, RATIFICATION BRIEF, which has been approved in conjunction with AEP-104 by the nations in the NATO AIR FORCE ARMEMENTS GROUP (NAFAG), is promulgated herewith.
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Dimitrios SIGOULAKIS
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NATO Defensive Aids System (NDAS)



Ratification Brief



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Contents

- Purpose of brief
- The problem space
- NATO DAS overview
- Benefits of NATO DAS
- NATO DAS plan
- The CST requests from ratifiers
- Summary



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Purpose of Brief

- This briefing is to introduce prospective Ratifiers to the proposed NDAS STANAG 4781
- The NDAS standard will be submitted for ratification in December 2019
- The aim of this brief is to support the ratifiers in understanding the standard




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In order to ease the ratification process - provide a clear understanding of what is included within Edition A of the STANAG

NDAS Smart Defence DAS Project (#1.32)












- Objectives
 - To provide NATO with the capability to protect air assets in complex threat environments.
 - Develop an open architecture DAS to support the integration of sensor and effector systems onto operational platforms.
 - Develop a NATO DAS Standardization Agreement 4781 (STANAG).
- Lead Nation POCs
 - Wg Cdr Chris Greenwood, Air Command, Air Capability, GBR
 - Dr Nick Law, Technical Lead, Dstl, GBR
- Sponsor
 - NAFAG – Aerospace Capability Group 3
 - ACG3 SG/2


Tier 1 Project = High Priority







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NDAS is an enabling element of an integrated DAS architecture which when combined with DAS sensors and effectors will support enhancements in platform protection in an increasingly contested and congested spectral environment. Whilst Edition A is about platform self-protection, the intention is to have sensed data more accessible to other platforms in subsequent work effort on the standard. The STANAG is managed by the Custodian Support Team under Aerospace Capability Group 3 Sub-group 2 (ACG3 SG/2).

Organisation

- International Government and Industry established team delivering a shared vision
- NATO Smart Defence is a Tier 1 Project that started within the Systems Concepts and Integration (SCI) 260
 - SCI-260 sought Industry advice on open architectures through NATO Industrial Advisory Group (NIAG) Study Group (SG) 185 and NIAG SG 211 and developed the draft Allied Engineering Publication (AEP)
- The SCI team has transitioned to a Custodian Support Team (CST) under Sub-Group 2 (SG2) as tasked by Aerospace Capability Group 3 (ACG3) in 2019
 - The team is chartered to
 - deliver STANAG 4781 documentation for ratification in December 2019
 - support the exploitation within SG2
 - develop and deliver future evolutions of the STANAG



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SCI 260; Defensive Aids Systems (DAS) / Aircraft Survivability Equipment (ASE) contribute to survivability by providing self-protection capabilities to the warfighter, the platform and the mission. The problem is that it takes too long and costs too much to upgrade and maintain these systems through life. Furthermore, DAS / ASE systems traditionally employ proprietary closed communication links between sub-systems.

Open interfaces support industrial strategies by enabling faster integration of novel and niche technical capabilities from small and medium enterprises as well as large organisations.

NIAG SG 185; Study provided an industry assessment of candidate defensive aids system (DAS) open architectures.

NIAG SG 211; Provide industry feedback and guidance to proposed solutions for the key 'NDAS implementation challenges' of :Off-boarding of DAS information (interchange of data between DAS and other platforms, and/or off-platform users such as troops on the ground), Security requirements and means to comply (on-board and off-board), Certification and accreditation for a dynamic DAS in a complex threat environment and Exportability.

The Problem Space

- Platforms are increasingly entering theatres where Anti-aircraft defence systems are becoming more advanced such that a traditional approach to air platform protection may not be effective:
 - Fast evolving threats
 - New capabilities can be slow and expensive to integrate, adapt and deploy on to Air platforms
 - Sub optimal integration of capability within the platform protection system could lead to reduced platform protection
 - Aircrew are likely to require more Situational Awareness
 - Countermeasures will require in-flight adaptation



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Information could be tied up within supplier's IP which restricts the level of integration capability; or ties-in integrators to particular solutions.
Easier to integrate new capability into an open system.

The Threat

- Threats to platforms are evolving quickly and becoming more capable
- Adversary systems proliferation worldwide
- Changes in the environment include:
 - Multi-spectral, search, guidance and seeker systems
 - Closely Integrated Air Defence Systems (IADS)
 - Quickly adaptable
 - Software defined
 - Unknown / unquantified capabilities



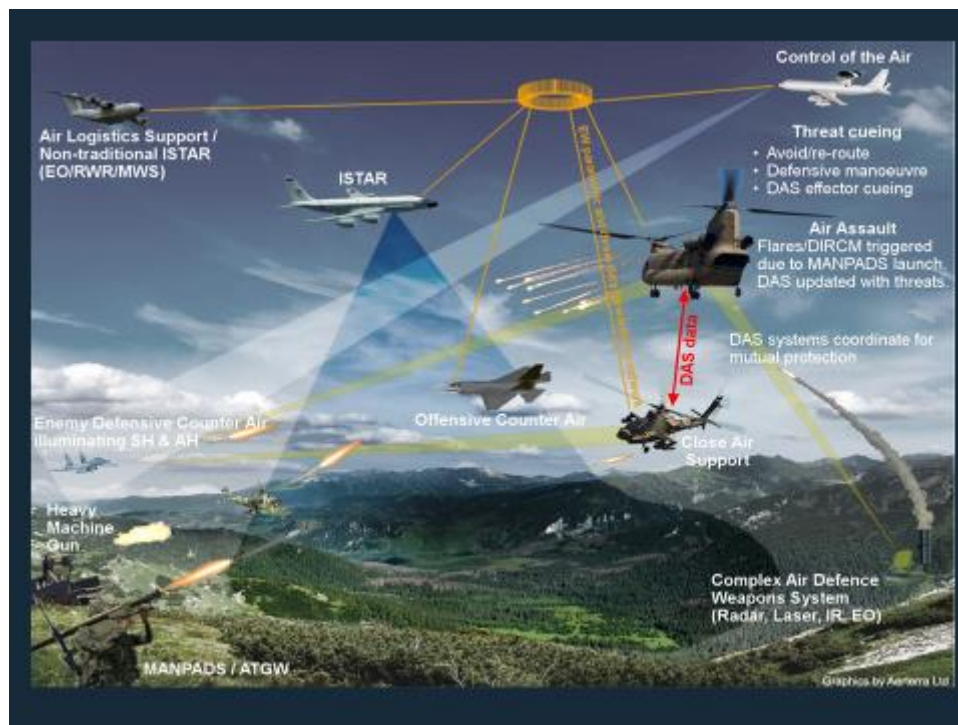
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Adversary RADAR Systems, SAMS and MANPADS are becoming increasingly more complex and integrated.



The figure depicts an operational view of operating within a complex Air Defence environment. Coalition forces face advanced surface to air missiles, MANPADS and hostile small calibre fire. Air Defence could consist of targeting achieved from the combination of multiple spectrums, e.g. RF, Laser, IR & EO. In this context, NDAS can be used to share track data from all on platform sensors of detected threat systems for the purpose of determining a collated survivability strategy. Furthermore, situational awareness to platform, crew and potentially sharing information with external mission participant / ISTAR could be provided.


NATO Defensive Aids System (NDAS)

- NDAS is
 - A standard definition of an Open Architecture and Common Message Set (CMS) for the purpose of integrating DAS equipment (e.g. Sensors, Effectors, Moderator etc.)
 - Focused on information exchanges between functions to enable interoperability, facilitate improved situational awareness and enable enhanced platform protection.
 - A scalable and evolutionary architecture, encompassing simple to complex DAS supporting
 - Incremental development based on threat environment and technology availability
 - future capability growth needs
- NDAS is not
 - A definition of a DAS or its functionality
 - A procurement specification for a DAS
 - Prescriptive on performance



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NATO Defensive Aids Systems (NDAS) is a Smart Defence Project led by the UK to respond to evolving threats and provide capability to protect NATO Air Platforms. As threats evolve, current standalone federated Defensive Aids Systems (DAS) will not be able to effectively defeat future complex threats but will require the intelligent integration of all on-board DAS sub-systems. NDAS has developed an open architecture capable of integrating sensors and effectors. The integrated system will manage information from multiple sensors, prioritise threats and provide the appropriate countermeasure response. This endeavour has resulted in the development of an Open Systems Architecture NATO Standardisation Agreement (STANAG), which will enable survivability upgrade solutions to be integrated in a more effective, agile and cost-effective way through-life. This will also ensure improved interoperability with NATO Allies through a standardised approach. There have been over 50 organisations across Governments and Industry who have contributed to the STANAG which was delivered to NATO for ratification in December 2019, with planned publication in December 2020 after ratification.

Benefits of NDAS Open Architecture

- Enables enhanced survivability
 - multi spectral threat detection and fusion
 - intelligent multi spectral effector optimization and coordination
 - in-air / in-mission defined countermeasure techniques
 - enhanced air platform(s) situational awareness through smart sensor integration and common message set (CMS)
 - supports enhanced test and evaluation and provision of survivability capability assurance



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Benefits of NDAS Open Architecture

- Efficiency, cost effectiveness and interoperability
 - increases reuse and reduces reliance on bespoke interfaces
 - industry product development building on NDAS common base – minimizing/eliminating project specific customization
 - accelerate the embodiment/integration/update of modular DAS solutions reducing the impact on platform flight critical software
 - optimization and automation of payload management
 - common data management and recording of DFCI communications
 - opportunity for common toolsets for test & evaluation and post mission analysis



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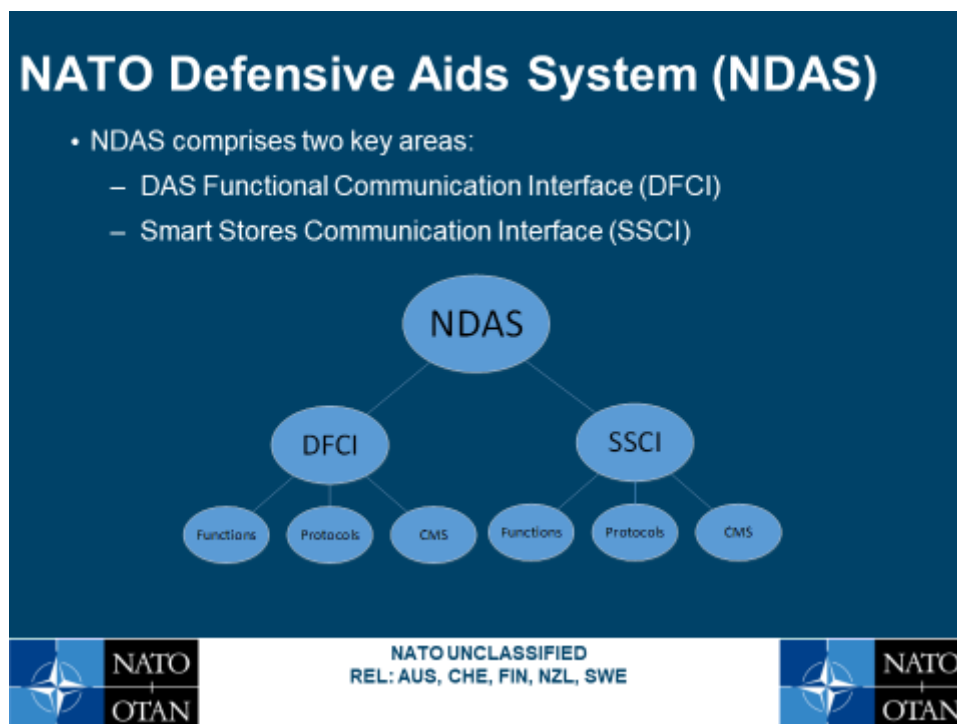
Benefits of NDAS Open Architecture

- Enables evolution of DAS implementation through enhanced sharing of best practice by SG/2
- Enables a growth path for on/off boarding, shared situational awareness, and cooperative effects

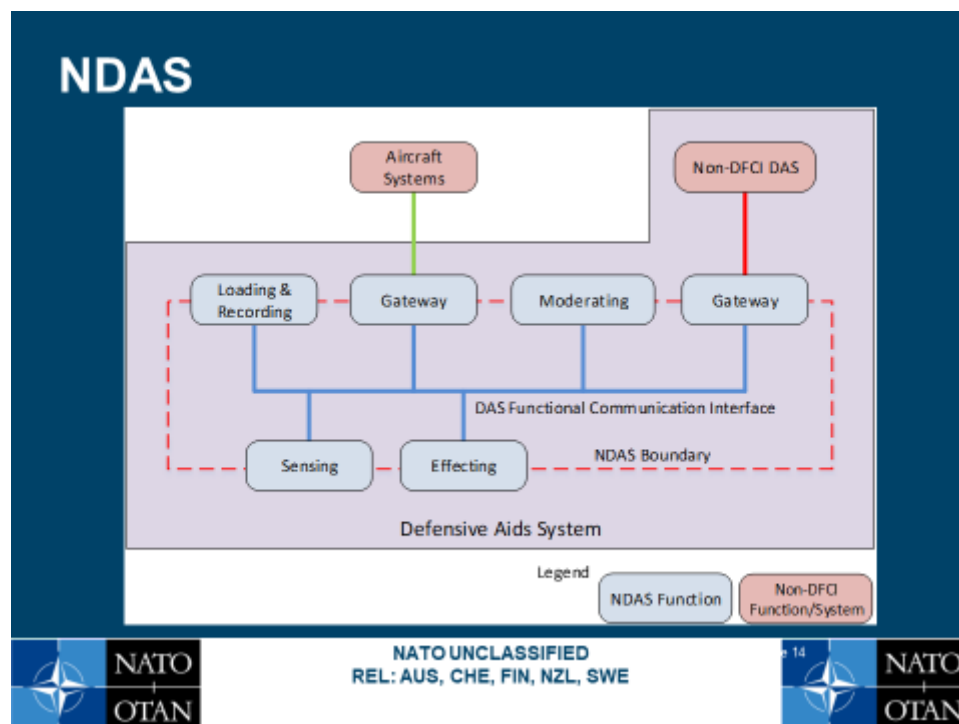


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NDAS is the approach taken by NATO and industry to standardize the interfaces, protocols and message set for platform integration. The NDAS Overview figure illustrates the document structure and the relationship between the DFCI and the SSCI. The DAS architecture is the fundamental enabler for improving aircraft survivability through the interoperability of subsystems as well as ease of integration of new capabilities (functions) into existing NDAS implementations on military platforms.



The NDAS architecture allows for an evolutionary approach. Platform safety critical interfaces are 'firewalled' through a high integrity platform gateway. This enables more rapid and cost effective DAS upgrades.

DFCI functions

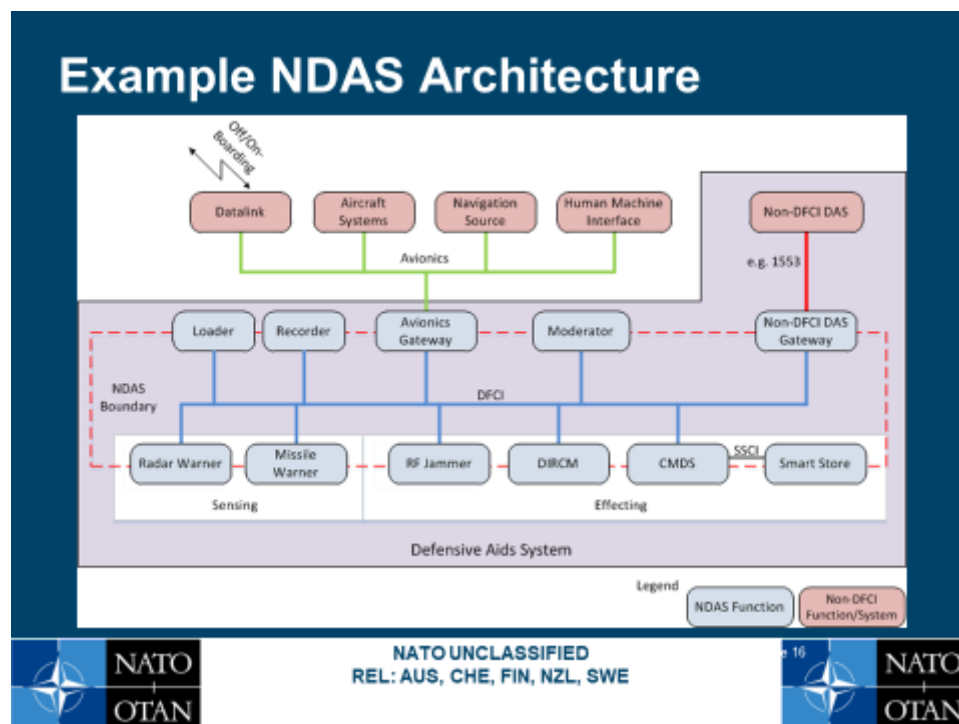
- The following DFCI functions could be used as building blocks of any STANAG 4781 compatible DAS
 - Sensing – detects threats and creates tracks, e.g. missile warner
 - Effecting – threat counter measure in response to a track, e.g. jammer
 - Gateway – provides connections to other data buses, which could be at different integrity levels, e.g. Mission Systems
 - Moderating - coordinates sensor and effector capabilities into a coherent suite of self-protection capability
 - Data loading and recording – storage of pre-determined set of data and access stored data for DFCI functions



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These are the functional groups currently covered by the DFCI. It is highly likely that new functions will fit into these groupings, however, if this is not the case then additional messages could be added to a subsequent edition. Depending upon the implementation, it is possible to load legacy equipment via the DFCI and associated gateway or use legacy support equipment, e.g. loaders.




The NDAS architecture allows for an evolutionary approach. Platform safety critical interfaces are 'firewalled' through a high integrity platform gateway. This enables more rapid and cost effective DAS upgrades.

DFCI Common Message Set (CMS)

- The CMS was derived from a knowledge of the interactions between current and anticipated future DAS functions
- Defines the format of the data that can be exchanged between functions to enable them to interoperate
- The CMS provides a tiered approach to data and can be extended to encompass new or higher level functions, whilst maintaining backwards compatibility with the data set.
- The CMS includes:
 - Threats
 - countermeasure execution
 - command and control
 - navigation and time
 - health, status, and logistics
 - wrapper for bespoke information
 - etc.

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The extent of the coverage of messages have been developed by an industry team of ASE capability providers. It is believed that the included message content should cover any DAS use case implementation.

DFCI reference specification

- The STANAG includes a reference specification based on Gigabit Ethernet.
 - selected as a ubiquitous standard available to most DAS equipment
 - Leverages open industry standard networking protocols and interfaces
- Subsequent editions of the STANAG could introduce additional reference implementations, their bearer channels and corresponding protocols, e.g. USA VICTORY



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Protocols used are open standards RFCs (Request For Comment) as defined by the IETF (Internet Engineering Task Force), for example RFC 768 - UDP (User Datagram Protocol). The CMS was derived based on the information exchanges required to support known and anticipated DAS interactions.

SSCI functions

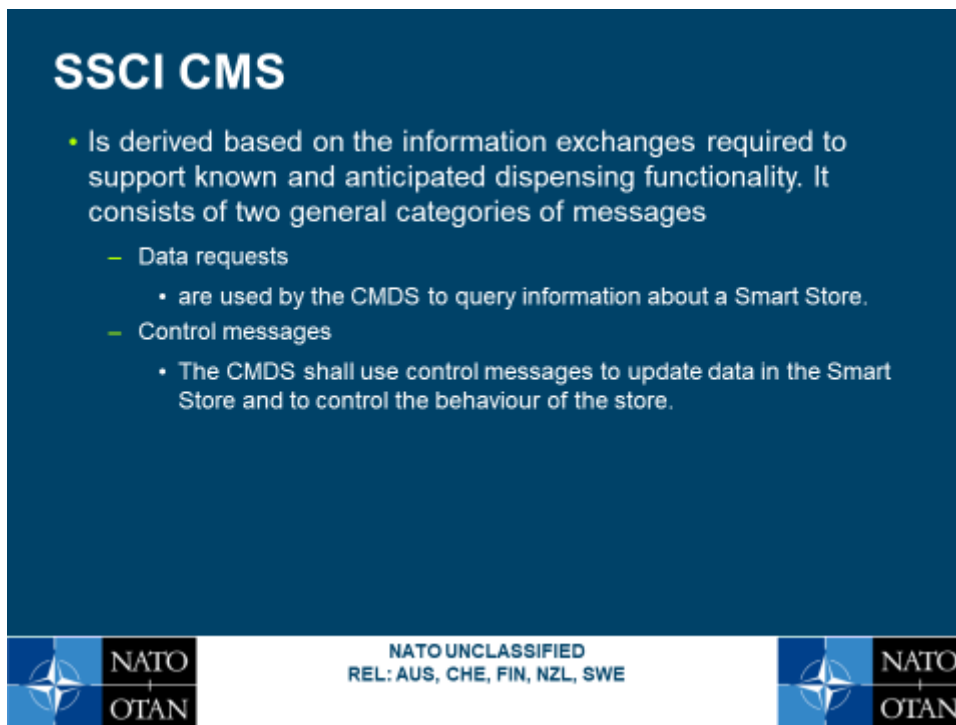
- Countermeasure Dispensing Systems (CMDS) - provide an interface between the DAS bus, which could be a legacy interface or DFCI, and the Smart Stores.
- SSCI enables the following functions
 - CMDS - will initiate dispensing and communication with the Smart Stores.
 - Smart Store – communicates with CMDS to provide optimised countermeasure effects.



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A traditional store will not respond to or be affected by the SSCI nor will the SSCI impact the stores normal operation.

A presentation slide with a dark blue background. The title 'SSCI CMS' is in large white letters at the top left. Below it is a bulleted list in white text. At the bottom of the slide, there are three logos: the NATO/OTAN logo on the left, the text 'NATO UNCLASSIFIED REL: AUS, CHE, FIN, NZL, SWE' in the center, and another NATO/OTAN logo on the right.

SSCI CMS

- Is derived based on the information exchanges required to support known and anticipated dispensing functionality. It consists of two general categories of messages
 - Data requests
 - are used by the CMDS to query information about a Smart Store.
 - Control messages
 - The CMDS shall use control messages to update data in the Smart Store and to control the behaviour of the store.

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The extent of the coverage of messages have been developed by an industry team of ASE capability providers. It is believed that the included message content should cover any DAS use case implementation.

SSCI Reference Specification

- Physical and protocol implementation matured at SG/2 and industry sponsored integration activities
- The Physical layer is standardised in the AEP 104 document, using the single wire fire line interface
 - The fire line has been adopted due to its commonality within CMDS industry base and does not impact the function safety case (Def-Stan 59-114 and MIL-STD-331)
- The protocol is based on the industry standard HDLC (High-level Data Link Control)
- Subsequent editions of the STANAG could introduce additional reference specifications



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Unlike the DFCI, the SSCI defines both the physical layer interface and protocol within AEP-104, e.g. it defines message content and the electrical interface. This is because there is no current open industry standard for the existing store fire line interface known to the CST.

STANAG Documentation

- The NDAS STANAG comprises a top-level document (STANAG 4781) that refers out to a detailed Allied Engineering Publication (AEP-104)
- The STANAG comprises of architecture descriptions and reference implementations
 - The reference specifications for the first issue of the STANAG determines an Ethernet bearer for DFCI and single wire interface for the SSCI
 - The standard is agnostic of physical interface, and other physical interface are supported through additional issues of reference specification within the STANAG



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Ratification



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Ratification

- STANAG submission for ratification December 2019
 - The CST would like to work to a 12 month ratification period
- Simple majority
 - 15 nations (half of 29)
- 9 specified nations
 - Belgium
 - Denmark
 - France
 - Germany
 - The Netherlands
 - Spain
 - Turkey
 - UK
 - USA

Whichever comes first



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Can alter promulgation criteria prior to submission for ratification. It is difficult to alter the specified nations once the STANAG has been submitted for ratification.

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Ratification responses		
• Ratifying and implementing		✓
• Ratifying and implementing – with reservations		✓
• Ratifying, future implementation		✓
• Ratifying, future implementation – with reservations		✓
• Not ratifying		-
— With objection		✗
• Not participating		-



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Any of the top four 'ratifying' responses count as ratification.

'Not ratifying' and 'Not participating' do not count as ratification, but do not stop proceedings.

"Not ratifying with objections" will halt the ratification process.

All the specified nations in the promulgation criteria have to ratify (i.e. any of the top four responses above) for the STANAG to become officially ratified.

Or a majority of NATO nations (15) need to ratify.

Once ratified then the STANAG can be officially promulgated.

Topics under consideration for future editions

- Analysis of SG/2 scenarios and vignettes will inform further NDAS development, including requirements delivered through collaboration with other domains and standards
 - On/off boarding
 - ISTAR communications
 - Collaborative DAS communications between multiple platforms
 - Enhancement of HMI, e.g. Situational Awareness and cueing
 - Data integrity and security
- Explore alignment with complementary standards, e.g. FACE and VICTORY
- Introduction of additional DFCI reference implementations, their bearer channels and corresponding protocols
- SSCI – additional reference implementations with a very low latency and significantly higher data rates to enable future classes of expendables
- Compatibility - methods and tools
- Redundancy and Reversionary behaviour



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CST Support

- Please contact us if you:
 - have questions on the STANAG
 - require clarification on the STANAG

Contact: STANAG 4781 Custodian Support Team
Stanag4781Cst@dstl.gov.uk



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Summary

- The threat to NATO platforms is increasing and becoming complex
- NATO SG2 has created the open NDAS STANAG 4781
 - It is an enabler for multiple benefits, including platform protection and survivability, by providing the means for advanced functionality to interoperate across common infrastructures
 - Covering both a DAS functional communication interface and a smart stores communication interface definition
- Future editions scoping has started
 - On/off boarding
 - High speed/low latency SSCI
 - Adding security into the architectural design is also important
- Exploitation has started



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Acronyms

Acronym	Meaning
ACG3	Aerospace Capability Group 3
AEP	Allied Engineering Publication
AH	Attack Helicopter
ATGW	Anti Tank Guided Weapon
CMDS	Countermeasures Dispensing System
CMS	Common Message Set
DAS	Defensive Aids System
DFCI	DAS Functional Communications Interface
DSTL	Defence Science Technology Laboratory
EO	Electro-optic
HDLC	High-Level Data Link Control
HQ	Headquarters
IR	Infrared
ISTAR	Intelligence Surveillance, Targeting, Acquisition and Reconnaissance
MANPAD	Man Portable Air Defence

Acronym	Meaning
NAFAG	NATO Airforce Armaments Group
NATO	North Atlantic Treaty Organisation
NDAS	NATO DAS
NIAG	NATO Industry Advisory Group
POC	Point of Contact
SCI	System Concepts and Integration
SG	Sub-Group
SH	Support Helicopter
SSCI	Smart Stores Communications Interface
UDP	User Datagram Protocol



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