NATO STANDARD

AEP-4754

NATO GENERIC VEHICLE ARCHITECTURE (NGVA) FOR LAND SYSTEMS

VOLUME I: ARCHITECTURE APPROACH

Edition A Version 1
FEBRUARY 2018

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED ENGINEERING PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)

INTENTIONALLY BLANK

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

22 February 2018

1. The enclosed Allied Engineering Publication AEP-4754, Volume I, Edition A, Version 1 NATO GENERIC VEHICLE ARCHITECTURE (NGVA) FOR LAND SYSTEMS VOLUME I: ARCHITECTURE APPROACH, which has been approved by the nations in the NATO Army Armaments Group, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4754.

2. AEP-4754, Volume I, Edition A, Version 1 is effective upon receipt.

4. This publication shall be handled in accordance with C-M(2002)60.

Dieter Schmaglowski
Deputy Director NSO
Branch Head P&C

Edvardas MAŽEIKIS
Major General, LTUAF
Director, NATO Standardization Office

INTENTIONALLY BLANK

RESERVED FOR NATIONAL LETTER OF PROMULGATION

INTENTIONALLY BLANK

RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

INTENTIONALLY BLANK

RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

INTENTIONALLY BLANK

TABLE OF CONTENTS

INTENTIONALLY BLANK

CHAPTER 1 INTRODUCTION

1.1. Purpose

The aim of the NGVA Standard AEP-4754 Volumes I through VII is to enable the member nations to realize the benefits of an open architecture approach to Land vehicle platform design and integration, especially in regard to the vehicle platform electronic data and power infrastructure and the associated safety and verification & validation process.

1.2. Application of the NGVA Standard

The NGVA Standard is to be applied to all future land vehicle platforms and vehicle platform sub-system, as well as current vehicle platform refurbishment and upgrade programmes.

This NGVA Standard is applicable to land vehicle platforms, ranging from simple to complex implementations. The requirements for these implementations are determined by the functionality required of the vehicle platform as a whole system including all sub-systems, and not the automotive or power elements alone. The requirements address equipment to be fitted as part of the initial operating capability and equipment likely to be fitted throughout the life of the vehicle platform. These requirements are expressed in the national system requirements documents and/or the sub-system requirements documents for the individual vehicle platforms concerned.

1.3. Agreement

Ratifying nations agree that the NGVA Standard is to be applied to all future land vehicle platforms and vehicle platform sub-systems, as well as current vehicle platform refurbishment and upgrade programmes. Nations may propose changes at any time to the NATO Standardization Office (NSO).

Germany will act as custodian to maintain Configuration Management (CM) and change management of this Standard and its associated AEP Volumes.

Ratifying nations have agreed that national orders, manuals and instructions implementing this Standard will include a reference to the AEP-4754 Volumes I through VII for purposes of identification.

The NGVA Standard and its associated Volumes I through VII shall be considered as the foundation standard for vehicle sub-system integration, and should any conflict arise between this and other extant NATO documentation, this document shall take precedence.

Deviations from the NGVA Standard shall be agreed by the relevant national procurement office.

1.4. Ratification, implementation, and reservations

Ratification, implementation and reservation details are available on request or through the NATO Standardization Office (NSO) (internet: http://nso.nato.int).

1.5. Feedback

Any comments concerning this publication should be directed to: NATO/NSO – Bvd Leopold III - 1110 Brussels - Belgium.

Proposals for changes and improvements of the NGVA Standard AEP-4754 volumes I through VII shall be sent to the NSO and then forwarded to the custodian who will collect them and will propose new editions of the NGVA Standard AEP-4754 Volumes I through VII.

The NGVA Standard Point-of-Contact as assigned by the NGVA Standard Custodian is BAAINBw K1.2, Ferdinand-Sauerbruch-Str.1, D-56073 Koblenz, Germany.

CHAPTER 2 DEVELOPMENT OF NGVA STANDARD

The NATO Generic Vehicle Architecture (NGVA) Standard was developed under the auspices of the Military Vehicle Association (MILVA).

MILVA is an association of government agencies and industries promoting Vehicle Electronics (Vetronics) in the military environment. MILVA provides an open forum to its members and publishes guidelines and standards on Vetronics issues. MILVA works in close co-operation with NATO through the Land Capability Group on Land Engagement of the NATO Army Armament Group (NAAG).

2.1. NGVA Standard Structure

Figure 1 below illustrates the Standard structure, the Volumes relationships and technical areas covered under each Volume.

NGVA Standard AEP-4754	
Volume I:	NGVA Architecture Approach (Describes the NATO Generic Vehicle Architecture (NGVA) concept)
Volume II:	NGVA Power Infrastructure (Defines the design constraints on power interfaces which form the NGVA Power Infrastructure)
Volume III:	NGVA Data Infrastructure (Defines the design constraints on the electronic interfaces that form the NGVA Data Infrastructure)
Volume IV:	NGVA Crew Terminal Software Architecture (Defines the design guidelines and constraints for standardized "Crew Terminal Software Applications")
Volume V:	NGVA Data Model (Describes the NATO GVA Data Model (NGVA DM), the Model Driven Architecture (MDA) approach used to produce the NGVA DM, the toolset required to produce and manage the configuration control of the NGVA DM and finally the applicability of the NGVA DM to Data Distribution Service (DDS) middleware installed on a GVA compliant platform.)
Volume VI:	NGVA Safety (Outlines the generic procedures to incorporate system safety related planning, development, implementation, commissioning and activities in systems engineering)

Volume VII:	NGVA Verification and Validation (Provides guidance for the verification and validation of NGVA systems regarding their conformity to the AEPs associated with this STANAG)

Figure 1: NGVA Standard AEP-4754

2.2. General Notes

2.2.1. Scope

NGVA is the approach taken by NATO and related industry to standardize the interfaces and protocols for military vehicle systems integration. The Vehicle Architecture (including data and power architectures) is considered as the fundamental enabler that can provide new capabilities on military platforms so as to improve overall effectiveness (including cost) and efficiency within the whole vehicle life cycle. The NGVA Standard does not include standard automotive electronics and power related information.

2.2.2. Warning

National governments, like their contractors, are subject to laws of their respective countries regarding health and safety. NATO STANAGs and Standards may set out processes and procedures that could be hazardous to health if adequate precautions are not taken. Adherence to those processes and procedures in no way absolves users from complying with their national legal requirements.

2.3. Normative References

The documents and publications shown in Table 1 below are referred to in the text of this AEP Volume. Documents and publications are grouped and listed in alpha-numeric order:

1. AAP-03	PRODUCTION, MAINTENANCE AND MANAGEMENT OF NATO STANDARDIZATION DOCUMENTS
2. ANSI/TIA/EIA-422-B (01/2000)	Electrical Characteristics of Balanced Voltage Differential Interface Circuits
3. DDS Interoperability Wire Protocol Specification v2.1	DDS Interoperability Wire Protocol specification (DDS-RTPS) (http://www.omg.org/cgi-bin/doc?formal/10-11-01.pdf)
4. DDSI-RTPS v2.2	OMG DDS Interoperability Wire Protocol specification (DDS-RTPS) (http://www.omg.org/spec/DDSI-RTPS/2.2/)
5. DDS-XTypes v1.0	OMG Extensible and Dynamic Topic Types for DDS (http://www.omg.org/spec/DDS-XTypes/1.0/)
6. EN4531	Connectors, optical, circular, single and multipin, coupled by threaded ring - Flush contacts
7. EU Directive	Restriction on the Use of Certain Hazardous

2002/95.RoHS Regulations 2008	Substances in Electrical and Electronic Equipment Regulations 2008
8. IAWG-AJT-301	System of System certification (related to avionic)
9. IDL version 3.5	Interface Definition Language http://www.omg.org/spec/IDL35/3.5
10. IEC 60793-2-10	Optical fibers – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibers
11. IEC 61508	Functional safety of electronic electrical/electronic/programmable electronic safety-related systems
12. IEEE 1012-2012	IEEE Standard for System and Software Verification and Validation
13. IEEE 1588-2008 (PTP v2)	Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
14. IEEE 802.3	Ethernet Standards Collection
15. ISO 16750-2	Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 2: electric loads
16. ISO 26262	Road vehicles – Functional safety. Management of functional safety.
17. ISO 9000:2015	Quality management systems – Fundamentals and vocabulary
18. ISO/IEC 15288:2008(E)	Systems and software engineering – System life cycle Processes
19. ISO/IEC/IEEE 29148-2011(E)	Systems and software engineering -- Life cycle processes -- Requirements engineering
20. ISO/IEC 17000:2004	Conformity assessment – Vocabulary and general principle
21. JSP 454	Land Systems Safety and Environmental Protection Part 2
22. MDA Guide revision 2.0	Model Driven Architecture http://www.omg.org/cgi-bin/doc?ormsc/14-06-01
23. MIL-STD 1275 E	MIL-STD-1275E, DEPARTMENT OF DEFENSE INTERFACE STANDARD: CHARACTERISTICS OF 28 VOLT DC ELECTRICAL SYSTEMS IN MILITARY VEHICLES (March 2012)., This standard covers the limits of transient voltage characteristics and steady state limits of the 28 volt (V) direct current (dc) electric power circuits of military vehicles.
24. MIL-DTL-38999 Series III Rev L Amdt 1(2015)	Connectors, Electrical, Circular, Miniature, High Density, Quick disconnect (Bayonet, Threaded, or Breech Coupling), Environment Resistant with Crimp Removable Contacts or Hermetically Sealed with Fixed, Solderable Contacts
25. ISO/IEC 12207:2008	Systems and software engineering. Software life

	cycle processes
26. MIL-STD-882E 11 May 2012	System Safety
27. OMG Data Distribution Service (DDS) v1.2	Data Distribution Service for Real-Time Systems ('DDS) (http://www.omg.org/cgi-bin/doc?formal/07-01-01)
28. STANAG 4697/AEP-79	Platform Level Extended Video Standard (PLEVID)
29. RFC 5905	Network Time Protocol Version 4: Protocol and Algorithms Specification
30. UML Version 2.0 Infrastructure Specification	http://www.omg.org/spec/UML/2.0/Infrastructure/PDF
31. UML Version 2.0 Superstructure Specification	http://www.omg.org/spec/UML/2.0/Superstructure/PDF
32. USB v2.0	Universal Serial Bus Revision 2.0 (http://www.usb.org/developers/docs/usb_20_071012.zip)

Table 1: Normative References

Reference in Standard AEP-4754 and its Volumes to any normative references refers to, in any Invitation to Tender (ITT) or contract, the edition and all amendments current at the date of such tender or contract, unless a specific edition is indicated. For some standards, the most recent editions shall always apply due to safety and regulatory requirements.

In consideration of the above and as best practice, those setting the requirements shall be fully aware of the issue, amendment status and application of all normative references, particularly when forming part of an ITT or contract.

2.4. Conventions

For the purposes of all AEP Volumes all requirements are specifically detailed in tables with each requirement classified as in the paragraph 2.6. Where an AEP Volume contains no specific requirement tables they should serve as implementation guidance until technical standardization requirements are developed and included.

2.5. Requirements Classifications

The following classifications are to be used for all NGVA related requirements.

2.5.1. Compulsory Requirement (CR)

The requirement needs to be implemented in order to conform to Standard AEP-4754 and to gain certification. Compulsory requirements are listed in the Requirements Tables inside the AEPs and marked as “CR”.

2.5.2. Optional Enhancement (OE)

Optional Enhancements do not need to be implemented in order to conform to Standard AEP-4754. However, if such a capability is present, it needs to be implemented according to the stated specification in order to be compliant. Optional Enhancements are listed in the Requirements Tables inside the AEPs and marked as “OE”.

2.6. Abbreviations

Abbreviations referred to in this AEP Volume are given in Annex A.

2.7. Terms and Definitions

2.7.1. NGVA Definitions

1. **Base Vehicle**: The basic vehicle structure and those systems needed to enable it to perform its automotive functions and mobility. Where fitted it also includes those systems needed to control turrets and other physical elements e.g. a mine plough.
2. **Base Vehicle Sub-System**: A system that forms part of the base vehicle
3. **Electronic Architecture**: The combination of the electronic based sub-systems and electronic infrastructure that supports the vehicle crew to undertake their operational tasks
4. **NATO Generic Vehicle Architecture (NGVA):** The term ‘NATO Generic Vehicle Architecture’ refers to the open, modular and scalable architectural approach applied to the design of vehicle platforms.
5. **Hard Switching:** The ability to control or operate a sub-system using physically based means.
6. **Measure of Effectiveness:** A description of how effective a solution candidate is for a particular assessment criterion.
7. **Measure of Performance:** A statement that describes the assessment criterion or criteria needed to satisfy a given requirement.
8. **Modular**: A modular architecture is designed in such a way as to allow the replacement or addition of sub-systems and upgrades as required without any undesirable emerging properties.
9. **NGVA Compliant:** NGVA Compliance applies to the whole vehicle platform and means that any sub-system existing on the platform complies with the requirements defined in STANAG 4754 and associated AEPs.
10. **NGVA Electronic Infrastructure:** The physical cables and connectors that provide means of distributing data around a base vehicle. It also includes any enabling logical components and functions e.g. Core platform management software, interface software, transport protocols and message definitions.
11. **NGVA Power Infrastructure:** The physical cables, connectors and other components that provide the means of distributing and controlling electrical power around a vehicle platform.
12. **NGVA Ready**: NGVA Ready applies at a sub-system level and means that sub-systems and components have been developed to a level where they can be efficiently integrated within a “NGVA Compliant” whole vehicle Electronics. This would mean passing an incremental process with two sequentially-related Compatibility levels:
    a. **Connectivity Compatibility**: Ensures that the (sub-) system can be physically integrated into the NGVA architecture without any negative

impacts to existing NGVA components. Physical power and network interfaces comply with the requirements of Power and Data Infrastructure AEPs.

b. **Communication Compatibility**: Connectivity Readiness and data interfaces (DDS/Video) with associated NGVA Data Model implementation that comply with the requirements of Data Model and Data Infrastructure AEPs.

13. **Operator:** Any person required to interface and control vehicle platform sub-systems.
14. **Power Management:** The means of prioritizing and controlling the electrical power loads throughout the vehicle platform.
15. **Scalable**: The trait of a system in being able to scale in order to handle increased loads of work.
16. **Soft Switching:** The ability to control or operate a sub-system using software functionality.
17. **Sub-System:** Separable elements or collections of equipment or software added to a base vehicle that provides operationally required capabilities over and above those delivered by the base vehicle.
18. **System:** A combination, with defined boundaries, of elements that are used together in a defined operating environment to perform a given task or achieve a specific purpose. The elements may include personnel, procedures, materials, tools, products, facilities, services and/or data as appropriate.
19. **Vehicle Crew:** All personnel located in the vehicle platform with defined roles needed to fulfil the necessary operational functions.
20. **Vehicle Platform**: The vehicle and all its integrated sub-systems.
21. **Vehicle Users:** The individuals and groups of people who interact locally to operate, support, sustain, maintain or otherwise interface directly with the Vehicle Platform and its sub-systems. It includes Service personnel, Reserve personnel, and Civilian employees, and may include personnel under other service supply contracts.

A complete list of the terms and definitions is available in Annex B.

CHAPTER 3 NATO GENERIC VEHICLE ARCHITECTURE APPROACH

This AEP describes the NATO Generic Vehicle Architecture (NGVA) approach offering justification of the NGVA concept through Key Drivers and Scenarios, and highlighting the benefits of this approach. Furthermore, the Standard management, development and structure are explained with a basic architecture design that follows some basic principles in terms of modularity and openness. Finally, some guidance is provided in defining User and System requirements within the acquisition process.

3.1. Justification

3.1.1. NGVA Key Drivers

The role of a military vehicle has evolved dramatically over the last few years. It is envisaged that near future missions will focus on the need for an agile platform that is rapidly deployable, mission configurable, highly survivable, and cost effective. The Vehicle Architecture will provide the necessary enablers to a fully integrated platform where even future capabilities can also be incorporated with minimum integration effort. Standardization and international cooperation between allied nations (NATO and EU) is seen as crucial to this vision. It is fundamental to understanding this architecture that the goal has been to achieve inter-changeability of components and subsystems between Allied platforms as well as to achieve data, video, and tactical information interoperability. While certain Volumes in this Standard make great strides to achieving both the inter-changeability and interoperability goals, further work is needed to enable seamless technical and operational collaboration. The missing links to achieving the ultimate goal of the architecture will be the work ahead for Volumes III, IV, and V. Other volumes, not yet written, but in draft stages (HUMS, Security, Effectors) will further enhance understanding both the requirements and implementing the provided guidance.

The key drivers for standardization and international cooperation currently materialized through NGVA are:

1. Agile and adaptive to the mission platforms
2. Innovation and faster technology insertion and exchangeability of components
3. System of Systems interoperability
4. Reduce integration risks and deployment time
5. Reduce through life costs
6. Reduce complexity (for all actors – user through to maintainer)

To realize the importance of these key drivers it is necessary to present a recognized view of the “Nature of Future Conflicts” and the “Implications” on the overarching requirement for NGVA.

3.1.2. The Nature of Future Conflicts

Predicting the next conflict is, and has always been, difficult. Global trends indicate increasing instability and growing opportunity for confrontation and conflict. State failure, extremists, increased competition for resources and the changing global balance of power will dictate why, where and how conflict occurs. In essence, the character of conflict will continue to evolve. Though it is impossible to accurately predict the exact character of the future conflict, in many future operations the armed forces are likely to face a range of simultaneous threats and adversaries in an anarchic and extended operating area.

One term often used to describe the character of future conflict is hybrid. This doesn't necessarily mean insurgency or stabilization. It's more correct to interpret hybrid as a change in mind-set of potential adversaries, who are aiming to exploit our weaknesses using a wide variety of high-end and low-end asymmetric techniques. If we have a very long acquisition process for new vehicles and related technology, it will allow an agile opponent to identify and attack vulnerable points in our armed forces. It is therefore important to be able to be more agile in acquiring new capabilities, allowing us to commit to a certain technology program at the last sensible moment, when the threat is clearer. This will lessen the risk of investing in the wrong technology, but still assure the right capability for the emerging conflict.

Another trend is that armies in most or all member nations are decreasing in size. The reason for the reduction in numbers is of course increasing costs of military equipment, at the same time as budgets are being reduced. So buying the right equipment at the right time is a good starting point in reducing costs. Getting the best price by creating more competition between industry suppliers will also be necessary. Reducing the total life cycle costs is just as important, as initial investment may only be a small part of the total cost. Again, competition for maintenance contract and upgrade programs will contribute towards reducing total cost.

The reduced defense budgets in the NATO countries mean that a smaller force, albeit international or coalition, will be required to carry out missions across the whole spectrum of operations and in a variety of environments. This can include conventional, full-scale war between nations, hybrid warfare with less clearly defined character, counter insurgency operations (COIN) and peacekeeping or peace supporting operations across the globe. To cope with this, our forces not only need equipment that can be readily adapted to the conflict at hand, but also personnel that will have the necessary skills level to handle the equipment and the opponent at hand. One may argue that the proficiency of our personnel will be our edge in future conflict, as opposed to technology in the past, because potential opponents have shown themselves to be very adept at putting military and consumer technology to use at a far higher pace than NATO forces. Accepting this premise means prioritizing the development of basic skills and mental agility that enables our personnel to adopt new equipment and procedures as dictated by the imminent threat. Reduced investment costs will help ensure that sufficient funds are available for training. But it will also be necessary to reduce the cost of that education and training. Even more use of simulators and embedded training will be one step towards better and cheaper training. One other approach is to reduce the burden of training by requiring new equipment to be as easy and intuitive to operate as possible. Commonality in parts, procedures and interfaces between different platforms and systems could further help the crews to reach the desired skills levels.

From this we may conclude that it is very hard to identify future scenarios, which will allow us to tailor our forces and materiel accordingly. On one hand is the less likely, but most dangerous scenario, of interstate warfare with a highly capable opponent. On the other hand is the more likely scenario of a conflict of a different, hybrid nature. Both scenarios will have to be taken into account. But whereas one can derive defined requirements from the first scenario, it is very hard to do so with the second scenario. The nature of the threat can be anything from guided antitank missiles and air power to homemade explosives and small arms fire, and may not reveal itself until conflict is imminent. Finding ways to speed up acquisition processes, reduce investment and running costs, prioritize cost effective training and develop an agile mind-set throughout the whole defense organization will be necessary to cope with an unpredictable future conflict.

The unpredictability of future conflicts and financial constraints imply for a need of a very agile allied force. In essence, strategically there is a need for:

1. taking advantage of rapid development of new technology and rapidly fielding new equipment gaining technological advantage of potential adversaries in preparation of future conflict,
2. taking advantage of increasingly rapid development of new technology and rapidly fielding new equipment gaining technological advantage of potential adversaries in preparation of future conflict,
3. responding to a newly emerging threat in a conflict area by rapidly enhancing or fielding new capabilities negating the opponents advantage before substantial losses are incurred,
4. addition of subsystem(s) already in the nations inventory to a vehicle platform, which is normally not fitted to the vehicle of the force tasked with a particular mission,
5. transferring a unit of personnel from their primary vehicle platform to a different vehicle more suited for the mission, possibly transferring subsystems with them to the new platform

3.1.3. NGVA Approach Benefits

Considering the above strategic needs the following have been identified as direct implications/benefits following the NGVA approach:

1. **Reduced platform integration time & cost;** the adoption of an "Open Systems" approach has been shown to reduce integration risk and decrease the required time, and therefore cost, to implement changes.
2. **Improved sub-system integration;** a NGVA compliant data and electrical power infrastructure, along with a NGVA HMI enabling process to improve communication between and control of sub-systems.
3. **Inherent modularity and scalability;** through the use of middleware and open interface specifications.

4. **Better obsolescence management, more 3rd party options;** a potentially broader supply base for replacement components and sub-systems.
5. **Reduced user burden** (crew, maintainer, trainer etc.); coherent control mechanisms for the whole platform.
6. **Integration with future training and simulation architectures;** a further potential advantage will be the future use of the NGVA as an integral part of vehicle simulated training.
7. **Enabler for automated collection of "System data";** to support Fleet management and to optimize maintenance, logistics, and support.
8. **Flexibility of Design;** the NGVA approach allows designers to identify and use COTS and MOTS technology options earlier in the lifecycle.

3.2. NGVA Basic Principles

Based on the justification given above, there are nine basic principles involved with adopting a NGVA approach that must be considered. Adoption will need a balanced view across all the principles on a platform-by-platform basis to realize maximum benefit. These principles are listed below and are not necessarily in a priority order:

1. Take account of previous investment;
2. Be applicable to current and future systems;
3. Use open, modular and scalable architectures and systems;
4. Facilitate technology insertion (upgrade, update, replace, repair, remove and addition);
5. Not needlessly implement in hardware any functionality that can be implemented in software;
6. Take a "whole platform" systems view, through life (including cost);
7. Be done in conjunction with industry and all relevant military stakeholders;
8. Be owned and maintained by the military organization(s) (or in this case, NATO);
9. Specify the minimum necessary to achieve desired benefits avoiding unnecessary constraint in implementation.

3.2.1. Open Modular Systems Architecture

In order to meet the NGVA basic principles, an open modular architecture is followed defined by:

1. Modularity;
2. Scalability;
3. Availability;
4. Open standards.

That in turn offers:

1. Accessibility and effective management of Intellectual Property;
2. Efficient contracting processes;
3. Effective governance;
4. Prudent re-use of legacy assets.

The architecture of a system is an expression of its structure i.e. how it is brought together, often at a high level of abstraction. For open systems, the architecture needs to be modular. This allows the designers to convince themselves and their stakeholders that the solution represented by the architecture is capable of achieving its capability objectives, through-life, and crucially, with the potential for a wide range of prospective evolutions of the base product designed-in from the start.

Realistically, open systems need to interface or interoperate with legacy modules. Developing architectures that support opened infrastructures and opened interfaces to legacy components is fundamental to a transition to an open system architecture, and the interfaces must be published in sufficient detail to enable change and evolution through the introduction or replacement of modules by any supplier.
In essence, an open system is a modular construction that has been designed in such a way that its modules have precisely defined and publicly owned interfaces. These allow independent suppliers (i.e. third parties) to provide new or improved capability by providing plug-compatible modules. An open system therefore adds commercial flexibility to the operational and technical flexibility enabled by modularity. This is essential to achieve value and innovation in procurement.

A module in an open system can also be regarded as a procurable element of a system, since there is little sense, from an open systems perspective, in understanding the subdivisions of a system at a level below that which can be exchanged or procured.

It is not essential that all the components of an open system are open, indeed it would be impossible to realize this ideal in most commercial scenarios due to the Intellectual Property they contain. Instead the openness refers to the interfaces to modules, which must be comprehensive in coverage and efficient in definition so that producing plug-compatible modules is both practical and economically sensible.

Open standards are enablers of modularity and availability in the form of publicly available documents that contain implementable specifications for interfaces, services, protocols or data formats, which have been established by consensus. The openness refers to the fact that it is not technology, product or vendor specific and its use and exploitation is available to all interested organizations if not for free, then at least for the payment of some nominal sum or participation license.

Open standards are the cornerstone of an open architecture. Their use reduces the risks associated with integration and interoperability with new systems and components (COTS and MOTS). In some cases, an interface may be so specialist or niche that no open standards have been created that can be exploited and so new standards are needed. Provided these new standards do not become proprietary, and provided there is willingness to make them available to any interested parties, openness can still be achieved. Finally, an endeavour to make these new standards as generic as possible (so they can be exploited across many domains) could mean they become the open standards of the future.

3.2.2. NGVA Architecture Basics

STANAG 4754 does not mandate a specific Architecture design, as that design will vary according to the specific requirements of the vehicle platform and its role. But it does provide some design constraints (rules) for the electronic and electrical infrastructure. It is based on established systems engineering principles that emphasize the need to take a whole systems and whole life view. It mandates the use of open standards for physical, electrical and data interfaces for interoperability within the platform taking into account safety and verification and validation concepts. This supports a full spectrum of vehicle platform functionality, from simple, low cost, low functionality vehicle platforms at one end, to highly sophisticated vehicle platforms with integrated survivability, surveillance and offensive functionality at the other. The STANAG is intended to be sufficient to allow sub-systems to interoperate as required but still allow a manufacturer to propose innovative implementations to the procurement agency.

Sub-systems are integrated into a vehicle platform through the NGVA platform infrastructure which consists of a data infrastructure, a power infrastructure and the NGVA Data Model used to define a data dictionary, common topics and data types to be used in all messaging across the infrastructure. This makes compliant sub-systems and enables through a coherent development process crew stations to be interoperable and platforms to be re-rolled more easily or upgraded when required.

In order to design an NGVA compatible system, specific requirements need to be formulated. This can be achieved by following a process where key sub-systems, crew roles, platform variants are identified and mapped to system functions, which lead first to a candidate architecture, to a logical architecture and then to a physical architecture to be implemented.

The requirement from the logical architecture and the parametric constraints determines the overall setup of the NGVA system including a suitable network topology, for example:

1. segregation between real-time and non-real-time data by using different networks or VLANs,
2. separate networks for high volume streaming data.

It is important to consider and allow for future additions to the architecture and capacity growth by designing in reserves, which will enable flexibility and innovation.

Vehicle platform level assessment requires the consideration of:

1. real time performance;
2. vehicle safety;
3. security issues.

Overall performance and safe operation of the vehicle platform is paramount. A system level assessment is needed to provide the parameters for a level of performance that the infrastructure must provide in terms of both, static capacity and dynamic loading and throughput. The assessment must take into account the role and needs of the vehicle platform and consider future capability enhancement.

The system integrator must ensure the reliable, smooth and quick start-up time of the important sub-systems in accordance with specific vehicle requirements and may need to tune the NGVA network by using QoS, Bandwidth Control, Traffic Shaping and use of VLANs as measures to achieve the desired performance.

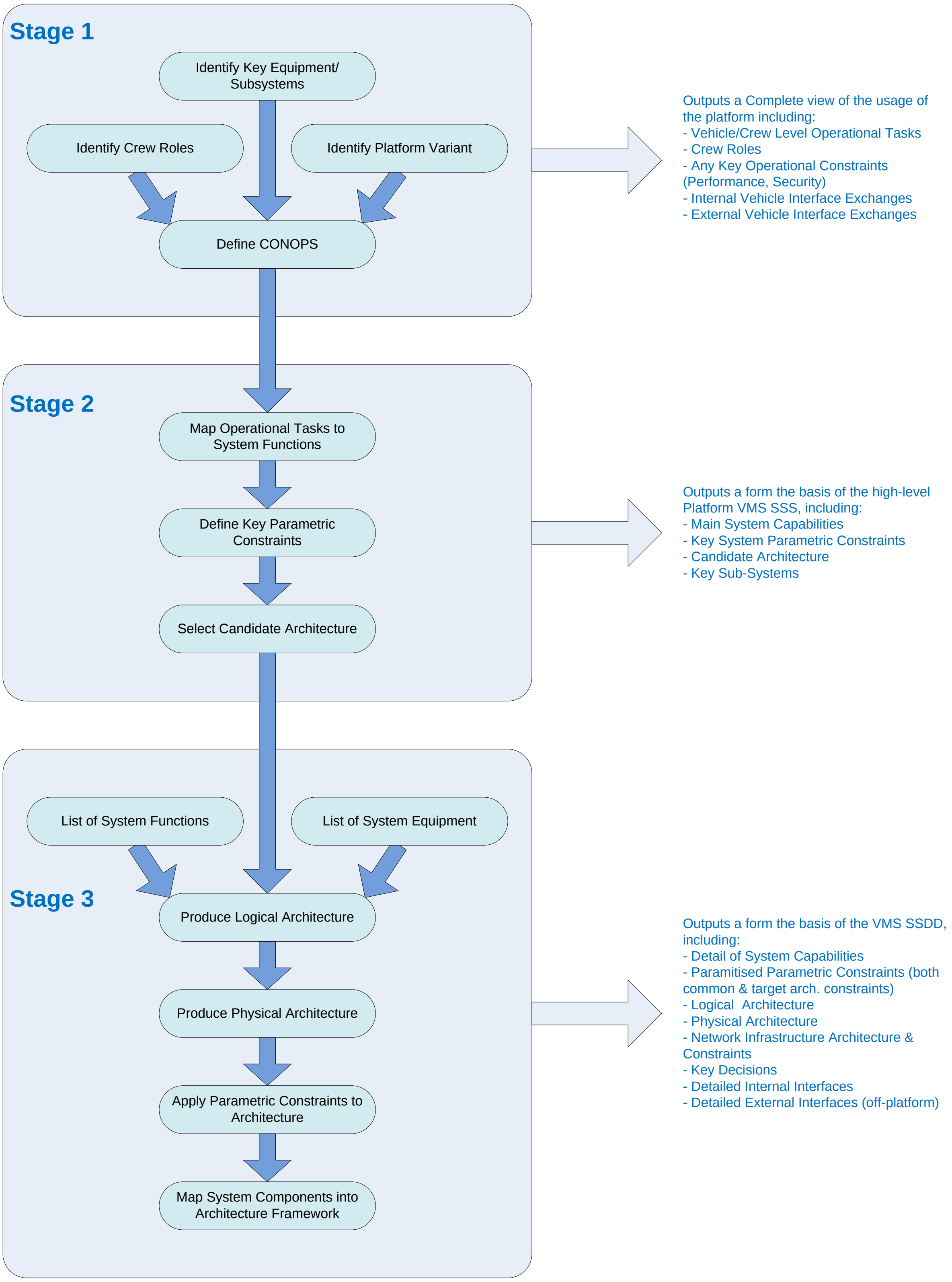

Figure 2: Example of Design Stages (Concept of Operations – CONOPS, Vehicle Mission System - VMS, System / Segment Design Description - SSDD, System / Subsystem Specification – SSS)

3.3. Standard AEP-4754 Structure

Following the NGVA Approach, it was decided that Standard AEP-4754 should be divided into the following Volumes:

1. Volume I: NGVA Architecture Approach
2. Volume II: NGVA Power Infrastructure
3. Volume III: NGVA Data Infrastructure
4. Volume IV: NGVA Crew Terminal Software Architecture
5. Volume V: NGVA Data Model
6. Volume VI: NGVA Safety
7. Volume VII: NGVA Verification and Validation

3.3.1. Volume I: NGVA Architecture Approach

This Volume describes the NATO Generic Vehicle Architecture (NGVA) approach offering justification of the NGVA concept through Key Drivers and Scenarios, and highlighting the benefits of this approach. Furthermore, the Standard management, development and structure are explained with a basic architecture design that follows some basic principles in terms of modularity and openness. Finally, some guidance is provided in defining User and System requirements within the acquisition process.

3.3.2. Volume II: NGVA Power Infrastructure

This Volume defines the power interfaces which form the NGVA Power Infrastructure, including the physical cable connectors and other components that provide the means of distributing and controlling electrical power throughout a vehicle platform. That means internal and external power supply or distribution. This will ensure that equipment compatible with the requirements defined in this section can be readily installed and used with minimal changes to the vehicle platform.

3.3.3. Volume III: NGVA Data Infrastructure

This Volume defines the design constraints on the electronic interfaces and protocols that form the NGVA Data Infrastructure which consists of a data network including cables, plugs, the packet layer up to data exchange middleware and network devices with their provided network services which are used for the interconnection of mission or automotive sub-systems inside the vehicle. Gateways shall be used for data connections outside the vehicle and for legacy systems. Defining and standardizing these common elements enables interoperability between platform sub-systems and also reduces the time taken to integrate new sub-systems. The aim however, is to constrain design options as little as possible to allow for flexibility and innovation.

3.3.4. Volume IV: NGVA Crew Terminal Software Architecture

The “Crew Terminal Software Architecture” defines the following building blocks for NGVA-conformant Crew Terminal Software Applications. According to the type of requirements (CR, OE) the system designer/integrator has to decide how to take them into account.

1. CT Software Design Principles (Architecture & Ergonomics)
2. CT Software Execution Environment
3. CT DDS Backbone for Inter-process Communication
4. Human Input Devices (HID)
5. CT Output Devices
6. CT Power Modes
7. CT Light Modes

3.3.5. Volume V: NGVA Data Model

The NGVA Data Model is the expression of the system information needs for a NATO land vehicle, stated in a technology independent way, and provides the means to automatically generate technology specific data interfaces for vehicle subsystems. The data interfaces created can then be added to subsystem software applications embedded on a vehicle platform that supports standardized data distribution over an Ethernet network. The NGVA Data Model is a set of jointly developed agreed upon modules that have achieved the desired level of maturity to be part of a given Version of the Standard.

The NGVA Data Model defines the data structure and format to be used by sub-systems and components communicating via Data Distribution Service (DDS) middleware installed on a compliant land platform.

The components on each NGVA compliant platform will implement all the modules or a subset of the Data Model modules as appropriate to its requirements.

3.3.6. Volume VI: NGVA Safety

This Volume outlines the generic procedures to incorporate system safety related planning, development, implementation, commissioning and activities in systems engineering. The AEP presents series of tasks to identify safety requirements, perform hazard analysis, safety reviews. Guidance on Safety management plan, independent safety audits and safety risk analysis are described. Safety Integrity Levels and its failure modes for NGVA compliant systems and sub-systems are described and guidance on certification and safety case development is presented.

3.3.7. Volume VII: NGVA Verification and Validation

This Volume provides guidance for the verification and validation of NGVA systems regarding their conformity to the AEPs associated with the STANAG. Based on the definition of common terminology, including verification methods and tools, this AEP outlines a generic conformity assessment procedure that is applicable to all AEPs. The AEP will use open standards as preferred references. However, this AEP-yy will also consider other industrial standardization documents (ISO, IEEE, etc.) as references to maintain continuity with previous efforts and widely-agreed approaches.

3.4. NGVA Management and Responsibilities

The NGVA has been developed under the auspices of MILVA (Military Vehicles Association). The NGVA as a conceptual approach will be evolve continuously and be revised according to the inputs from allied nations and custodian inputs, and is going to be revised accordingly. It is important to note that the NGVA as an open standard has been developed not only for the benefit of NATO Nations but for the potential use by other nations and organizations worldwide. Hence, communication and coherence with developments within organizations such as the European Defence Agency (EDA) are important for the NGVA to have a more positive effect and progress.

Furthermore, the NGVA development relies on distinctive and specialized fundamental and applied research so innovative ideas can be nurtured. This will ensure that NGVA always represents state-of-the-art capability insertion approach. To enable a coherent approach to the underpinning research, Multi-national Research Centres of excellence (MNRC) involving Government, Industry and Academia are planned to be hosted in different Allied nations offering direct and independent communication, sharing and knowledge transfer across multi-national research communities.

Figure 3 presents the management and development structure of NGVA and way forward.

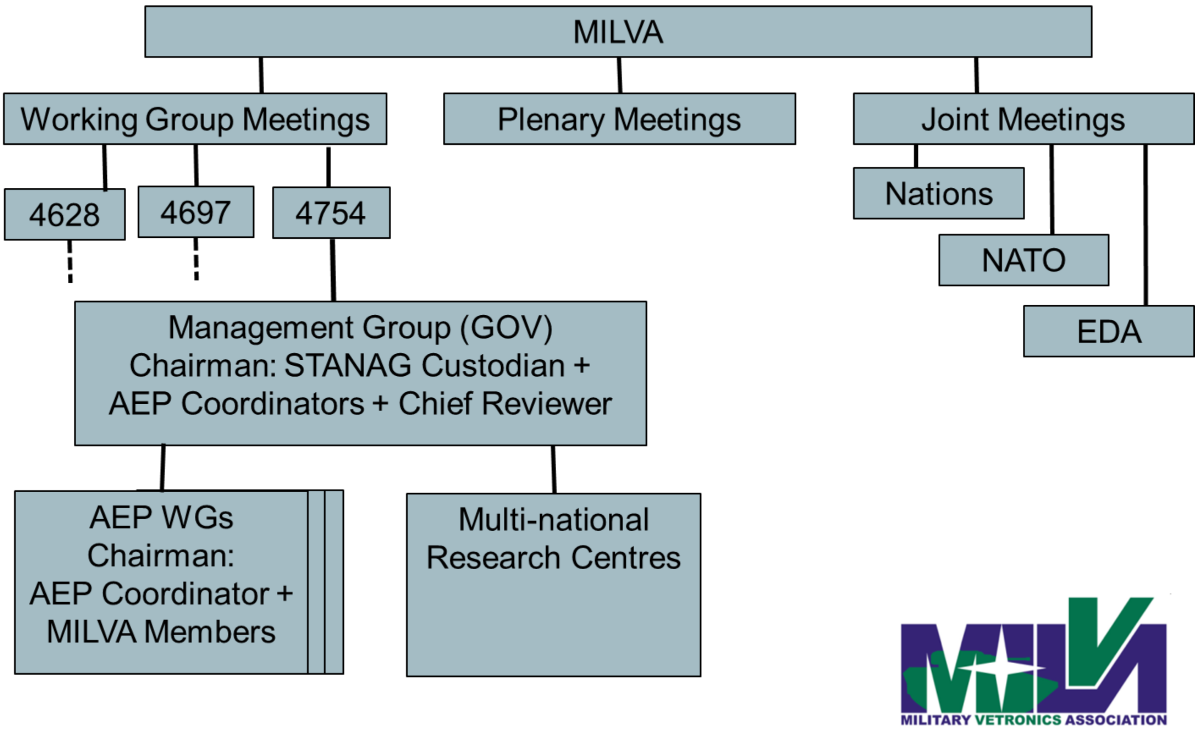

Figure 3: Management and development structure of NGVA

The responsibilities for each element within the management structure are as follows:

1. The STANAG Custodian is the German MOD that chairs also MILVA that as an organization is used to provide a communication pathway between different Nations and a vessel for promoting standardization. A very important MILVA activity is STANAG development and dissemination through Joint meetings.
2. Management Group with different Nations Government representatives, the STANAG Chief Reviewer and AEP Coordinators are responsible for the STANAG coherent management, development and publication.
3. AEP Working Groups (WG) are responsible for the individual AEP development and maintenance.
4. MNRCs are responsible in filtering and transferring research knowledge and understanding beneficial to NGVA and hence, provide recommendations in developing further existing AEPs as well as creating new ones.

3.5. STANAG Users Responsibilities

In order to implement the NGVA Approach across different Nations there are a number of responsibilities that need to be adopted by those delivering vehicle systems.

The individual nation government delivery teams shall define the appropriate functional and non-functional requirements to ensure that the delivered vehicle platform meets the requirements of STANAG 4754 and individual AEPs.

The individual Nation Government delivery team shall be responsible for ensuring the successful integration of all sub-systems onto the vehicle platform.

The individual Nation Government delivery team in communication with Industry shall take a whole vehicle platform system view when defining platform specific NGVA requirements using STANAG 4754 and associated AEPs. This includes all the on-board sub-systems, one of which is the automotive sub-system. This whole vehicle platform system view shall include through-life issues such as maintenance, configuration control, safety certification, repair, technology insertion, disposal and cost.

3.5.1. User and System Requirements Guidance

As **guidance**, in order that NGVA is afforded the level of consideration, every vehicle platform should include the following Key User Requirement and Key System Requirement (KSR):

KUR: The User (Capability) requires the implementation of the vehicle platform to standardize the approach according to STANAG 4754/AEP-4754

KSR: The system shall have …………………………… that conforms to STANAG 4754/AEP-4754

As further **guidance**, the KUR should have the following:

1. **Owner** (Individual Nation Government delivery team)
2. **Measure of Effectiveness** (for example: “The ability for a 3rd party integrator to be able to rapidly reconfigure, and electronically integrate new sub-systems and components, onto the vehicle platform.”)
3. **Justification** (for example: “Open Systems are seen as a way to achieve the level of agility and freedom of action that will be required by Army 2020. The NGVA Approach as described in STANAG 4754 is based on open systems architectures and technical standards and as such has been mandated to be applied to all new vehicle projects, upgrades and equipment updates.”)
4. **Validation Criteria** (for example: “Trials, tests, inspections and reviews to ensure sufficient context and design information, free from commercial and other constraints, exists to allow a 3rd party to integrate new equipment and software functions onto the vehicle platform. Ensure any ITAR restrictions do not compromise to openness and ability to integrate new components. The Authority who must be satisfied with NGVA STANAG conformance is the individual Nation Government delivery team.”)
5. **Priority** as Mandatory
6. **Remarks** (“Given the Defence-wide implications of non-compliance, any trading of this requirement needs to be agreed with the Nation Government delivery team and associated sponsor.”)

Each acquisition project should have a detailed and staged process that should be **guided** by:

1. **Project Start-up** that will define the NGVA tailored approach for the specific project.
2. **Detailed Requirements** are to be selected and agreed by the Nation Project Delivery Team.
3. **Progressive Acceptance** should be followed for each stage of the project implementation to assure verification and validation.

Each NGVA related requirement could have a priority assigned to it that would indicate the importance of compliance so as to aid the tailoring process. As guidance the following priorities are given:

1. Mandatory – Normally legislative or safety or security related requirement that must be met based on National guidelines.
2. Key – is Compulsory Requirement (CR) that is an essential requirement for NGVA compliance.
3. Priority 1 – is considered as Optional Enhancement (OE) that is normally important but negotiable with the National Government delivery team.
4. Priority 2 – Desirable requirement considered as system specific.

INTENTIONALLY BLANK

ANNEX A ABBREVIATIONS

AAC	Advanced Audio Coding
AEP	Allied Engineering Publication
ALARP	As Low As Reasonably Practicable
BIT	Built in Test
CI	Configuration Item
CM	Configuration Management
COIN	Counter Insurgency Operations
CONOPS	Concept of Operations
COTS	Commercial Off The Shelf
CR	Compulsory Requirement
DC	Direct Current
DDS	Data Distribution Service
DDSI	Data Distribution Service Interoperability
Def Stan	Defense Standard
DM	Data Model
ECM	Electronic Counter Measures
EDA	European Defense Agency
EMC	Electro-Magnetic Compatibility
EU	European Union
GPS	Global Positioning System
GVA	Generic Vehicle Architecture
HID	Human Interface Device
HUMS	Health and Usage Monitoring System
IDL	Interface Definition Language
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISO	International Standards Organization
ITT	Invitation to Tender
IV&V	Independent Verification and Validation
KSR	Key System Requirement
KUR	Key User Requirement
LAN	Local Area Network
LRU	Line Replacement Unit
MDA	Model Driven Architecture
MILVA	Military Vetronics Association
MNRC	Multi-national Research Centers
MOD	Ministry of Defense
MOTS	Military Off-The-Shelf
N/C	Not Connected
NAAG	National Army Armament Group
NATO	North Atlantic Treaty Organization
NGPOC	NGVA Point of Contact
NGVA	NATO Generic Vehicle Architecture
NSA	NATO Standardization Agency
NSO	NATO Standardization Office

NTA	Network Technical Authority
OE	Optional Enhancement
OMG	Object Management Group
PCM	Pulse-Code Modulation
PDT	Power Distribution Terminal
PE	Platform Equipment
PIM	Platform Independent Model
PLEVID	Platform Level Video Distribution
PSM	Platform Specific Model
RFC	Request for Comments
RoHS	Restriction of Hazardous Substances
SA	Situational Awareness
SAE	Society of Automotive Engineers
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
SRD	System Requirement Document
SSDD	System/Subsystem Design Description
SSS	System/Subsystem Specification
TA	Technical Agreement
TE	Terminal Equipment
UML	Unified Modeling Language
USB	Universal Serial Bus
VMS	Vehicle Mission System
VOX	Voice Operated Transmission
VSI	Vehicle Systems Integration Standards & Guidelines
WG	Working Group(s)
XTypes	Extensible Types for Data Distribution Service (DDS)

ANNEX B TERMS AND DEFINITIONS

1. **Accreditation Body**: Authoritative body that performs accreditation. [ISO/IEC 17000]. NOTE: The authority of an accreditation body is generally derived from government. [ISO/IEC 17000]
2. **Accreditation**: Third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks. [ISO/IEC 17000]
3. **ALARP**: As Low As Reasonably Practicable. A risk is ALARP when it has been demonstrated that the cost of any further Risk Reduction, where the cost includes the loss of defense capability as well as financial or other resource costs, is grossly disproportionate to the benefit obtained from that Risk Reduction. [Def Stan 00-56 Issue 4]
4. **Analysis**: The processing of accumulated data obtained from qualification methods. Examples are reduction, interpolation, or extrapolation of test results. [MIL-STD 498 SSS]
5. **Attestation**: Issue of a statement, based on a decision following review, that fulfillment of specified requirements has been demonstrated. [ISO/IEC 17000]
6. **Audio Data**: Data used for real-time audio distribution which may be generated by audio sensors but also includes digital voice communication data.
7. **Audit**: An examination of implemented process.
8. **Automotive Data**: Data related to the pure automotive capability which may be distributed on an automotive bus based network which lies outside of but needs to be interfaced to the NGVA infrastructure via an Automobile Network Gateway.
9. **Automotive Network Gateway**: A component that provides a controlled data bridge between an Automotive Bus Based Network and the NGVA Infrastructure.
10. **Auxiliary Electrical Power Device**: Auxiliary electrical power devices are all units that are able to provide auxiliary electrical power to the vehicle network. For example Diesel-Engine driven generators, Fuel Cells, Photovoltaic Cells.
11. **Base Vehicle**: The basic vehicle structure and those systems needed to enable it to perform its automotive functions and mobility. Where fitted it also includes those systems needed to control turrets and other physical elements e.g. a mine plough.
12. **Base Vehicle Equipment**: Automotive equipment for a vehicle family.
13. **Base Vehicle Sub-System**: A system that forms part of the base vehicle.
14. **Certification (Safety Case):** Process and declaration of the acceptance of a safety case by a Certification authority.
15. **Certification**: Third-party attestation related to products, processes, systems or persons. [ISO/IEC 17000]. NOTE: Certification is applicable to all objects of conformity assessment except for conformity assessment bodies themselves, to which accreditation is applicable. [ISO/IEC 17000]
16. **Class**: A Class is an element of a Class Diagram; one of the diagram types that form UML.
17. **Conformity**: Fulfillment of a requirement. [ISO 9000:2005]. NOTE: The term “conformance” is synonymous but deprecated. [ISO 9000:2005]

18. **Conformity Assessment Body**: Body that performs conformity assessment services. [ISO/IEC 17000]. NOTE: An accreditation body is not a conformity assessment body. [ISO/IEC 17000]
19. **Conformity Assessment**: [Objective evidence] that specified requirements relating to a product, process, system, person or body are fulfilled. [Adapted from ISO/IEC 17000]. NOTE: The subject field of conformity assessment includes activities such as demonstration, test, analysis, inspection and certification, as well as the accreditation of conformity assessment bodies. [Adapted from ISO/IEC 17000]
20. **CI:** A Configuration Item (CI) is a component of a system that is treated as a self-contained unit for the purposes of identification and change control. All CIs are uniquely identified by CI version numbers. A CI may be a primitive system building block (e.g. code module) or an aggregate of other CIs (e.g. a sub-system is an aggregate of software units).
21. **DDS:** Data Distribution Service is a type of middleware that uses the Publish/Subscribe paradigm. It is governed by the Object Management Group (OMG).
22. **DDS User Data:** Application data transmitted by the DDS Middleware as opposed to the data which is used for DDS middleware operation and administration.
23. **Demonstration**: The operation of the system, or a part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis. [MIL-STD 498 SSS]
24. **Downgraded mode:** Degraded mode of operation that is actively entered by a system or subsystem in response to a detected error, in order to reduce the effects of the error. Degradation can include reduced functionality, reduced performance, or both in order to permit survivability capabilities.
25. **Electronic Architecture**: The combination of the electronic based sub-systems and electronic infrastructure that supports the vehicle crew to undertake their operational tasks.
26. **Error:** An error is a deviation from the required operation of the system or sub-system.
27. **External Gateway**: A component which provides data services from the vehicle NGVA Infrastructure to the outside world (e.g. other vehicles, dismounted soldiers, etc.) or which consumes external data services.
28. **Fault:** A defect within a system
29. **Gateway to Legacy Systems**: A component which enables data connections to or from legacy systems which do not provide an NGVA data interface.
30. **Hard Switching:** The ability to control or operate a sub-system using physically based means.
31. **Hazard:** A hazard is a situation in which there is actual or potential danger to people or to the environment.
32. **Hazard Analysis**: The process of describing in detail the hazards and accidents associated with a system, and defining accident sequences. [Def Stan 00-56 Issue 4]
33. **Hazard Identification:** The process of identifying and listing the hazards and accidents associated with a system. [Def Stan 00-56 Issue 4]

34. **Hazard Log:** The continually updated record of the hazards, accident sequences and accidents associated with a system. It includes information documenting risk management for each hazard and accident. [Def Stan 00-56 Issue 4].
35. **IDL:** Interface Definition Language is a specification language used to describe a software component's interface.
36. **Independent Safety Auditor:** An individual or team, from an independent organization, that undertakes audits and other assessment activities to provide assurance that safety activities comply with planned arrangements, are implemented effectively and are suitable to achieve objectives; and whether related outputs are correct, valid and fit for purpose. [Def Stan 00-56 Issue 4]
37. **Independent Verification and Validation (IV&V):** V&V performed by an organization that is technically, managerially, and financially independent of the development organization. [IEEE 1012]
38. **Inspection**: The [physical] examination of system components, documentation, etc. [adapted from MIL-STD 498 SSS]
39. **Life Cycle:** All phases of the system's life, including design, research, development, test and evaluation, production, deployment (inventory), operations and support, and disposal. [MIL-STD-882E].
40. **Measure of Effectiveness:** A description of how effective a solution candidate is for a particular assessment criterion.
41. **Measure of Performance:** A statement that describes the assessment criterion or criteria needed to satisfy a given requirement.
42. **Middleware**: Software that acts to abstract application software from the hardware/software infrastructure.
43. **Mission Equipment**: Equipment that is fitted to the vehicle to perform its mission. This equipment can be permanent or temporary installed to the vehicle using the NGVA power infrastructure.
44. **Mitigation Strategy:** A measure that, when implemented, reduces risk. [Def Stan 00-56 Issue 4]
45. **Mode:** A designated system condition or status (e.g., maintenance, test, operation, storage, transport, and demilitarization). [MIL-STD-882E].
46. **Model Driven Architecture**: MDA is an open specification for software generation management by the Object Management Group (OMG). For more details on MDA see the OMG FAQs (http://www.omg.org/mda/faq_mda.htm).
47. **Modular**: A modular architecture is designed in such a way as to allow the replacement or addition of sub-systems and upgrades as required without any undesirable emerging properties.
48. **NATO Generic Vehicle Architecture (NGVA):** The term 'NATO Generic Vehicle Architecture' refers to the open, modular and scalable architectural approach applied to the design of vehicle platforms.
49. **NGVA Compliant:** NGVA Compliance applies to the whole vehicle platform and means that any sub-system existing on the platform complies with the requirements defined in STANAG 4754 and associated AEPs.
50. **NGVA Data Model**: A NATO specific release of the Data Model formed from modules contained within the Subversion repository.
51. **NGVA Electronic Infrastructure:** The physical cables and connectors that provide means of distributing data around a base vehicle. It also includes any

enabling logical components and functions e.g. Core platform management software, interface software, transport protocols and message definitions.

52. **NGVA Power Infrastructure:** The physical cables, connectors and other components that provide the means of distributing and controlling electrical power around a vehicle platform.
53. **NGVA Ready**: NGVA Ready applies at a sub-system level and means that sub-systems and components have been developed to a level where they can be efficiently integrated within a "NGVA Compliant" whole vehicle Electronics. This would mean passing an incremental process with three sequentially-related levels:
    a. **Connectivity Compatibility**: Ensures that the (sub-) system can be physically integrated into the NGVA architecture without any negative impacts to existing NGVA components. Physical power and network interfaces comply with the requirements of AEP-yy and AEP-yy.
    b. **Communication Compatibility**: Connectivity Readiness and data interfaces (DDS) with associated NGVA Data Model implementation that comply with the requirements of AEP-yy.
54. **Objective evidence**: Data supporting the existence or verity of something. [ISO 9000:2005]. NOTE Objective evidence may be obtained through Demonstration, Test, Analysis, Inspection, or Special qualification methods.
55. **Operator:** Any person required to interface and control vehicle platform sub-systems.
56. **PIM**: A Platform Independent Model is a UML model which is independent of any software platform.
57. **Power Management:** The means of prioritizing and controlling the electrical power loads throughout the vehicle platform.
58. **PSM**: A Platform Specific Model is a UML model which is includes information relating to a specific software platform.
59. **QoS:** DDS topics are assigned a Quality of Service on a per topic basis. The Quality of Service governs the way in which that topic is handled by a DDS system thereby allowing tuning of the overall system.
60. **Requirement**: Need or expectation that is stated, generally implied or obligatory. [ISO 9000:2005]
61. **Review**: Verification of the suitability, adequacy and effectiveness of selection and determination activities, and the results of these activities, with regard to fulfillment of specified requirements by an object of conformity assessment. [ISO/IEC 17000]
62. **Risk:** An assessment of the significance of a hazard based on a function of its probability of occurrence and an appropriate numerical indication of the severity of its consequences
63. **Risk Acceptance**: The systematic process by which relevant stakeholders agree that risks may be accepted. [Def Stan 00-56 Issue 4]
64. **Risk and ALARP Evaluation**: The systematic determination, on the basis of Tolerability Criteria, of whether a risk is broadly acceptable, tolerable or unacceptable, and whether it is ALARP or whether any further Risk Reduction is necessary. [Def Stan 00-56 Issue 4]

65. **Risk Estimation**: The systematic use of available information to estimate risk. [Def Stan 00-56 Issue 4]
66. **Risk level**: The characterization of risk. [MIL-STD-882E].
67. **Risk Management**: The systematic application of management policies, procedures, and practices to the tasks of **Hazard Identification**, **Hazard Analysis**, **Risk Estimation**, **Risk and ALARP Evaluation**, **Risk Reduction** and **Risk Acceptance**. [Def Stan 00-56 Issue 4].
68. **Risk Reduction**: The systematic process of reducing risk. [Def Stan 00-56 Issue 4]
69. **Safe:** Risk has been demonstrated to have been reduced to a level that is ALARP and broadly acceptable or tolerable, and relevant prescriptive safety requirements have been met, for a system in a given application in a given operating environment. [Def Stan 00-56 Issue 4]
70. **Safety**: The expectation that a system does not, under defined conditions, lead to a state in which human life or the environment is endangered. [Def Stan 00-56 Issue 2].
71. **Safety Audit:** A systematic and independent examination to determine whether safety activities comply with planned arrangements, are implemented effectively and are suitable to achieve objectives; and whether related outputs are correct, valid and fit for purpose.
72. **Safety Case:** A structured argument, supported by a body of evidence that provides a compelling, comprehensible and valid case that a system is safe for a given application in a given operating environment. (definition from Def Stan 00-56 Issue 4)
73. **Safety and Environmental Case Report:** A report that summarizes the arguments and evidence of the Safety Case, and documents progress against the safety program. [Def Stan 00-56 Issue 4]
74. **Safety Integrity:** The likelihood of a safety-related system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time.
75. **Safety Integrity Level:** A classification of the required level of safety integrity defining the processes that must be applied to the development of system.
76. **Scalable**: The trait of a system in being able to scale in order to handle increased loads of work.
77. **Severity:** The magnitude of potential consequences of a mishap to include: death, injury, occupational illness, damage to or loss of equipment or property, damage to the environment, or monetary loss. [MIL-STD-882E].
78. **Soft Switching:** The ability to control or operate a sub-system using software functionality.
79. **Special Qualification Methods**: Any special qualification methods for the system, such as special tools, techniques, procedures, facilities, acceptance limits, use of standard samples, preproduction or periodic production samples, pilot models, or pilot lots. [MIL-STD 498 SSS]
80. **Stakeholder**: Individual or organization having a right, share, claim, or interest in a system or in its possession of characteristics that meet their needs and expectations. [ISO/IEC/IEEE 15288]

81. **Sub-System:** Separable elements or collections of equipment or software added to a base vehicle that provides operationally required capabilities over and above those delivered by the base vehicle.
82. **Survivability:** Ability of a system to fulfill its mission in a timely manner in presence of attacks, failures, or accidents.
83. **System:** A combination, with defined boundaries, of elements that are used together in a defined operating environment to perform a given task or achieve a specific purpose. The elements may include personnel, procedures, materials, tools, products, facilities, services and/or data as appropriate.
84. **System Failure**: A system failure occurs when the system fails to perform its required function.
85. **System safety**: The application of engineering and management principles, criteria, and techniques to achieve acceptable risk within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system life-cycle. [MIL-STD-882E].
86. **System safety engineering**: An engineering discipline that employs specialized knowledge and skills in applying scientific and engineering principles, criteria, and techniques to identify hazards and then to eliminate the hazards or reduce the associated risks when the hazards cannot be eliminated. [MIL-STD-882E].
87. **Test**: The operation of the system, or a part of the system, using instrumentation or other special test equipment to collect data for later analysis. [MIL-STD 498 SSS]
88. **Third-party:** A person or body that is independent of the person or organization that provides the system, and of user interests in that system. [Adapted from ISO/IEC 17000]
89. **Topic:** A topic is a DDS data structure that has a name, a number of attributes and has an associated Quality of Service.
90. **UML**: Unified Modeling Language is an open specification for software modeling issued by the Object Management Group (OMG).
91. **Validation**: Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled. [ISO 9000:2005]. NOTE: Validation is the set of activities ensuring and gaining confidence that a system is able to accomplish its intended use, goals and objectives (i.e., meet stakeholder requirements) in the intended operational environment. [ISO/IEC/IEEE 15288]
92. **Vehicle Crew:** All personnel located in the vehicle platform with defined roles needed to fulfill the necessary operational functions.
93. **Vehicle Platform**: The vehicle and all its integrated sub-systems.
94. **Vehicle Users:** The individuals and groups of people who interact locally to operate, support, sustain, maintain or otherwise interface directly with the Vehicle Platform and its sub-systems. It includes Service personnel, Reserve personnel, and Civilian employees, and may include personnel under other service supply contracts.
95. **Verification**: Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. [ISO 9000:2005]. NOTE: Verification is a set of activities that compares a system or system element against the required

characteristics. This may include, but is not limited to, specified requirements, design description and the system itself. [ISO/IEC/IEEE 15288]

96. **Vetronics Data**: Data which is defined in the NGVA Data Model and distributed via the NGVA infrastructure (does also include HUMS data).
97. **Video Data**: Data used for real-time video distribution.
98. **Voice Communications / Voice Data:** Voice Communications describes the intercom systems inside a vehicle but also the communication outside the vehicle, e.g. to higher echelons, to other vehicles, or to dismounted soldiers. Voice Data is distributed for Voice Communications but specific requirements need to be fulfilled such as maximum latency and a suitable session management for the voice connections. Voice data is a subset of Audio Data and may be also raw or compressed using an audio codec.

AEP-4754(A)(1)
VOL I