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Generic Vehicle Architecture (GVA)

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FOREWORD

AMENDMENT RECORD

Amd No.	Date	Text Affected	Signature and Date

HISTORICAL RECORD

a) This Defence Standard (Def Stan) has been produced on behalf of the Ministry of Defence (MOD) by UK Defence Standardization (DStan).

b) This Def Stan has been agreed by the Authorities concerned with its use and is intended to be applied to all future Land vehicle designs, orders, contract action and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Def Stan, the GVA Office shall be informed through the project or delivery team concerned so that a remedy may be sought.

c) Please address any enquiries regarding this Def Stan, whether in relation to an Invitation to Tender (ITT) or to a contract in which it is incorporated, to the responsible technical or supervising authority named in the ITT or contract.

d) Compliance with this Def Stan shall not in itself relieve any person from any legal obligations imposed upon them.

e) This Def Stan has been devised solely for the use of the MOD and its contractors in the execution of contracts for the MOD. To the extent permitted by law, the MOD hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, liability resulting from negligence) for any loss or damage however caused when the Def Stan is used for any other purpose.

This Def Stan includes the technical aspects for Health and Usage Monitoring Systems (HUMS) and supersedes Def Stan 25-24 (Health and Usage Monitoring Capability for Land Platforms).

DEVELOPMENT OF DEF STAN 23-09

This Def Stan has been developed through the collaborative efforts of the MOD and industry, and builds on the extant Vehicle Systems Integration (VSI) and previous work including the Vehicle Technology Integration Demonstrator (VTID).

There are a number of areas in which further work is needed and future iterations of the Def Stan will be expanded to cover these areas as relevant technologies and processes develop to the appropriate level of maturity.

This Def Stan shall be reviewed, revised and re-released as necessary at 18 month intervals. Ongoing projects must assure that the GVA Office is consulted on methods of implementation, best practice and formally agree an appropriate implementation plan.

MOD Single Point of Contact:

GVA Point of Contact (GPOC), GVA Office, Director Land Equipment, Defence Equipment and Support, MOD Abbey Wood, Bristol BS34 8JH. E-mail: DESLE-DEFSTANS@mod.uk

0 Introduction

0.1 Purpose

The purpose of this Def Stan 23-09 is to enable the MOD to realise the benefits of an open architecture approach to Land platform design and integration, especially in regard to platform infrastructure and the associated Human Machine Interface (HMI) in order to improve operational effectiveness across all Defence Lines of Development (DLOD), reduce integration risks and reduce the cost of ownership across the fleet. This is achieved by mandating and applying the appropriate interface standards.

0.2 Application of the Standard

This Def Stan is owned, sponsored and managed by the Director Land Equipment (D LE), Defence Equipment and Support (DE&S), as the authority on behalf of the MOD and it is to be applied to all future land platform procurement and current platform refurbishment and upgrade programmes. This Def Stan shall be reviewed and reissued every 18 months to keep it in date as technology progresses and new standards are developed.

This Def Stan is applicable to the full spectrum of land platforms, ranging from simple to complex implementations. The requirements for these implementations are determined by the functionality required of the platform as a whole system that includes all sub-systems, and not the automotive or power elements alone. The requirements address both equipments to be fitted as part of the initial operating capability and those likely to be fitted through life. These requirements are expressed in the System Requirements Document (SRD).

It is important to understand where systems are not compliant with this Def Stan and why. Deviations from this Def Stan shall be agreed by the GVA Office in conjunction with the project or delivery team concerned. Instances of non-compliance shall be recorded in the project risk register.

0.3 Precedence

This Def Stan shall be considered the foundation standard for platform integration, and should any conflict arise between this and other extant documentation, this document shall take precedence.

0.4 Additional Information

A GVA Guide is available in parallel with this Def Stan to add background to the Def Stan and explain best practice to both MOD and Industry stakeholders. It should be read in conjunction with the Def Stan and is available from GPOC.

1 Scope

This Def Stan specifies the mandatory standards to be used in the design and implementation of Land platform electronic and power infrastructures, mechanical interfaces, HMI and Health & Usage Monitoring System (HUMS), together with requirements for Interface Control Documents (ICDs) and Verification and Validation (V&V).

2 Warning

The MOD, like its contractors, is subject to both United Kingdom and European laws regarding health and safety at work. Many Def Stans set out processes and procedures that could be injurious to health if adequate precautions are not taken. Adherence to those processes and procedures in no way absolves users from complying with legal requirements relating to health and safety at work.

3 Normative References

The documents and publications shown in Annex A are referred to in the text of this Def Stan. Documents and publications are grouped and listed in alpha-numeric order.

Reference in this Def Stan to any normative references refers to, in any 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 clause above, users shall be fully aware of the issue, amendment status and application of all normative references, particularly when forming part of an ITT or contract. Responsibility for the correct application of standards rests with users.

UK DStan can advise regarding where to obtain normative referenced documents. Requests for such information can be made to the DStan Helpdesk. Details of how to contact the helpdesk are shown on the outside rear cover of Def Stans.

4 Definitions

For the purposes of this document, the following terms and definitions apply.

Generic Vehicle Architecture (GVA). The term ‘Generic Vehicle Architecture’ refers to the open, modular and scalable architectural approach applied to the design of platforms to deliver the MOD’s desired operational, technical and cost benefits.

Open. Openness is defined as the use of published and freely available standards to define software and hardware interfaces, in order to allow a common approach to be taken. An open standard has no barriers to implementation by a third party. Open standards facilitate rapid replacement and upgrade of equipment as required. Open standards are used throughout this Def Stan.

Scalable. Scalability can be broken down into horizontal and vertical scalability, defined as:

Horizontal scalability is the ability of the system performance to be scaled by the addition or subtraction of system elements (scale out).

Vertical scalability is defined as additional resources being available or added to existing system elements to increase their performance. Vertical scalability addresses how the existing architecture can be extended to provide additional performance (bandwidth, processing power, etc) by exploiting existing spare capacity, simple replacement, or minor modification (scale up).

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.

GVA Office. The MOD GVA Office is the authority for all matters relating to this Def Stan and can be contacted through the GPOC.

Health and Usage Monitoring System (HUMS). A generic term for the technology used on platforms to gather, process and store system data onboard a platform.

System Information Exploitation (SIE). Use of HUMS data and information on and off the platform.

Platform – The term ‘platform’ is used in this Def Stan to refer to the vehicle and all attached sub-systems, temporary and permanent.

5 Abbreviations

Abbreviations referred to in this Def Stan are given in Annex B.

6 Generic Vehicle Architecture

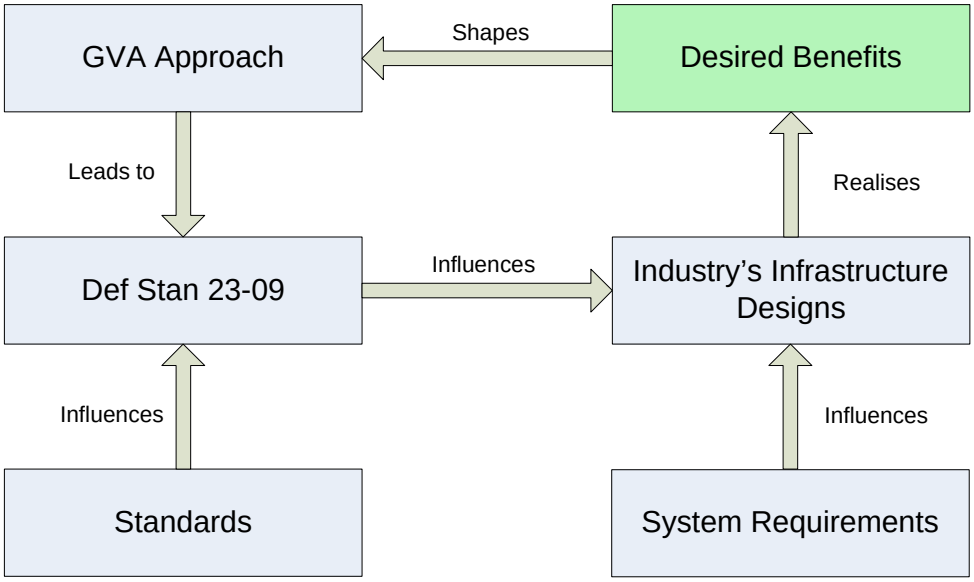

Figure 1: Def Stan 23-09 Context

6.1 Approach

GVA is the *approach* taken by MOD and industry to ensure that sub-systems on land platforms are properly integrated (electronically, electrically and physically). As shown in Figure 1, this Def Stan is an output from the GVA approach and is not an architecture or design in itself. This Def Stan will achieve its purpose when implemented in conjunction with a platform SRD. It does not mandate a specific design, as the design will vary according to the specific requirements of the platform and its role.

The GVA approach is based on established systems engineering principles that emphasises the need to take a whole systems view and the use of open standards for interfaces. It is a crew centric approach based on a common multifunctional crewstation HMI which allows the platform to be controlled through screens and input devices.

6.1.1 Land Open Systems Architecture (LOSA)

GVA sits in the context of the Land Open Systems Architecture (LOSA), a higher level architecture in a brigade context. It is intended to bring together Land domain architectures such as vehicles, dismounted soldiers, static bases, universal fires, tactical communications and Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR). GVA is an essential component of LOSA and many of the standards mandated in GVA are directly applicable to other areas within LOSA.

6.1.2 GVA Principles

The nine basic principles of the GVA approach and Def Stan 23-09 are that they must:

1. Take account of previous MOD investment;

2. Be applicable to current and future systems;

3. Use open, modular and scaleable 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, though life (including cost);

7. Be done in conjunction with industry and all relevant MOD stakeholders;

8. Be MOD owned and maintained;

9. Specify the minimum necessary to achieve MOD's desired benefits avoiding unnecessary constraint in implementation.

6.2 Generic Key Systems Requirement (KSR) for GVA

This Def Stan supports a full spectrum of platform functionality, from simple, low cost, low functionality platforms at one end, to highly sophisticated platforms with integrated survivability, surveillance and offensive functionality at the other. This Def Stan is intended to be sufficient to allow sub-systems to interoperate as required but still allow a manufacturer to propose innovative implementations to the MOD.

The contracting authority shall mandate the use of this Def Stan in the SRD for any platform acquisition, update or refresh, and, in doing so, define the appropriate functional and non-functional requirements to ensure that the architecture is appropriately specified by the systems integrator.

The MOD platform delivery team shall be responsible for ensuring the successful integration of all vehicle sub-systems onto the platform in accordance with the appropriate sub-system guides and this Def Stan.

Every platform SRD shall contain the following KSR and supporting note which are expanded upon in this Def Stan:

> ***KSR:*** ***The system shall have an open infrastructure that conforms to Def Stan 23-09.***
>
> ***Supporting Note:*** ***The system shall have an open infrastructure for the integration of platform sub-systems comprising an electronic infrastructure that makes use of OMG DDSI wire protocol and the Land Data Model, and a power distribution infrastructure, supported by the common Human Machine Interface. The infrastructure shall provide power management for these systems and for the collection and storage of sub-system data for condition based maintenance, asset management and configuration control purposes.***

The SRD will provide the detailed functional and non functional requirements for the infrastructure such as the number of outlets for data and power, initial and future sub-systems to be supported and the provision and location of crewstations.

When defining requirements and using this Def Stan, all parties shall take a whole platform system view which includes all the on-board sub-systems one of which is the automotive sub-system. This view shall include through-life issues such as maintenance, configuration control, safety certification, repair, technology insertion, disposal and cost. This is essential to ensure that consideration is given to potential additional or alternative sub-systems which may need to be installed in order to re-role the platform, or increase capability as a result of changing operational requirements.

6.3 Basic Architecture

6.3.1 Interfaces and Boundaries

Sub-systems are integrated into a platform through the platform infrastructure which is consists of an electronic infrastructure and a power infrastructure together with a set of mechanical mountings and connectors, and common HMI requirements. This makes compliant sub-systems and crewstations interoperable and enables platforms to be re-roled or upgraded when required. The basic architecture is shown in Figure 2.

This document standardises common interfaces (electronic, power and mechanical) by mandating standards. It uses the publish and subscribe model for data sharing and ensures interoperability by using the OMG DDSI wire protocol, together with the Land Data Model. The Land Data Model is used to define all functionality and messaging across the infrastructure.

Any development required of the Land Data Model shall be controlled through the GVA Office. No unique versions shall be developed as having a single data model is required to achieve interoperability.

The boundaries of Def Stan 23-09 within the platform architecture are shown in Figure 2.

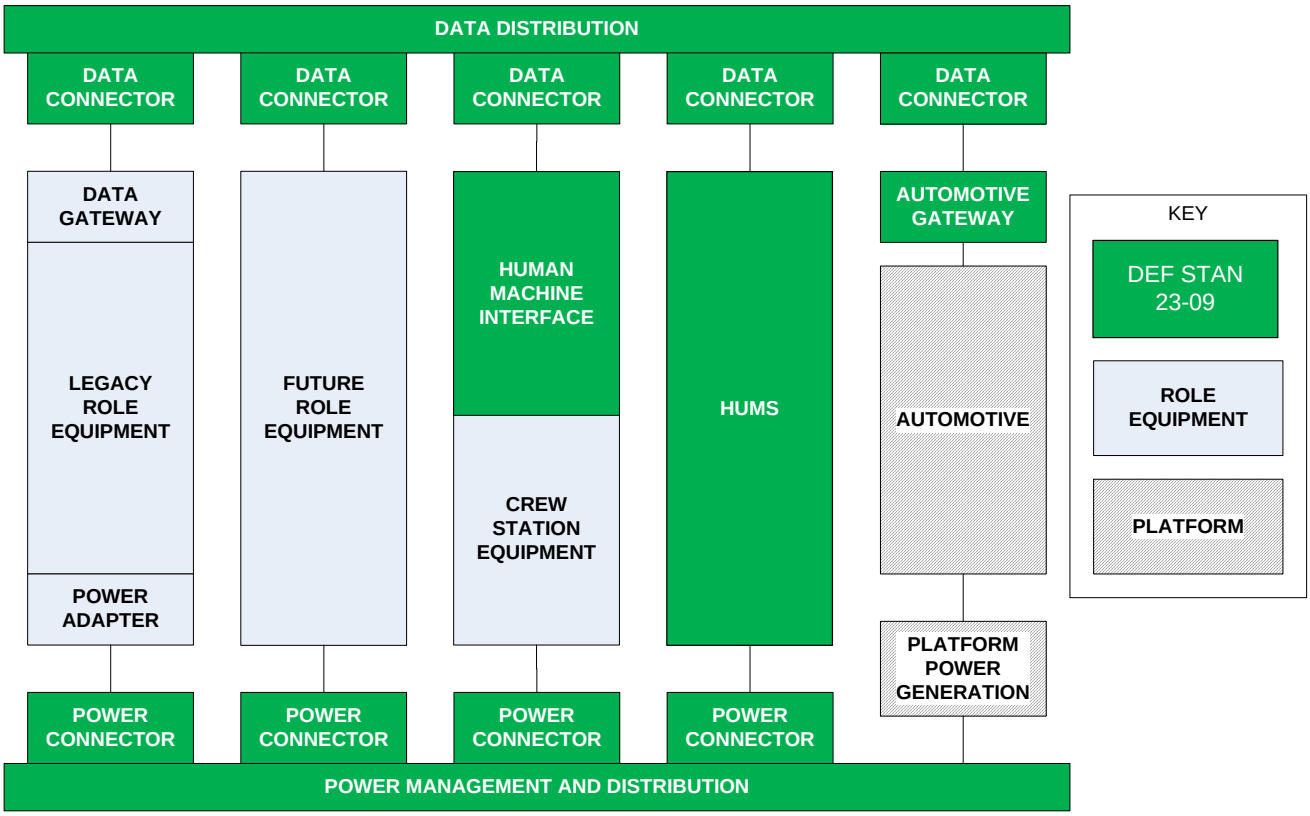

Figure 2: Def Stan 23-09 Interfaces and Boundaries

NOTE: Def Stan 23-09 includes mechanical standards in order that the design benefits of GVA approach can be realised. These are not illustrated in Figure 2.

The GVA Office will control the interfaces defined at Figure 2 through the definition of specific standards, the data model and use of ICDs.

This Def Stan defines the platform infrastructure and interfaces to it and assumes that:

1. Future equipment will be constructed to meet the interfaces;

2. Automotive aspects will continue to be aligned to the wider automotive standards, and a gateway to the infrastructure shall be required

3. Where legacy equipment is used, adapters and /or gateways may be required between this equipment and the infrastructure for both data transfer and the supply of power.

4. There will be a transition period where legacy non-compliant role equipment may be used in conjunction with the infrastructure.

6.3.2 Mechanical Interfaces

This Def Stan standardises common mechanical interfaces, such as antenna mountings. Where there is a requirement to be able to re-role the platform, for example, from Command Post to Troop Carrier or Ambulance, this will be specified in the platform SRD and will determine the extent to which common fixings, rails and racking shall be used.

6.3.3 Security in Data Buses

This iteration of the Def Stan reflects the current state of data transmission in which data classified RESTRICTED or lower is typically physically separated from that classified higher than RESTRICTED. For example, Electronic Counter Measures (ECM) fill data is classified higher than RESTRICTED; in this case physical separation is used to assure security.

This does not prevent there being an infrastructure above RESTRICTED, provided it complies with current security regulations and this Def Stan. MOD security guidance is given in Joint Service Publication (JSP) 440, which references other specific MOD documents or polices (such as Defence Information Assurance Notices (DIANs)) and Her Majesty's Government security standards and policies, including CESG Information Assurance (IA) Standards and Good Practice Guides.

JSP 440 defines the four possible "Modes of Secure Operation" (Part 8, Section 2, Part 2), which are:

- Dedicated Security Mode;
- System High Security Mode;
- Compartmented Security Mode;
- Multi-level Secure (MLS) Mode.

The details of these particular modes are expanded upon in JSP 440.

The individual requirements for security will be project specific but the aspects to consider in systems security are:

- Control of access to data;
- Secure data transmission;
- Secure data storage;
- Sanitisation of protectively marked data
- Secure data and crypto key loading and deleting.

Innovative solutions can be considered so long as there is a path to successful accreditation that clearly identifies the risks involved and the GVA Office is made aware through the project or delivery team concerned.

Connectors used on RESTRICTED and CONFIDENTIAL and above networks shall have different keyway polarizations (as defined in later sections).

6.3.4 Safety Criticality in Data Buses

Buses carrying safety critical data may require physical separation from other buses. A Time Triggered Protocol (TTP) network shall be used where appropriate.

The design shall recognise that data traffic may increase over time and that this must not interfere with safety critical features.

There is also a requirement to ensure that the latency, associated with the delivery of messages from certain equipment, is kept to an acceptable level by ensuring these messages are passed over a dedicated infrastructure where necessary. For example, firing circuits for weapon systems or active protection systems must be controlled through a separate dedicated bus.

6.4 General Functionality

6.4.1 Crewstations and the Hard Control Panel

The crew centric approach requires that each crewstation shall be configurable to different role functionality within the platform to promote flexibility and workload sharing. These roles shall be defined in the platform SRD. Each crewstation shall be multifunctional in operation, allowing the platform to be controlled from the displays and input devices, and providing access to sensor data and video imagery. Each crewstation shall utilise the common HMI, described in Section 10 Human Machine Interfaces, to provide a common look and feel when operating any platform.

Where sub-systems can be controlled using soft-switching, this shall be carried out at the crewstation.

Where hard switching is required, this shall be implemented on the common hard control panel.

6.4.2 Communications Systems

Where off-board communication is provided by BOWMAN, an approved gateway shall be required to connect the electronic infrastructure to BOWMAN. The gateway shall meet the relevant security requirements.

Alternative or additional communications equipment may be fitted to meet specific requirements. The electronic infrastructure shall be capable of interfacing with these systems to provide control from the crewstation (as defined in the platform SRD).

Defensive Aids

The electronic infrastructure shall provide means of monitoring any defensive aids and, if safety permits, control them through the crewstation. Latency requirements may dictate the use of a deterministic network (see 6.3.4).

There shall be an interface to the single common hard control panel that allows the crew to switch the ECM on/off. ECM status information shall be available at each of the crewstations to allow all crew members to monitor the equipment.

Direction on where to go for advice on implementation of ECM shall be sought from the GPOC.

6.4.3 Remote Weapon Systems (RWS)

Where RWS are fitted, the electronic infrastructure shall be capable of interfacing and displaying information, including video, at any of the crewstations. Safety issues require hard controls to permit weapon station movement and firing. At Present the firing circuit for the weapon must be controlled through a separate discrete line.

6.4.4 Sub-System Compatibility

It is important to ensure all sub-systems, which are connected to the infrastructure are compatible in terms of Electro-Magnetic Compatibility (EMC) and any other sources of interference. Given the requirement to exchange sub-system equipment between platforms, it is important to guarantee minimal levels of emission to ensure compatibility when exchanging equipment, especially in a theatre of operations. To comply with this Def Stan, all sub-systems shall comply fully to Def Stan 59-411 Land Class A and the Force Protection (FP) ECM EMC Control Plan. Further guidance is available from the GPOC.

7 Electronic Infrastructure Standards

7.1 Introduction

The electronic infrastructure shall consist of:

- One or more Local Area Network (LAN) for non-deterministic data and video distribution;
- Connectors including Universal Serial Bus (USB) for peripheral devices only;
- Time stamp service;
- DDSI wire protocol with the Land Data Model;
- Video utilising Def Stan 00-82;
- Safety critical (deterministic) networks using TTP where appropriate. Refer to 6.3.3 and 6.3.4.

The electronic infrastructure shall be accessed through a number of collocated data and power outlets as specified in the SRD. Growth in the number of data outlets shall be considered.

Data outlets shall contain data sockets and are to be easily accessible to prevent direct hardwiring of equipment.

Note: It is understood that the transfer of data from a CANBus (MilCAN and/or SAE J1939) onto the LAN may be required in some cases. Such cases shall be highlighted to the GVA Office through the project or delivery team concerned.

7.2 Standards for LAN Technologies

IEEE 802.3ab (Ethernet) technology shall be used for passing data on the platform that does not require deterministic operation. All cabling shall be capable of operating at 1000Mb/s.

All switches shall be capable of both 100 BASE-T and 1000 BASE-T operation to allow for legacy equipment and future growth. Connected equipment can be either 100 or 1000 BASE-T as appropriate. The switch shall be capable of switching at the Internet Protocol (IP) layer i.e. Layer 3.

If required by the platform SRD (directly or derived), each Ethernet switch shall also provide 10GBASE-SR ports for high-bandwidth intra-switch backbone functionality and/or enhanced sub-systems requiring high bandwidth.

7.3 100/1000Mb Ethernet

7.3.1.1 Connector Orientation

To ensure that connectors can only be fitted to the correct security domain:

- Connectors used on RESTRICTED and below networks shall be Type N keyway polarization.
- Connectors used on CONFIDENTIAL and above networks shall be Type A keyway polarization

7.3.1.2 Single Connector

Where single Ethernet connection is required (eg for interfacing role equipment), the connector shall be of type MIL-DTL-38999 Series III, D38999/XXαB35SN (or A) with specification:

- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – B;
- Contact arrangement – 11-35;
- Contact type – S (Socket);
- Keyway polarization – N or A (security classification dependant);
- Other elements of this specification shall be in accordance with the SRD.

The pin out for the single Ethernet connector shall be:

Pin	Pair	Wire
1	4	2
2	4	1
3	1	1
4	1	2
5	2	2
6	2	1
7	3	2
8	3	1
9	N/C	
10	N/C	
11	N/C	
12	N/C	
13	N/C	

Table 1: Single Ethernet Connector Pin Out

Highlighted pins 3-6 shall be used for 100Mb connections.

7.3.1.3 Dual Connector

Where dual Ethernet connection is required (eg to maximise available switch space), the connector shall be of type MIL-DTL-38999 Series III, D38999/XXαC35SN (or A) with specification:

- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – C;
- Contact arrangement – 13-35;
- Contact type – S (Socket);
- Keyway polarization – N or A (security classification dependant);
- Other elements of this specification shall be in accordance with the SRD.

The pin out for the dual Ethernet connector shall be:

Pin	Ethernet Channel	Pair	Wire		Pin	Ethernet Channel	Pair	Wire
1	A	4	2		12	N/C		
2	A	4	1		13	N/C		
3	A	1	1		14	N/C		
4	A	1	2		15	B	4	2
5	A	2	2		16	B	4	1
6	A	2	1		17	B	1	1
7	A	3	2		18	B	1	2
8	A	3	1		19	B	2	2
9	N/C				20	B	2	1
10	N/C				21	B	3	2
11	N/C				22	B	3	1

Table 2: Dual Ethernet Connector Pin Out

7.3.2 10Gb Ethernet

7.3.2.1 Cable

Fibre Optic cable shall be ISO/IEC 11801 type OM3 50/125µm compliant.

7.3.2.2 Connector Orientation

10Gb Ethernet connectors used on RESTRICTED and below networks shall be Type D polarization.

10Gb Ethernet connectors used on CONFIDENTIAL and above networks shall be Type E polarization

7.3.2.3 Connector

The 10Gb Ethernet connector shall be of type MIL-DTL-38999 Series III, D38999/XXαB2SD (or E) with specification:

- Contact specification – MIL-PRF-29504/5;
- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – B;
- Contact arrangement – 11-2;
- Contact type – S (Socket);
- Keyway polarization - D or E (security classification dependant).
- Other elements of this specification shall be in accordance with the SRD.

The pin out for the 10Gb Ethernet connector shall be:

Pin	Function
1	Tx Ethernet
2	Rx Ethernet

Table 3: 10Gb Ethernet Connector Pin Out

7.4 Time Stamp Services

The standard RFC 5905 shall be used for all time stamp services.

7.5 Standards for Data Distribution

The interface messaging protocol standard used shall be OMG Data Distribution Service (DDS). This is not vendor specific. The interface shall comply with Real-Time Publish-Subscribe DDSI Wire Protocol (OMG Specification version 2.1).

The Land Data Model shall be used to define all functionality and messaging across the infrastructure, this will include the configuration for DDSI. The data model and guidance is available from the GPOC.

Sections 9.6.1.1/2/3/4 of the Real-time Publish-Subscribe Wire Protocol DDSI Wire Protocol Specification define the configurations that are to be supported by the protocol:

DefaultMulticastLocator = {LOCATOR_KIND_UDPv4, “239.255.0.1”, PB + DG * domainId + d0} where PB = Port Base Number = 7400.

7.6 Standards for Peripheral Devices

Universal Serial Bus (USB) shall only be used for the local attachment of peripheral devices (e.g. pointing devices) to a main processing node such as a crewstation. USB storage devices shall not be used.

7.6.1 USB Connector

The USB connector shall be of type MIL-DTL-38999 Series III, D38999/XXαA35N with specification:

- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – A;
- Contact arrangement – 9-35;
- Contact type – S (Socket);
- Keyway polarization – N.

The pin out for the USB connector shall be:

Pin	Function
1	USB Ground
2	USB_2_D-
3	USB_2_D+
4	USB_1_D-
5	USB_1_D+
6	USB 5v

Table 4: USB Connector Pin Out

7.7 Standards for Platform Video

Def Stan 00-82 shall be used for the distribution of video within the platform. Both uncompressed and compressed images can be transmitted. Compressed images may be in either JPEG 2000 format (ISO/IEC 15444-1) or MPEG-4 (ISO/IEC 14496).

7.8 Standards for Point to Point Serial Interfaces

Although out of the scope of this Def Stan, where point to point serial interfaces are required to interface to legacy equipment, agreement shall be obtained from the GVA Office by the project or delivery team concerned on a case by case basis. RS422 is the preferred solution and will require a serial to Ethernet conversion.

8 Power Infrastructure Standards

8.1 Introduction

The overarching standard for platform system power is Def Stan 61-5 Part 6. This Def Stan requires that all platforms and equipment shall be designed to meet Def Stan 61-5 Part 6.

28V DC shall be the primary supply voltage for platform installations. It shall be the responsibility of the platform integrator to provide outlets with the appropriate individual power protection.

The power infrastructure shall be accessed through a number of collocated power and data outlets as specified in the SRD. Growth in the number of power outlets shall be considered.

The failure of a single power outlet shall not cause the loss of power at any other outlet.

Each platform power outlet shall be rated at either 28V, 100A continuous; 28V, 20A continuous, as specified in the SRD.

Power outlets shall contain power sockets and are to be easily accessible to prevent direct hardwiring of equipment.

8.2 Power System Architecture

Def Stan 61-5 Part 6 defines two basic types of equipment, Platform Equipment (PE) and Terminal Equipment (TE).

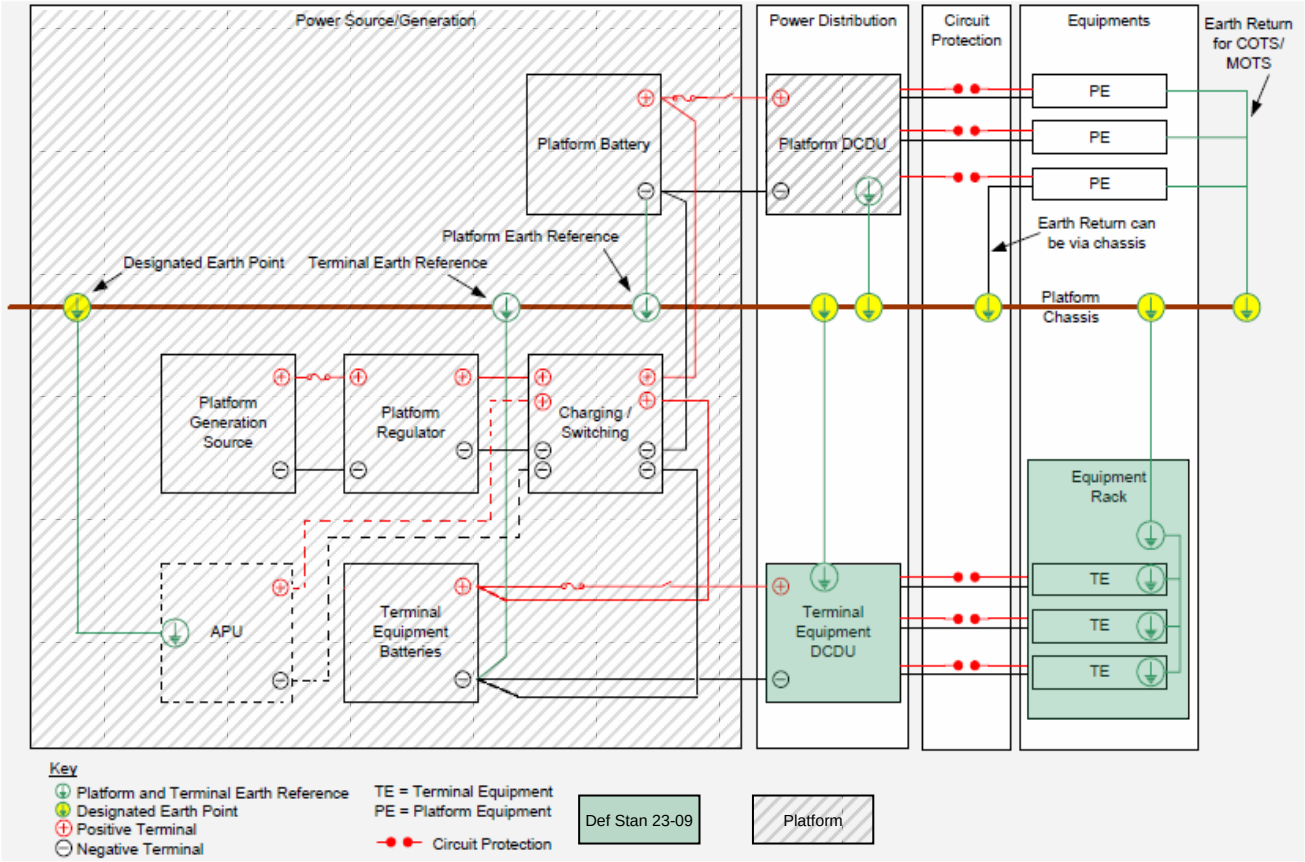

Figure 3: Example Power System Architecture

Figure 3 is a modified version of that in Def Stan 61-5. It shows the boundaries of the power infrastructure and the Auxiliary Power Unit (APU) connected to a central charging/switching block. This provides the facility for the APU to charge both the PE and TE batteries. In addition, this figure defines the earthing methodology that shall be implemented, noting that the earthing solution will be platform specific.

The local distribution points shall be network enabled electronic Power Distribution Terminals (PDT) such that power control shall be conducted from the common crewstation. The power management system shall be capable of indicating to the user the status of each power outlet including instantaneous load (VA), switch status (On/Off), breaker/fuse status, and shall provide the crew with the ability to enable and disable each power outlet individually.

8.3 Power Interfaces

8.3.1 Equipment Power Connectors

8.3.1.1 20A Power Connector

The 20A power connector shall be of type MIL-DTL-38999 Series III, D38999/XXαC4SN with specification:

- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – C;
- Contact arrangement – 13-4;
- Contact type – S (Socket);
- Keyway polarization – N.

The pin out for the 20A power connector shall be:

Pin	Function
A	+28V
B	0V
C	+28V
D	0V

Table 5: 20A Power Connector Pin Out

8.3.1.2 100A Power Connector

The 100A power connector shall be of type MIL-DTL-38999 Series III, D38999/XXαG75SN with specification:

- Shell Style – where XX depends on application;
- Plating – α (where α is not W);
- Shell Size – G;
- Contact arrangement – 21-75;
- Contact Type – S (for Socket);
- Keyway Polarization – N.

The pin out for the 100A power connector shall be:

Pin	Function
A	+28V
B	0V
C	+28V
D	0V

Table 6: 100A Power Connector Pin Out

8.3.2 External Power Connection – 28V Input/ Output

The platform shall have an external 28V, 500A continuous connector which connects to the PE battery. The connection shall be fused to protect the wiring. Where fitted, this connection shall be both an input and output. The connector used shall be compatible with connectors to FV564833.

8.3.3 Power Provision and Conditioning

Def Stan 61-5 Part 6 provides criteria for power conditioning and recommendations for growth in numbers of power outlets. The number of outlets is dependent on vehicle configuration and equipment fit.

The power conditioner may need to stabilise voltage, filter input and output supplies, and improve transient response. The conditioning required will depend on the platform supply being used, power management systems, cabling and the power demand from the system.

Power conditioning shall be incorporated within the power system units (e.g. the power management unit, outlet points and power inputs), unless this causes integration issues, in which case the power conditioning unit shall be a central self contained unit.

8.3.4 EMC Requirements

Refer to 6.4.5.

8.4 Power Management System

The power management system comprises 3 elements; monitoring, advice and control.

8.4.1 Power Monitoring

Power monitoring is defined as the facility to monitor the generation and the demand from attached loads.

The power monitoring system shall sufficiently monitor and/or model the PE and TE power systems to enable a power management capability.

The user shall have overall control of the power system. The power management system shall ask for confirmation from the user before disconnecting any systems to save power.

Any over-current protection or battery over-discharge protection shall happen automatically without the need for user intervention.

8.4.2 Power Advice

Power advice is defined as the potential to advise the crew on managing loads based on a set of rules.

When no generating source is running, the PE and TE batteries shall not be connected together, except in an emergency. If a facility to parallel the PE and TE batteries is provided, the crew shall be provided with a visible warning of this state.

All power generating sources shall be current limiting.

The power system shall as a minimum:

- Advise the crew on PE battery status to provide advanced warning in order to prevent the battery from being inadvertently discharged to the point where the platform engine cannot be restarted;

- Advise the crew on TE battery status to provide advanced warning in order to prevent inadvertent discharge of the batteries;

- Alert the crew to fault conditions in the power system, such as over-current and short circuit conditions;

- Inform the crew of the battery life remaining in hours and minutes at the current load;

- Indicate to the user the status of each power outlet including the load in order to enable power management by the crew;

- The crew shall be informed after a protective action has been performed, provided the power architecture is still operating.

8.4.3 Power Control

Power control is defined as the facility whereby the crew can manually switch loads from a distribution unit using individual switches on a panel or with soft keys on the HMI.

- **Sequential Start** – Where there is a high initial inrush current risk, power outlets to systems shall be configurable to start in a set sequence. There shall be a delay of approximately 100ms between each power outlet starting to smooth out the inrush peak current without adding any appreciable delay to the platform systems powering up.

- **Current Limit/Short Circuit Protection** – Each power outlet shall have a short circuit protection. This shall be reconfigurable with an automatic reset (e.g. PDT).

- **Battery Power Saving** – The power management shall be configurable to disable power outlets where appropriate when running on battery only.

- **Power Management System Override** – It shall be possible to manually override the power management system and enable power to all systems in exceptional circumstances, e.g. failure. Circuit protection shall remain fully operational in the override mode.

9 Mechanical Standards

The table below defines standards that shall be considered in the design of the platform. This list is not exhaustive.

Standard	Description
Def Stan 00-35	Environmental Handbook for Defence Materiel
Def Stan 59-35	Requirements for Cable Accessories to be Used with Electrical Connections Employed in Marine, Airborne and Land System Applications
Def Stan 59-411	Electromagnetic Compatibility for equipment, systems and platforms
Def Stan 61-12	Wire, Cords and Cables Electrical-metric Units
SECAN Doctrine and Information Publications (SDIP)-29*	Facility Design Criteria and Installation of Equipment for the Processing of Classified Information
SDIP-27*	NATO TEMPEST Requirements and Evaluation Procedures

Table 7: Standards that define the Mechanical Infrastructure

*SDIP-29 and SDIP-27 shall be used for all platforms that contain equipment that processes protectively marked data at CONFIDENTIAL or above.

9.1 Platform Interface

9.1.1 Antennas

9.1.1.1 Antenna Mounting

Special consideration shall be given to the positioning of intentional radiating antennas to maximise performance (polar plots), minimise cross coupling to other equipments and minimise Radiation Hazard (RADHAZ) field strengths within, and at access points to, the platform. The minimum separation between the antennas shall be no less than 300mm.

Priority shall be given to the spacing between ECM and communications antennas first as these are the most likely to cause significant interference. The minimum spacing between BOWMAN and ECM antennas shall be 2.5m where practicable. This assumes filters and correct frequency ranges are used. If this is not possible, further guidance is available from the GPOC

9.1.1.2 Antenna Ground Plane

Platforms shall include a ground plane for antennas.

If the antenna mounting area of the platform is non-metallic then an antenna ground plane(s) shall be installed.

With current solutions the minimum amount of metallic ground plane surrounding each antenna, for optimum performance, is a circle which has a radius equal to the individual antenna height. Where it is not possible to locate an area large enough to apply this, the metallic area should be as large as possible, ideally with the antenna placed in the centre of the area. The system integrator when designing the vehicle shall ensure that there is a full understanding of the requirements for ground planes for the ECM systems to be employed. Figure 4 is an illustration of the required antenna footprint; further guidance is included in the GVA Guide available from the GPOC.

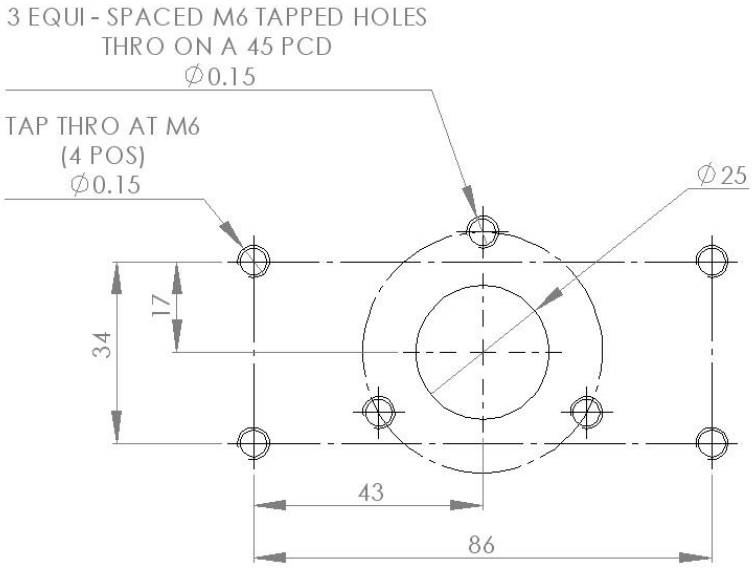

Figure 4: Antenna Footprint

9.1.1.3 Antenna/Ground Plane Location

For virtually any antenna fitted to a platform, the resultant antenna performance and radiation pattern will be affected by the position of the antenna and the size, shape and height of the platform. The maximum practicable separation between the antenna and other items on the roof shall be used. The Global Positioning System (GPS) antenna shall be located in a position that allows the antenna to see as much sky as possible with minimum platform obstructions. System integrators should to employ modelling techniques during design and development.

9.2 Mechanical Interface

9.2.1 Basic Interface Fixing Pattern

A basic interface pattern of 400mm x 300mm (horizontal and vertical) fixture spacing shall be applied. It is considered to be good practice to mount to at least four fixing points and ideally, where possible, six or more mounting points. The number of fixings shall be commensurate with the agreed load cases to the subject vehicle. Note: this is a pattern which does not mandate the type of fixing eg studs.

9.2.2 Fixing Pattern

Any fixings used at the basic interface shall be strong enough to withstand, without failure, the load cases determined by the environmental and operational conditions and threats that have been defined for the vehicle. Where explicit load cases have not been defined for a particular vehicle, then the design practice in accordance with Def Stan 00-35 shall be adopted.

9.2.3 Roof Mountings and Ingress /Egress Hatches

If a ring mounted Protected Weapon Station (PWS) is to be used on the platform, the specification in Table 9 for weapon ring mounting shall be used. Figure 5 is an illustration of the required weapon ring fixing footprint; further guidance is included in the GVA Guide available from the GPOC. For platforms with PWS but without a ring mount, an appropriate mounting plate shall be fitted to accommodate the station.

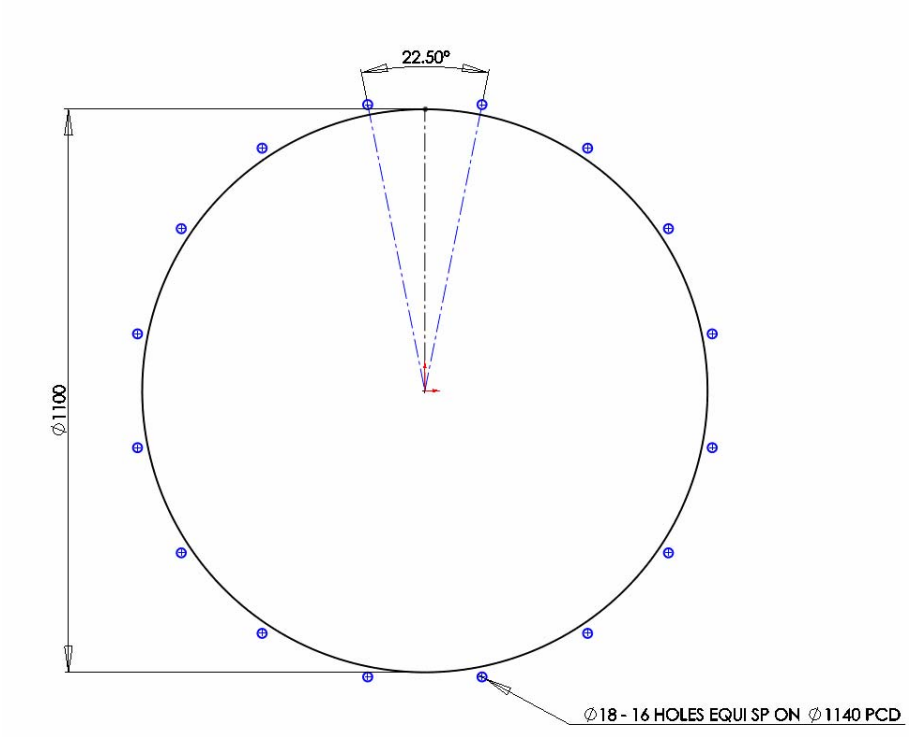

Figure 5: Weapon Ring Fixing Footprint

The minimum dimensions for ingress/egress hatches shall be as specified in Table 9. For more information on ingress/egress from vehicles, see Def Stan 00-250 Part 3 for guidance.

Weapon Ring Mounting	A minimum of: 16 x M16 x 2 @ 1140mm pitch circle diameter. Current internal diameter of the weapon ring: 984mm. Adjustment may be required dependent on the vehicle roof material.	• To accommodate legacy weapon rings (currently part of the Land Rover Weapons Mounted Installation Kit (WMIK)) • To provide interface with other roof mounted systems including PWS.
Ingress/Egress Hatch	Circular: 710mm (Minimum internal diameter) Rectangular: 710mm x 510mm Circular or rounded rectangular profiles are considered most suitable to allow ease of access for users with body armour on. Being symmetrical they allow access/egress independent of the direction the user is facing.	• Appropriate means of escape shall be afforded to the system (including when fitted with additional protection systems such as bar armour). Ideally ingress/egress points shall be located on at least two planes of the vehicle to enable escape in the event of an overturn. • Roof hatches need to be operable from both inside and out, allowing for casualty evacuation by personnel outside the vehicle. These should take note of relevant security measures. • The location of handholds/foot treads and texture of the surface once out of the hatch also needs to be considered to allow the users a safe egress route once on top of the vehicle.

Table 8: Specifications for Weapon Ring Mounts and Hatches

10 Human Machine Interface

10.1 Introduction

This section contains the human factors requirements of the common HMI. More specific details of the HMI interface structure, layout and design are described in the HMI Definition Document available from the GPOC.

This section is structured as follows:

- Related Human Factors Defence Standards;
- Common Crewstation HMI;
- In-service hardware limitations;
- Role variations;
- Environmental Issues.

10.2 Related Human Factors Defence Standards

This Def Stan has drawn on a number of sources, including existing Human Factors (HF) standards, MOD funded research and development. The Defence Standards in Table 10 should be referred to for additional information and references to applicable International and British standards.

Related HF Sources	Description
Def Stan 00-250 Human Factors for Designers of Systems	This is the primary Def Stan for HF. It provides HF requirements for use in User and Systems Requirement documents, describes the HF integration process and associated methods and contains a large quantity of guidance intended for use across a wide range of systems used in a variety of domains. Def Stan 00-250 also provides references to relevant British and International Standards. Def Stan 00-250 Part 0 Issue 1: "Human Factors for Designers of Systems Part 0: Human Factors Integration" Def Stan 00-250 Part 1 Issue 1: "Human Factors for Designers of Systems Part 1: Overarching People-Related Requirements" Def Stan 00-250 Part 2 Issue 1: "Human Factors for Designers of Systems Part 2: Particular People-Related Requirements" Def Stan 00-250 Part 3 Section 9 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance - Section 9 People Characteristics" Section 10 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance - Section 10 Systems Safety" Section 11 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance - Section 11 Training" Section 12 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance - Section 12 Operations, Maintenance & Support" Section 13 Issue 1: "Human Factors for Designers of Systems Part 3:

	Technical Guidance - Section 13 The Workplace" Section 14 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance -Section 14 The Environment " Section 15 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance - Section 15 Work Equipment" Section 16 Issue 1: "Human Factors for Designers of Systems Part 3: Technical Guidance – Section 16 Living Spaces"
Def Stan 00-25 Part 14 Human Factors for Designers of Equipment	Military Land Vehicle Design Issue 1 - This Def Stan provides requirements and guidelines for HF in military land vehicle design. It provides information to vehicle and vehicle sub-system equipment designers. It is intended to help them understand the HF issues which should be considered during military land vehicle/platform design and procurement. It also intends to help HF experts who may not be aware of some of the military and design issues associated with these types of systems.

Table 9: HF Information Sources

Platforms shall comply with Def Stan 00-250 and Def Stan 00-25 part 14 and a Human Factors Integration process shall be adopted as part of procurement and systems engineering activities.

10.3 Common Crewstation HMI

This Def Stan provides the framework against which the common crewstation HMI shall be designed. What follows is a description of the overall crewstation concept. However, not all vehicles will have this level of functionality and crewstations for some roles (e.g. driver) may be deliberately constrained in functionality while in others new functionality may need to be added depending on specific SRD requirements.

The software element of the HMI shall be open, flexible and scalable to allow the addition of subsystems or functionality at a later date.

10.4 Crewstation Components

The crewstation HMI shall be the means by which the user interacts with the platform systems. The HMI shall include all the controls/user input devices and means of presenting information to the user.

The basis of the HMI design shall be that it is intuitive to use by the crew under stressful conditions and that information presentation is unambiguous. The HMI shall be designed such that the user can control the vehicles sub-systems to the required level of performance, while the vehicle is moving over the full range of terrain types on which the platform will operate.

The crewstation shall consist of the following elements to allow user interaction with the system:

- Display;
- Bezel Buttons;
- Hand Controller(s);
- Hard Control Panel;
- Speaker.

It is intended that the crewstation is a single display multifunction device but where a specific role requires it, and if the space allows, a multiple screen solution is not discounted.

10.4.1 HMI Layout and Structure

A detailed description of the crewstation layout and functionality is provided in the HMI Definition Document available from the GPOC.

Figure 6 provides an overview of the display layout. This shows the top level menu screen layout that shall be used for all crewstations.

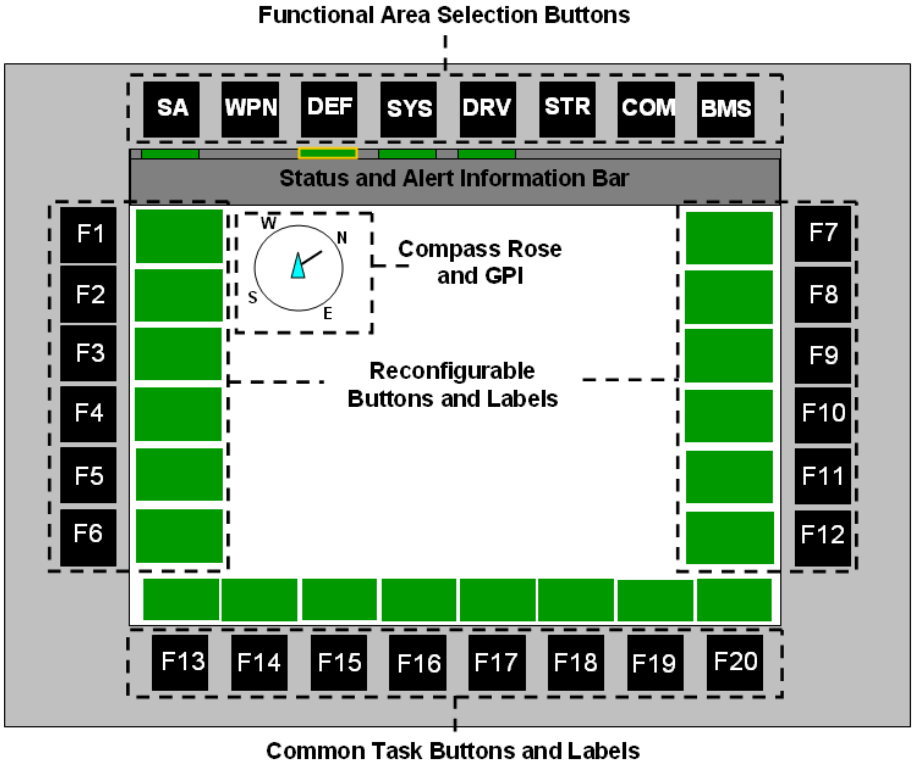

Figure 6: HMI Display and Screen Layout

The HMI screen shall use the following elements:

10.4.1.1 Status and Alert Information Bar

This shows essential status information to the user.

This shall be present on all screens and shall include:

a. The status of key systems (e.g. ECM, GPS, RWS);

b. Indication of the number of current system alerts classified into: warning (W), caution (C) and advisory (A) alert categories; (the letters (W, C and A) can be used). When a new warning occurs, a message describing the nature of the warning shall appear in a bar directly beneath the status and alert information bar;

c. The local date-time group and the vehicle's own position grid reference;

d. Vehicle Power Status.

If the status bar has been hidden and a warning occurs then it shall reappear.

10.4.1.2 Functional Area Selection Buttons

These are menu buttons that are used for the sole purpose of selecting the functional area with which the user wishes to interact. These shall be common across all platforms and crewstations.

Selecting the current functional area shall take the operator to the top level menu of that functional area. When a new functional area is selected the system shall return the operator to the last accessed page within that functional area.

10.4.1.3 Reconfigurable Menu Buttons and Labels

These are menu buttons whose function changes depending on the functional area or subsystem selected. The labels are the active information tags associated with the programmable functionality, which reconfigure for different menus. When there are consistent functions across the different sub menus, these shall always be allocated to the same button to aid learning and make the system more intuitive to use.

10.4.1.4 Common Task Buttons

The bottom row of bezel buttons shall be reserved for those controls that are used in many or all of the functional areas. The labels describing the functionality of each button shall be provided on the display. This will allow for slight amendments to the functionality of these buttons to be made depending on the sub-systems fitted to the platform. The following tasks shall be common across all platforms:

- **Up.** Takes the user up a level in the menu structure within the current functional area;
- **Alerts.** This brings up a display detailing all current system alerts, including their initiation time and priority level;
- **Threats.** This brings up a display detailing all the current threats, including their initiation time and priority level;
- **Enter.** Enters data into a field or activates a highlighted menu option;
- **Arrow Up** and **Arrow Down.** Allow the user to scroll up and down menu options or change numerical values in fields where required;
- **Ack.** Allows the operator to acknowledge warning messages or alarms;
- **Labels.** Allows the user to hide or display the labels associated with the bezel buttons and some overlays (such as the compass rose and Gun Position Indicator (GPI)).

10.4.1.5 Compass Rose and Gun Position Indicator

If the vehicle has a navigation system, weapon system or panning sensor, then the compass rose/GPI shall be displayed on every screen. The GPI should also be used to display additional information relevant to platform, including the direction and field of view of panoramic sensors and the direction of threats (where threat sensors such as laser warning receivers are fitted). The user shall be able to select whether the compass rose and GPI are orientated ‘heading-up’ or ‘north-up’.

The compass rose shall be located in the top left of the display. If a threat warning is received while the compass rose is hidden, then the compass rose shall reappear.

10.4.1.6 System Blackout

Each operator shall be able to switch off his display independently of the underlying processing from anywhere within the menu structure with a single key press of F12. Once the user has “blacked out” the screen, all controls shall be locked to avoid unintentional operation. Pressing any bezel button twice shall reactivate the display without initiating the underlying functions of those keys.

10.4.1.7 Display Brightness adjustment

The user shall be able to adjust the brightness of the display from anywhere within the HMI menu structure.

10.4.1.8 Display Characteristics

All displays shall comply with ISO 9241-303:2008(E).

10.4.2 Auditory Alarms

The crewstation shall utilise or provide a speaker capable of providing auditory alarms to the users 10dB above expected background noise levels. The crewstation should be capable of providing auditory warnings through the vehicle intercom system, should one be fitted. The user shall be able to configure the maximum and minimum volume limits of auditory alarms. The user shall be able to adjust the volume of the auditory alarms within the limits set. For more detail on signals, alarms and warnings, see the GVA HMI Definition Document available from the GPOC.

10.4.3 Crewstation HMI Functional Areas

The functionality of the common crewstations shall be split into a number of functional areas, defined below, which are selected by pressing the corresponding functional area selection buttons along the top of the display. This is intended to be a framework against which sub-system functionality can be placed. The following describes each of these areas:

1. **Situational Awareness (SA)** This shall provide the means to display and control of video systems and other sensor information e.g. Local Situational Awareness Systems (LSAS), commander’s sight(s), gunner’s sight and other sensor system displays (e.g. shot detection systems). This mode shall also provided control any surveillance systems on the vehicle, such as pan/tilt cameras and ;

2. **Weapon Systems (WPN)** This shall be for weapon system control and include the weapon sight.

3. **Defensive Systems (DEF)** This shall display information from and control the defensive sub-systems such as ECM;

4. **System Status (SYS)** This shall be for platform sub-system control, status/health information and crewstation configuration;

5. **Driving Information and Driving Aids (DRV)** This shall be for all the information and driving aids the driver needs to manoeuvre the vehicle, for example, instruments, steer-to commands, driver-relevant camera views;

6. **Special to Role Functions (STR)** This shall be for all functionality associated with any specialist equipment fitted to the vehicle (e.g. engineering vehicle crane);

7. **Communications (COM)** This shall be used for the management and control of communications functions;

8. **Battlefield Management System (BMS)** This shall display and control of BMS/Command and Control (C2) systems.

The order of buttons, from left to right, shall be 1 to 8 as above.

In some instantiations, one or more functional areas may not be present. To indicate which are present to the operator, a green bar shall be located directly underneath the bezel buttons. When a functional area button is selected the green bar shall have a yellow outline to indicate the functional area that the user is currently in.

Where appropriate, information, video and system control can be repeated across several functional areas.

10.4.4 Controls and Input Devices

10.4.4.1 Bezel Keys

The HMI shall provide hard keys (bezel keys), positioned around the edge of the display (8 buttons across the top, 8 reconfigurable buttons across the bottom of the display and 6 reconfigurable buttons on each side) such that each key is directly and unambiguously associated with a menu option.

The size of the hard keys shall be in accordance with guidance laid down in Def Stan 00-250 Part 3 Section 15. The type of keys selected shall provide positive tactile feedback that the key has been pushed.

Labels on the buttons shall be either backlit or of high contrast with the background colour with the default being white text on a black background.

10.4.4.2 Text and Data Entry

The HMI shall have the facility to input free text and numerical data where necessary. This can be achieved through use of a QWERTY keyboard(s), an on-screen keyboard with touch screen or similar suitable technology.

QWERTY keyboard entry shall not be relied upon for interaction with the system when the vehicle is in motion.

10.4.4.3 Hard Control Panel for Safety or Operationally Critical Controls

Where functions are identified as being critically important from a safety or operational perspective, these shall be operated by a single control dedicated to that function on the common hard control panel. These shall be designed in accordance with Def Stan 00-250 Part 3 Section 15 and shall not be able to be operated accidentally.

The hard control panel shall be accessible by the commander and preferably by one other member of the crew. In vehicles that have a rear access door for passengers, a second hard control panel may be required in the rear of the vehicle (e.g. to allow passengers to purge vehicle systems in case the vehicle is abandoned).

When a new sub system is added to the infrastructure any safety related hardware or controls shall be added to the hard control panel.

The commander shall be provided with a control to stop and start the collection of GPS data by the HUMS.

10.4.4.4 Touch Screens

Touch screens can provide a rapid and intuitive means of conducting some types of interaction with systems, particularly selection and manipulation tasks but the lack of tactile feedback whilst on the move and accidental operation limit their utility as the sole means of interacting with a crewstation.

Where touch screens are used:

- They shall be able to be used both with and without gloves;
- They shall not provide the sole means of interacting with the system;
- The labels used to indicate the functionality of the bezel buttons shall also act as soft keys;
- The size of buttons or areas intended to be selected or manipulated by touch shall be in accordance with the guidance laid down in Def Stan 00-250 Part 3 Section 15;
- They shall be robust enough to withstand the abuse they will receive over a lifetime of use in a military vehicle (e.g. scratching, grease, decontamination agents, solvents, physical shock etc.).

10.4.4.5 Hand Controllers

Depending on the sub-systems fitted to a vehicle, hand controllers will have two main functions:

1. As a pointing device, moving a cursor on the display (i.e. ‘mouse’ functionality);
2. Operating trainable systems such as sighting or weapon systems.

Hand controllers shall be fixed securely to the vehicle (providing stability for the users hand when using the controller whilst on the move)

The position control devices used on the hand controller shall be of the ‘stiff stick’ (force transducer) thumb controller type. For quick and accurate operation, the thumb controller shall provide the optimal level of control for both gross and fine continuous movements of the cursor or subsystem.

When a HMI requires hand controllers for operating both trainable systems and cursor control, these shall be implemented on separate hand controllers; trainable systems shall be the right hand controller and cursor control shall be the left hand controller.

Where space allows an arm rest should be provided to support the arm when using the hand controller(s), so as to minimise user fatigue and improve effectiveness on the move.

10.4.4.5.1 Control of trainable weapon/sight systems

The weapon/sight controller shall have the following controls operated by the right hand controller:

1. Thumb controller to control the movement of the trainable system;
2. Safety system to prevent unintended operation of the system (e.g. ‘Deadmans handle’);
3. Button to auto-slew the system to a specific orientation or target (if such a facility is available).

Any weapon/sight controller required shall also have the following controls which shall be integrated into the single right hand controller.

1. Guarded trigger to fire a weapon system;
2. Toggle switch to change sight magnification;
3. Button to activate a laser range finder;
4. Selector to toggle between TI and day sights/cameras.

10.4.4.5.2 Cursor Control

The cursor pointing device shall be implemented on a separate controller from that used to control sighting or weapon systems, such as a separate control handle or integrated into a display bezel. If implemented on a control handle, the separate cursor controller shall be designed for left handed control, with a thumb controller to move the cursor and a trigger or button on the front of the handle for simultaneous left forefinger operation while the cursor is being controller by thumb. This forefinger control shall mimic the action of a “left mouse button” and an additional button beside the thumb controller shall mimic the action of a ‘right mouse button’.

Where the platform solution warrants increased hand control functionality which may present a conflicting set of HMI requirements, this shall be discussed and a suitable arrangement agreed with GVA Office through the project or delivery team concerned.

10.5 Modes

Within the system set up, there shall be 3 main modes: operational, maintenance and training. It shall be possible to switch between them in the top level of the System functional area. Operational mode shall be the default mode on start up. In addition, Off and Standby modes shall be available to the commander.

Operational: all normal use of the vehicle including crew maintenance tasks.

Maintenance: including calibration and access for higher levels of repair including access to technical publications.

Training: allows use of the system in synthetic environments including field exercises.

10.6 Establishing Crew Roles

Within the platform there will be a number of roles e.g. commander, driver, gunner. The commander shall be able allocate roles to each crewstation according to his needs by enabling or disabling services, thereby managing the information and sub-system control available at each crewstation. He shall be able to do this at any time through the Crewstation /Role Allocation screen.

For some roles, the functionality available at their crewstation may need to change dynamically during the course of the mission. For example, the driver may only have access to the key functionality required for the driving task whilst the vehicle is in motion, but need much greater access to vehicle other sub-systems when static.

10.6.1 Management of System Control between Users

Where a platform contains multiple crewstations, users shall be able to interact with their crewstation independently of each other, i.e. access different functional areas, information or video images.

Each crewstation in the platform shall have the capability of being used by any user role. Once selected, the system shall only allow the functionality associated with the role to be conducted from that crewstation unless over-ridden by the commander.

Where more than one user has the ability to interact with a particular interface or control a certain sub-system, a method of preventing the users from attempting to interact with the same system simultaneously shall be implemented. The exact method will vary with application, but the method must have resilience against incapacitation of the sub-system user or the critical failure of any crewstation. The functional hierarchies given to different crew members and the ability to override must be defined as part of the requirements set by the project or delivery team concerned in conjunction with the GVA Office.

The ability to enable certain platform wide functions, such as putting the system into a silent, blackout or night vision goggles mode, shall apply to all crewstations when selected from a single crewstation, unless configured otherwise by the commander from the Crewstation /Role Allocation screen.

10.7 System Start up

On start-up, the commander shall be presented with the ‘START-UP’ screen. This shall show the status of the platform and all of its sub-systems (Red, Amber, Green) and indicate any faults (see Section 11 HUMS). The system shall indicate the appropriate remedial action (crew task or local repair) as described in the appropriate technical publications, for example, Army Equipment Support Publication (AESP).

Once complete, pressing the System button once shall enable the commander to access the Crewstation /Role Allocation screen.

Crewstations shall preserve their commander configured functionality for 24 hours after any shut-down, thereafter reverting to the default setting. Changing the configuration of default setting shall be a maintainer (not crew) task.

10.8 In-service hardware limitations

It is appreciated that for some legacy platforms it may not be appropriate, or cost effective, to remove or replace existing crewstations and therefore some amendments may be required to the design layout defined above to allow the functions to map against the in-service display types. These amendments shall be determined on a case by case basis through the project or delivery team concerned and controlled by the GVA Office.

10.9 Environmental Resilience

The components of the HMI shall be resilient to the environmental conditions expected during normal use. For example the HMI shall be able to withstand: vibration, shock, dust and water ingress and other environmental issues including foreseen misuse (e.g. accidental rifle or boot strike to front of display during ingress and egress). These shall be defined in the SRD.

11 Health Usage and Monitoring System

11.1 Introduction

HUMS is the ability to gather, process, display and enable data export on-board the platform. HUMS is the input to System Information Exploitation (SIE) in a common message format that can be distributed and shared with other systems, solutions or applications. Further clarification on the relationship between HUMS and SIE is in GVA Guide available from the GPOC.

11.2 System Requirements

The system shall use the electronic infrastructure to gather, process, display and enable data export of HUMS data. This does not include the means to remove data from the platform.

An Ethernet socket shall be provided to enable off-board access to and export of the data from the platform.

All HUMS data shall be considered to be classified UNCLASSIFIED unless specified to the contrary and agreed by the GVA Office. Where sensitivities exist, the commander shall have the ability to stop (and then re-start) the collection of GPS or other positional data by the HUMS but this is never to be the default configuration.

Where applicable, the transfer of any HUMS data from a CANBus (MilCAN and/or SAE J1939) onto the LAN shall use the Land Data Model.

There shall be different levels of access for the crew and maintainers appropriate to their role through the common HMI. In determining the HUMS information to be displayed, the potential for 'information overload' shall be considered in line with the HMI definition document available from the GPOC.

System providers shall develop and deliver a through life HUMS management strategy to set a methodology to test, analyse and fix the threshold settings and diagnostic routines utilised by the HUMS.

11.3 Types of Data

11.3.1 Condition

The system shall automatically gather selected on-condition task data. Elements which cannot be gathered automatically will require the crew to provide the appropriate input.

Reliability Centred Maintenance (RCM) analysis provides the means to identify the relevant parameters to be monitored and is defined in Def Stan 00-45.

11.3.2 Status

The platform shall automatically gather the status of Mission Essential Systems (MES). MES (including mobility systems) shall be identified functionally in the system's Failure Criticality Matrix to be provided to and agreed with the GVA Office through the project or delivery team concerned.

The crew shall be informed of the status of Mission Critical Systems/ MES through the common HMI.

11.3.3 Utilisation

The system shall gather system usage data. Such data is to be related to expected failure modes and is likely to be different for different systems. It is possible for some items to have inferred utilisation e.g. from circuit breaker status rather than directly measured.

11.3.4 Configuration

The platform system shall automatically gather unique asset information for Line Replacement Units (LRU) and software configuration across the system,

Where manual entry is required, the system shall allow authorised users only to:

1. Update/edit the system configuration information for those assets which cannot conduct automatic update;

2. Update/edit the system configuration information for those assets where automatic entry has failed.

Note: LRU includes hardware and firmware elements

The system shall update the configuration record when new LRU and software updates have been added.

11.3.5 Failure

The platform system shall automatically generate an event record for all detected and predicted failures. The platform system shall enable manual generation of event records where the crew detect a failure and/or where additional information is required. The event record shall include:

1. Failure detection:
    a. Date/time;
    b. Failure type including fault codes;
    c. Vehicle location (GPS);
    d. Relevant situational/tactical information (including terrain type);
    e. Relevant measure of usage.
2. Failure acknowledgement:
    a. Date and time.
3. Failure rectification:
    a. Date and time;
    b. Actions undertaken.

11.3.6 Environment

The HUMS shall gather x-y-z acceleration of the platform chassis for an acceleration event. The default setting shall be for events in excess of 4g and shall be adjustable by a maintainer (not crew).

11.4 Data and Algorithm Ownership

The GVA Office shall have full and open access to data generated on its platforms, on-board diagnostic/prognostic algorithms and the outputs from on-board diagnostics/prognostics. Any commercial confidentiality issues identified by any party shall be raised so that the appropriate access controls can be put in place by the GVA Office.

11.4.1 Role Equipment

The HUMS shall gather the following information for role specific equipment on the platform:

1. Type of role equipment fitted;
2. Individual identifier for each type of role equipment fitted and NATO Stock Number (NSN) where available;
3. Operational status of each type of role equipment fitted.

11.5 Onboard Processing and Storage Requirements

11.5.1 Diagnostics

The HUMS functionality shall have an automated means of fault detection and isolation to the failed LRU. This may be supplemented by guidance to be provided to crew and/or maintainers to assist diagnostics. This function includes failure detection, failure isolation and built in test and includes the more general function of platform testability.

Detailed guidance on testability is given in Def Stan 00-42 Part 4 and this shall be used to determine the scope and requirements of all aspects of platform testability. Where appropriate, vehicles shall also comply with ISO 15031 which standardises the implementation of emissions related on-board diagnostics for heavy vehicles.

11.5.2 Prognostics

HUMS data shall be used to inform the crew of the useful working life of critical systems using the common HMI. Critical systems and their working life parameters shall be defined in the SRD by the project or delivery team concerned with the input of the GVA Office.

11.5.3 Frequency of Collection and Data Reduction

Frequency of capture and data reduction techniques used to reduce the impact of the stored data on both the on-board storage capability and the data transfer mechanism shall be determined in the SRD by the project or delivery team concerned in consultation with GVA Office.

11.5.4 Data Storage

The system shall store processed data/information for a period of no less than 4320 operational hours. The period is to cover a deployment of 6 months where there is no opportunity to download data.

11.5.5 HMI

The following HUMS data shall be available on the common crewstation:

- System/equipment on condition data (prognostics);
- System/equipment usage data;
- Configuration data;
- Failure records (diagnostics).

11.5.5.1 Event Logging

Events shall be logged automatically according to a predetermined set of rules and may be regarded as alerts for use in the HMI where appropriate, including but not limited to:

1. Vehicle start-up;

2. Excessive shock inflicted on the platform;

3. Excessive number of gear changes in a predetermined time;

4. Excessive engine revolutions, etc.

11.5.5.2 Failures

The platform shall indicate failures, or predicted failures, in the following classifications with an indication of their relative importance and in line with the HMI Definition Document:

A description (clear text) of the failure based on a fault code shall be provided through the common HMI to maintainers, including crew that are performing maintenance.

The common HMI shall display the embedded Interactive Electronic Technical Publication (IETP) module pertinent to the detected failure upon user request.

1. **Warnings.** Permanently continue to indicate failure, or predicted failure, unless:

    a. Corrective action is taken;

    b. Override is selected (but to reappear when either override is de-selected, every 30 minutes, at start up or shutdown).

2. **Cautions**. Can be acknowledged by crew but are to be repeated at start up and shutdown and every 2 hours until corrective action is taken;

3. **Advisory**. Can be acknowledged by crew but are to be repeated at start up and shutdown and every 24 hours until corrective action is taken.

11.6 Data Capture and Exploitation

11.6.1 Minimum Data Set

The HUMS system shall be configurable through-life to enable and disable access to available data as requirements for it develop or change.

This shall be a maintainer activity and shall be a supplier agnostic, rapid and inexpensive process.

The minimum default data set to be captured shall be:

1. Context	The following information shall be provided to enable the data captured to be contextualised:
a.	Date information captured;
b.	Time information captured;
c.	Location of platform when information captured defined as latitude and longitude.
2. Automotive	The following information shall be captured as the default configuration:
a.	Vehicle information fields:
i.	Vehicle Registration Number (also known as 'platform id');
ii.	Vehicle speed;
iii.	Vehicle distance travelled.
b.	Engine information fields:
i.	Percentage throttle demanded;
ii.	Percentage engine load delivered;
iii.	Engine hours run;
iv.	Engine rpm;
v.	Engine oil pressure;
vi.	Engine oil temperature;
vii.	Fuel consumption rate;
viii.	Air inlet temperature.
c.	Transmission information fields:
i.	Gearbox Oil temperature;
ii.	Gear selected;
iii.	Gear engaged.
d.	Cooling System information fields:
i.	Water temperature.
e.	Power System Information fields:
i.	Battery voltage (PE);
ii.	Battery voltage (TE);
f.	Reported faults.
3. Environment	The following shall be captured about the environment that the platform experienced to assist in the analysis of vehicle condition:
a.	x-y-z acceleration for an event in excess of 4g (default setting; see 11.3.6).
4. Role equipment	The following shall be captured for role specific equipment fitted to the vehicle:
a.	Type of Role equipment fitted;
b.	Individual identifier for each type of role equipment fitted;
c.	Operational status of each type of role equipment fitted.

Table 10: Minimum Data Set

11.6.2 Standard for Data Logging

On the platform, all relevant data shall be logged into a local file store, the format of which shall be:

#!# timestamp # topic # payload

For example:

#!#1269302401#local/Panther/FB16AB/J1939/speed-mph#20

#!#1269302402#local/Panther/FB16AB/J1939/throttle-%#10

where:

a. #!# - is a start mark to allow for multiple line payloads;

b. timestamp - the timestamp in seconds (since Jan 1 1970), though milliseconds can also be accommodated if required;

c. # - a separator;

d. topic - the message topic as further described below;

e. # - a separator;

f. payload - a payload , typically in text for readability but binary is also supported, though <cr>#!# would be read as a new record.

The topic shall be composed of:

bus id / platform type / platform id / sensor type / sensor id

where:

a. "bus id" is a name for a conceptual message bus within the broker and between brokers. "local/" shall be used to indicate the message is being sent local to the local broker;

b. "platform type" is the vehicle family, for example, Panther;

c. "platform id" is a unique identifier of the platform and shall be the vehicle registration number, for example, FB16AB;

d. "sensor type" identifies the unit sending or receiving the data, for example, J1939, sniper . It can also indicate virtual sensor types, for example "pos" - for position, which may have been derived from a sniper detector, or a compass or satellite link or other indicator of position. This allows data to be "flattened" into more common, more useable forms;

e. "sensor id" is a sub part of a sensor - for example engine-oil-temp-C for a J1939 unit. These shall include an indicator of measurement units to aid readability.

11.7 Off Board Data Transfer

11.7.1 Physical Transfer

It shall be possible, as a minimum, to access the data for export utilising any platform Ethernet interface and it shall be possible to load additional software for this purpose onto the system at a later date.

For the life of this version of this Def Stan, data will be transferred off-board using an Ethernet connection.

Where the opportunity arises and security conditions permit, data may be exported wirelessly, in which case, the IEEE 802.11 standard shall only apply with the agreement of the GVA Office.

11.7.2 Data Definitions

Taking account of the Minimum Data Set and the Data Logging Standards above the following HUMS data definition shall be used:

Topic Name	Data Type	Description
<channel>	String	A description of how the information is published, for example locally. Enumeration.
<vehicle-type>	String	Type / model of vehicle. Enumeration
<vehicle-reg>	String	Registration number. Enumeration.
GPS/pos	String	Normalized position, all fields are optional. Comma separated. Consisting of: • Timestamp (UTC) • Latitude (decimal degrees) • Longitude (decimal degrees) • Altitude • Speed • Heading • Tilt • Roll
J1939/oil-temp-C	String	Engine oil temperature, in C
J1939/air-inlet-temp	String	Air temperature at the engine inlet, in C
J1939/speed-kph	String	Speed, in kph to the nearest kph
J1939/gear	String	Current gear selection
J1939/battery-V	String	Battery voltage
J1939/water-temp-C	String	Water temperature, in C
J1939/errors	String	Reported faults - J1939 error messages
J1939/alert	String	Reported faults - Human readable alert message
J1939/engine-hours	String	Total Engine hours run
J1939/fuel-rate-mlph	String	Fuel Consumption rate (averaged/filtered)

Topic Name	Data Type	Description
J1939/selected-gear	String	Current gear selected
J1939/throttle-%	String	Percentage throttle demand (filtered)
J1939/engine-load-%	String	Percentage engine load delivered (filtered)
J1939/trip-km	String	Distance travelled in km
J1939/total-km	String	Total distance travelled in km
J1939/trip-fuel-used-l	String	Fuel this trip
tilt/rav	String	Rolling average g experienced, over last 10 seconds
tilt/alert	String	Alert string (if g shock greater than Xg)
tilt/GPS	String	Position of last vehicle shock, where the shock is greater that a defined value X
tilt/bump	String	Count of number of ‘bumps’ since start, a bump is defined as a shock > X/2.
tilt/pos	String	Normalized position of last vehicle shock

Table 11: HUMS Data Definitions

12 Validation and Verification

12.1 Verification

Verification is an assessment of the results of both the design/development processes and verification process carried out by a supplier, system integrator or designer. It sets out to prove that the requirements defined in this Def Stan have been followed and met.

Verification is not simply testing, as testing alone cannot always show the absence of errors. It is a combination of reviews, analysis and test.

12.2 Validation

Validation is an assessment to confirm that the requirements which define the intended use or application of the system have been met.

The overall intention is to build a vehicle that operates correctly for all the defined scenarios in the system CONUSE, noting that the CONUSE may change through life. Validation must also address the ability of the system to cope with various faults and failure modes.

12.3 Aspects of V&V

There are three aspects of V&V to be addressed:

1. Verification that the implementation by the system Design Authority (DA) meets the requirements of this Def Stan;

2. Verification that equipment designed to interface to the GVA meets the requirements of this Def Stan;

3. Validation by the system integrator that the implementation by the system DA together with the equipment connected to it performs in accordance with its intended use and the requirements of this Def Stan.

12.4 Verification Plan

A verification plan shall be written to define the verification process and will be part (where applicable) of the Integrated Test, Evaluation & Acceptance Plan (ITEAP).

The verification plan shall include:

1. The organisational verification responsibilities within the verification process;

2. A description of the verification methods to be used:

    a. Review methods, including check lists or other aids;

    b. Analysis methods, including traceability and coverage analysis.

3. A description establishing the methods for verification independence, where necessary. Independent verification may be needed for requirements that are of a safety critical or high security nature;

4. A description of verification tools, guidelines for using these tools, and any hardware test equipment;

5. Re-verification guidelines for system/design modifications;

6. For any previously developed or off-the-shelf equipment, a description of the methods to satisfy the objectives of this Def Stan.

12.5 Verification Cases and Procedures

Verification cases and procedures shall be produced that detail how the verification process activities are implemented. These shall include descriptions of the:

7. **Reviews and Analysis Procedures.** Details that are additional to the description in the verification plan that describe the scope and depth of the review or analysis methods to be used;

8. **Test Cases.** The purpose of each test case, inputs, conditions, expected results and pass/fail criteria. Also any dependence on the output of a previous test case;

9. **Test Procedures.** The step-by-step instructions of how each test case is to be set up and executed, how the test results are evaluated and under what test environment/conditions to be used. This is to ensure that all tests are repeatable.

Note in some cases there will be a single test and therefore one test case.

12.6 Verification Results

Verification results shall be produced from the verification process activities.

The verification results shall:

- Indicate each procedure that passed or failed during the activities, and the final pass/fail results, for each review, analysis and test;

- Identify the item (its configuration or version number) reviewed, analysed or tested;

- Include results of tests, reviews and analysis, including traceability analysis.

12.7 Further Guidance

Further guidance on V&V is available in the GVA guide available from the GPOC.

12.8 GVA Certification

A certification process is to be introduced in 2011 for products that intend to be compliant with Def Stan 23-09. Only products certificated using authorised test houses will be able to claim this compliance marking. Further information will be available from the GPOC.

13 Interface Control Document

13.1 Introduction

A defined ICD is necessary to ensure a consistent approach to interface definition to allow modification of the system capability through life.

For this purpose, an ICD shall be produced for the electronic and electrical infrastructure on the platform and for each of the sub-systems attached thereto. Such ICDs shall be approved by the GVA Office for both the platform and the functional elements being interfaced. The written format of these documents shall be agreed by the GVA Office through the project or delivery team concerned.

The GVA Office shall hold a library of ICDs that shall be populated by the project and delivery teams concerned.

13.2 ICD Structure

No single ICD format can cover all possible interfaces that may be present on a platform. Each interface shall be assessed individually against the relevant sections of the Def Stan. The structure below shall be adhered to and the content represents the minimum information required, further solution specific information shall be included as required.

A. General Content

1. SRD number or other specific reference document for which the equipment was designed;

2. Constraints applied in design and integration and the reasons for the decisions taken;

3. The processes undertaken to verify and validate the equipment and its interface(s), including test and compliance criteria;

4. Detail of compliance with Def Stan 59-411Land Class A, Electro-Magnetic Compatibility.

B. Electronic Interfaces and Standards

1. Standards and protocols use, including version numbers;

2. Connectors:

    a. Location;

    b. Manufacturer and part number;

    c. Polarisation;

    d. Pin-outs;

    e. Labelling.

3. DDS: vendor and version of software used;

4. DDSI: version used;

5. Land Data Model:

    a. Topics published;

b. Topics subscribed to;

c. Quality of service required;

d. Data model version used.

6. Video: Def Stan 00-82 Digital Video Distribution:

a. Def Stan version used

b. Device type (transmitter, receiver, both)

c. List of supported video formats (resolution, encoding format, frame rate)

d. Metadata.

C. Power Interfaces and Standards

1. Detail of compliance with Def Stan 61-5 Part 6, Electrical Systems for Military Platforms;

2. Standards including version numbers;

3. Requirements for voltage & current;

4. Limits: under voltage /over voltage lock outs;

5. Power dissipation and /or cooling requirements;

6. Connectors:

a. Location;

b. Manufacturer and part number;

c. Polarisation;

d. Pin-outs;

e. Labelling.

7. Details of earthing solution as appropriate.

D. Mechanical Interfaces

1. Physical dimensions of equipment;

2. Weight, and centre of mass if relevant;

3. Mounting points.

E. HMI

1. HFI requirements placed on the crewstation for the new equipment, e.g. allocation of menus sub-menus, or buttons to control functionality;

2. HFI requirements placed upon the equipment by the crewstation e.g. expected response to already defined crewstation functionality such as purge commands;

3. HFI Standards including version numbers;

4. Version of the HMI Definition Documents used.

F. HUMS

1. The data set used to collect system and sub-system data together with the data types, the limiting collection parameters used and frequency of collection;

2. Details of any embedded diagnostics or prognostics;

3. Details of how to reconfigure the data set;

4. Details of the volume reduction techniques used;

5. Reference to the through life HUMS management strategy (see 11.2).

G. Safety

Reference to the safety case for equipment and/or software.

H. Security

1. Any specific data security requirements of the interface;

2. Data retention and protection policies pertaining to the equipment and its effect on the infrastructure.

Annex A Normative References

The following documents and publications are referred to in this Def Stan. The latest versions of these documents and publications shall be used, except where a version is stated below. In such cases guidance can be gained from the GPOC.

Def Stan 00-25 Part 14	Human Factors for Designers of Equipment – Military Land Vehicle Design
Def Stan 00-250 Part 0	Human Factors for Designers of Systems – Human Factors Integration
Def Stan 00-250 Part 1	Human Factors for Designers of Systems – Overarching People-Related Requirements
Def Stan 00-250 Part 2	Human Factors for Designers of Systems – Particular People-Related Requirements
Def Stan 00-250 Part 3	Human Factors for Designers of Systems – Technical Guidance
Def Stan 00-35	Environmental Handbook for Defence Material
Def Stan 00-42 Part 4	Reliability and Maintainability (R&M) Assurance Guide - Testability
Def Stan 00-45	Using Reliability Centred Maintenance to Manage Engineering Failures
Def Stan 00-82	Digital Video Distribution
Def Stan 59-35	Requirements for Cable Accessories to be Used with Electrical Connectors
Def Stan 59-411	Electromagnetic Compatibility
Def Stan 61-12	Wires, Cords and Cables, Electrical – Metric Units
Def Stan 61-5 Part 6	Nominal 12V and 24V DC Electrical Systems in Military Platforms – 28V DC Electrical Systems in Military Vehicles
Def Stan 61-5	Low Voltage Electrical Power Supply Systems

Force Protection ECM EMC Control Plan (Tailored Limits) – Available through the GPOC

Generic Vehicle Architecture Guide – Available from the GPOC

Human Machine Interface Definition Document – Available from the GPOC

IEEE 802.11	Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
IEEE 802.3ab	1000BASE-T Gbit/s Ethernet over twisted pair at 1 Gbit/s (125 MB/s), 1999
ISO 15031	Road Vehicles – Communication Between Vehicle and External Equipment for Emissions-Related Diagnostics
ISO 2941-303:2008	Ergonomics of Human Systems Interaction- Part 3: Requirements of Electronic Visual Displays
ISO/IEC 11801	Information Technology – Generic Cabling for Customer Premises
ISO/IEC 14496	Information Technology – Coding of Audio-Visual Objects
ISO/IEC 15444-1	Information Technology – JPEG 2000 Image Coding System: Core Coding System

JSP 440	The Defence Manual of Security
Land Data Model	Available from the GPOC.
MIL-PRF-29504	Termini, Fibre Optic Connector, Removable, General Specification For
OMG DDS	Data Distribution Service for Real-Time Systems (DDS)
Real-time Publish-Subscribe Wire Protocol DDS Interoperability Wire Protocol Specification, Version 2.1, OMG, Jan 2009	
RFC	Network Time Protocol Version 4: Protocol and Algorithms Specification
RS422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
SAE J1939	Recommended Practice for a Serial Control and Communications Vehicle Network
SDIP-27	NATO TEMPEST Requirements and Evaluation Procedures
SDIP-29	Facility Design Criteria and Installation of Electrical Equipment for the Processing of Classified Information

Annex B Abbreviations

APU	Auxiliary Power Unit
C2	Command and Control
COM	Communications
DIAN	Defence Information Assurance Notices
DCDU	Direct Current Distribution Unit
DDSI	Data Distribution Service Interoperability
Def Stan	Defence Standard
D LE	Director Land Equipment (DE&S, UK MOD)
DRV	Driving Aids
ECM	Electronic Counter Measures
FP	Force Protection
GPOC	GVA Point of Contact
GVA	Generic Vehicle Architecture
HMI	Human Machine Interface
IA	Information Assurance
IEC	International Electrotechnical Commission
IP	Internet Protocol
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance
ITT	Invitation to Tender
JSP	Joint Services Publication
LAN	Local Area Network
LRU	Line Replaceable Unit
MES	Mission Essential Systems
MIL-PRF	Military Performance
MPEG	Moving Picture Experts Group
BMS	Battle Management System
CANBus	Controller Area Network Bus
COTS	Commercial Off The Shelf
DC	Direct Current
DDS	Data Distribution Service
DEF	Defensive Systems
DE&S	Defence Equipment and Support (UK MOD)
DLOD	Defence Lines of Development
DStan	UK Defence Standardization
EMC	Electro-Magnetic Compatibility
GPI	Gun Position Indicator
GPS	Global Positioning System
HF	Human Factors
HUMS	Health and Usage Monitoring Systems
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organisation
ITEAP	Integrated Test Evaluation and Acceptance Plan
JPEG	Joint Photographic Experts Group
KSR	Key System Requirement
LOSA	Land Open Systems Architecture
LSAS	Local Situational Awareness Systems
MilCAN	Military Controller Area Network
MLS	Multi-Level Secure
MOD	Ministry of Defence

MOTS	Military Off-The-Shelf
N/C	Not Connected
NSN	NATO Stock Number
PDT	Power Distribution Terminal
PWS	Protected Weapon Station
RCM	Reliability Centred Maintenance
RWS	Remote Weapon Station
SAE	Society of Automotive Engineers
SIE	System Information Exploitation
STR	Special to Role
TE	Terminal Equipment
URD	User Requirements Document
V&V	Verification and Validation
VTID	Vehicle Technology Integration Demonstrator
WPN	Weapon System
NATO	North Atlantic Treaty Organisation
NEC	Network Enabled Capability
OMG	Object Management Group
PE	Platform Equipment
RADHAZ	Radiation Hazard
RFC	Request for Comments
SA	Situational Awareness
SDIP	SECAN Doctrine and Information Publications
SRD	System Requirement Document
SYS	System Status
TTP	Time Triggered Protocol
USB	Universal Serial Bus
VSI	Vehicle Systems Integration
WMIK	Weapons Mounted Installation Kit

Defence Standards are published by and obtainable from:

Defence Equipment and Support

UK Defence Standardization

Kentigern House

65 Brown Street

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File Reference

The DStan file reference relating to work on this standard is D/DStan/36/9

Contract Requirements

When Defence Standards are incorporated into contracts users are responsible for their correct application and for complying with contractual and statutory requirements. Compliance with a Defence Standard does not in itself confer immunity from legal obligations.

Revision of Defence Standards

Defence Standards are revised as necessary by an up issue or amendment. It is important that users of Defence Standards should ascertain that they are in possession of the latest issue or amendment. Information on all Defence Standards can be found on the DStan Website www.dstan.mod.uk, updated weekly and supplemented regularly by Standards in Defence News (SID News). Any person who, when making use of a Defence Standard encounters an inaccuracy or ambiguity is requested to notify UK Defence Standardization (DStan) without delay in order that the matter may be investigated and appropriate action taken. Sponsors and authors shall refer to Def Stan 00-00 part 2 before proceeding with any standards work.