



Delivering Dismounted Effect

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**ADMINISTRATION PAGE**

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EXECUTIVE SUMMARY

Historically the mounted and dismounted domains have been managed concurrently but within different organisations, and whilst cognisant of each other, they lack synergy. Feedback from operations and training suggests that there are persistent integration issues resulting from the conflicting approach of either soldier or platform primacy. The driver behind this research was to understand how integration could be effected better at all levels across the Mounted and Dismounted Close Combat capability domain.

Specifically, the aim of this DCC-MCC (Dismounted and Mounted Close Combat) Integration Study was to deliver a series of Integration guiding principles, exploitable by the Army's capability development and equipment programmes.

This study aim was achieved by capturing and defining the key issues prevalent in the DCC-MCC environment, by means of a review of operational and training feedback literature, an analysis of use cases to identify interface requirements against tasks, and through stakeholder engagement workshops. The scope of the work was bounded to all land platforms operating within the context of Future Force 2020 (FF2020) Military Tasks and in all anticipated environments.

The study sought to identify fundamental Integration guiding principles to consider when embarking upon any project involving mounted or dismounted personnel, and for related acquisitions. Consequently, this research identified two broad sub categories of Integration guiding principles in the DCC-MCC domain, covering 'Overarching Principles' and 'Programme Principles'. The overarching principles provide guidance for an overall procurement and structural approach, and the programme principles focus on achieving integration between and within DCC and MCC procurement programmes.

The DCC-MCC Integration guiding principles established to enhance Combat Effectiveness are:

Overarching

- **Planning for integration risk**
- **Doctrine coherence**
- **Integrated training**

Programme

- **Dismount workload**
- **Platform crew mental workload**
- **Dismount support to platform combat effectiveness**
- **Platform support to dismount combat effectiveness**
- **Maintain capability in transition**
- **Platform capacity**
- **Interface standardisation**
- **Communications**
- **Situational awareness**

The Integration guiding principles developed provide an informed and evidenced basis against which future capability should be guided and should now be exploited in guidance documentation, the derivation of requirements, and system design.



The study also delivered a series of frameworks and architectures that are exploitable by desk officers and researchers within the DCC-MCC Integration domain: DCC-MCC use cases; Integration Issues Framework; Mounted/Dismounted Architecture views and an Interface Matrix.

The LORST¹/OOST analysis reviewed over 60,000 operational issues and identified over 400 DCC-MCC issues, of which:

- 61% concerned Physical Ergonomics relating to 'Fitness to Fight'² and Sustainability of the integrated capability;
- 18% concerned Training;
- 15% concerned Situational Awareness and related Communications for both platform personnel and the dismounts;
- 6% concerned Doctrine complexity and shortfall.

The issues collated in the Task Breakdown workshop broadly mirrored those collated from the LORST/OOST³ reports. The frequency of issue occurrence was noted and this knowledge contributed to the arguments as to whether these issues can be regarded as being critical or enduring. Physical and Information interfaces constitute the highest number of interfaces, and place a particular burden on soldier sight and touch/manipulation (hands).

A large number of historical and current issues relating to mounted and dismounted integration were also identified from the literature reviews and these included:

- Doctrinal complexity and shortfall;
- The delivery of Situational Awareness to both the platform and dismount through a communications network;
- Physical ergonomics and sustaining the integrated capability (including provision of power and data);
- Training issues.

It identified that the previous management structure of the Army historically contributed to the incoherence and often conflicting needs of the dismounted and mounted domains. The study highlighted the additional interface complexity faced by both the platform personnel and dismounts when operating together and the need for greater architectural coherence. The interfaces were grouped into three main categories - Information, Physical and Power - which retains coherence with existing architectural work for the Soldier and Platform/Vehicle Systems.

The study recommends that in order to support future DCC-MCC programmes the following additional work is undertaken:

¹ Land Operational Research for Science and Technology.

² The term 'Physical (Fit to Fight)' relates to the "Physical Integration" aspects covering the physical issues that enable the dismount to be 'fit to fight' when they reach their destination.

³ Operational Observations for Science and Technology.



- An investigation into the Situational Awareness and communications requirements in the mounted and dismounted environment. This would further refine the Information Exchange Requirements and inform the MORPHEUS stakeholder community of the particular challenges of integrating Dismounted Situational Awareness and platform situational awareness.
- Detailed ergonomic analysis across a varied platform fleet to mitigate a large number of legacy issues and start to identify solutions that can be applied to existing or future capability thus enabling a system-level view of capability integration of multiple interfaces and elements.
- The definition of integration-focussed requirements is conducted and contributed to associated programmes (Mechanised Infantry Vehicle (MIV), Dismounted Situational Awareness (DSA), MORPHEUS, etc.)
- The development of DCC-MCC bespoke BFM for exploitation in operational analysis (OA), experimentation and to provide much needed context for the capability to develop further.



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1 INTRODUCTION

Historically the mounted and dismounted domains have been managed concurrently but within different organisations, and whilst cognisant of each other, they lack synergy. Feedback from operations and training suggests that there are persistent integration issues resulting from the conflicting approach of either soldier or platform primacy (from the dismounted and mounted domains respectively). The development of future Army structures (FF2020) demonstrates a change of approach towards an integrated solution for force levels and organisation, reinforcing the requirement to establish a coherent approach to the mounted and dismounted domains. DCC-MCC Integration is the first step in this process and its scope includes all land platforms (manned and autonomous) and the environmental and operational spectrum identified through FF2020. The output of this research is intended to enable the MoD to manage this integration risk. This study broadly examines the dismount soldier and vehicle interface to highlight areas worthy of more detailed examination. As such it concentrates principally upon the dismounts and parent vehicles and thus excludes interfacing to other vehicle types such as heavy armour.

1.1 CONTRACTUAL

DCC-MCC Integration Study has been conducted as part of Delivering Dismounted Effect (DDE) Engine Room activities and conducted by the DDE Consortia in close liaison with the Dstl Land Environment Group.

1.2 BACKGROUND

Previous MOD vehicle Human Factors Integration (HFI) work (and the resultant guidance that has been developed⁴) has primarily focused on the vehicle crew (driver, commander, gunner etc.) and less so on any dismounted passengers. Anecdotal evidence indicates these dismounted personnel have poor physical and cognitive performance (including situational awareness) operating with, and travelling in, vehicles due to integration issues. Current practice is for each individual vehicle programme to be responsible for defining the integration required with the DCC soldier. This approach has led to varying levels of integration effectiveness.

1.3 AIM

The aim of this DCC-MCC Integration Study is to improve the understanding of the integration issues and human related concerns⁵, and as a result to provide guidance for desk officers, requirements managers, system designers and researchers interested in the dismounted and mounted close-combat capability areas:

- Articulating the close combat mounted problem space (where platforms and dismounted personnel operate together as part of a coherent capability).
- Establishing a set of 'Integration guiding principles' for application in capability development.

⁴ Arrowsmith, C., Bond, R., Oudenhuijzen, A., Roche, A. (2014) Human Systems Integration for Land Vehicles WP1 D2 Technical Guide TIN 2.034. DHCSTC report reference: UC-DHCSTC_I2_H_T2_034/003.

⁵ includes those relating to Physical HF, Dismounted Power & Data (DSA), SA, and C2.



1.4 OBJECTIVES

To support the aim, the component objectives for the study are to:

- Establish existing evidence regarding DCC-MCC Integration problems by collating historical integration issues from operations, research and training.
- Identify and present the key interfaces between dismounted personnel and vehicles across the scope of operations and the environment.
- Identify the tactical tasks and operations that are affected by these interfaces and integration requirements.
- Identify DLOD Integration issues.
- Develop and test a set of DCC-MCC Integration guiding principles.

A presentation, developed and updated through the study, provides a useful summary of the work undertaken and can be seen at Annex A.

1.5 REPORT STRUCTURE

The report is structured as follows:

- Section 2 – the study Method applied;
- Section 3 - the Integration Issues captured and the derived Integration guiding principles;
- Section 4 – the study Conclusions and Recommendations;
- Section 5 – Inclusions;
- Supporting Annexes.



- Help understand existing policy requirements;
- Support the creation of an Integration Issues Framework for capturing key issues and recommendations.

Further detail regarding the Literature Review can be found at Annex B.

2.1.2 Stakeholder Workshops

A series of workshops were conducted throughout the study to inform the investigation and analysis, these included:

- An initial Task Breakdown workshop, led by Dstl on 27 July 2015, was used to explore the key issues associated with DCC-MCC Integration.
- A Stakeholder Workshop on 13 January 2016 was used to expose the developing integration work to the military, supplier and research stakeholders and thus gain their inputs and feedback. The workshop approach is outlined at Annex D.
- An Integration Principles Workshop conducted on 21 January 2016 to discuss and refine the Integration guiding principles.

2.1.2.1 Task Breakdown Workshop

This workshop collated a set of task and integration issues, grouping them within the following framework:

- Situational Awareness & Information Exchange;
- Physical Integration;
- General Issues.

This framework provided the basis for work conducted to identify and capture Integration Issues as well as providing a reference database for the production of the use cases.

2.1.2.2 Stakeholder Workshop

This workshop engaged the stakeholders by conducting the following discussion sessions:

- Integration Issues based on the collected issues and the Issues Framework;
- Interfaces initiated through presentations of relevant architecture views and the interface matrix;
- The DLOD Review Framework.

The opportunity was taken to brief the Stakeholders on the Integration guiding principles part of the study and to capture their initial thoughts regarding utility and need. The key points of note from this workshop were:

- This study resonates with the approach the Army is taking in developing FF2020, particularly regards the development of management structures and force organisation;
- The need to ensure coherence across programmes, such as MIV, MORPHEUS and DSA, which are dealing with similar issues;
- That the Stakeholders agreed the principal integration issues were being captured but that caution was needed to ensure balance between HERRICK and Contingency Operational requirements, and to take account of where soldier behaviours were deviating from those required, e.g. use of seat belts and hearing protection;
- The need for coherence between generic vehicle and soldier architectures especially given the large number of vehicle Design Authorities and the lack of an overarching responsible authority;



- The capture of DLOD Framework enhancements covering Training, Doctrine and Concepts, and Information plus the concern raised about the lack of a coherent mounted and dismounted management structure.

2.2 DEVELOPMENT OF USE CASES

2.2.1 Introduction

In order to articulate context to the DCC-MCC problem space a task-based framework, expressing the missions and activities of the mounted and dismounted elements, was needed. Given that insufficient study time existed to develop a series of Battlefield Missions (BFMs), to link planning assumptions and detailed tasks and requirements, it was decided to exploit the existing DCC use case library activities that were applicable to the mounted space. These selected use cases, extended where appropriate, will provide the building blocks from which the Battlefield Missions can be developed at a later date.

The main aim of developing these use cases was to identify and capture tasks relating specifically to DCC-MCC integration to ensure that the key DCC-MCC interfaces were identified and defined. The opportunity was also taken to extend these existing Use Cases to incorporate greater detail covering human functionality and human-centric requirements within such tasks.

The use cases detail the tasks required of the dismounted and mounted operators when conducting specific operational activities, such as 'moving tactically' or 'locating the enemy', and provide a layered task framework that can be used to model the mounted space to support the analysis required.

As a result the following amendments were made to the Use case library:

- Develop Existing Use Cases:
 - Add decisions and amend/add tasks that were not captured in each use case;
 - Develop the Information Requirements against each task.
- Categorise each task by human function (sensory, physical and cognitive);
- Develop any additional Use cases required to ensure full coverage of the DCC-MCC problem space.

A detailed explanation of the approach can be found at Annex E.

2.2.2 Outcomes

The principal outcomes of this work were:

- 'Move Tactically by Platform' was the only new use case that needed to be developed as all other use cases were directly relevant to the mounted-dismounted domain. Most physical and cognitive tasks are applicable to both the mounted and dismounted state, which meant minimal need for developing new use cases. The relevant extant use cases were updated to fully capture the needs of the mounted/dismounted soldier;
- The categorisation of individual tasks by human function⁶ enabled a more objective method to identify cognitive and physical burden of the soldier, and more clearly articulates the concurrency and sequencing of task nature. This method can be used to accurately determine the burden on the dismount and platform crew over all tactical tasks;

⁶ Sensory, cognitive, psychomotor and physical stress / effort.



- The use case development updated the information requirements of each task, creating a more comprehensive and exploitable framework that determines information flow, content and quality for each use case. As a result, Information Exchange Requirements (IERs) can now be clearly determined for the mounted-dismounted domain. This is also of utility for information modelling in support of information-based programmes, e.g. DSA, platform programme C4I, MORPHEUS, etc.;
- The links between ‘Scenario – BFM – use cases – requirements’ have been strengthened and expanded to capture the physical and cognitive functions of the human at the centre of the system. Future work should consider incorporating the developed use cases within BFM as this would enable a more objective analysis of task duration and burden to be achieved.

2.3 INTERFACE IDENTIFICATION AND ASSESSMENT

2.3.1 Overview

This work sought to identify the key interfaces between DCC infantry and vehicles, and the vehicle crew members, in order to inform integration assessment activities, and to provide input to existing architectures (SSA, GSA, GVA) and the research programmes.

The Soldier System Architecture (SSA)⁷, aligned with the Generic Soldier Architecture (GSA) and the Generic Vehicle Architecture (GVA), provided the principal input to this work as it had identified and mapped vehicle interfaces against the DCC Soldier and his equipment. These interfaces were also mapped to the DCC use case library so providing relationships with specific soldier activities and tasks.

The interfaces were categorised through the following process:

- Identifying the Interface Zones⁸ and Operating States⁹ for both Soldier and Vehicle Platform to produce a layered framework. For the Soldier System the layers encompass the Human, the Protection System, the Load Carriage System and the Soldier Systems (effector, sensor, mission specific equipment, and communications);
- Capturing the physical, information (data) and power interfaces within and between soldier systems, the platform system and the environment;
- Updating and maintaining the related links to Integration Issues and Use cases.

This analysis, represented in Figure 2, identified the discrete and cross-layer interfaces within each system, and included capabilities that may exist in the future, e.g. soldier-based Health and Usage Monitoring Systems (HUMS), wireless technologies, etc. Note that Figure 2 illustrates every interface that has been identified and does not relate to a specific platform.

The identified interfaces were then analysed to determine ‘integration points’ between the ‘entities’; in this case, the soldier and the vehicle. Where there appeared to be gaps a further analysis was conducted to ensure all relevant interfaces had been captured. A detailed description of this work is at Annex F.

⁷ SEA Ref: Soldier System Architecture (SSA), as detailed within the accompanying User Guide (SEA/14/TR/12461).

⁸ For the soldier the zones equate to Helmet, Torso and Weapon, and for the vehicle platforms the zones are the Station, the Passenger Zone, and the Platform.

⁹ Covers Mounted (Mobile or Static), Transition (Embus and Debus), Dismounted (Moving) and Dismounted (Static).

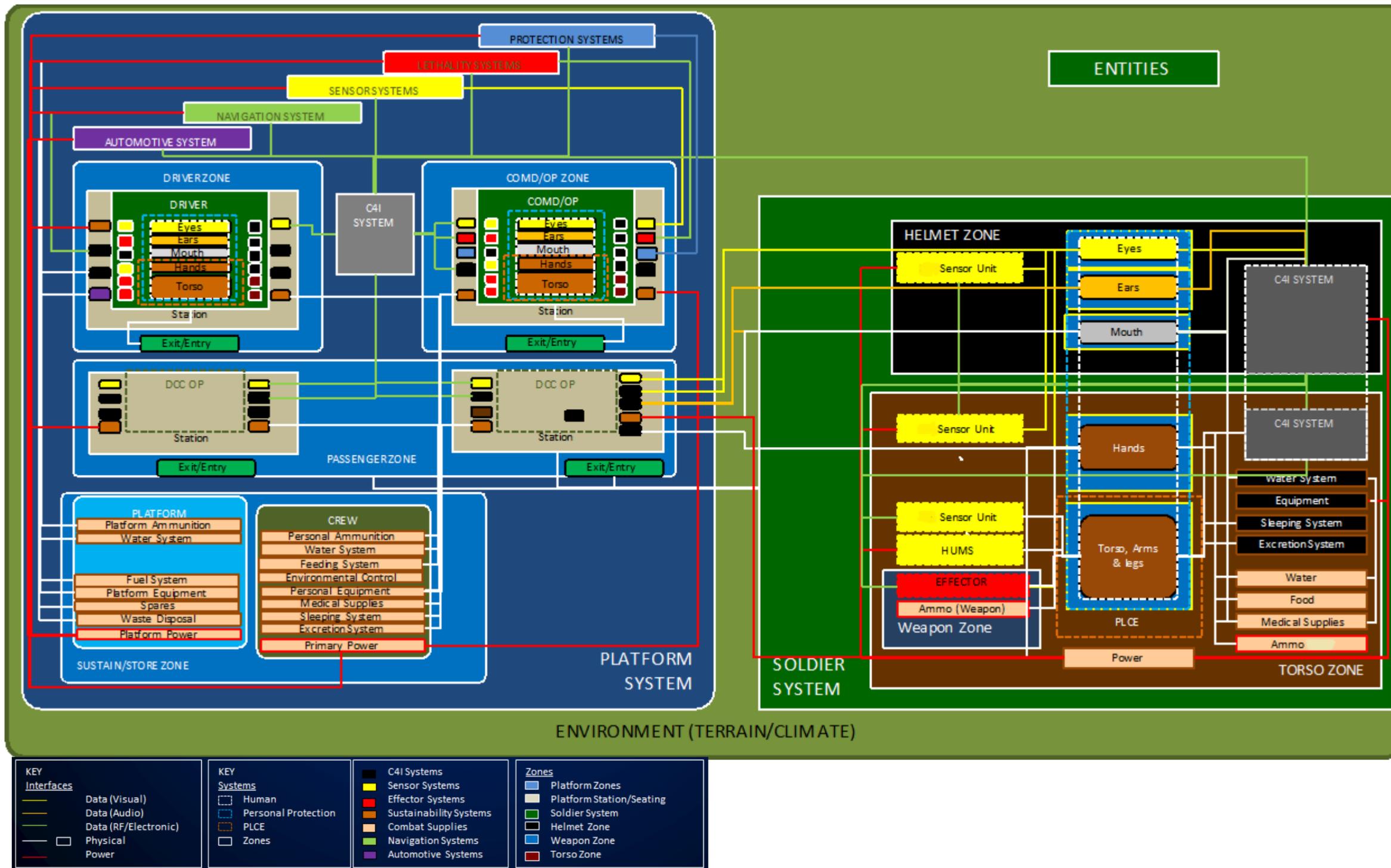


Figure 2 - Architecture view showing representation of mounted and dismantled interfaces.



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2.3.2 Interface Categorisation

The interface work identified and recorded the functional, information, cognitive, physical and electromagnetic interfaces within the DCC-MCC domain, via architectural views and tabular matrix format, see Annex F.

There are a large number of interfaces that exist within the soldier system and these have to be sustained in both the dismounted and mounted state. These catalogued interfaces have been grouped into three main categories - Information, Physical and Power – which is coherent with existing architectural work for the Soldier and Platform/Vehicle Systems. The different interface categories are:

- **Information Interfaces** - incorporating all mediums through which information is passed:
 - From a human perspective this relates to visual, auditory and haptic¹⁰ mechanisms;
 - From a technical perspective this relates to, information systems hosted upon voice and data communications systems and networks.
- **Physical Interfaces** - include all the interfaces involving solids, liquids and gases:
 - From a human perspective this includes physical touch and feel, respiratory, alimentary and nervous system components with temperature a key parameter;
 - From a technical perspective this includes all 'matter' interfaces, but particularly solid to solid and environmental control systems.
- **Power interfaces** - relate to the interfaces across which electrical power is transmitted.
 - Technically this relates to stored charge and recharging mechanisms, and their interconnection devices to soldier or platform hosted devices;
 - Generally these interfaces involve transmission of power to or from devices carried or worn by the soldier, however an example of a direct power interface with the soldier is human power generation devices.

Another important consideration is that interfaces can be temporary or permanent, and for these interfaces it is important to understand any time criteria that applies. The interface matrix captured whether interfaces are permanent (P), regular (R) or occasional (O) by determining the permanent and temporary nature of interfaces in differing operating states (relationship) between the dismount and platform. The Operating States analysis proved highly useful to capture the variations in interface persistence, and further BFM based analysis will be necessary to capture these characteristics more fully. Also no prioritisation has been applied to the interfaces and thus any future capability development work might benefit from such consideration.

2.3.3 Assessing the Interfaces

The assessment activity sought to identify and better understand the key integration issues and human related concerns related to DCC-MCC integration with particular focus on those relating to physical integration, integration of dismounted power and data, situational awareness and command and control. This was achieved by consolidating and extracting relevant GFI and exploitation of stakeholder engagement (through the stakeholder workshops) to identify:

- Operational and doctrinal Integration Issues.
- Physical and Cognitive (HF)/Equipment Integration Issues.
- Electronic and RF Integration Issues.
- Power and Data Integration Issues.

¹⁰ Olfactory can also be included in this grouping



These Mounted/Dismounted Interface Issues, presented in section 3, were reviewed and collated to provide a coherent categorisation of the integration issues within the Issues Framework.



3 FINDINGS

This section documents the results of the approach undertaken and covers Integration Issues, Integration guiding principles and associated DLOD Issues.

3.1 INTEGRATION ISSUES

3.1.1 Assessment Outcomes

The LORST¹¹/OOST analysis reviewed over 60,000 operational issues and identified over 400 DCC-MCC issues, of which:

- 61% concerned Physical (Fit to Fight)¹² and Sustainability;
- 18% concerned Training;
- 15% concerned Situational Awareness and Communications;
- 6% concerned Doctrine and Capability.

The issues collated in the Task Breakdown workshop broadly mirrored those collated from the LORST/OOST¹³ reports. The frequency of issue occurrence was noted and this knowledge contributed to the arguments as to whether these issues can be regarded as being critical or enduring.

Physical and Information interfaces constitute the highest number of interfaces, and place a particular burden on soldier sight and touch/manipulation (hands). This often leads to the requirement for the soldier to manage a number of interfaces concurrently or in rapid sequence. This complexity is further compounded as the existing soldier system interfaces are not supplanted by equivalent vehicle interfaces and still need to be maintained. The need to transition interfaces (e.g. intra-soldier system to soldier-platform system) further complicates matters for the soldier.

The following observations were made against the issues captured:

- The vast majority related to the relationship between the individual and the platform; notably the physical (whilst mounted, transitioning and dismounted) and cognitive (Situational Awareness);
- Almost all such issues covered the routine and 'normal' tasks conducted by soldiers when operating with vehicles;
- Doctrinal and capability issues related to the lack of, or confusion with, existing doctrine for operating with platforms, compounded by the large number of vehicle types that dismounts have to operate with;
- There are a large number of issues relating to command relationships and the realities of command and control within the mounted and dismounted states;
- Situational awareness and communications issues are significant and probably constitute the highest priority for mounted operations;
- The inability for dismounts to understand or be informed (by voice or data) during all states (mounted, dismounted and transitional) is a critical issue, as is the additional burden on the vehicle commanders to ensure that dismounts and crew understand the situation;

¹¹ Land Operational Research for Science and Technology.

¹² The term 'Physical (Fit to Fight)' relates to the "Physical Integration" aspects covering the physical issues that enable the dismount to be 'fit to fight' when they reach their destination.

¹³ Operational Observations for Science and Technology.



- Physical Integration issues were numerous and mostly focussed on the comfort of the soldier (and his equipment) whilst mounted and during transition from mounted to dismounted;
- Maintaining capability through comfort, rest and the ability to recharge (water, power, and food) was also a repeated concern;
- Training issues constituted a notable part of the issues summary and related, for the most part to a lack of training and familiarisation with platforms prior to deployment on operations.

3.1.2 Issues Summary

A detailed description of the integration issues identified can be found at Annex G. The summarised headline integration issues discovered were:

- **Doctrine & Capability.** Doctrinal implications of contingent and intervention operations. Command and Control issues, ranging from:
 - Complexity of organisation;
 - The ability for commanders to communicate with platforms and dismounts;
 - Over burdening of platform commanders and dual responsibility of commanding the platform AND commanding the dismounted or integrated battle.
 - Organisation variation and complexity, driven by capacity limitations and hierarchical legacy organisation over a highly varied platform fleet.
- **Situational Awareness & Communications.** A significant number of issues that cover the current shortfalls, and an anticipation of emerging issues including:
 - Situational awareness of dismounts and platform crews in the mounted, dismounted and transitional states;
 - Intra-platform, inter-unit and multinational communications issues by voice (radio communications);
 - ISTAR issues between the platform and dismount.
- **Physical (Fit to Fight) and Sustainability.** The largest set of issues, that covered most of the physical interfaces between the dismount, the crew and the platform and included dismount/platform configurations, physical integration aspects and tasks, the human senses and individual and team sustainability issues, equipment, power, protection, casualty and POW management.
- **Training.** A small but significant area of issues that links to all other identified issues including:
 - Training preparation (over and under-training);
 - Live Firing Training, and the lack of live firing training in preparation for mounted operations;
 - Lack of emergency drills training.



3.2 DCC-MCC INTEGRATION GUIDING PRINCIPLES

3.2.1 Introduction

DCC-MCC Integration guiding principles aim to enhance the combat effectiveness of the integrated capability by providing direction and guidance to all stages of capability development and the acquisition cycle. The principles are enduring and can be applied to legacy and future capability and will assist in the derivation of doctrine, concepts, requirements and systems to develop a fully integrated capability. They directly complement and enhance the more integrated approach recently adopted by the MOD to further develop FF2020 and apply to all land platforms (manned and unmanned) and dismounted operators operating at tactical or operational level. The principles were developed from the output of the integration issues, interfaces, DLOD review and use case work conducted in the study.

An Integration guiding principle is an enduring, high level, aspirational concept that directs, guides and informs the whole process of defining integration requirements and designing integration solutions.

High level principles provide a small set of concise overarching statements that guide the development of lower level concepts. In particular, the definition of a set of requirements for a programme, and the subsequent development of an optimised design to meet those requirements, involves a series of trade-offs. The Integration guiding principles should strongly inform those trade-offs.

The Integration guiding principles are intended for anyone involved in:

- Generating or informing requirements for Soldier Systems or vehicles;
- The trade-off process for system/equipment designs for Soldier Systems or vehicles;
- Authorising or approving the procurement of systems/equipment.

3.2.2 Overarching Principles

The Workshop process used to generate and refine these principles identified that they fell into two classes. The majority of principles provided guidance on the delivery of integration within and between procurement programmes, but there were some overarching principles, which provided guidance to the overall procurement approach and structure. The former have been designated 'Programme Principles' and the latter have been highlighted as 'Overarching Principles'.

3.2.3 Integration Guiding Principles

The following principles were established:

Overarching Principles

1. **Planning for integration risk** - All programmes that involve any potential integration between platforms and dismounts should conduct an appropriate level of integration de-risking at the outset and throughout the lifecycle of the Programme.
2. **Doctrine coherence** - Doctrine development to support platform and dismount integration capability should complement integrated Concepts and be approached iteratively, cognisant of emerging organisations and systems. Awareness of DCC-MCC Integration should be maintained at a doctrinal level in order to manage incoherent platform mixes and organisational variations.



3. **Integrated training** – Integrated DCC-MCC training capability requirements should be determined at the beginning of the capability development process such that integrated Platform and Dismount capability acquisition maximises blended training, minimises training burden and facilitates federated training.

Programme Principles

4. **Dismount workload** - The Dismount-Platform integration should optimise the Dismount's physical and mental workload in all operating states (usually this will be a reduction in workload). The Platform should carry any additional burden¹⁴ arising from DCC-MCC Integration wherever possible.
5. **Platform crew mental workload** - Integration with Dismounts should optimise the Platform crew's mental workload in all operating states (usually this will be a reduction in mental workload).
6. **Dismount support to platform combat effectiveness** - Integration with Dismounts must complement the combat effectiveness of the Platform. Dismount integration must optimise the preparation, conduct and sustainment of all operational capabilities of the Platform.
7. **Platform support to dismount combat effectiveness** - The combat effectiveness of the Dismounts should be maintained or enhanced through replenishment, sustainment and protection, in all operating states, by integration with the Platform.
8. **Maintain capability in transition** - The Dismount-Platform integration should not impose any additional physical or cognitive workload on the Dismounts when transitioning between the mounted and dismounted states (i.e. embussing or debussing).
9. **Platform capacity** - Platforms shall provide sufficient secure and safe space to accommodate the individual dismount, tactical groupings of dismounts and all their mission critical and operational equipment for the duration of the operational tasks, ensuring immediate accessibility between dismounts, platforms and equipment where required.
10. **Interface standardisation** - The physical, information and power interfaces between Dismounts and Platforms must be common across all platforms and across all operating states.
11. **Communications** - The Dismount-Platform integration shall ensure that seamless, bi-directional communications are maintained between the Dismounts and the Platforms in all operating states.
12. **Situational awareness** - Both Dismount and Platform Local Operating Pictures (LOP) should be coherent with the Common Operating Picture (COP) and each other, across all operating states.

Additional information and discussion against each of the principles is contained within Annex H.

¹⁴ e.g. additional physical hardware, equipment and information bearer systems needed to support embarked dismounted personnel.



3.2.4 Principles Test

Table 1 below, provides a brief overview of the application of the Integration guiding principles to the Warrior programme and against the future MIV programme. This testing was conducted to provide 'proof of concept' validation based on worked examples against a known programme. Based on Warrior issues that *could have* been mitigated they highlight relevant considerations the MIV programme should take forward as it progresses. This assessment was conducted by ex-military SMEs and where no information or experience could be applied, no entry was made in the following table.

Table 1 Integration Guiding Principles Test Cases

Principle	Warrior	Mechanised Infantry Vehicle (MIV)
Planning for integration risk	This assessment has been unsighted to the risk planning for Warrior so no comment can be made.	The de-risking of potential integration issues arriving from the phased delivery nature of the DSA capability.
Doctrine coherence	Doctrinal coherence – Warrior was defined as an IFV and therefore doctrine for its use was coherent from its predecessor the 432.	Doctrinal coherence of MIV hinges on its use case – is it an IFV and therefore doctrinally coherent with the Armoured MCC/DCC, or is it a Medium lift capacity and therefore it should be coherent with MASTIFF / FOXHOUND doctrine?
Integrated training	Integrated training between armoured infantry dismounts and their platform (Warrior). This is trained at unit level in preparation for integration with other arms on Brigade exercises (e.g. BATUS). As such, this principle existed for the Warrior programme.	All units involved in the MCC/DCC battle must regularly train together in order to build confidence, understanding and transferable skills.
Dismount workload	Warrior Platform Battlefield Information System Application (PBISA) information (LOP) was not transferrable to the dismounted commander.	Platform information (LOP / COP) must be transferable to the dismount commander in real time when both mounted and dismounted.
Platform crew mental workload	Increased in the MCC / DCC environment due to requirements for additional SA on both dismounted soldiers and vehicle commanders.	MIV commanders must not be burdened by trying to manage additional SA required - therefore applying this principle suggests the need to take this additional SA need into account when addressing and optimising the MIV Commander's SA burden.

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Principle	Warrior	Mechanised Infantry Vehicle (MIV)
Dismount support to platform combat effectiveness	Dismounted capability only complemented the platform capability in limited environments.	Dismounts must have a means to pass information to the MIV platform to 'add value' and complement the platform systems capabilities such as through enhancing target acquisition and SA.
Platform support to dismount combat effectiveness	Limited support is provided to the dismounted component. Equipment storage is insufficient and additional capabilities have not been planned for. i.e. the additional size of OSPREY body armour	A coherent level of support - Days of Supply (DOS) must be agreed and planned for both physically and doctrinally.
Maintain capability in transition	Transitioning dismounts are faced with comms and SA issues when disembarking from the Warrior platform.	The transition from MIV to operationally effective dismounts must be simple and add no further physical burden. This must be matched by an ability to reduce the cognitive burden, potentially by integration into the LOP / COP.
Platform capacity	Warrior was not designed to contain the required dismounted anti-armour capabilities that were planned for in conflicts in Iraq.	MIV must be coherent with the future DCC programme to reflect the ISS pulses of VIRTUS and DSA. It must also take into account future munition developments in its planning (Future ASM and NLAW etc).
Interface standardisation	Specific technical details on the interfaces within Warrior have not been assessed so no comment can be made against this principle.	The MIV project must understand the ability of MORPHEUS to overrule GSA and GSV in its direction and integration authority. Therefore there must be a proactive effort from the MIV programme to understand the likely outputs from MORPHEUS programme.
Communications	Warrior is not fully interoperable with the DCC PRR. Integration is thus limited to the Section Commander and above and is based upon BOWMAN communications.	MIV must be designed 'fitted for but not with' the technical capability to interface with the current planned DCC suite of communications and data devices.
Situational awareness	Warrior does not provide seamless situational awareness to ALL dismounts. It can only be done through the BOWMAN system via the Section Commander.	This issue should be addressed under MORPHEUS therefore MIV capability owner should be a stakeholder in the MORPHEUS programme.

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3.3 DLOD REVIEW

3.3.1 Overview

The DLOD review sought to identify potential pan-DLOD interventions to enhance DCC-MCC integration that could optimise DCC-MCC combat effectiveness. The TEPIDOILI structure was used to conduct this review, that being:

- Training.
- Equipment.
- Personnel.
- Information.
- Doctrine and Concepts.
- Organisation.
- Infrastructure.
- Logistics.
- Interoperability.

3.3.2 DLOD Review Coverage

Table 2 summarises the DLOD aspects that were identified as relevant to DCC-MCC integration.

Table 2 DLOD Review Findings

DLOD Review Coverage	
Training	<ul style="list-style-type: none"> • Individual & Collective Training. • Live, Virtual and Constructive (LVC) Environments • Assessment & Experimentation. • Training Needs Analysis (TNA). • Through-Life Training Strategy.
Equipment	<ul style="list-style-type: none"> • Acquisition, Management and Storage of Equipment, Integration, Connectivity and Coherence. • Equipment Mix, Scale and Deployment. • Technology Readiness and Network.
Personnel	<ul style="list-style-type: none"> • Soldier is the Centre of the System. • Recruitment, Career Management and Retention. • Skills and Qualifications. • Information Management competencies, Trials, Experimentation and User Feedback.
Information	<ul style="list-style-type: none"> • Security. • IERs, Information Exchange and Modality. • MORPHEUS & DSA. • Network capacity and protocols. • Information Management. • Architectures.
Doctrine & Concepts	<ul style="list-style-type: none"> • Align and update Doctrine to reflect emerging concepts and the reality and flexibility of conflict. • Experimentation, OA and Lessons Learned. • Techniques, Tactics & Procedures (TTPs).

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DLOD Review Coverage	
Organisation	<ul style="list-style-type: none"> • Coherent structures and Organisation across DCC-MCC Domain. • Command Structures. • Interfaces support. • Force Generation.
Infrastructure	<ul style="list-style-type: none"> • Expeditionary and Training Infrastructure. • LVC Environment. • Familiarity. • Storage capacity.
Logistics	<ul style="list-style-type: none"> • Sustaining the Man and Platform. • Comprehensive Support Solution. • RAMD and Asset Tracking.
Interoperability	<ul style="list-style-type: none"> • Man to Man. • Intra and Inter-platform. • Tactical, Operational and Strategic Interoperability. • Architectures. • MORPHEUS.

3.3.3 DLOD Review Findings

The initial review findings were presented to the Stakeholders at Workshop 2, and the resultant analysis was updated from the additional insights, issues and comments gleaned. Fuller details of this review can be found at Annex I.

Most of the DLOD Issues identified related to the traditional issues that occur within this kind of analysis. There was an emphasis on the Training and Information DLOD during discussion at the Workshop. A brief summary of each DLOD is as follows:

- **Training.** The emphasis in Training was on the need to establish a comprehensive individual and collective training programme to encompass the mounted/dismounted role for both dismounts and platform crews. There was also a need to fuse the existing live, virtual and constructive environments. A detailed TNA would be required early on in the acquisition cycle of emerging programmes to establish what was required of blended training.
- **Equipment.** Equipment Procurement would require consideration of the dismounted soldier (for platform based procurement) and both the mounted and dismounted environments (for dismounted combat programmes). Technology Watch would also need to cover the application of technology to both platform and dismount, with an emphasis on integrating the two capabilities. Training equipment would also need to be considered in parallel to operational equipment.
- **Personnel.** Career management would be the driver for personnel, ensuring that a robust career path would be open to both mounted and dismounted personnel, exploiting the skills required by both. This would also improve retention. Selection of personnel to fulfil the role of information managers would also be a consideration if the aspiration to achieve common operating picture and seamless information exchange was to be achieved.



- **Information.** The classification of information across the DCC-MCC boundaries presents an issue as it will likely be at the SECRET level. However, detailed Information Exchange Requirements should be developed to fully understand the requirements of the DCC-MCC capability. This in-turn will inform development of networks (e.g. MORPHEUS) to ensure they can manage the required information demands. There will be a need for wider interoperability to support ISTAR functions, such as Find, as these will necessitate management of information to and from both dismounts and platforms.
- **Doctrine & Concepts.** A coherent and evidenced DCC-MCC doctrine needs to be developed to inform both the utility of the DCC-MCC construct but also as an underpinning baseline to inform all of the other DLODS. This should be achieved through Operational Analysis, Experimentation and modelling. Endorsed lessons identified and learned from both UK Operations and Training supplemented by information from NATO and the ABCA community should also be used to shape this doctrinal development.
- **Organisation.** The fundamental concept underpinning the Organisational DLOD is one of coherence. Given the potential advantages that a better integrated DCC-MCC capability brings there may be a need to adjust command organisation structures to rebalance and allow fuller exploitation. Rapid reorganisation and bespoke mission force constructs are familiar from recent operations but potentially increased ability to visualise the battlespace may change the requirements for existing command organisations.
- **Infrastructure.** The correct infrastructure elements to enable the DCC-MCC construct must be in place. The extra demands that an enhanced DCC-MCC capability places upon the traditional mounted and dismounted capability infrastructure elements needs to be catered for, including that related to expeditionary, training and information environments.
- **Logistics.** DCC-MCC has not changed the fundamental Equipment Support (ES) principle of repair/resupply as far forward as possible but the optimum Integrated Logistic Support (ILS) Strategy for DCC-MCC capability will only become apparent as the capability is developed and considered as an integrated capability as opposed as a series of more stove piped capabilities.
- **Interoperability.** A key output of implementing the DCC-MCC Integration guiding principles is to achieve enhanced interoperability between mounted and dismounted when embarked, transitioning or disembarked. Such improved interoperability requirements will need to be considered and traded within the overall context of delivering military effectiveness for both the soldier system and the fighting platform, and its range of hosted CIS. Thereafter, in the context of achieving wider interoperability force-wide, multi-nationally, and with NGOs, the DCC-MCC capability, including hosted CIS, needs to be considered as a single unified capability in order to ensure such requirements are adequately treated and catered for within the overall human-systems context.



4 CONCLUSIONS AND RECOMMENDATIONS

This section presents the detailed conclusions and recommendations arising from this DCC-MCC Integration study.

4.1 CONCLUSIONS

The study concluded the following:

Programme Coherence. The often incoherent approach between the mounted and dismounted domains is created by the way in which the Army's Capability and Acquisition programmes are structured. Desk officers tend to be either responsible for the mounted or the dismounted domain. Yet to achieve real gains with respect to DCC-MCC Integration a coherent approach across associated programmes, such as MIV, DSA and MORPHEUS, is highly necessary.

Utility of L2 as Evidence. Caution must be applied when using Operational, Training and Experimentation Lessons Learned (L2) feedback given the differing experiences generated by contingency and HERRICK type operations, as it is hard to distinguish between those aspects which relate to poor integrated capability design and those which relate to the soldier being expedient in operational circumstances.

Management Organisation. There are a large number of Design Authorities across the specific platform programmes and the ability to progress DCC-MCC Integration will be held back unless an overarching 'Integration Authority' has the remit to oversee relevant DCC-MCC integration factors relating to the land platforms, the soldier system and with MORPHEUS.

Platform Type and Nature. The ability of the dismounted soldier to conduct tasks that do not relate to close proximity activities whilst mounted e.g. Locate the Target, Defeat the Target is determined by the type of platform that the soldier is mounted on. Protected Platforms with closed accommodation prevent the soldier from conducting these tasks unless the capability to 'find' is available. Unprotected platforms with an open accommodation, e.g. Utility Trucks, allow the soldier to conduct these tasks so contributing to and enhancing the vehicle mounted system but provide lesser protection. Enhancing the combat effectiveness of the integrated capability through exploiting the dismounts capability to find and deliver effects is viewed as beneficial, but needs to be balanced against protection requirements within differing scenarios.

Interfaces Types. There are a large number of interfaces that exist within the soldier system which are sustained in both the dismounted and mounted state, covering Information, Physical and Power. Cataloguing these interfaces assists in achieving greater coherence between existing architectural work being undertaken on both the Soldier and Platform/Vehicle Systems.

Interface Nature and Integration. It was determined that interfaces can be temporary or permanent in nature and it is therefore important to understand any time criteria that might apply to such interfaces. The documented interface matrix demonstrates whether interfaces are permanent (P), regular (R) or Occasional (O) and further analysis may be appropriate to better understand the burden/commitment necessary to manage the interfaces, both operationally and in acquisition/support terms.

Operating States. It was shown that the permanent and temporary nature of interfaces must be considered according to the operating states (relationship) between the dismount and platform. These DCC-MCC Operating States allows timeliness criteria relating to each interface to be captured.



Interface Burden. Physical and Information Interfaces constitute the highest number of interfaces and place particular burden on sight (visual interfaces) and touch/manipulation (hands). This often leads to the requirement for the soldier to manage a number of interfaces concurrently or in rapid sequence. This complexity is further compounded as the existing soldier system interfaces are not supplanted by equivalent vehicle interfaces and need to be maintained. The need to transition interfaces (e.g. intra-soldier system to soldier-platform system) further complicates matters for the soldier.

Doctrine Related. Doctrinal issues related to the lack of, or confusion with, existing doctrine for operating with platforms, compounded by the large number of vehicle types involved. Most of the issues discovered were not related to doctrine, however.

Architectures. The Architecture views developed during the study have relevance to the wider GVA/GSA work. The generated VSA and SSA views are a useful visual tool in portraying the integration problem, and should be used as supporting documentation for programmatic Integration Documents.

Utility of Use Cases. The strengthening and expanding of the links between the applicable Scenario, BFM, use cases and Requirements to capture the physical and cognitive functions of the human, at the centre of the system, proved highly valuable. The categorisation of individual tasks by human function enabled a more objective method of identifying the cognitive and physical burden of the soldier, and more clearly articulates the concurrency and sequencing of tasks. Further benefit can be obtained by incorporating these developed use cases within BFMs. This will enable a more detailed objective analysis of task duration and burden to be undertaken, so providing an exploitable tool to support further detailed analysis and experimentation.

4.2 INTEGRATION ISSUES.

The study identified the following Integration issues, Integration guiding principles and DLOD implications:

- **Doctrine & Capability.** Doctrinal and Capability issues relate to the lack of or confusion with existing doctrine with operating with platforms, compounded by the large number of vehicle types that dismounts have to operate with.
- **Situational Awareness and Communications.** Situational Awareness and Communications issues were significant and probably constitute the highest priority for mounted operations. The inability for dismounts to understand or be informed (by voice or data) during all states (mounted, dismounted and transitional) is a critical issue as is the additional burden on the vehicle commanders to ensure that dismounts and crew understand the situation. As an enabler for all combat tasks, enhancing SA and communications is likely to deliver the greatest benefit for enhancing combat effectiveness.
- **Physical Integration and Sustainability.** Physical Integration issues were numerous and mostly focussed on the comfort of the soldier (and his equipment) whilst mounted and during transition from mounted to dismounted. Physical discomfort and the difficulties of operating/sustaining within a constrained environment formed the basis for most of these issues due to lack of capacity, poor design and little or no environmental control. Maintaining capability through comfort, rest and the ability to recharge (water, power, and food) was also a repeated concern/issue. Of prime concern was the dismounts being 'fit to fight' when they reach their destination.



- **Training.** Training Issues were notable and related, for the most part, to a lack of training and familiarisation with platforms prior to deployment on operations, particularly regarding adequate emergency drill training.

Integration Principles. The study has identified a set of viable Integration guiding principles to inform current and future Capability Development and related Acquisition activities within the DCC-MCC domain (Section 3.2 and Annex H).

DLOD Review. The Training and Information DLODs proved significant as they raised some complex, high impact issues for the development of the DCC-MCC Capability (Section 3.3 and Annex I).

4.3 RECOMMENDATIONS

The following recommendations are made based upon the study.

Programme Coherence. To overcome current DCC-MCC coherence issues an authority with programme responsibility for achieving consolidated capability should be developed within the Capability Directorates and Programme Offices.

Principles. The DCC-MCC Integration guiding principles should be socialised widely and applied to future programmes, and incorporated within related DEFSTAN/Policy Documentation.

Capability Integration. Further investigations be conducted into the integration of DCC-MCC interfaces and systems to achieve consolidated future mounted/dismounted capability with reduced system complexity, such that the burden on both the dismounts and the platform crew can be reduced and optimised.

Human Factors Integration. Rationalisation of the physical integration requirements regarding dismounts with platforms in order to inform emerging programmes and assist in the development of legacy programmes.

Further Analysis through use of BFM. BFMs should be developed to incorporate the use cases for the DCC-MCC domain so as to enable a more objective analysis of task duration and burden to occur in support of further concept development work. In line with the development of FF2020 BFMs the BFMs would also provide a useful context for OA, experimentation and analysis.



5 INCLUSIONS

5.1 REFERENCES

- [1] *"Survey of Warrior Crew Tasks"*, Bamford, Teeder, Suttie, DERA/CHS/PP5/CR97094-1.0 dated Jun 97
- [2] *"LORST POTD Herrick 8"*, Lewthwaite, Blendell, Gladen, Dstl/CR34919 dated 31 Mar 09
- [3] *"LORST POTD Herrick 9"*, Lewthwaite, Blendell, Gladen, Bartlett, Dstl/CR38819 dated 30 Oct 09
- [4] *"LORST POTD Herrick 10"*, Lewthwaite, Blendell, Gladen, Bartlett, Dstl/CR42897 dated 31 Mar 10
- [5] *"LORST POTD Herrick 11"*, Lewthwaite, Bartlett, Catherall, Powell, Dstl/CR50973 dated 28 Oct 10
- [6] *"LORST POTD Herrick 12"*, Lewthwaite, Bartlett, Powell, Macintyre, Dstl/CR54490 dated 31 Mar 11
- [7] *"Armoured Infantry in Urban Operations – Issues and Insights"*, Lewthwaite, DSTL/CR64319 dated 18 May 12.
- [8] *"OOST POTD Herrick 14 and 15"*, Antolik, Kelly, Viligiardi, Davis, Dstl/WP68880 dated 11 Dec 12
- [9] *"Development of the Mounted Systems Human Factors Assessment Framework"*, Saunders Jones, Strickland, White, DSTL/TR65105 dated 31 Mar 13
- [10] *"OOST POTD Herrick 16"*, Antolik, Kelly, Viligiardi, Davis, Taylor, Ham, Dstl/WP76732 dated 31 Oct 13
- [11] *"OOST POTD Herrick 17"*, Kelly, Viligiardi, Davis, Dstl/CR80702 dated 31 March 14
- [12] *"The Lessons from Operations"*, Parsons, DSTL/LR79289 dated 30 Jan 14
- [13] *"OOST POTD Herrick 18"*, Antolik, Kelly, Viligiardi, Davis, Mcleod, Caesar, Taylor, Ham, Dstl/WP/CR83276 dated 08 Aug 14
- [14] *"OOST POTD Herrick 18"*, Kelly, Viligiardi, Davis, McLeod, Dstl/CR87508 dated 31 Mar 15
- [15] *"2015 Lessons to Inform Collective Training, TD and CD"*, ACOS Trg, HQ Fd Army Trg Ops OFT15 dated 30 Nov 15
- [16] *"2014 Lessons to Inform Collective Training, TD and CD"*, ACOS Trg, HQ Fd Army Trg Ops OFT15 dated 30 Nov 15
- [17] *"Observations from Training"*, ACOS Trg, HQ Fd Army Trg Ops OFT15 dated 14 Dec 15
- [18] *"DCC Use Case Library"*, Stinchcombe, Cieresko, Watts, SEA/P/CD0234 dated Jun 12



5.2 ABBREVIATIONS

AOB	Any Other Business
AITAT	Armoured Infantry Training and Advisory Team
ATDU	Armour Trials and Development Unit
BFM	Battlefield Mission
C4I	Command, Control, Communications, Computation and Information
Casevac	Casualty Evacuation
Comd	Commander
CD	Capability Development (function)
CD	Capability Directorate (organisation)
CSP	Capability Sustainment Programme (Warrior CSP)
DCC	Dismounted Close Combat
DDE	Delivering Dismounted Effect
DE&S	Defence Equipment and Supply
DLOD	Defence Lines of Development
DSA	Dismounted Situational Awareness
DSTL	Defence Science and Technology Laboratories
FDCC	Future Dismounted Close Combat (Research Programme)
FF2020	Future Force 2020
GSA	Generic Soldier Architecture
GFI	Government Furnished Information
GVA	Generic Vehicle Architecture
HFI	Human Factors Integration
HQ	Headquarters
HUMS	Health and Usage Monitoring Systems
ISTAR	Information, Surveillance, Target Acquisition and Reconnaissance
JIM	Joint Information Management
LAN	Local Area Network
LORST	Land Operational Report for Science and Technology
LVC	Live, Virtual and Constructive (Environments)
MCC	Mounted Close Combat
MIV	Mechanised Infantry Vehicle
PI	Platoon

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POW	Prisoner of War
OA	Operational Analysis
OOST	Operational Observations for Science and Technology
RAMD	Reliability, Availability, Maintenance and Duration
Sect	Section
SSA	Soldier System Architecture
SME	Subject Matter Expert
TEPIDOILI	Training, Equipment, Personnel, Information, Doctrine and Concepts, Organisation, Infrastructure, Logistics and Interoperability (DL0Ds)
TTP	Tactics, Techniques and Procedures
Veh	Vehicle
VSA	Vehicle System Architecture
WP	Work Package
WR	Warrior (Fighting Vehicle)



ANNEX A - STUDY PRESENTATION



ANNEX B - LITERATURE REVIEW



B.1 WP 1.1 LITERATURE REVIEW & STAKEHOLDER ENGAGEMENT

B.1.1 Introduction.

A literature review of Government Furnished Information (GFI) was initially conducted and this process continued throughout the study.

B.1.2 GFI

Primary GFI used was as follows:

- HFI Documentation. HF Guidance and specific man-machine interface research reports and policy documentation.
- Lessons Identified. Lessons from operations and training documentation (e.g. LORST/OOST).
- Programme Reports. Programme reports from platform programmes (e.g. Warrior CSP, Jackal, Scout/Ajax) and dismantled programmes related to operating with platforms.
- A Task Breakdown Workshop¹⁵.

It should be noted that access to GFI was in some cases, limited by commercial sensitivities and general availability of the documents. In particular, it is recognised that there was limited GFI available covering the area of training and this is something that should be examined further in any future studies.

Documentation was analysed in order to:

- Develop an Integration Issues Framework outlining issues and recommendations.
- Collate issues identified and common themes in order to provide the basis for interfaces definition and identification of the integration issues.
- Ensure that any analysis was coherent with existing policy and cognisant of legacy and current issues

A list of reference documents utilised can be found in section 5.1 of this report.

B.2 INTEGRATION ISSUES FRAMEWORK

The associated integration issues identified as part of the literature review activities are included in the associated Annex B2 Integration Issues spreadsheet.

¹⁵ As summarised in report DSTL/TR90549 1.0, 18th August, 2015.



ANNEX C - TASK BREAKDOWN WORKSHOP



C.1 STAKEHOLDER WORKSHOP 1 TASK BREAKDOWN.

Stakeholder Workshop 1 was conducted on 27 July 2015 by DSTL and was designed as a kick-off workshop at the beginning of the project. The aim was to identify the scope of work and explore key issues associated with DCC-MCC Integration. The attendees were technical Subject Matter Experts (SMEs) and military advisors from both the mounted and dismounted domains. The workshop collated a series of task and integration issues and provided a framework of issues that were grouped as follows:

- Situational Awareness & Information Exchange.
- Physical Integration.
- General Issues.

The task breakdown has been incorporated into Annex B2, under the 'Task Breakdown Issues' tab.

The detailed presentation from the workshop has been included as a separate PowerPoint presentation and is included at Appendix C2.



ANNEX D - STAKEHOLDER WORKSHOP 2



D.1 STAKEHOLDER WORKSHOP 2 INTEGRATION ISSUES, INTERFACES AND DLOD ISSUES.

D.1.1 Approach

Workshop 2 was conducted on 13 Jan 16 and included military, acquisition and research stakeholders. The purpose of the workshop was to expose the work conducted to the wider stakeholder community and exploit the experience and expertise of the stakeholders to develop each work package. The Workshop was conducted interactively and included:

- **Introduction.** A briefing articulating the background and context to the project, explaining the work that had been conducted, and presenting the key deliverables to date.
- **Integration Issues.** An interactive session presenting and discussing the Integration Issues framework with input, comment and amendment from the stakeholder group.
- **Interfaces.** An interactive session presenting and discussing the interfaces WP; presenting the architecture views and interface matrix.
- **DLOD Review.** An interactive session presenting and discussing the DLOD Review framework. The DLOD Review was subsequently amended and can be seen at Annex J.
- **Integration Guiding Principles.** A briefing to the stakeholders as to this future WP and a discussion as to what the needs of the stakeholder group would be.
- **Summary.** A summary of the Workshop and AOB

During the interactive sessions, verbal and written input from stakeholders was collated and each relevant Annex updated.

D.1.2 Insights

- **Introduction.** The study generated much interest from the stakeholder group as it resonated with the approach that the Army was taking in developing FF2020; particularly in the development of management structures and force organisation.
- **Programme Coherence.** A number of programmes are dealing with the same issues identified in the study and the need to ensure synergy between programmes (and exploit the work conducted in related programmes) was raised. Of particular note was the MIV programme, which is currently undergoing similar analysis and still in its concept phase. In addition, the importance of exploiting the work for both the MORPHEUS and DSA Programmes was highlighted.
- **Integration Issues.** Stakeholders were generally very happy with the Integration Issues framework and content that it captured the key issues. There were a few additions and much discussion of the Information Exchange Issues. Caution when using operational feedback was expressed (particularly HERRICK-related issues) as some of the issues may not necessarily have such impact in contingency operations. In addition, concern was expressed against lessons where soldiers had not necessarily acted as they had been taught e.g. not wearing hearing protection, not wearing seat-belts, etc. being used as evidence for supporting documentation.



- **Interfaces.** Architectural views stimulated some discussion with stakeholders based on the need to ensure coherence with GVA and GSA. The development of Vehicle System Architecture (VSA) within the project was offered to interested stakeholders and this generated some interest, although there was a view that the architectures were generally not fully utilised in platform programmes. It was accepted that the VSA and SSA views were a useful visual tool to help to demonstrate the problem space, and as supporting documentation to Integration Documents for programmes. The large number of Design Authorities for specific platform programmes was highlighted and concern that there was no generic Design Authority overseeing all land platforms.
- **DLOD Review.** There were a number of additions to the DLOD Framework presented; particularly within the Training, Doctrine and Concepts and Information DLODs. The issue of a coherent mounted/dismounted management structure was highlighted, with concern expressed as to the current polarisation of mounted and dismounted programmes.
- **Integration Guiding Principles.** Requirements Managers expressed their needs for Integration guiding principles, although this ranged from high-level statements in DEFSTANs to detailed requirements articulation. It provided a useful backdrop to the Integration guiding principles work.

D.2 WORKSHOP PRESENTATION

The information circulated at the workshop is held in the accompanying PowerPoint document, Annex D2 MCC DCC Integration Workshop.



ANNEX E - DEVELOPMENT OF USE CASES



E.1 INTRODUCTION

In order to articulate context to the DCC MCC problem space the need to provide a task-based framework, expressing the missions and activities of the mounted and dismounted elements, was identified. The aspiration was to develop a series of Battlefield Missions, providing the linkages between planning assumptions and detailed tasks and requirements, but this was unachievable in the given timeframe. Exploitation of the DCC use case library, existing work within the dismounted domain, provided a database of activities that could be applied to the mounted space. Use cases detail the tasks required of the dismounted and mounted operators when conducting specific operational activities, such as moving tactically or locating the enemy. They provide a layered task framework that can be used to model the mounted space and ensure that follow on analysis can consider all aspects of the operational tasks being conducted. The project also provided the opportunity to develop the existing use cases to a greater level of detail, incorporating human functionality and human-centric requirements into the tasks. The use cases also provide the building blocks from which the Battlefield Missions can be developed as required.

E.2 BACKGROUND

Contextual analysis through the use of the DCC use case library was undertaken to support the Dstl task breakdown conducted to date. The DCC use cases were reviewed and updated as appropriate to ensure they are at a sufficient level of resolution to describe the activities/tasks as expressed in the Dstl Task Breakdown. They were also used to generate information for any gaps identified within the Task Breakdown Summary.

System interfaces, as part of the VSA, were mapped to the use cases to identify where the DCC Soldier needed to interact with the vehicle (or component within the vehicle) in order to conduct the specified task. Again, where no interfaces were identified, this indicated that the task did not relate to, or could be conducted independently from, the vehicle, or that an interface 'gap' (i.e. no way of supporting the specified task) was available.

The use cases also provided building blocks to support BFM analysis and assessment activities). Through contextualisation of the use cases (e.g. the operational context taken from the BFM) it was possible to assess user tasks in representative operations and this was used as part of the DLOD assessment task.

E.3 METHOD

E.3.1 Introduction

The approach to developing the use cases involved the exploitation of previous work conducted on FDCC and DDE, developing existing use cases to capture the needs and demands of the Mounted and Dismounted domains. Work was focussed on the soldier and commander use cases to identify improvements that could be made to the current framework and develop further use cases to fill any gaps identified. In outline, the following amendments were made to the Use case library:

- Develop existing use cases.
 - Add decisions and amend/add tasks that were not captured in each use case.
 - Develop the Information Requirements against each task.
- Categorise each task by human function (sensory, physical and cognitive).

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- Develop any additional use cases required to capture the DCC-MCC problem space.

E.3.2 Development of Existing Use Cases

The existing use cases have been used in a number of programmes as a tool for analysis and experimentation, and provide a critical linkage between requirements and context, articulating in detail the cognitive and physical tasks and demands on the soldier. They have been developed incrementally and the DCC-MCC Integration project provided an opportunity to continue this development. The emphasis on human factors from both a physical and cognitive perspective reinforced the need to continue this development. Cognitive tasks (not required previously) were therefore inserted within the context of each use case; notably, decision points and detailed physical tasks were developed. The utility of the use cases in determining task-specific information needs and exchange was proved in recent work¹⁶, and this was expanded as part of this work. This complemented the emphasis on information exchange and situational awareness within the DCC-MCC context.

E.3.3 Human Function Categorisation

Initial work on DCC-MCC Integration identified that the problems tended to derive from Situational Awareness, physical integration and system issues. This indicated that improved Human Factors Integration was key to mitigating many of these issues. The use cases were developed accordingly, offering greater resolution by identifying the physical or cognitive aspects of each task. The Human Factors VACP¹⁷ (visual, audio, cognitive and psychomotor) framework, traditionally used across Human Factors research, was developed and mapped to each task, categorising the human functions of sensory, cognitive and physical. A summary table of each function is shown at Table 3 below:

Task Category		
Sensory	Visual	Visual sensing through seeing (eyes)
	Audio	Audio sensing through hearing (ears)
	Haptic	Haptic sense through touch and feel (limbs, torso, head)
Cognitive	Understand	Understanding information relevant to task following intellectual processing and short term memory
	Recall	Remembering and recalling historical information from memory
	Decide	Deciding on a course of action as a result of understanding
	Rest	No active cognitive thoughts
Physical Psychomotor	Manipulate	Input, operate and receive through physical dexterity (e.g. operating weapon, inputting text)
	Communicate	To impart information through visual (physical), audio (voice) or haptic means (e.g. talking, hand signals)
	Consume	Consumption of liquids, food or medicines
	Excretion	Passing of waste through defecation and urination
Physical Stress/Effort	Rest	No physical movement
	Move	To propel the body by walking, running, crawling, swimming
	Support	To carry mission load and support equipment for use (e.g. effector, sensor)
	Static Posture	No propulsion in standing, seated, crouching, prone posture
	Apply Force	To apply force by pull, push, lift and drop (e.g. digging, carrying, removing objects)

Table 3 Human Function Categorisation

¹⁶ As part of the Dismounted Close Combat Sensors project.

¹⁷ McCracken and Aldwich (1984)



E.3.4 Develop Additional Use Cases

A vast majority of the use cases are equally applicable to both the dismounted and mounted domains as the core soldier functions: command, control and information exchange; delivering effects; locating the target; maintaining situational awareness; and sustaining capability, do not change significantly other than through method. The manoeuvre requirements of the soldier in DCC however, required a new use case to be developed: 'UCR046 Move Tactically by Platform'. This was developed through existing knowledge and SME input, cognisant of the feedback from the Task Breakdown Workshop. The Use case covers the embus, manoeuvre and debus functions of the dismounted soldier and is applicable to all platforms within scope.

E.3.5 Insights

- For the dismount, most physical and cognitive tasks are applicable to both the mounted and dismounted state. This meant that whilst amendments were required to update the use cases to capture the needs of the mounted/dismounted soldier, there was minimal need to develop new use cases.
- The categorisation of individual tasks by human function enabled a more objective method to identify cognitive and physical burden of the soldier and more clearly articulates the concurrency and sequencing of task nature. This enables cognitive and physical burden to be identified and modeled within the context of the mounted-dismounted domain.
- The use case development also provided the opportunity to update the information requirements of each task, thereby providing a more comprehensive framework that can be exploited to determine information flow, content and quality of each use case. This can be best utilised in information modelling in support of information-based programmes e.g. DSA, platform programmes (C4I), MORPHEUS, etc.
- The links between Scenario – BFM – use cases – Requirements have been strengthened and expanded to capture the physical and cognitive functions of the human at the centre of the system. Incorporating the developed use cases within BFMs will enable a more objective analysis of task duration and burden.
- The ability of the dismounted soldier to conduct tasks that do not relate to close proximity (use cases) whilst mounted e.g. Locate the Target, Defeat the Target is determined by the type of platform that the soldier is mounted on. Protected Platforms with closed accommodation will prevent the soldier from conducting these tasks unless the capability to find is presented to the soldier. Unprotected platforms with an open accommodation allow the soldier to conduct these tasks and therefore contribute to and enhance the mounted system.
- The timeliness, concurrency and sequential nature of the use cases created some confusion due to the way in which they were presented. Greater clarity would be delivered through the development of BFMs that use the use cases as their building blocks.

E.4 USE CASE LIBRARY

The updated use case library is contained within the accompanying Excel files, Annex E4.1 and Annex E4.2.



ANNEX F – INTERFACE IDENTIFICATION



F.1 OVERVIEW

In order to fully understand the DCC-MCC integration issues, identification of the interfaces between dismounts and vehicles is essential to understand how the relevant entities interact. This task exploited the Soldier System Architecture (SSA) as this, whilst developed for the DCC Soldier, identified and mapped vehicle interfaces against the DCC Soldier and his equipment. Additionally, this was conducted in compliance with the Generic Soldier Architecture (GSA) and the Generic Vehicle Architecture (GVA). These interfaces are also mapped to the DCC Use case library, providing a relationship to the Soldier activities and tasks.

This task reviewed the interfaces identified within the SSA to identify 'integration points' between the soldier and the vehicle. This has been done alongside the use case development to ensure functional tasks and activities, where required, can be traced to interfaces. Where gaps were identified, an update exercise has been conducted to ensure all relevant interfaces have been captured.

F.2 METHOD

Interfaces were developed architecturally and in tabular form articulating the relationships within and between the soldier system, the platform and the environment, exploiting existing work from SSA and GVA. Interface development was then conducted as follows:

- Identify Interface Zones and Operating States for the Soldier System and Platform System adopting a layered framework. Operating States relate to the various configurations of the soldier system and the platform system, whether the soldier is mounted, dismounted or transitioning from one to the other.
- Identify and develop SSA and related VSA architectures through exploitation of existing architectural views and capturing the physical, information (data) and power interfaces within and between the soldier systems, the platform system and the environment.
- List and categorise the interfaces and produce a database of interfaces covering all states. Links to integration issues and Use cases were retained throughout.

F.2.1 Interface Zones

F.2.1.1 Soldier System

The Soldier System is architecturally configured in zones, with the human being at the centre of the system. Whilst the Helmet, Torso and Weapon zones are clearly articulated within SSA, interfaces generically occur in layers:

- **Human.** The physiological centre of the soldier system and consists of the body, senses and internal organs.
- **Protection System.** The protection system includes headgear (helmet), body armour, clothing, footwear and gloves, protecting the human from environmental and hostile effects. Interfaces with the human are generally physical, direct and permanent, creating a layer around the human. Some of the protection system elements are temporary e.g. eye protection, gloves, helmet and body armour resulting in direct interface between the human and outer layers.



- **Load Carriage System.** The load carriage system has physical and direct interface with the protection system internally and soldier systems externally. The load carriage system may include elements of the protection system e.g. body armour as fully integrated.
- **Soldier Systems.** Soldier systems constitute all individual and team systems used by the soldier e.g. effector (weapon system), sensor systems, mission specific equipment, and communications system. They have direct interfaces (physical, data and power) with the human or via the protection or load carriage systems.

Figure 3 below illustrates how the soldier system is built up in layers when considered in terms of specific interfaces. Note that in this context, HUMS relates to the soldier.

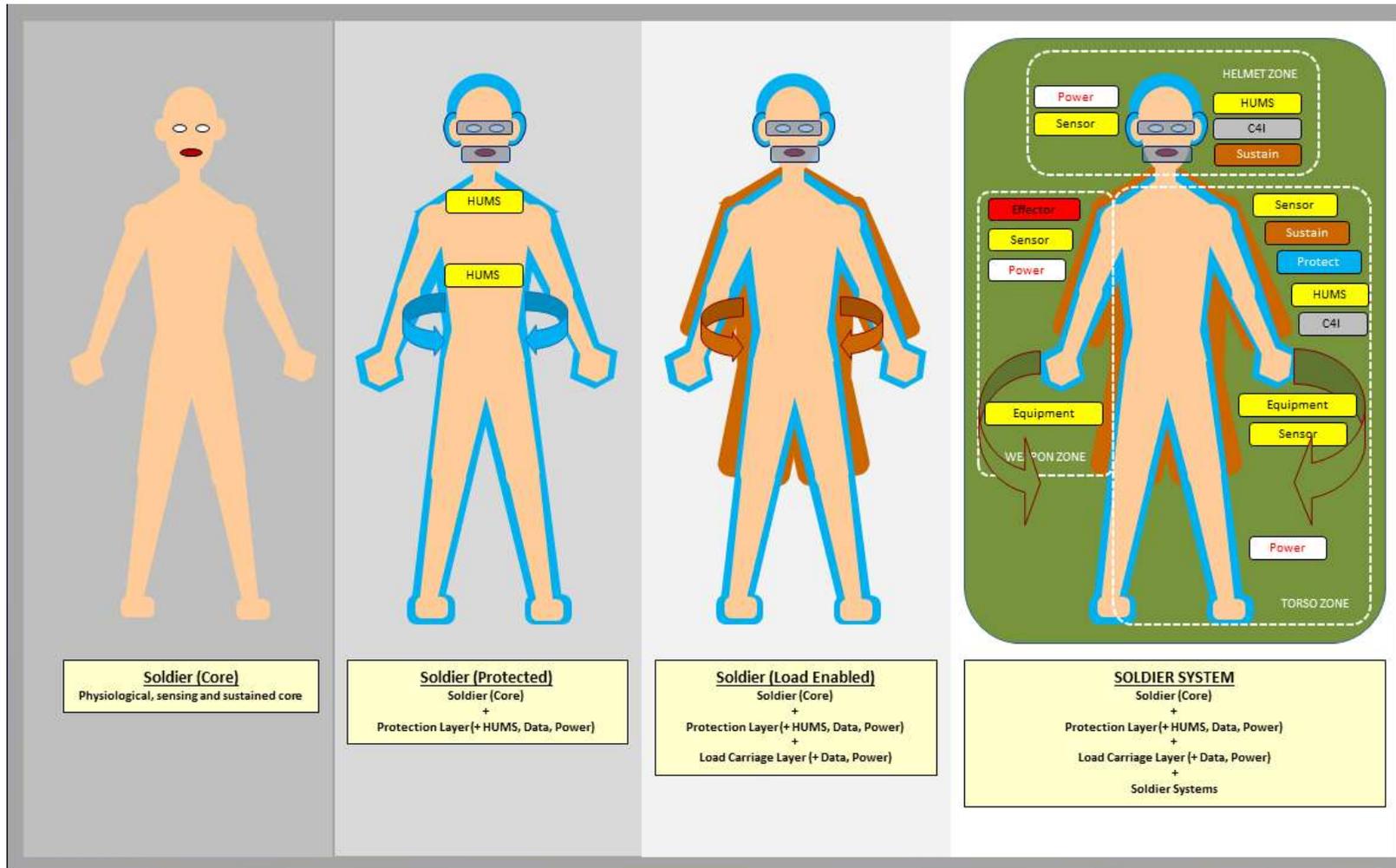


Figure 3 Soldier System Interface Zones

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F.2.1.2 Platform System

GVA does not specify zones in the same way that the Soldier System does, but having exploited the architectural views (focussed on power and data) it is possible to identify such zones in relation to the soldier (both dismounted and vehicle crew):

- **Station.** The Station is the seating system for the soldier, accommodating him securely within the passenger or crew zone. The station includes the seat, seating security system and importantly the systems (interfaces) that the soldier requires direct and immediate access to, enabling him to operate whilst mounted.
- **Passenger Zone.** The Passenger Zone encases the station or stations. Its purpose is to store entities and equipment, and has access in and out (entry/exit). Interfaces with the soldier system include other soldiers, stowed equipment and resources that do not require immediate availability by the soldier.
- **Platform.** The Platform represents the vehicle system and encases the zone or zones where soldiers are located. The platform constitutes all vehicle systems (e.g. automotive, sensors and effectors) and accommodates other zones (and therefore stations), equipment and resources. The Soldier System may interface with or require access to each of these components.

Figure 4 illustrates the soldier system mounted within the platform zones, layered within the station and passenger zone within the platform. Figure 5 shows a simplistic representation of interfaces that exist within the Soldier System, between Soldier Systems (mounted and dismounted) and between the Soldier System and the Platform System. It shows, at a higher level, the approach taken when identifying the interfaces in architectural form and that subsequently make up the Interface Matrix at Appendix F4. Note that HUMS is assumed to relate to soldier monitoring systems.

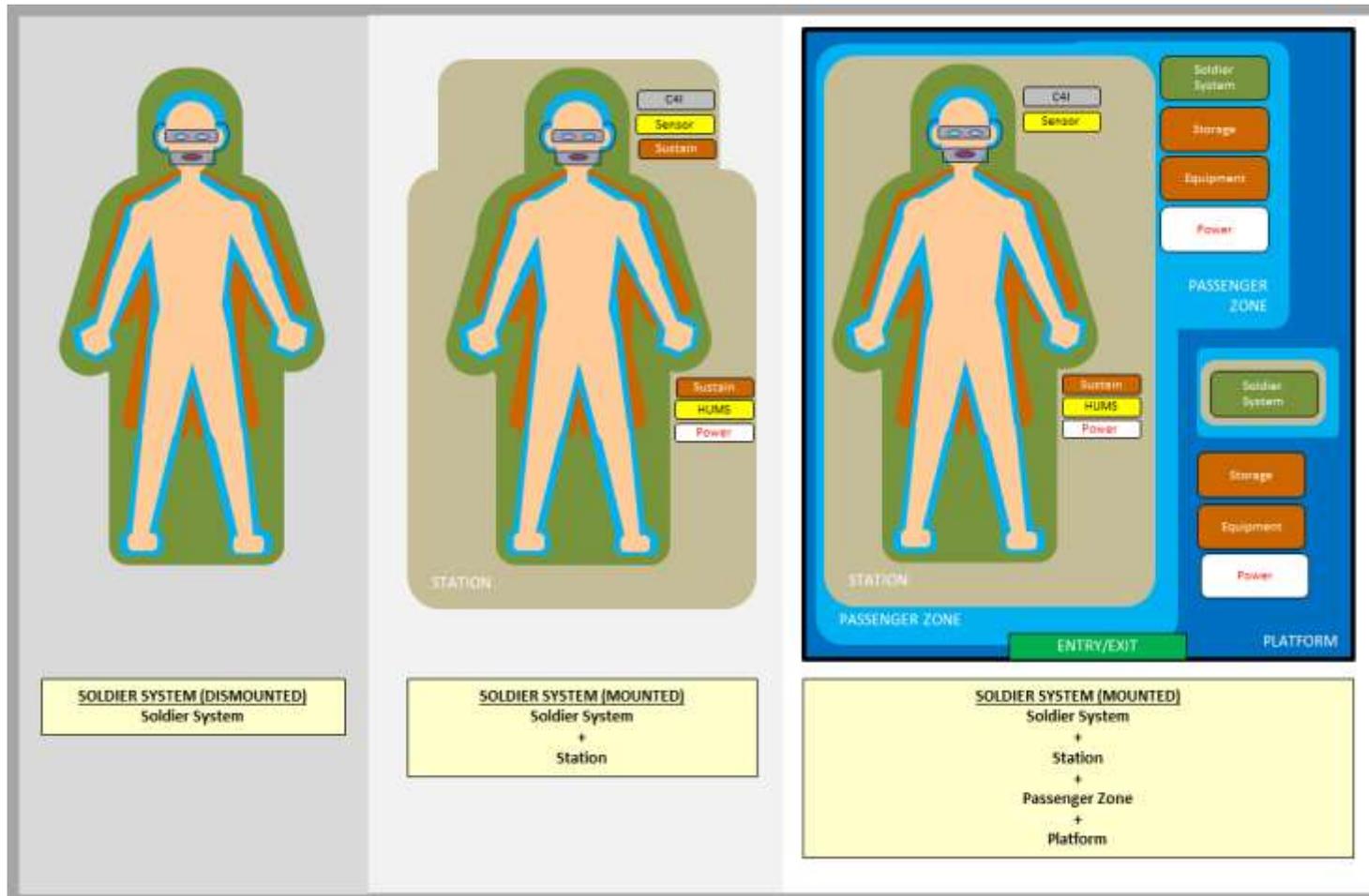


Figure 4 Platform System Interface Zones

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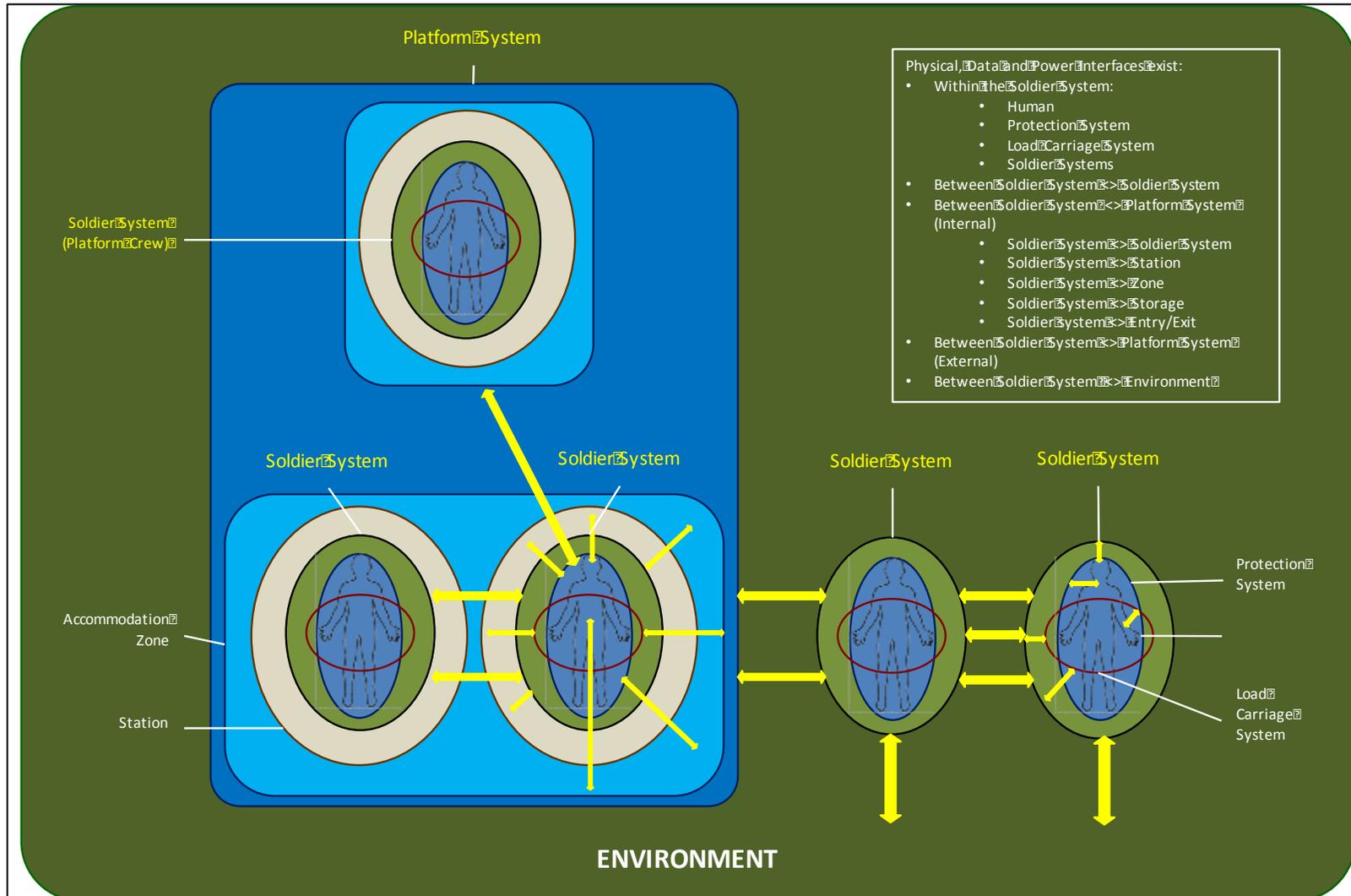


Figure 5 Soldier System and Platform System Interface Zones

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F.2.2 Interface States

The use cases articulate changes in posture and the relationship between the soldier and the platform dependent on the operational need. Interfaces fluctuate dependent on the mounted state of the soldier. These have been identified as follows:

- **Mounted (Mobile or Static).** Encompasses the normal state of dismounts moving tactically or operationally within the vehicle, whilst the vehicle crew are operating the platform. It includes the 'head-out' condition, e.g. when providing 'top cover sentry'.
- **Transition (Embus and Debus).** Transition states include alighting (embus) and dismounting (de-bus) the platform. These states are usually very short in duration and capture a change in interfaces between the platform and dismounted soldier.
- **Dismounted (Moving).** This captures the operational and tactical tasks of the dismount operating with the platform whilst dismounted. The vehicle crew operate the platform. It is likely that this state requires further articulation owing to the relationship between the dismount and platform and the distance between the platform and dismount:
 - The **Immediate State** is the zone where the dismounts operate in very close physical proximity to the platform and can be protected by the armour system of the platform
 - The **Tactical State** is the zone where the platform and dismount can influence each other and so are within communications, delivering effects and ISTAR range. They operate within the Area of Influence.
 - The **Separated State** is the zone where the dismount and platform cannot influence each other through delivering effects but may be able to communicate and share ISTAR. They operate together within the Area of Interest.
- **Dismounted (Static).** This captures the operational periods when the platform is static (e.g. in a defensive posture) and therefore the dismounts and crew are dismounted from the vehicle. A crew member is likely to be operating the platform systems through rota.

Figure 6 to Figure 10, below, show the Operating States identified in the study and used when analysing the fluctuating interfaces between the Soldier System and the Platform System. They include the static, mobile and transitional states and directly relate to the use cases.

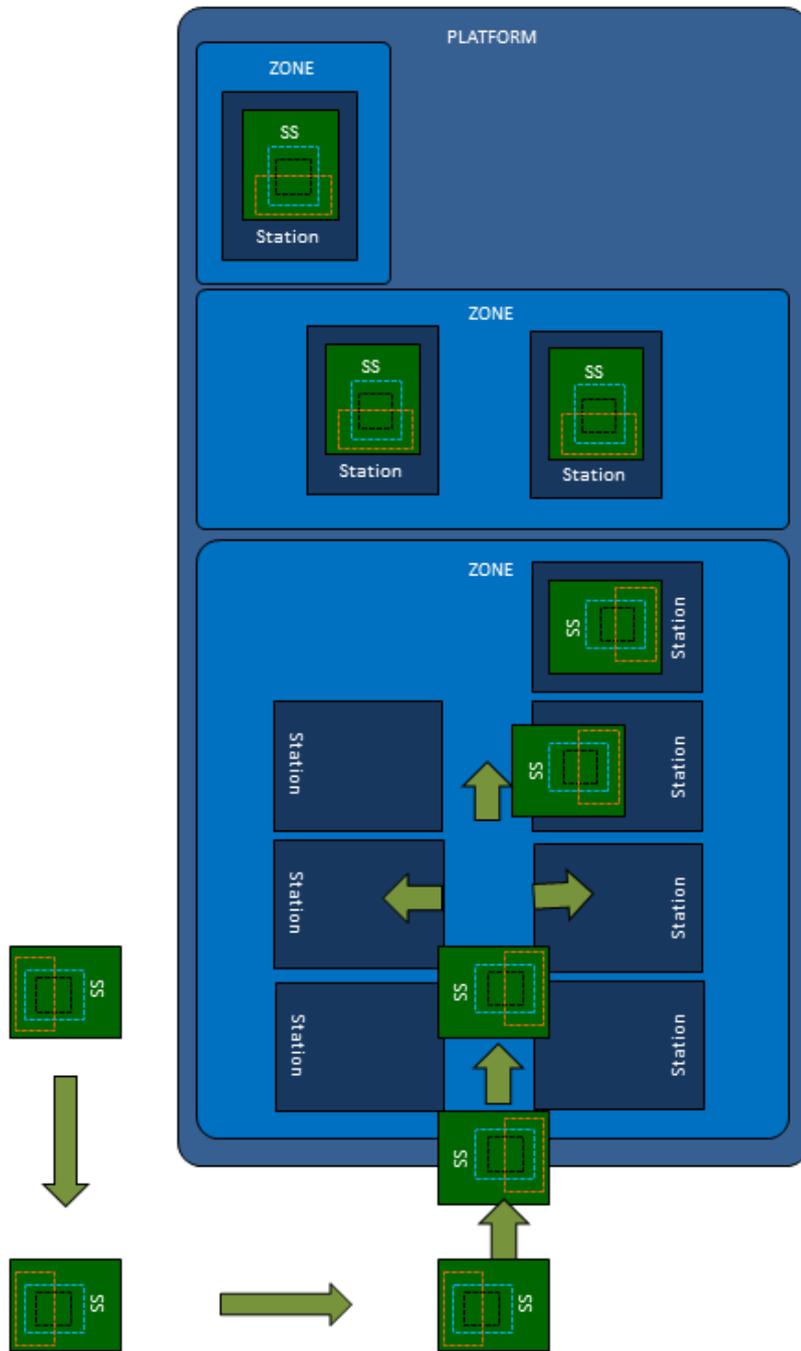


Figure 6 Transition - Embus

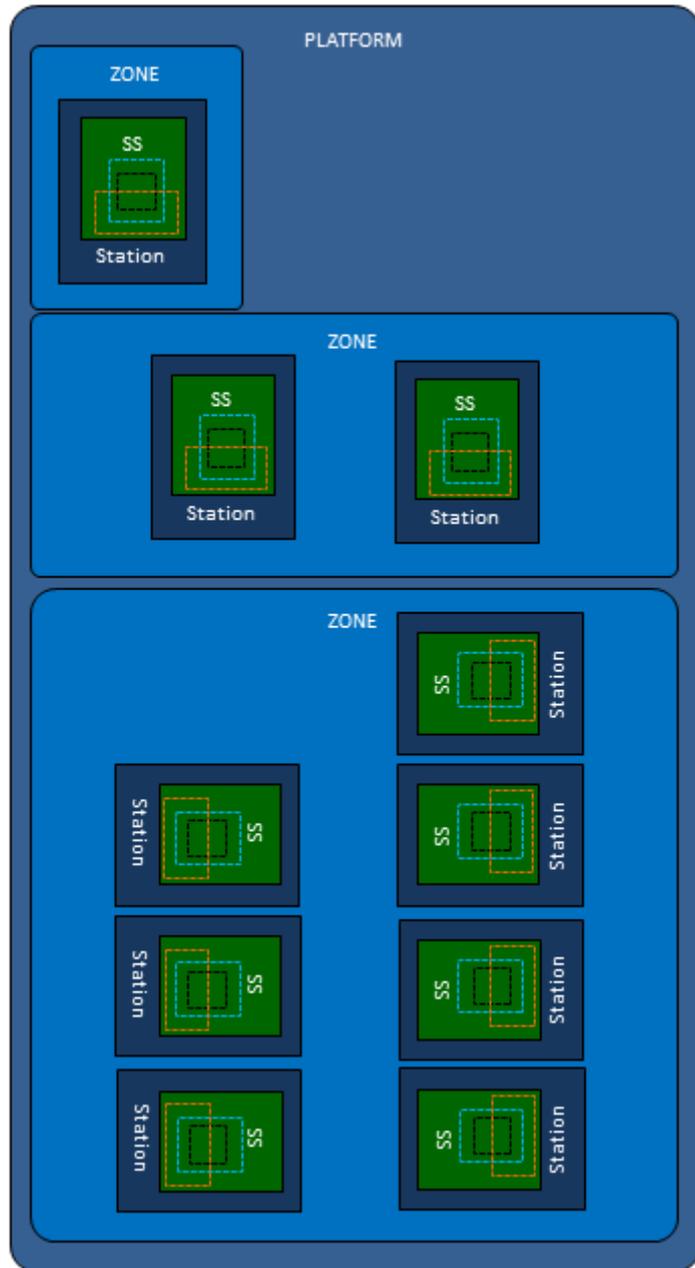


Figure 7 Mounted

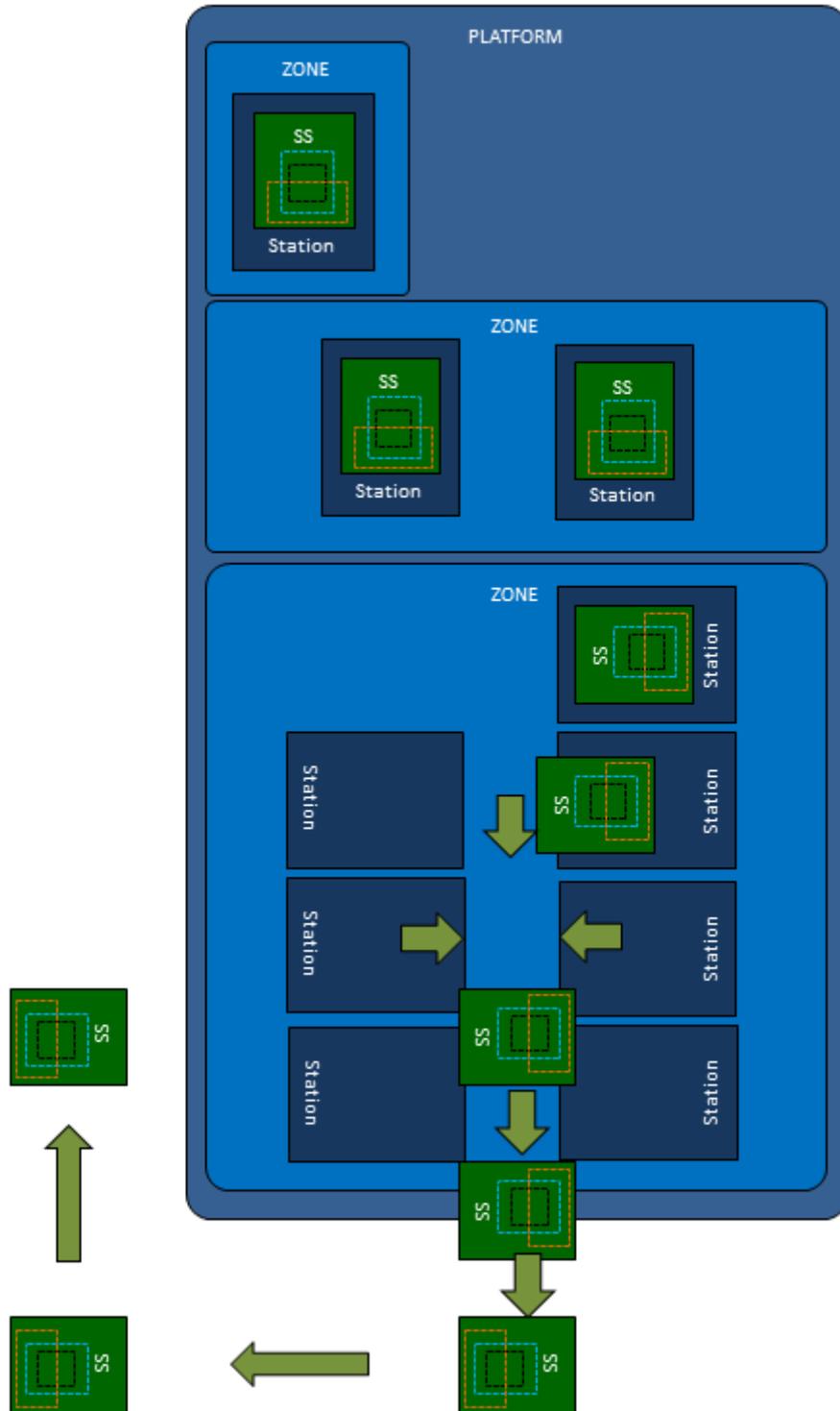


Figure 8 Transition De-bus

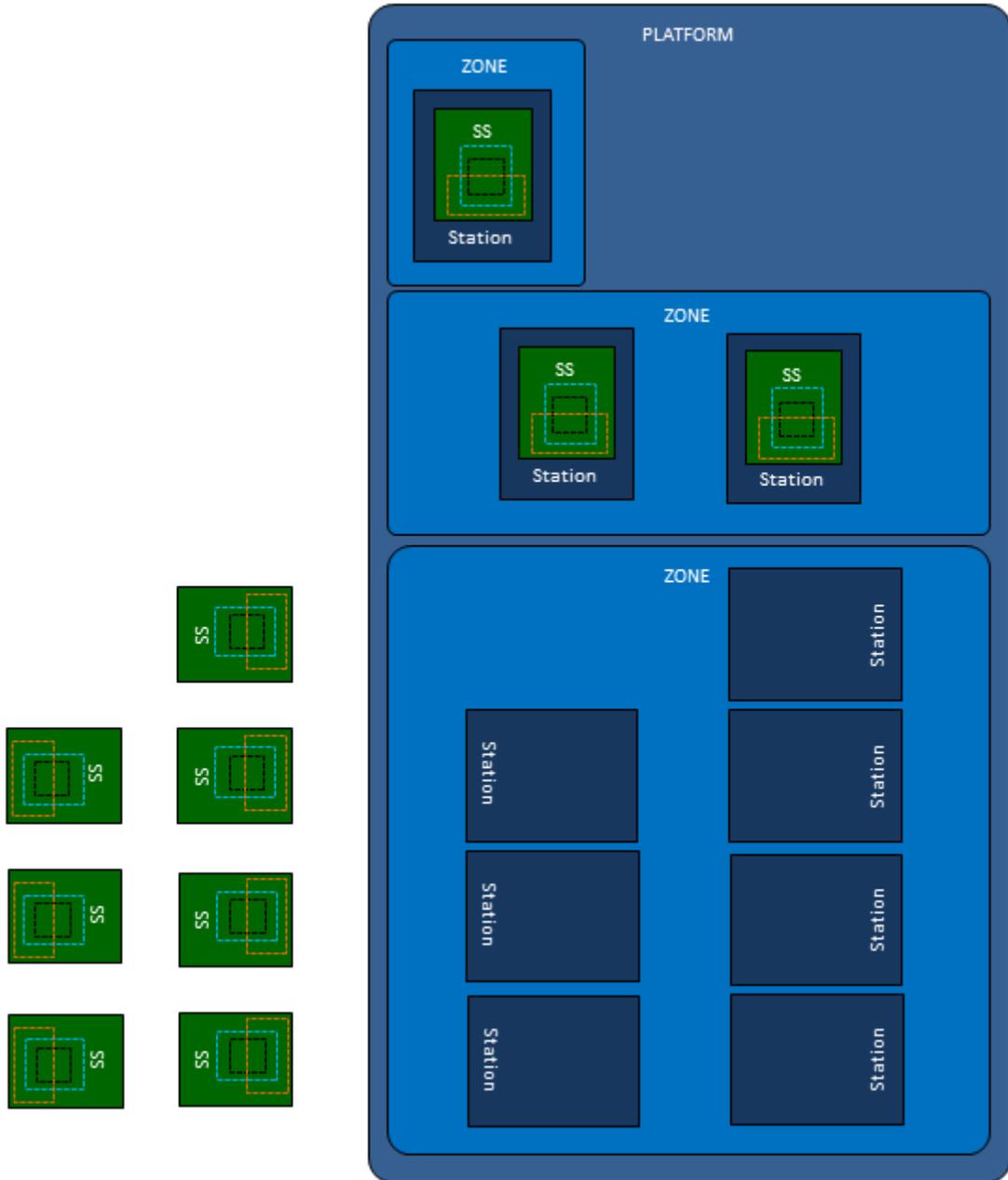


Figure 9 Dismounted (Moving)

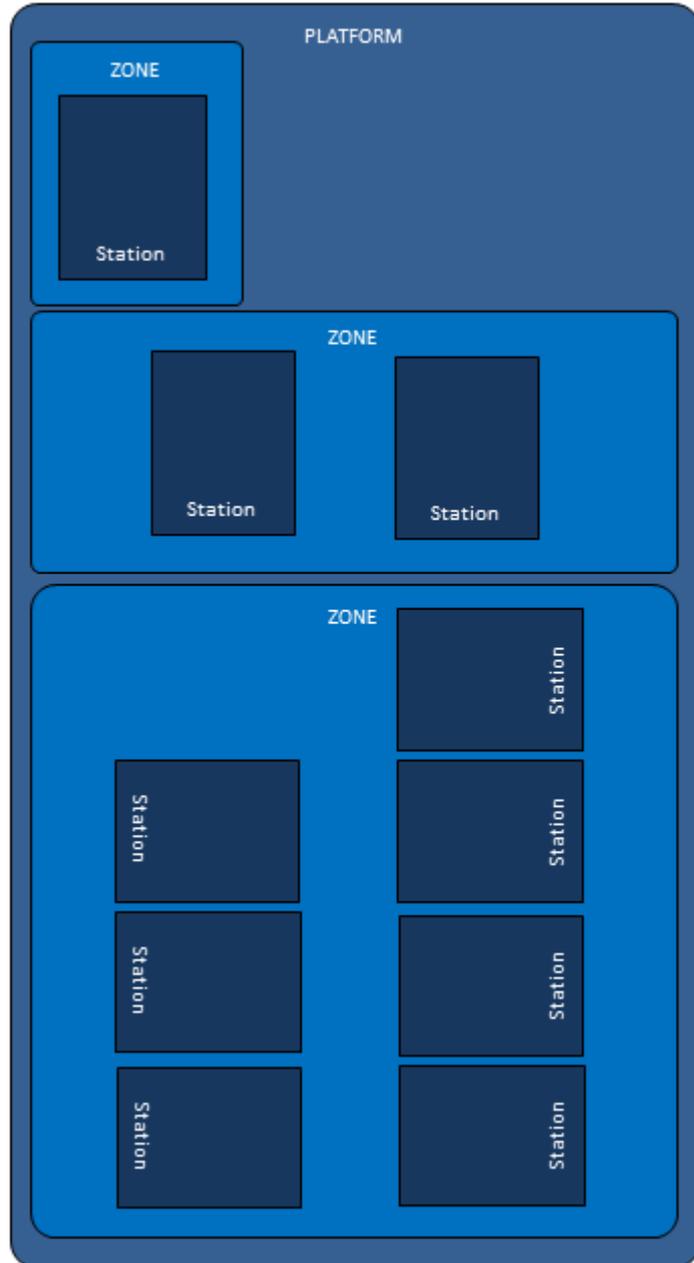
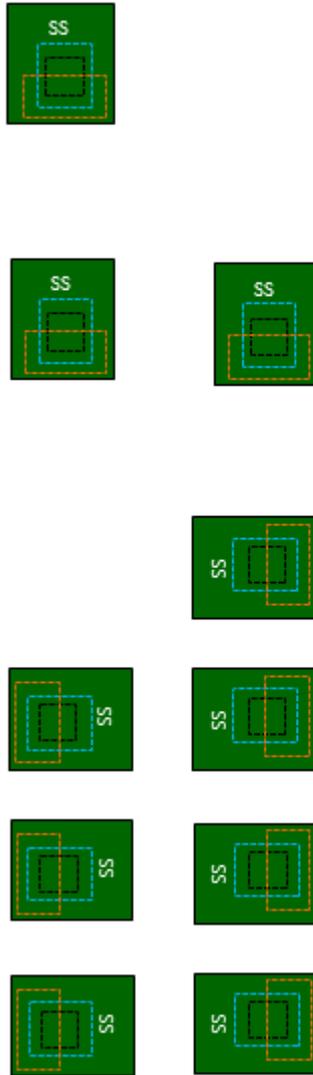


Figure 10 Dismounted (Static)



F.2.3 Architectures

Using the existing SSA as a start point, and with reference to GVA, architectures for the soldier and platform were developed to capture the interfaces that exist within the context of the various states (F.2.2). These provide a visual and technical representation of the DCC-MCC interfaces.

Note that the updated architectures are contained within Enterprise Architect, in the same format as the SSA, and can be supplied on request. The information presented in this section has been extracted from the SSA and is intended to provide a readily accessible of the information held in the architecture.

F.2.3.1 Integrated System

The architectures have been integrated to represent the systems working together, and visually capture all of the identified interfaces within the system. Views are presented when the dismount is dismounted, operating with the platform (

Figure 11) and mounted (

Figure 12).

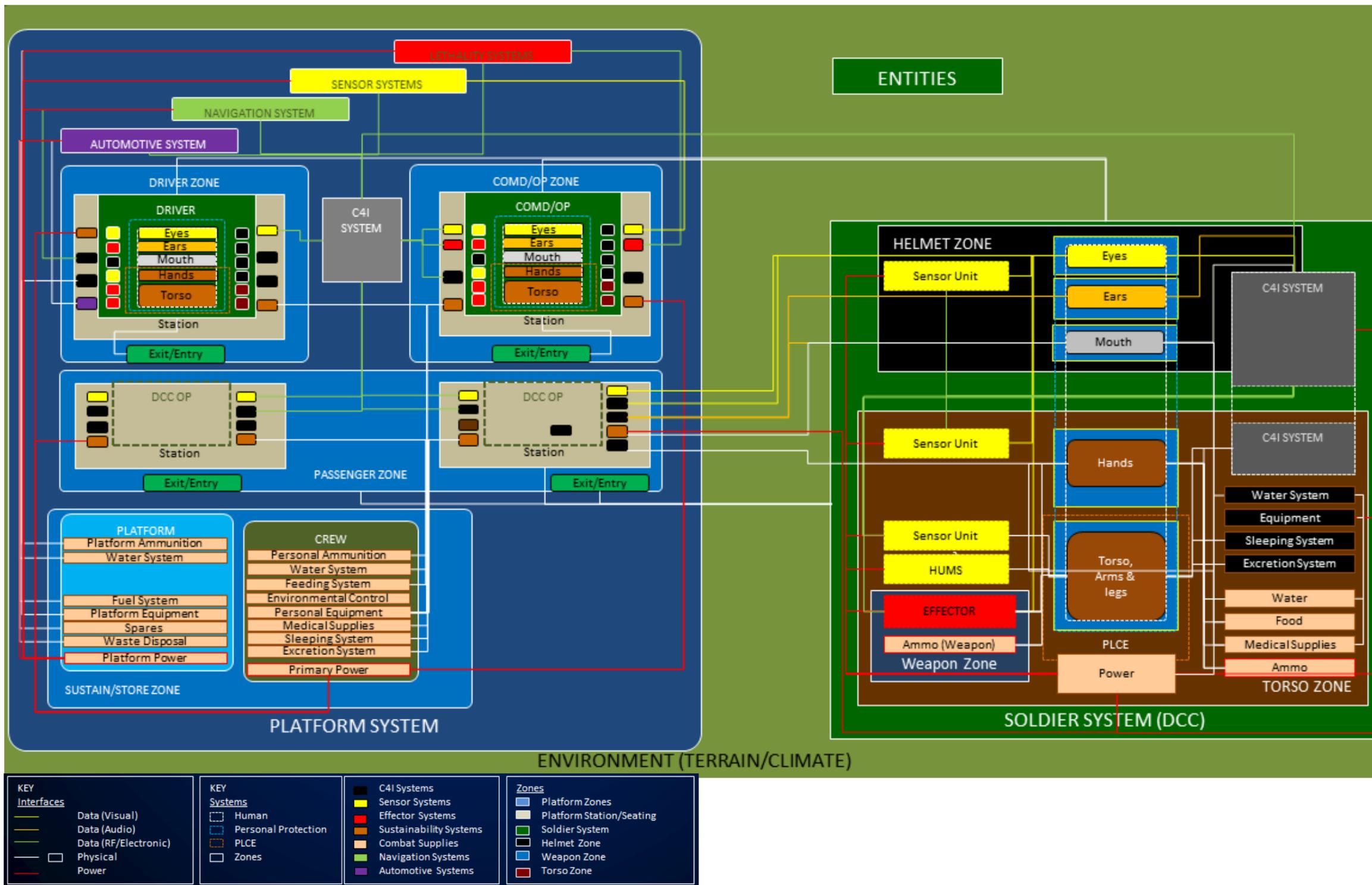


Figure 11 Integrated Architecture – Dismounted, Operating With Vehicle



F.2.4 Interface Database

Interfaces identified through developing (and articulated within) the architecture were captured on a spreadsheet (Annex F4) and constructed around the framework of capability and interface nature. Interfaces occur between and through soldier and platform zones and can be categorised into physical, information and power interfaces as follows:

F.2.4.1 Physical Interfaces

Physical interfaces include all interfaces that involve touch, direct physical contact and from the human perspective, respiratory and alimentary interfaces:

- Human to Solid (Nutrition, Equipment, Physical Sensors, Clothing, Protection Systems, Environment (Climate & Terrain)).
- Human to Liquid (Hydration, Environment (Climate & Terrain (Water))).
- Human to Gas (Air Systems, Threat, Environment (Climate (Air))).

All of these interfaces have an impact on the physical and cognitive burden of the Soldier System, and often exist concurrently in each operating state. Articulating each physical interface builds a detailed picture of where that burden lies and enables a better understanding of what can be economised and reduced. Accurate identification of physical interfaces will provide the justification used to articulate requirements for a future integrated capability.

F.2.4.2 Information Interface

Information interfaces include all interfaces through which information is passed (information exchange) and incorporate the visual and auditory senses of the human:

- Human (Voice) to Transmitter (Microphone, VR System) to Communications Network.
- Human (Voice) to Human (Hearing).
- Human (Hearing) to Receiver (Earphone, Loudspeaker, Hearing Protection) to Communications Network.
- Human (Hearing) to Environment (Climate, Terrain & Entities).
- Human (Sight) to Receiver (Visual Display).
- Human (Sight) to Environment (Terrain & Entities).
- And in future more novel interfaces may exist covering other sensory channels such as 'haptic'.

Information Interfaces, when combined with the information requirements identified in the use case work show a quantifiable sensory and cognitive burden that the soldier system is subject to. Further analysis will identify the points at which information and sensory overload exist and therefore where opportunities exist to enhance the system. The combination of information will provide the basis to accurately determine Information Exchange Requirements, to support the Sensor and Network requirements to deliver this.

F.2.4.3 Power Interfaces

Power Interfaces include all those where energy is passed and have been updated to include emerging technologies (wireless power).

- Power Unit to Specified System.



- Power Unit to Power Unit.

Identifying the power interfaces, in both the provision of power or the reconstitution of portable power units, shows the liability that the platform has in delivering power support to soldier systems whilst supporting the power requirements of the platform.

F.2.4.4 Interface Matrix

A matrix incorporating all interfaces within the DCC-MCC domain is at Appendix F4. It shows, in spreadsheet form, the relationship between each part of the capability to all other parts and encapsulates all Operating States. It also shows the type of interface (physical, information, power) and the nature (durability) of the interface; whether that is Permanent (P), Regular (R) or Occasional (O).

F.3 INSIGHTS

- There are a large number of interfaces that exist within the soldier system and these are sustained in both the dismounted and mounted state. Interfaces have been grouped into three main categories: Information, Physical and Power and this engenders coherence with existing architectural work on both the Soldier and Platform/Vehicle Systems.
- Information Interfaces incorporate all mediums through which information is passed. From a human perspective, this can be achieved through visual, auditory and haptic¹⁸ means and, from a technical perspective, information systems including voice and data communications systems and networks.
- Physical Interfaces include all interfaces that involve solids, liquids and gases. From a human perspective, this includes physical touch, feel, respiratory, alimentary and nervous system. Temperature is a key element of this. From a technical perspective this includes all matter interfaces, but particularly solid to solid and environmental control systems.
- Power interfaces relate to most technical systems but not directly to the human unless the human can be used to generate power (static power). Currently power interfaces exist through physical means (battery – connector – lead – connector – system) but also include power generation (recharging) for all subsystems within the DCC-MCC domain.
- There would be great benefit and system efficiencies in integrating interfaces so that information and power can be transmitted through the same interface.
- Interfaces can be temporary or permanent, and it is therefore important to understand the time criteria related to each. The interface matrix (Annex F4) demonstrates whether interfaces are permanent (P), regular (R) or occasional (O) although additional analysis would be required to realistically determine the burden/commitment that is required to manage interfaces in this way.
- Developing the operating states became a necessity during the study and these were used to capture the variations in interface relationship. They also provide excellent building blocks for the development of vignettes and BFM, in the future. This need to define the operating states was also identified during development of the use cases.
- The permanent and temporary nature of interfaces must be considered according to the states (relationship) between the dismount and platform. BFM analysis would be a useful means to further determine this.

¹⁸ Olfactory can also be included in this grouping



- Interfaces have not been prioritised in this study, but would be useful in order to focus any subsequent analysis and assist in capability development.
- Physical and information interfaces constitute the highest number of interfaces, and place particular burden on sight and touch/manipulation (hands). This often leads to the requirement for the soldier to manage a number of interfaces concurrently or in rapid sequence.
- The interfaces that exist within the soldier system are maintained, as opposed to being replaced, when the soldier operates with the platform system, therefore compounding the complexity of his tasks.
- Occasionally the soldier must replace the interfaces he has (intra-soldier system to soldier-platform system) which adds complexity and potential points of failure to the system. It also disrupts the coherency of relationships within information, physical and power interfaces. Ideally the interfaces that exist within the soldier system should be exploited in the mounted and dismounted state so that the soldier does not have to transition to different interfaces each time he operates with the platform system.



ANNEX G– INTEGRATION ISSUES



G.1 OVERVIEW

It is fundamental to identify key integration issues and human related concerns relating to the integration of dismounted personnel and vehicles, based on related literature and SME input. This included:

- Physical HF (e.g. anthropometric, lighting, vibration, noise, etc.).
- Dismounted power and data integration with vehicles (including DSA).
- Situational awareness (from both a soldier's perspective of the situation outside of the vehicle when mounted, the location and status of vehicles when dismounted, and from a vehicle crew perspective, of the location and status of dismounted personnel).
- Command and Control (including between passengers, and between passengers/dismounts and crew).

References included vehicle programmes (e.g. WR CSP, BUFFALO, MASTIFF, JACKAL, VIKING), operational lessons learned, and feedback from the Armour Centre, ATDU and AITAT.

G.2 METHOD

Integration Issues were collated from historical and current references and involved an analysis of relevant GFI and exploitation of SME Workshops. Mounted/Dismounted Interface Issues were reviewed and collated to identify the most coherent framework against which to categorise the issues.

During the analysis the term 'Physical (Fit to Fight)' was coined. It relates to the "Physical Integration" aspects covering the physical issues that enable the dismount to be 'fit to fight' when they reach their destination.

G.2.1 Integration Issues Identified from Task Breakdown Study

Dstl conducted the Task Breakdown Workshop and concluded that issues could be grouped as follows:

- Situational Awareness.
- Fit to Fight. This term included the physical, ergonomic and sustainability issues, principally relating to the dismount.
- General issues. This captured doctrinal and capability issues and was the term selected to categorise these issues.
-

G.2.2 Integration Issues Identified from LORST/OOST

The integration issues collated at Appendix G4 have been categorised in the following groups:

- Doctrine & Capability.
- Situational Awareness & Communications.
- Physical (Fit to Fight) & Sustainability.
- Training.

In the interests of coherence across the integration and interface activities, this framework was adopted. Issues were repeatedly identified within each operational tour and across tours and these, whilst not exhaustive, give an indication of the enduring nature and emphasis of each issue. Of all issues collated from LORST/OOST:

- 61% concerned Physical (Fit to Fight) & Sustainability.



- 18% concerned Training.
- 15% concerned Situational Awareness and Communications
- 6% concerned Doctrine and Capability.

G.2.3 Integration Issues Summary

A full breakdown of consolidated issues from operational lessons learned can be found at Appendix B2. Issues collated from all sources were then summarised to produce a generic issues list, summarised below.

G.2.3.1 Doctrine & Capability

Issues raised included:

- Doctrinal implications of contingent and intervention operations.
- Command and Control issues, ranging from complexity of organisation, the ability for commanders to communicate with platforms and dismounts, over burdening of platform commanders and dual responsibility of commanding the platform AND commanding the dismounted or integrated battle.
- Organisation variation and complexity, driven by capacity limitations and hierarchical legacy organisation over a highly varied platform fleet.

G.2.3.2 Situational Awareness & Communications

A significant number of issues that cover the current shortfalls, and an anticipation of emerging issues include:

- Situational awareness of dismounts and platform crews in the mounted, dismounted and transitional states.
- Intra-platform, inter-unit and multinational communications issues by voice (radio communications).
- ISTAR issues between the platform and dismount.

G.2.3.3 Physical (Fit to Fight) & Sustainability

The largest area of issues concerned the physical interfaces between the dismount, the crew and the platform and included dismount/platform configurations, physical aspects and tasks, the human senses and individual and team sustainability issues:

- Physical (Fit to Fight), covering crew comfort, seating systems, seating space etc..
- Equipment, primarily looking at storage space for the dismount's equipment within the platform.
- Power, including both the ability for dismounts to be able to recharge secondary power sources and the limitations of the platform power supply.
- Protection, not solely threat protection, but covering issues such as hearing protection.
- Casualty and POW management, where there are conflicting requirements on vehicles if used for CASEVAC actions.



G.2.3.4 Training

In occurrence terms a small but significant set of training issues were identified that link to all other identified issues:

- Training preparation, both over and under-training of the dismounts and platform crew.
- Live firing training, with there being a noted lack of live firing training in preparation for mounted operations.
- Emergency drills, with a lack of emergency drill training being highlighted.

G.3 INSIGHTS

- Issues collated in the Task Breakdown workshop broadly mirror those collated from the LORST/OOST Reports and can be grouped/categorised in the same way. The frequency of some issues has been captured and this strengthens the case for a number of issues as being critical or enduring.
- Whilst there are a number of issues relating to the doctrinal application of mounted operations, a vast majority relate to the relationship between the individual and the platform; notably the physical (interface-related whilst mounted, transitioning and dismounted) and cognitive (Situational Awareness).
- Each summary issue can be supplemented by a 'solution' and whilst it is not the aim of this study to develop solutions, this method does provide an indication of measures that need to be achieved for mounted operations against which requirements and principles can be articulated.
- Almost all issues related to the routine and 'normal' tasks conducted by soldiers when operating with vehicles. There was very little on the 'Question 4'¹⁹ moment and emergency procedures, which often define the outcome of a task or mission. This may have to be achieved by modelling or further engagement with the stakeholder group.
- Doctrinal and capability issues relate to the lack of, or confusion with, existing doctrine for operating with platforms, compounded by the large number of vehicle types that dismounts have to operate with. The capacity of platforms to cope with existing dismounted organisations is not coherent and this results in dismounts having to compensate for the realities of operations by re-configuring their organisational structures. This links to physical capacity and storage space within platforms. In addition, there are a large number of issues relating to command relationships, compounded by organisational change and uncertainty, and the realities of command and control within the mounted and dismounted states.
- Situational awareness and communications issues are significant and probably constitute the highest priority for mounted operations. The inability for dismounts to understand or be informed (by voice or data) during all states (mounted, dismounted and transitional) is a critical issue, as is the additional burden on the vehicle commanders to ensure that dismounts and crew understand the situation.
- Physical integration issues were numerous and mostly focussed on the comfort of the soldier (and his equipment) whilst mounted and during transition from mounted to dismounted. Physical discomfort and the difficulties of operating/sustaining within a constrained

¹⁹ 'Question 4' relates to Question 4 of Mission Analysis: 'Has the Tactical Situation Changed?' and relates to events and incidents that occur on operations that are unexpected and unplanned, testing the operator's ability to react to a changing situation accordingly.



environment formed the basis for most of these issues due to lack of space, poor design and little or no environmental control. Maintaining capability through comfort, rest and the ability to recharge (water, power, and food) was also a repeated concern.

- Training issues constituted a notable part of the issues summary and related, for the most part to a lack of training and familiarisation with platforms prior to deployment on operations. Of specific note was the importance of emergency drills in training that may need to be employed on operations.

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ANNEX H

INTEGRATION GUIDING PRINCIPLES – ADDITIONAL INFORMATION

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H.1 THE DCC-MCC INTEGRATION GUIDING PRINCIPLES – ADDITIONAL INFORMATION

ID	Principle	Explanation	Additional Remarks
Overarching Principles			
1	<p>Planning for integration risk - All programmes that involve any potential integration between platforms and dismounts should conduct an appropriate level of integration de-risking at the outset and throughout the lifecycle of the Programme.</p>	<p>All programmes that involve any potential integration between platforms and dismounts and that are being delivered in multiple stages, shall conduct an appropriate level of integration de-risking. As a rule the following activities must be conducted at the initial phases of capability development:</p> <ul style="list-style-type: none"> a) An Integration De-Risking Study (applicable where platforms and equipment is being procured in phases or pulses and the integration activity is being deferred to a later phase). b) An Integration Mapping Exercise to identify all Interfaces within each part of the system and between systems and coherent with supporting architectures. c) A doctrinal review to ensure coherence between doctrine and operational effectiveness. d) A System Integration Document (SID) capturing the integration policy solution to these issues and owned by a DCC-MCC system integration authority. 	<p>Historical evidence shows that limited planning and de-risking against the integrated capability in the concept phase of almost all platform and dismounted programmes leads to operational inefficiencies when dismounts and platforms operate together. Physical and Cognitive over-burdening of dismounts and platform crew through limited information systems and platform/equipment design are applicable to almost all programmes. Often this is due, at least in part, to the platform or dismount centric approach of each programme, with insufficient cognisance paid to the 'other' role.</p> <p>The SID, dependent on what overarching Integration Responsible Authority is initiated for DCC-MCC Integrated Capability might wish to promulgate this downstream as a DEFSTAN, taking account of other relevant publications such as Def Stan 00-251 Human Factors Integration.</p>

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ID	Principle	Explanation	Additional Remarks
2	<p>Doctrine coherence - Doctrine development to support platform and dismount integration capability should complement integrated Concepts and be approached iteratively, cognisant of emerging organisations and systems. Awareness of DCC-MCC Integration should be maintained at a doctrinal level in order to manage incoherent platform mixes and organisational variations.</p>	<p>Development of Concepts and Doctrine to guide and bound the development and implementation of integrated DCC-MCC capability must be conducted at least in parallel to the development of the capability. The Concepts and Doctrine development must be iterative reflecting system development changes effecting individual and tactical grouping levels, including technology refreshes and enhancements. Adopting a DLOD-focused approach throughout the life of a programme will go some way to achieving this. The DCC-MCC capability authorities must be made aware of any changes, identifying at the earliest opportunity any resultant impacts upon doctrine. Awareness will also be necessary in order to manage incoherent platform mixes and organisational variations.</p>	<p>The variety of platform and dismount configurations and types, combined with a lack of doctrine to support operational capability has had a negative impact on the operational effectiveness of tactical groupings conducting mounted-dismounted operations, particularly in recent operations where the nature of tasks and proliferation of UOR systems has created complexity and incoherence. Supporting doctrine has not developed in line with these changes resulting in a lack of guidance and direction for commanders to operate in more complex environments. This has resulted in operational inefficiency and incoherence.</p>

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ID	Principle	Explanation	Additional Remarks
3	<p>Integrated training – Integrated DCC-MCC training capability requirements should be determined at the beginning of the capability development process such that integrated Platform and Dismount capability acquisition maximises blended training, minimises training burden and facilitates federated training.</p>	<p>Integrated training of both platforms and dismounts singularly and together must be established at the beginning of the capability development process. This includes:</p> <ul style="list-style-type: none"> a) Training Needs Analysis for the Integrated DCC-MCC capability as well as for the mounted and dismounted needs. b) Platform and Dismount integration capability designed to minimise training burden and facilitate federated training. c) Training opportunities must be maximised, from the outset, by consideration of the required use of live, virtual and constructive environment training facilities in the solution architecture. d) Training facilities established to support DCC-MCC joint training in the constructive and virtual environment so that this can be conducted effectively in advance of and in parallel with live training. 	<p>Feedback from training and operations demonstrates limited opportunity for dismounts and platform to train together collectively prior to operational deployment, and limited facilities for simulated and constructive training. This results in units not being prepared for, and having to learn and train whilst on operations. This has a detrimental impact on the operational effectiveness of these units. The complexity of training with multiple platform and dismount types and configurations further compounds this problem. Lack of realistic simulated training systems for dismounts, platforms and importantly integrated mount-dismount capability is currently a significant limitation.</p>

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ID	Principle	Explanation	Additional Remarks
Programme Principles			
4	<p>Dismount workload - The Dismount-Platform integration should optimise the Dismount's physical and mental workload in all operating states (usually this will be a reduction in workload). The Platform should carry any additional burden arising from DCC-MCC Integration wherever possible.</p>	<p>Dismount-Platform integration shall optimise the physical and cognitive workload of the Dismount in all operating states.</p> <ul style="list-style-type: none"> a) Equality or reduction in Dismount's physical workload (including physical power) by: b) Equality or reduction in Physical stress and psychomotor tasks. c) Reduction in Physical load with no additional equipment required to be carried by the Dismount. d) Optimisation of Dismount's Mental Workload through Situational Awareness (SA), information exchange and sensory demands by: e) Maintaining seamless SA both inside and outside the platform. f) Not increasing information interfaces or cognitive tasks when operating with the platform (mounted and dismounted). g) Optimising sensory load where the demands on visual audio and haptic sensors must be minimised, not duplicated and coherent with the overall capability. h) The Platform should carry any additional matter (physical hardware and equipment, information bearer systems) arising out of DCC-MCC Integration requirements. 	<p>The Dismount is already subject to significant physical and mental workload whilst conducting dismounted operations.</p>

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ID	Principle	Explanation	Additional Remarks
5	<p>Platform crew mental workload - Integration with Dismounts should optimise the Platform crew's mental workload in all operating states (usually this will be a reduction in mental workload).</p>	<p>Mental Workload of the Platform crew must be optimised when integrated with Dismounts in all operating states by:</p> <ul style="list-style-type: none"> a) Maintaining the cognitive tasks of the platform crew with no additional tasks due to the integration of Dismounts to the capability. b) Optimising the dismount's local operating picture, (coherent with the platform crew's operating picture) to prevent additional information tasks being imposed on the platform crew to supplement the dismount's situational awareness. c) Fully integrated communications network to enable seamless communications for both platform crew and dismounts and prevent platform crew from becoming an additional (relay) information interface between higher command and the dismounts. 	<p>Adherence to this principle will also prevent the increasing data feeds from the dismounted soldiers (sensors) overwhelming the Platform Crew</p> <p>To reduce the significant need for platform crews to brief dismounts so their SA is enhanced and appropriate.</p>

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ID	Principle	Explanation	Additional Remarks
6	<p>Dismount support to platform combat effectiveness - Integration with Dismounts must complement the combat effectiveness of the Platform. Dismount integration must optimise the preparation, conduct and sustainment of all operational capabilities of the Platform.</p>	<p>Integration with Dismounts must complement or enhance the combat effectiveness of the Platform by, optimising the operational capability of the Platform to:</p> <ul style="list-style-type: none"> a) Maintain Situational Awareness (SA) where the dismount does not become an additional burden to, but contributes to the LOP. b) Communicate where the dismount’s network provides the platform with additional capability for information exchange. c) Manoeuvre where the integration of dismounts (whether mounted or dismounted) does not impede or negatively influence the manoeuvrability of the platform. d) Find where effective integration of sensors enables the dismount to enhance the ISTAR plan by utilisation of dismounted sensors. e) Deliver effects where the dismount does not constrain the use of platform effectors and can enhance the lethality of the integrated DCC-MCC capability by utilising dismounted effectors. f) Survive where the dismount can contribute to the information exchange, find and manoeuvre capabilities of the integrated capability and provide protection for the platform in complex terrain. <p>Also, complement the Platform’s capability to prepare for and sustain operational capability to:</p> <ul style="list-style-type: none"> a) Maintain, Repair and Replace the integrated capability (and sub-systems of) by not adding to the logistic or capacity burden of the platform beyond that designed. b) Endure on operations by dismounts maintaining a level of self-sustainability, not over-burdening the platform and contributing to the integrated capability. 	<p>This principle addresses the perception of the dismount being a burden or hindrance to the operational effectiveness of the platform, and instead recognises and encourages proactive system design that enables the dismount to contribute to the combined platform-dismount combat effectiveness.</p>

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ID	Principle	Explanation	Additional Remarks
7	<p>Platform support to dismount combat effectiveness - The combat effectiveness of the Dismounts should be maintained or enhanced through replenishment, sustainment and protection, in all operating states, by integration with the Platform.</p>	<p>The combat effectiveness of the Dismounts, when operating as part of the integrated DCC-MCC capability, must be maintained or enhanced, in all operating states. Enhancing the physical and cognitive condition of the dismount can be achieved through:</p> <ul style="list-style-type: none"> a) Provision of a secure and comfortable environment (seating, space, temperature and air condition) whilst mounted. b) Removal of physical burden whilst mounted and dismounted. c) Enabling rest and sustenance to the Dismount. d) Enhancement of Situational Awareness whilst mounted. e) Ensuring physical comfort. f) Reducing cognitive stress. g) Enabling quality rest. <p>The physical capability of the Dismount to communicate, manoeuvre, find and deliver effects, and the cognitive capability to understand and make decisions, must not be degraded by integration with the Platform in all operating states. This is achieved by:</p> <ul style="list-style-type: none"> a) Replenishment. The Dismounts must be replenished with combat supplies (ammunition, food, water, power, fuel, medical supplies) supplemented by the platform. b) Sustain. The Dismount's physical and mental condition must be optimised throughout their interaction with the platform by appropriate management of environmental stresses. c) Protect. The protection of the Dismount shall be enhanced through the platform's improved lethality, ISTAR, mobility and/or physical protection. 	<p>The dismounts currently have to overcome issues such as those relating to vibration, adverse air quality and temperatures, motion sickness, all of which lead to reduced combat effectiveness.</p> <p>Thus this principle is primarily about ensuring that the dismount is capable/ready to fight/operate after travelling in the vehicle.</p>

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ID	Principle	Explanation	Additional Remarks
8	<p>Maintain capability in transition - The Dismount-Platform integration should not impose any additional physical or cognitive workload on the Dismounts when transitioning between the mounted and dismounted states (i.e. embussing or debussing).</p>	<p>The integration of platform and dismount must not result in any additional physical or cognitive workload for either the dismount or the platform crew during transition by:</p> <ul style="list-style-type: none"> a) No additional physical or psychomotor tasks on the dismount when entering, securing, releasing and exiting the platform. b) No additional mental workload on the dismount or platform crew when embussing or debussing the platform. c) Seamless maintenance of information exchange, situational awareness and the LOP for both dismount and platform crew throughout transition. <p>Transition includes all interfaces, physical and cognitive tasks that are incorporated when moving between the mounted and dismounted operating states. Transition includes planned and emergency embussing and debussing operating states and constitute the most vulnerable states within the integrated DCC-MCC capability.</p>	<p>The transition is viewed as being a significant problem. In some platforms dismounts currently have to transition between communications systems/headsets, and can result in dismounts and vehicles operating in close proximity to each other leading to greater risk of fratricide and RTAs, etc.</p>

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ID	Principle	Explanation	Additional Remarks
9	<p>Platform Capacity - Platforms shall provide sufficient secure and safe space to accommodate the individual dismount, tactical groupings of dismounts and all their mission critical and operational equipment for the duration of the operational tasks, ensuring immediate accessibility between dismounts, platforms and equipment where required.</p>	<p>This principle is established to ensure the following requirements are addressed:</p> <ul style="list-style-type: none"> a) Tactical Grouping, the Dismount zone must allow adequate and secure space to accommodate the appropriate operational grouping, fully equipped with personal and group equipment. b) Individual Load, the Dismount station must allow adequate and secure space to accommodate the Dismount, fully equipped with personal equipment (e.g. the Soldier System). c) Stowed Load, the Platform must provide adequate and secure stowage for all mission critical equipment (internal or external as appropriate). 	<p>Consideration must be given to which standard of individual load will be relevant to the platform as this will impact the feasible space for individual and stowed load. For example, the 'fight light' loading would potentially be the recommended standard as Dismounts are likely to dismount for the majority of the time in the DCC environment.</p> <p>It is also acknowledged that mission critical equipment will vary from mission to mission and therefore it is possible that this principle may not be achievable in all cases. It should, however, remain an overarching consideration for all situations.</p>

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ID	Principle	Explanation	Additional Remarks
10	<p>Interface standardisation - The physical, information and power interfaces between Dismounts and Platforms must be common across all platforms and across all operating states.</p>	<p>Interface designs shall be common across the Platform fleet, irrespective of Platform type. All dismount touch points should offer the same look and feel (e.g. seat belts may not be identical but the way they are operated by the user should be consistent). The provision of common interfaces (physical, data, power) to all platforms reduces the complexity of interface management and enables flexibility in operating with a variety of platforms.</p> <p>Commonality of interfaces within the soldiers system and platform system, and between the soldier systems and platform systems must be achieved to exploit operational effectiveness through standardisation, flexibility and minimising the training burden across all operating states. This includes commonality of:</p> <ul style="list-style-type: none"> a) Physical interfaces including seating systems and stations, electronic connectors and all interfaces that involve touch. b) Information Interfaces including all visual, audio and haptic interfaces. c) Power interfaces including power units for all operational systems recharging and re-generation systems. <p>This principle does not seek to mandate that all Platforms must be fitted with an identical suite of interfaces; only that where they are fitted they all need to conform to a common, universal design standard to provide common symbology, look and feel.</p>	<p>All information interfaces need to be standardised (e.g. with common symbology and look and feel) but should still be tailorable to / accommodate the requirements of the individual user, task, operational environment (e.g. different levels of display fidelity). This standardisation also need to take account of the differing needs regarding numbers of icons displayed and to what level of detail, e.g. a section commander may need different level of detail to the rifleman, to the vehicle commander, etc.</p>

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ID	Principle	Explanation	Additional Remarks
11	<p>Communications - The Dismount-Platform integration shall ensure that seamless, bi-directional communications are maintained between the Dismounts and the Platforms in all operating states.</p>	<p>The Communications system of the integrated DCC-MCC capability must be designed to ensure that seamless, bi-directional communications are maintained between all dismounts and platform crew throughout all operating states</p> <p>Communications includes all means of information exchange: audio (e.g. voice), visual (e.g. data) and haptic. Each communication link between nodes should enable bi-directional communications.</p> <p>This Principle applies to Dismount-to-Dismount and dismount-to-platform communications between operating states and during transition operating states.</p> <p>An appropriate level of bi-directional communications must be provided between tactical groupings e.g. between dismounts and other co-operating Platforms, other than their own parent Platform (Platform's within the tactical grouping).</p>	<p>It is important to note that communications is key for both operational effectiveness and safety.</p>



ID	Principle	Explanation	Additional Remarks
12	<p>Situational awareness - Both Dismount and Platform Local Operating Pictures (LOP) should be coherent with the Common Operating Picture (COP) and each other, across all operating states.</p>	<p>The dismount and platform situational awareness (SA) must be coherent within and outside the tactical grouping. The Local Operating Pictures (LOPs) of the dismount and platform (crew) must be coherent with each other to mitigate the responsibilities of the platform crew to supplement SA for the dismount and exploit shared SA. The LOPs must be coherent with higher formation Common Operating Picture (COP) and all must be maintained or enhanced across all operating states.</p> <ul style="list-style-type: none"> a) Within the tactical grouping, DCC-MCC integration must enable the dismount to maintain an appropriate LOP, coherent with the platform LOP, across and in transition between all operating states. b) Within the tactical grouping, DCC-MCC integration must enable the platform crew to maintain an appropriate LOP, coherent with the dismount LOP, across and in transition between all operating states. c) Between tactical groupings, DCC-MCC integration must enable dismounts and platform crews to maintain an appropriate LOP, coherent with other tactical grouping's LOPs, across and in transition between all operating states. d) Dismount and platform crew Local Operating Pictures (LOPs) must be maintained as a coherent sub-set of the higher formation COP. 	<p>For the purposes of this study, the LOP has been considered to be the Unit level and below, and the COP to be the next Unit command level up. For example, the dismount Section Commander will have a LOP of his Section and the individual Riflemen within his Section and a COP of the other Sections in the Platoon. An individual Platform will have knowledge of its own dismounts and its own situation as its LOP, and the other platforms in the Platoon as a COP.</p>

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H.2 DEFINITIONS USED WITHIN THE PRINCIPLES

Term	Definition
Cognitive Burden	The cognitive and mental load sustained by the human (dismount and platform crew) through mental, sensory and communication tasks and in response to environmental stresses.
Cognitive Condition	The mental state of the human being as a result of conducting tasks (such as maintaining Situational Awareness), physical fatigue and comfort, morale and medical health.
Combat Effectiveness	The level of sustained capability for the Dismount or Platform to conduct key tasks of survivability, manoeuvre, command, control and communication, delivery of effects and find.
Combat Supplies	Combat supplies include ammunition, nutrition, hydration, power and equipment (mission specific and spares).
Common Operating Picture (COP)	Formation Headquarters geographical depiction of the operational area of responsibility including the environment, all entities and actions, and incorporating historical, live and future events. The COP applies to the level of an individual and one level above within an organisational hierarchy. I.e. A Platoon Commanders COP would be SA of the other PLs within the Company context and an understanding of the other Companies within the battlespace.
Dismount	The human user engaged in dismounted tasks and operations, both mounted and dismounted on platforms.
Integration	The process of bringing together the component subsystems into one system and ensuring that the subsystems function together as one system.
Interfaces	Interfaces include physical interfaces, information interfaces and power interfaces.
Local Operating Picture (LOP)	Tactical Grouping geographical depiction of the tactical area of responsibility; as a coherent sub-set of the COP; including the environment, all entities and actions, and incorporating historical, live and future events. The LOP applies to the level of the individual and below within the organisational hierarchy. i.e. a Section Commander will have SA of all of his subordinates and his peers (other Section Commanders) within a platoon.
Mental Workload	The mental (cognitive) effort exercised by the human (dismount and platform crew) whilst conducting cognitive (sensing, communication and understanding) and sensory (visual, audio and haptic) tasks and coping in response to

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Term	Definition
	environmental stresses.
Operating State	The relationship between dismount and platform on operations and includes the Mounted (dismounts and platform crew on platforms, both secured and 'head up'), Dismounted (dismounts and platform crew operating off-platform in intimate support, within the area of influence and the area of interest) and transitional states (embussing or debussing the Platform).
Physical Burden	The physical load sustained by the human (dismount and platform crew) through psychomotor, physical effort and load carriage tasks, and in response to environmental stresses.
Physical Condition	The physical state of the human being as a result of sustenance (food, water, rest), work (energy used) and medical health.
Physical Workload	The psychomotor and stress effort exercised by the human (dismount and platform crew) whilst conducting physical and sensory tasks, and coping in response to environmental stresses.
Platform	The manpower, equipment and systems of manned and autonomous vehicles that interact with the dismount and the platform through carriage and/or the conduct of operational tasks.
Replenish	Supply of combat supplies to full operational load.
Situational Awareness	The perception of elements in the battlespace of interest within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future in order to make appropriately informed and timely decisions that facilitate the accomplishment of the mission.
Station	The space immediately surrounding the Dismount when he is mounted inside the Platform and includes seating and the area immediately physically accessible space to him.
Sustain	Maintain and support the Dismount through assessment, maintenance, supply, repair and replacement of all combat functions.



ANNEX I – DLOD REVIEW



I.1 INTRODUCTION

This annex details the findings of the DLOD review for the DCC-MCC capability space. Information is presented in the tables below. Note that the DLODS follow the TEPIDOILI format as follows:

- Training.
- Equipment.
- Personnel.
- Information.
- Doctrine and Concepts.
- Organisation.
- Infrastructure.
- Logistics.
- Interoperability.

I.2 TRAINING

TRAINING	
General	DCC-MCC Integration offers the opportunity to increase the percentage chance of tactical mission success, and improve the efficiency in which this is done. These benefits are dependent on there being enough adequately resourced individual and collective training opportunities. At this stage it should not be assumed the time required for training will be reduced.
Individual (Unit) and Phase 1-3 Training	MCC DCC Integration needs to be introduced to units at the individual level across an entire brigade at the beginning of the training cycle. Soldiers need to complete phase 2 training having successfully achieved MCC DCC Integration competency at platoon level.
Collective Training (CT)	After individual training, all CT events should be integrated (mounts-dismounts) and must facilitate competency and currency for individuals at section, platoon (CT2) and company level (CT3). DCC-MCC capability must be incorporated at CT1 to 3 training activities for all units committed to or likely to be committed to operational deployment. Realistic and comprehensive collective training is underlined, including an increasing need to incorporate Joint Information Management (JIM) aspects, even at low tactical levels. Overseas collective training events will be conducted as part of larger Battalion and Brigade training exercises, and this will address the environmental and interoperability issues surrounding Manoeuvre Support
Synthetic	Representative and integrated DCC-MCC systems need to be coherent and must be introduced to all current simulated training systems and their training staffs duly familiarised by the time the first units to be converted reach the part in the training continuum where they meet that particular simulated training means.
Simulated Training	Simulated training must be exploited to enrich DCC-MCC training capability. Existing training systems must be developed in order to support emerging technologies, the developing threat and enhanced TTPs. Simulated training will avoid skill-fade and prepare for major exercises and operations in a relatively low-cost environment, but must not replace live training.

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TRAINING	
Live, Virtual and Constructive (LVC) Training	MCC DCC Capability must adopt the concept of blended training, optimising the live, virtual and constructive environments. Integration of live, virtual and constructive environments will facilitate the seamless passage of standardised information across these environments, with the additional capability to incrementally upgrade the training environment in anticipation of the operational DCC-MCC capability. The need for associated simulation capability is key and applies to each of the platforms and personnel within MCC DCC capability.
Simulation Technology	The rapid development of simulation technology must be embraced in the same way as the technologies required to deliver the operational MCC and DCC systems. This requires close engagement and relationship with R&D and industry and sharing of emerging requirements and technological developments. Synthetic wrap for live training and experimentation, virtual and constructive simulation will be critical.
Assessment and Experimentation	DCC-MCC experimentation activities must be conducted in order to objectively identify the measures of performance and effectiveness that are achievable in the near and mid-term future. This will provide a baseline against which capability enhancements can be identified; building an evidence base for Scrutiny; with a view to future capability enhancements.
Training Needs Analysis (TNA)	A Training Needs Analysis will identify the individual training requirements to ensure that users (including mounted and dismounted commanders) are properly trained in the employment and operation of the dismounted soldier and the platform.
Through-life Training strategy	Training influence and the development of specialised sub-systems will influence spiral acquisition and the renewal strategy for the broader DCC-MCC capability. This will include emerging training systems and methods that can be exploited within the DCC-MCC domain and subsequently the training capability of DCC-MCC will require enhancement and development through the life of the programme.



I.3 EQUIPMENT

EQUIPMENT	
Acquisition	It is anticipated that DCC-MCC systems will adopt a spiral acquisition approach to allow incremental delivery of and improvement to capability, both as the User's requirement and MOD's understanding of the requirement evolve. Equipment, including software, must be designed and procured in a modular way using open standards and COTS-based solutions and directed by the Integration guiding principles. This will maximise MOD's the ability to upgrade through wider availability of compatible equipment and at the same time reduce the associated time and cost of upgrading, leveraging the investment industry makes in other civilian markets. Compatibility between all DCC-MCC systems and tactical CIS is critical and must be ensured.
Performance Specification	This will be articulated through the URDs and SRDs of each of the capabilities within the DCC-MCC domain, informed at first through previous work, experimentation and CCD activities. Requirements should be specified in terms of the integrated capability and not just the component dismantled and mounted elements. Supported by a spiral acquisition approach, the requirement should be further refined through operational and training feedback, technology availability and maturity, emerging threat and affordability.
Networking	Availability and agility of network space will be driven by the technological solution, both of DCC-MCC capability and Bowman/MORPHEUS. The requirement to deliver agile, robust networks in support of the operational and training environments is enduring. Network management and constraints imposed by security must be developed during the early stages of the programme. Security requirements present a significant constraint to the technical development of DCC-MCC internal communications capability.
Connectivity & Interoperability	The modularisation of mounted and dismantled equipment should be approached in a manner so that a user's equipment can be rapidly upgraded to a commander role, and vice-versa, by simply adding/exchanging a small number of modules. To further simplify future connectivity (plus reducing training, logistics and other burdens), CNR and PRR replacement equipment should share common equipment modules with the generic MCC DCC capability.
Force Mix of Equipment	Modularisation of DCC-MCC equipment and standardisation of interfaces across platform and personal equipment will maximise the flexibility associated with equipment force mixes, with units able to configure the system to their individual requirements.
Technology Readiness	To exploit COTs equipment improvements, a close relationship between the DCC-MCC Capability Owner and what is a fast-moving commercial communications and IT industry is critical. An open approach to the incorporation to MOTs and COTS equipment must be established through-life, including software development. This must be supported by a responsive Research and Development (R&D) strategy, exploiting commercial CIS developments whilst retaining an appropriate level of CIS expertise in MOD ²⁰ .

²⁰ For example: Cabinet Office Review of Major Government IT Projects, 2000 (McCartney Report)



EQUIPMENT	
Technology Demonstration	In support of rapid technology developments, an appropriate through life technology demonstration programme must be established. There must be a clear route from technology demonstration to Integration into fielded equipment.
Scaling and Deployment for IOC	The equipment acquisition must map against the requirements of IOC and FOC delivering the platforms, dismounts, sensors and enabling technologies against these milestones. This must incorporate the opportunity to familiarise and train with the equipment and includes the need for training systems prior to OC. Whole Fleet Management (WFM) principles must also be applied and in place before IOC.

I.4 PERSONNEL

PERSONNEL	
Manpower	Developing the DCC-MCC capability must not increase, and aim to reduce, the manpower burden on Defence in the intermediate or long term. Fielding Teams will be required however, to issue incremental DCC-MCC equipment to units and train unit trainers. Information Management may place an additional training burden on existing sub-unit and tactical grouping roles.
Skill Set	Future electronic systems (Information and Power) must be designed to accommodate the physical and cognitive abilities of the user (both mounted and dismounted) to prevent more demanding recruit entry standards. The use of commercial communication technologies will bring familiarity and potential for exploiting HMI conventions gained from devices including smartphones, games consoles and PCs.
Recruitment and Selection	Adopting an integrated DCC-MCC capability approach will not adversely influence the existing recruitment and selection criteria applied to mounted and dismounted operators and commanders by demanding higher levels of intellectual or physical abilities. The requirement for competencies will remain and this will determine selection criteria. Potentially greater investment is required however, to ensure that personnel are retained as they will develop specialist skills and competencies within the DCC-MCC capability.
Retention	Integrated DCC-MCC capability will present the opportunity to offer benefits to the User that may improve retention: Incremental career progression and dual qualifications (platform and dismount) that will better prepare the User during his career: a high level of specialist competence and subsequent reliance by other personnel and units, and exciting and fulfilling employment. Conversely, it is important that investment in mounted and dismounted personnel is sufficient to retain the high skill level that will exist across operators and commanders.



PERSONNEL	
Information Management	DCC-MCC Integration will demand better information exchange and situational awareness for mounted and dismounted personnel. It will also create information hubs at platform, platoon and company level where information will have to be managed as a result. Information Managers will require a higher level of competence and expertise ²¹ than currently expected of infantry recruitment. This can be achieved by more stringent selection for career streaming, or better training and education to prepare those individuals for the enhanced IM roles that they will fill. This will provide additional opportunities in career qualification. IM competencies must be identified early and formalised within the career management plan, alongside the other qualifications gained by the mounted/dismounted User.
User Feedback to Integrated DCC-MCC Capability	User feedback processes must be established within the training, experimentation and operational environments in order that individuals can contribute to the development of the integrated DCC-MCC capability. It has the added advantage of developing additional responsibility and ownership of the capability by the User. Lessons learned and user feedback processes must be formalised and continue to contribute as part of the capability development process.
Trials and Experimentation	The assessment phase must be designed to provide the maximum opportunity to understand the impact that integrated DCC-MCC capability will have on the Users, platforms, equipment and tactical groupings. This can be achieved through the spectrum of analytical assessment, but the value of live trials and experimentation will provide the most realistic and greatest value in learning.

I.5 INFORMATION

INFORMATION	
Security	Information shared within the DCC-MCC domain will be largely classified as SECRET therefore the systems and supporting protocols will be constrained by applicable mandatory information management requirements. Additional security classifications may be introduced to enable information exchange that may reduce the immediate burden on the soldier but could introduce an additional requirement at the systems interfaces. All elements of the DCC-MCC domain and its interfaces with must be UK Crypto compliant. Careful consideration of the full impact of additional security domains must be considered and any significant increase in physical weight and bulk for the dismount, for security reasons alone, must be avoided.

²¹ In Information Technology



INFORMATION	
Information Exchange Requirements (IERs)	DCC-MCC capability IERs must be identified developed and articulated in order to inform the information exchange requirements of the capability; that will in turn drive the network structure and technology provided within the system. IERs must be coherent with those identified within MORPHEUS and DSA and complement the needs of both the mounted and dismounted commanders and operators. Both MORPHEUS and Integrated DCC-MCC capability should be developed in parallel to deliver the most efficient and innovative means by which IERs can be supported and exchanged.
Networks	The aspiration (through MORPHEUS and DSA) is that the integrated DCC-MCC capability will deliver assured, bi-directional information exchange throughout the network at every level of command and node (platform or dismount) by voice and data. Network loading will fluctuate significantly over time, both in terms of voice and data, and whilst voice will take primacy, the ability to exchange data and voice information at the required latencies is critical. Agile, robust networks responsive to a fluctuating demand must be delivered within the DCC-MCC capability to facilitate assured information exchange and enable other core capabilities.
Capacity	The nature of the DCC-MCC capability information requirements, including the rapidly developing need for ISTAR product and geospatial data, create a need for considerable data storage on both the platform and dismount. This is further exacerbated by the need to archive operational records. Information is likely to have to be stored locally, with the need for automated updates (version control) etc.
Information Management	Company HQ will become the principal IM Hub ²² ; the interface that manages information through MORPHEUS, DSA and within the integrated MCC DCC capability and will have a critical role in the creation, manipulation, fusing and de-conflicting of information, managing the COP and subsequent LOP. Within DCC-MCC capability the IM requirement may also extend to lower levels (platoon/platform). Human expertise and technological information management services will be needed at company group level and this may require the creation of a Company-level Information Manager role.
Find	Integrated DCC-MCC capability is an integral part of the ISTAR Plan, due to its complex suite of mounted and dismounted sensors and the aspiration to exchange collected information within and outside the capability. Mounted and Dismounted systems will disseminate information collected by all sensors organic and inorganic to the tactical grouping, collating and managing at sub-unit HQ. Collected information will be exchanged in real or close to real time and the network must be capable of facilitating this, supporting collaborative actions whilst locating or tracking the environment and threat.

²² NEC4CC Findings.



INFORMATION	
Information sources	Platforms and the mounted and dismounted Users are battlefield sensors and therefore an integral part of the ISTAR plan and 'Collect' function, disseminating information across the area of operations. Information sources include platform sensors, personal sensors, personal and platform displays, integrated GPS systems and presentation, external ISTAR sources and the combat network delivering voice, data (e.g. imagery, FMV). This is clearly complex and requires early design and development for new capabilities in concert with information management.
Interoperability requirements	Integrated DCC-MCC capability must achieve a level of interoperability with all assets and entities within the User's Area of Responsibility (AOR). All elements of the capability should be compatible with relevant GSA, GVA and GBA interfaces and fully interoperable with the battlefield communications network as a bearer (BOWMAN/MORPHEUS/PRR). The capability must conform to the appropriate data models and standards to allow onwards interoperability with collation partners and be able to receive ISTAR feeds from all assets within the Area of Operations. The capability should, in addition, be able to interoperate with UK PAG and civilian emergency services in support of UK Resilience Operations, and International Civilian Agencies in support of disaster relief operations.
Security, Standards and Protocols	DCC-MCC CAPABILITY will operate in the Tactical SECRET space; storage and security interfaces between networks, hardware and software must be clearly defined and articulated within the GVA. All elements and interfaces with BOWMAN/MORPHEUS or other supporting networks must be UK Crypto compliant. Commonality of Information standards and services is critical; command tools, applications and templates will need to be standardised; establishing a 'common information language'; and network protocols to enable dynamic establishment and agility of networks at all levels of command within and outside DCC-MCC CAPABILITY.
Information Operations	In line with the Army's transition to a more integrated approach to mounted and dismounted capability, Integrated DCC-MCC capabilities must develop an effective Information Operations (IO) campaign to all personnel in the management, administration and operational roles in order to ensure commanders and staff at all levels are aware of the objectives, capabilities and constraints of the capabilities.



I.6 DOCTRINE & CONCEPTS

DOCTRINE & CONCEPTS	
Concepts	Integrated DCC-MCC capability has developed significantly over recent operations and has become less well-understood, more complex and less supported by operational concepts. Defence has recognised this and so a more integrated approach to the DCC-MCC capability area should deliver more robust concepts for its operation and employment.
Doctrine	There is a significant gap in the development and application of doctrine according to the capabilities, organisation and equipment of existing and emerging force levels. This must be addressed as a priority and will require a better appreciation of the likely operating environment and threat and a better understanding of the manpower and equipment capabilities and constraints. This is seen as an iterative process due to the equipment and organisational situation that exists currently, and an adoption of integrated capability as opposed to discrete capability as its building blocks. Doctrine is needed to provide direction and education to Users within the DCC-MCC domain.
Operational, Training and Experimentation Lessons Learned (L2).	Feedback from operations and training will help to identify, refine and even constrain concepts, and apply to all levels of doctrine. It is important that through the development of TTPs that feedback is able to influence doctrine and therefore an iterative process. Much of what has been learned is through operational lessons from Op HERRICK and whilst these are invaluable, the L2 from contingency training must also be enabled to influence doctrine as it is a developing capability. It is expected that many lessons will be quickly learned both from operations, training and experimentation activities as the DCC-MCC capability currently exists. These lessons need to be publicised as efficiently as possible in order to inform emerging capability development, subsequent fielding plans and tactical doctrine notes or TAM inserts.
Drivers	High level doctrine and associated R&D influences the framework within which the integrated DCC-MCC capabilities will operate at Force, Operational and Tactical level. The key drivers for Integrated DCC-MCC capability concepts and doctrine are Director Force Development (DFD) and the Future Operating Environment (FOE) (articulated through Future Land Operating Concept (FLOC)), including the changing threat, the increasing importance of JIM ²³ and coalition considerations and the increasing complexity and diversity of operations. A clear connectivity of doctrinal principles and integration principles will underpin the components; operational and tactical employment of the integrated DCC-MCC capabilities.



DOCTRINE & CONCEPTS	
Experimentation and Operational Analysis (OA)	A clear and comprehensive relationship between doctrine, concepts and capability (moral and physical components) must be established. This can be achieved through the conduct of: Doctrine Force Development; Operational Analysis (OA); Research and Experimentation, and establishing an open relationship between them. Integrated DCC-MCC capability will benefit from OA/Experimentation against predicted operational scenarios and tasks set in the contingency operations context. This can be achieved through modelling of operational tasks against agreed metrics within the context of an operational mission. The same activities can be conducted live, during training, to establish metrics for baseline and capability enhancements.

I.7 ORGANISATION

ORGANISATION	
Network	Agile networking will have implications on organisational structures; enabling greater flexibility and challenging legacy organisations and hierarchical principles.
Command	The robust, agile network and enhanced battlespace visualisation delivered through an integrated DCC-MCC capability will offer the opportunity for commanders to effectively command and control more units and entities than they currently manage. This will support potential shifts in organisation by, for example, enabling the 'rule of four' ²⁴ to be implemented in the mounted/dismounted domain and at the lower tactical levels (platoon and company). Better visualisation enables commanders to cognitively and concurrently manage more moving parts (entities and sub-units).
Organisational Interfaces	The nature of the information, power and physical interfaces between attached assets, tactical groupings and headquarters; and between platforms, personnel and equipment; requires further investigation and will need extensive testing in experimentation and modelling, covering human and technical issues, necessary information flows and battle-planning tasks. Similar consideration will be needed for standard (FST) and non-standard attachments to the company including the interfaces within sub-unit and tactical grouping HQs.
Force Generation	FF2020 articulates the force generation plan, established for the whole close combat domain, and the integrated DCC-MCC capability as an embedded capability must be ready to meet these commitments. The scaling and deployment configurations of DCC-MCC capability must fulfil the operational, operational support and training commitments and meet the force generation of high readiness, follow on and support tasks.

²⁴ The 'rule of four' concept was analysed at the Platoon Combat Experiment #2 and examined reorganising the Infantry Platoon into four Sections as opposed to the standard three.



ORGANISATION	
Structures	Existing structures may be required to change to fulfil the operational requirements of the integrated DCC-MCC capability. This is due to the proliferation of legacy platforms (limited in capacity and capability) within the future army structures. Dismounted organisation may be required to change to complement the integrated capability, as was indeed experienced on recent operations.
Deployment Options	The flexibility of the generic integrated DCC-MCC capability organisation means that tactical groupings at all levels can be deployed in multiple configurations, constrained by interfaces, retention of key capabilities, manpower and sustainability issues. Deployment options require further investigation through OA and experimentation to determine the optimum options.

I.8 INFRASTRUCTURE

INFRASTRUCTURE	
Estate	The UK Defence Estate (including estates outside of the UK) must be developed, including the implementation of dedicated networks, to support effective training by integrated DCC-MCC units. Training exploitation demands better assessment methods for mounted and dismounted capabilities and subsequent instrumentation of the estate: insertion of sensors to geographical features, the high resolution mapping of terrain (including urban facilities) and establishment of dedicated, high capacity networks for the transfer of data and voice.
Simulators	Enhanced and integrated DCC-MCC unit and the infrastructure to support them are required and must provide representative network availability and characteristics of the operational capability and be able to simulate against the integrated capability, and not the discrete elements of platforms and dismounts.
Storage	Secure storage facilities for platforms and equipment supporting the DCC-MCC capability must be adequate and accessible for training, experimentation and deployment purposes both in home bases and in theatre. The requirement for secure information storage will significantly increase.
Expeditionary Infrastructure	It is important that the infrastructure requirements to support and maintain the integrated DCC-MCC capability within an expeditionary environment are captured and should be coherent with Generic Base Architecture (GBA). Given an increase in liaison and shared facilities with other agencies and organisations, adequate secure storage must reach the smallest Forward Operating Base (FOB). Network nodes and a comprehensive suite of recharging facilities should be linked to availability targets, enabling assured communications and the rapid regeneration of power.

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INFRASTRUCTURE	
Training Infrastructure	Unit Integrated DCC-MCC capability must have the same training infrastructure requirements normally associated with a sub-unit deployed on operations. This will include: hard standing space will be required to store platforms and equipment; replenishment facilities for power, fuel, food and water; training communications networks and training system interfaces to enable realistic communications and allow federated and distributed training; simulator training systems.
Virtual and Constructive Training Infrastructure	Dismounted and Platform simulators must provide representative network availability and characteristics of the operational capability, as well as the additional demands of synthetic wrap and augmented simulation for the User, both mounted and dismounted and when operating together. This can be achieved by making best use of existing infrastructure and available Local Area Network (LAN) infrastructure, and must include network peripherals and the demands of power. Within UK this will result in the provision of secure COTS infrastructure and licences to utilise systems over COTS networks.
Information Storage	Secure storage facilities for close combat capability must be adequate, as for any CIS, both in home bases and in operational environments, and the aspiration to reduce hardware footprint in an operational environment should not place any additional demands on existing storage capability. Information storage will be significantly higher and the capability to securely store data will need to be met, both in the home base and in operational environment.

I.9 LOGISTICS

LOGISTICS	
Personnel	Additional manpower may be required for the maintenance of emerging DCC-MCC units support solution to enable level 1, 2 and 3 repairs.
Maintenance	The ES policy of 'repair forward' must be adhered to. The exact maintenance policy for Integrated DCC-MCC units will be identified through the application of ILS principles and a level of repair analysis during the assessment phase of the project. Unit (level 1&2), formation (level 2&3) and force (level 3) support should remain the preserve of the military whilst the majority of Level 4 maintenance is likely to be provided by the manufacturer or contracted support.



LOGISTICS	
Support Solution	Integrated DCC-MCC capability is a significant and critical battlefield system-of-systems. ES units (1st and 2nd line) must be equipped and trained to support the forward diagnosis and repair of equipment and platform items in order to maintain the capability in the hands of the user. Current planning must allow for traditional support across the whole life of the capability. The support solution is expected to explore possibilities through Total Support Force (TSF) through the Whole Force Concept (WFC) initiative. The optimum Integrated Logistic Support (ILS) Strategy for DCC-MCC capability will only become apparent as the capability is developed and considered as an integrated capability as opposed as a series of more focussed capabilities.
Spares	Repair and diagnosis forward will optimise the number of spares required. All spares must be codified and data inputted on the inventory management system in service at the time.
Storage/ Sustainment issues	Units will hold a Basic Unit Fleet of platforms and DCC-MCC equipment to conduct CT 1 & 2. Universal power requirements, recharging and resupply of power storage units must be considered up front and the facilities for diagnosis and repair must be included in this appreciation. Equipment and power supplies monitoring, within the context of incremental combat supplies monitoring will become an essential requirement of integrated DCC-MCC capability in the near future.
Operational Resupply	Spares pack of Line Replacement Units (LRUs) must be held at each First line repair location for operations and training; providing the user with immediate spares for dismounted soldier systems, platform systems and equipment; sustaining operational capability, enabling backloading and replacement. Enhanced availability of the DCC-MCC capability is key here and requires to be identified through assessment and experimentation to assist with planning yardsticks. Combat supplies for this equipment include fuel, lubricants and water, ammunition and explosives. The system is to be able to operate to its full capacity utilising in-service fuel and lubricants and once again, their usage should be kept to a minimum.
Equipment RAMD	The requirements for Personal equipment, Platform equipment and Platform RAMD ²⁵ are critical to the integrated MCC DCC capability and will need careful specification to ensure high availability throughout operational tasks and for training and assessment; the Battlefield Mission (BFM).

²⁵ RAMD - Reliability, Availability, Maintainability and Durability



LOGISTICS	
Redundancy	Integrated DCC-MCC capability must aim to duplicate capabilities at every level e.g. two commanders with each subunit in order to ensure consistent, high availability of the capability (due to the specialist nature of operator, platform and command roles). This will reduce risk through increased resilience from the threat and environment, and present the opportunity reduce duplication in secondary capabilities e.g. the carriage of spares and reducing reversionary operations. The implications of achieving this will add burden to the training and preparation of the force and increase the logistics burden to support duplicated equipment. As the platform and dismount are to be considered as elements of the same capability, there are additional opportunities to engender duplication through even greater efficiencies when viewing the system as a whole.
Personnel Support	The integrated DCC-MCC capability itself will have a direct impact on the management of personnel and if managed coherently; will better sustain the User in battle and through casualty management. As well as fuel, lubricant and equipment availability, the monitoring, maintenance and resupply of hydration and nutrition for personnel through combat supplies monitoring is key.
Asset Tracking	An integrated DCC-MCC capability would benefit from parallel logistics monitoring capability; both soldier level and platform level; that would be integrated with the LOP and develop the capability to track platforms, mounted and dismounted assets around the battlefield. This capability would also be reflected within the training systems that support an integrated DCC-MCC capability. This could be achieved through exploitation of the existing and future communications network but will also require additional logistic monitoring sensors to be integrated both on the man and on platform.
Repair and Replace	The User must identify, replace and repair each of the mounted and dismounted capabilities at first line. This will have implications on training and the positioning and carriage of spares as far forward as is necessary. There is an additional need for an embedded fault-finding capability within both the platform and soldier systems to alert the user. The carriage burden of these capabilities should be sustained by the platform. Equipment and power supplies monitoring, and an integrated support and replacement capability will be required to deliver this capability.

I.10 INTEROPERABILITY

INTEROPERABILITY

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INTEROPERABILITY	
Interoperability on the Platform	There are a large number of legacy and emerging systems within and with which an integrated DCC-MCC capability will need to operate. There is an enduring and developing requirement for physical, information (digital, electronic) and power based interoperability and Integration. The requirement for common data and power infrastructure will drive emerging integration needs for DCC-MCC capability. Implementation of incremental enhancements and upgrades to MCC DCC capability will benefit from early experimentation and technical interoperability studies. Combat Networks, soldier systems, platforms and information technology on the platform will all require to be interoperable; if not fully integrated to gain the maximum benefit from the wider Close Combat capability.
System Interoperability	The Generic Vehicle Architecture (GVA) is responsible for detailing standards against which procurement and integration of platforms must be conducted against. Linkages to LOSA, COIL, GSA and GBA should clearly articulate interoperability requirements with other systems, networks (including BOWMAN, MORPHEUS) and platforms and soldier systems. The integrated DCC-MCC capability already interoperates with; and requires to interoperate with; a large number of legacy and emerging systems; requiring physical, information, digital, electronic and power-based interoperability and Integration.
Operational and Tactical Interoperability	Many of the operational and tactical interoperability requirements will be achieved through coherent doctrine and exploitation of the Networks that will support an integrated DCC-MCC capability (initially BOWMAN, to be replaced by MORPHEUS). Integration with the Combat Network will fulfil some of this requirement, but there remains the need to exchange information directly with intimately supporting assets: appropriate interface with specialists, fratricide avoidance, and interface with relevant local assets operating within the close combat unit's Area of Responsibility (AOR). This will require both technical and physical interoperability to be implemented at the tactical and operational level.
Strategic Interoperability	UK Defence will need to work in close co-operation with partners, but it will also need sufficient conventional military power to underpin its diplomatic manoeuvring and to retain influence within any coalition. Interoperability with political, industrial, security and disaster relief agencies place further emphasis on interoperability requirements for Integrated DCC-MCC capability and must be implemented during development of the capability.

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INTEROPERABILITY	
Joint and Multi-National Interoperability	MORPHEUS will provide the wider connectivity and commonality to force elements across Defence. There remains a requirement for direct interoperability with naval and air assets: sea-borne assets for manoeuvre, manoeuvre support and ISTAR connectivity; air-borne assets for ISTAR, manoeuvre and casualty evacuation communication. The UK will routinely operate with allies and partners, in particular as a supporting partner in a US-led coalition. In other operations, the UK may be called upon to lead a non-US coalition. Operations will be increasingly interdependent and it will therefore be necessary to seek closer joint interoperability and even Integration. Interoperability between coalition partners will become relevant for an integrated DCC-MCC capability in terms of C4I, TTPs, liaison and culture. Training, Network, ISTAR, and security aspects should be the priority.
Interoperability with Security and Disaster Relief Agencies	It is mandated and likely that an integrated DCC-MCC capability must be able to operate in and outside the UK in support of security, policing and disaster relief agencies. Integrated or interoperable communications with such agencies, tempered by security implications, are implied requirements of DCC-MCC capability and need to be developed in liaison with such agencies. In the UK mainland, there is an opportunity for the wider close combat capability (of which DCC-MCC is a large part) to be designed to interoperate within the national security and policing network, facilitating secure communications and the passage of data.
Generic Vehicle Architecture and Standards	The Generic Vehicle Architecture (GVA) is responsible for detailing standards against which procurement and Integration of soldier systems, including DCC-MCC capability, must be conducted. Linkages with the Land Operating System Architecture (LOSA), Common Operating Infrastructure - Land (COIL), Generic Soldier Architecture (GSA) and Generic Base Architecture (GBA) will also provide the basis for interoperability with other system and platforms.
MORPHEUS and DSA	Relationship with MORPHEUS and DSA is critical and requires both integration and interoperability interfaces to be designed into the capability retrospectively, or for emerging capabilities, designed in at the start. MORPHEUS is a key enabler to the network, services and functionality of a fully integrated DCC-MCC capability. Commonality and integration of hardware, software and the network provide the building blocks for this capability and will be an integral part of design of the capability.

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ANNEX J

REPORT DOCUMENTATION FORM

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A copy of this form is to be completed by the principal author for all Dstl reports. When complete, it is to be bound as the last numbered pages of the finished report.

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16a. Abstract:	The DCC-MCC Integration study has examined the integration issues between Dismounts and Platforms within the close combat domain. The process has exploited task based analysis, use case analysis and the Soldier System Architecture to inform development of a set of Integration guiding principles which provide overarching guidance for all programmes that fall within the DCC-MCC boundary. These have been complimented with a DLOD assessment of the issues and implications of identified problem areas and how the principles may be exploited to resolve these in future developments.	
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