Ministry of Defence

de&s

LOSA

Land Open System Architecture

A Primer and Guide to the MOD’s Land Data Model, Generic Vehicle Architecture, Generic Soldier Architecture, and the Generic Base Architecture.

V2

“Our urgent aim is to achieve an ‘any/any network’, one that is capable of connecting any sensor, from any domain, from any partner, to any effector. This will create an internet of military things, capable of quickly, cleanly, and efficiently integrating sensors and effectors for impact.”

CGS RUSI LWC Jul 24

Foreword

In a world defined by rapid technological change and complex threats, the British Army’s success on the modern battlefield depends more than ever on our ability to harness data, dominate the electromagnetic spectrum, and outpace our adversaries. This is not the responsibility of a specialist few. In the era of digital warfare, it involves us all.

At the core of this transformation is the Land Open Systems Architecture (LOSA) approach, supported by frameworks such as the Generic Vehicle Architecture (GVA), Generic Soldier Architecture (GSA), and the Land Data Model (LDM). Together, these help form the foundation of fifth generation land forces; a modern, agile, and networked army. They support a Digital Targeting Enterprise where any sensor, from any partner, in any domain, can seamlessly connect to any effector, delivering decisive effects over ever increasing distance and speed. Realising this helps double the fighting power of the British Army by 2027, and tripling it by 2030.

GVA and GSA are critical enablers of this vision. GVA transforms platforms into versatile carriers of sensors, effectors, and software, delivering capability to the edge. GSA equips soldiers with modular, interoperable systems that enhance their effectiveness, survivability, and adaptability. LOSA helps unify these elements, prioritising open standards and modularity to enhance interoperability, foster innovation, and align with the Land Industrial Strategy.

This is a shift in focus. Platforms remain essential, but they are no longer the only means of generating combat power on and from the land. Instead, we must prioritise the sensors, effectors, and data they enable, delivering informed options to commanders and lethal effects at a tempo that outpaces our adversaries. The future is data-centric, software-driven, AI fuelled, and interconnected. LOSA helps unlock this.

General Sir Roly Walker KCB DSO
Chief of the General Staff, (CGS)

Foreword

For Land Forces, I am convinced that the Land Open Systems Architecture (LOSA) is fundamental to maintaining our technological edge and flexibility in the face of evolving threats.

LOSA provides a transformative approach, enabling Defence to share and exploit data seamlessly across the Land Environment and the wider joint domain. By using open interfaces and common data standards, LOSA ensures our platforms can be updated and upgraded with the agility required to meet the demands of current and future operations.

I am proud that internationally LOSA has already gained recognition, with NATO adopting its latest iterations. This highlights LOSA's status as a world-leading framework and supports the UK's NATO-first policy, enhancing interoperability with our allies. As a joint effort between the UK Ministry of Defence and industry, LOSA's global recognition also strengthens British industry's position, supporting the Defence Industrial Strategy.

Beyond acquisition, LOSA drives efficiencies in support by standardising interfaces, reducing training requirements, streamlining spares, and speeding up repairs. It provides a stable framework for integrating legacy and non-LOSA systems, delivering operational benefits that enhance resilience, responsiveness, and readiness.

In short, LOSA is the "data glue" enabling the Land Environment's digital transformation. It fosters collaboration with industry, from major defence primes to SMEs, to deliver a data-enabled, agile, and interoperable Land Force. By adopting LOSA, we are future-proofing our capabilities, reducing barriers to innovation, and ensuring the British Army remains at the forefront of military effectiveness.

Lt Gen Anna-Lee Reilly CB FREng
DE&S Director General Core

Contents

What is LOSA?

- LOSA is: a set of design principles and rules that underpin the delivery of the open system, these are codified in the suite of LOSA standards.
- LOSA is: an **approach** to designing the Architecture, NOT the Architecture in itself. The Architecture includes BOTH Hardware AND Software.
- LOSA is not: the 'mission system' or its component parts. It uses open, modular and scalable technical architecture and interface standards from which the electronic mission system architecture is created.

Land	The Land Environment
Open (Standards)	Ensuring interoperability with new / wider systems that may wish to operate with legacy systems in the Land Environment
Systems	The 'things' that embody force elements (cross-DLOD)
Architecture (Approach)	How 'things' fit together (relationships between things)

The LOSA approach seeks to define open interfaces and standards at various levels to facilitate operational agility. This is achieved at multiple levels – whether through data centricity at the tactical to operational level (enabling the rapid transmission of common mission data to enable quicker decisions to be made), through to timely and cost-effective integration and upgrade of sub-systems and components through life – enabling a choice of manufacturers and sub-system suppliers – removing the historical 'hand cuffs' of Original Equipment Manufacturer (OEM) lock-in.

The Open aspect is in relation to the Open Standards it applies – rather than an OEM interface that has been made 'Open'.

The Land Data Model (LDM) is the foundation for Data Centricity and interoperability across all domains (vehicles, soldiers etc). Whilst we call it the Land Data Model, the abstracted and agnostic nature of the LDM enables it to be used across any area or discipline and perhaps it is better thought of as the Data Model – Land.

So what? LOSA is an **approach** – in some respects akin to the Manoeuvrist approach – to designing the 'data and digital' fundamentals of the Equipment-DLoD's contribution to capability. It does not tell you what to do, just how to approach it. It moves the electronic architecture construct (whether vehicle or human oriented) from a 'point to point' design to a 'publish and subscribe' design, which has data sharing at its heart.

LOSA changes the design philosophy:

- We must consider the system (i.e., including the mission system architecture) from the outset which ensures integration and interoperability (i.e., Force Centric Capability Management – FCCM).
- Historically we designed 'platforms' & 'installed' sub-systems (i.e., system of systems).

So what? LOSA will help create the 'modernised digital Army' envisaged by Chief of the General staff (CGS).

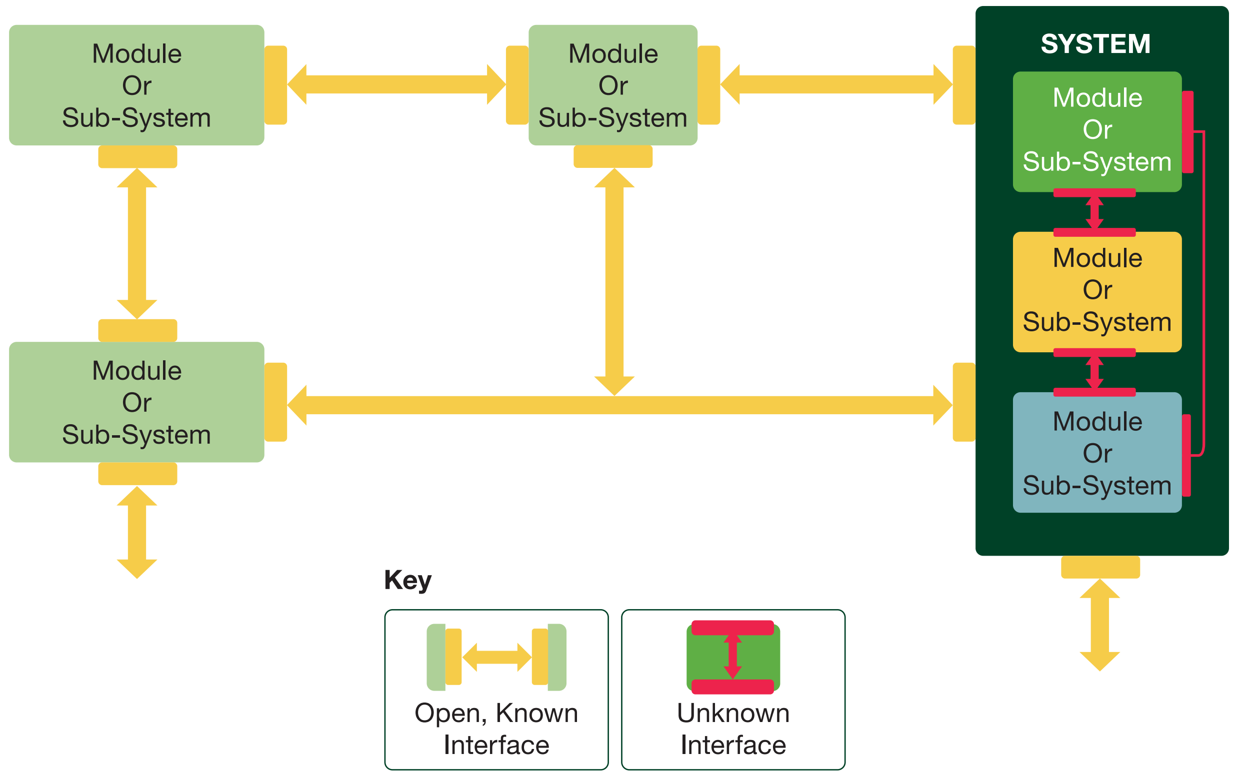
What is an Open System?

An Open system is one in which the components and protocols conform to standards independent of a particular supplier. (Oxford Languages).

An Open System is a modular construction that has been designed in such a way that its modules have precisely defined and publicly owned interfaces. It could be a Mission System, equipment, logical component, or sub-component. It is not essential that all the components of an Open System are completely open. This is an ideal situation, but not always the case. Openness refers to the interfaces to and between defined modules of the architecture.

The original MOD requirement for Open Systems was financial – i.e. through life costs would be reduced, limitations due to industrial and commercial practices would be removed and freedom of action and operational sovereignty would be restored. As LOSA has matured the operational benefits associated with exploiting data have come to the fore.

LOSA Open System



Simplified illustration of Data Interfaces (Open and Closed)

Data Centricity as Part of the Architecture

Data at the Centre of the Design

Data is at the heart of the LOSA; data is the core reusable asset that can be shared and utilised regardless of the technology or mission systems that use it.

Data-centricity significantly simplifies, integration, modularisation, portability, and capability enhancement. The Army relies on a Sense, Decide, Act decision action cycle – so any means to speed that up, automate processes and remove inadvertent data corruption (i.e. humans in the loop) will expedite our tempo – making the Army more lethal and less vulnerable.

What is Data Architecture? – Data architecture refers to the design and structure of data systems, ensuring that data is stored, accessed, and managed efficiently. It is the thinking and planning of, for example, a plumbing system so that water can flow freely to where it is needed, and any tap can draw water from anywhere.

Importance of Data Architecture – A robust data architecture ensures that businesses can make data-driven decisions, optimise operations, and provide better services. Imagine trying to find a book in a library without a catalogue system.

What Most Systems Currently Look Like:

Most Systems of systems consist of multiple Mission systems (including sensors and effectors). Each system connects specifically **only** to the other systems (sensors or effectors) and **only** for the **specific data** it requires at that point. Even if the data is via ethernet and a switch, it is still 'addressed' to a specific, unchangeable system – i.e. it is point to point (see diagram on page 11).

But what happens if you need to add to this System?

- Any new systems that need to receive (or send) data from any of the existing mission systems will need their own link and interface to that particular system.
- The original Mission Systems and Sensors will also need to be re-engineered (SW and/or HW) to allow for specific data links.
- Any Capability uplift – i.e. a change to the baseline, whether new technology, or even obsolescence management – requires SW and maybe HW changes, potentially affecting all connected systems. It is likely that detailed changes with multiple Design Authorities (DA) and Original Equipment Manufacturers (OEM) will need to be addressed.
- **So what?** There is a real risk that some mission systems will need to be completely upgraded and replaced due to an inflexible design, or the cost becomes too expensive to conduct a needed capability enhancement.

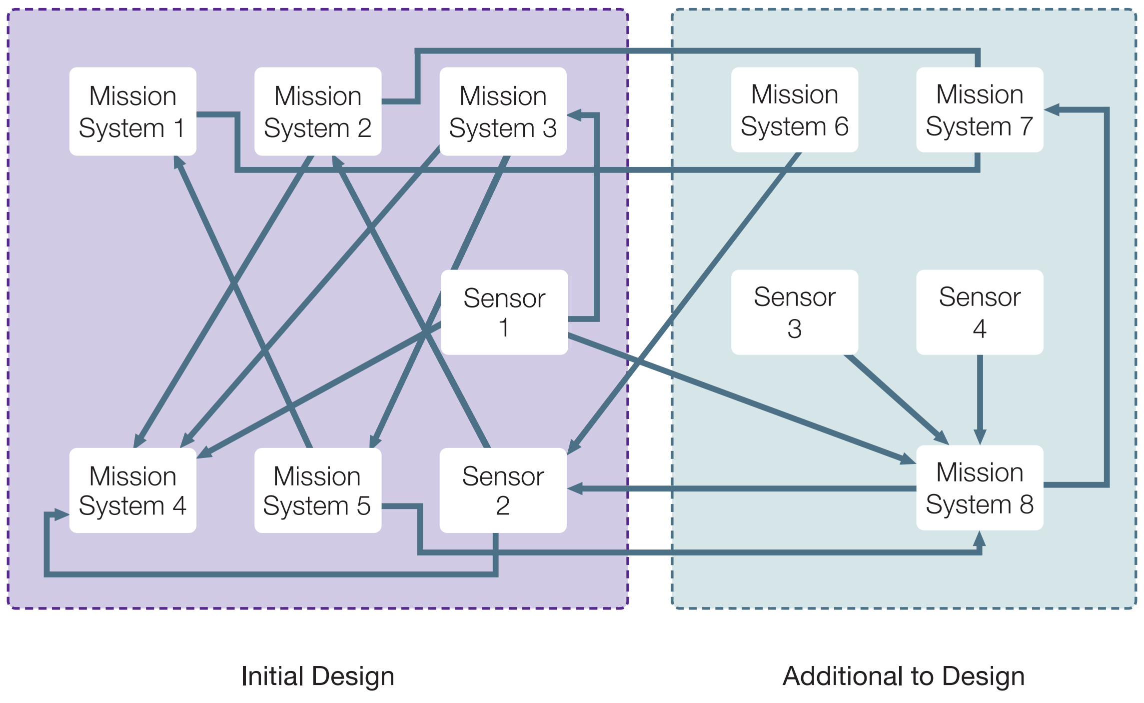
What a Data Centric System Looks Like?

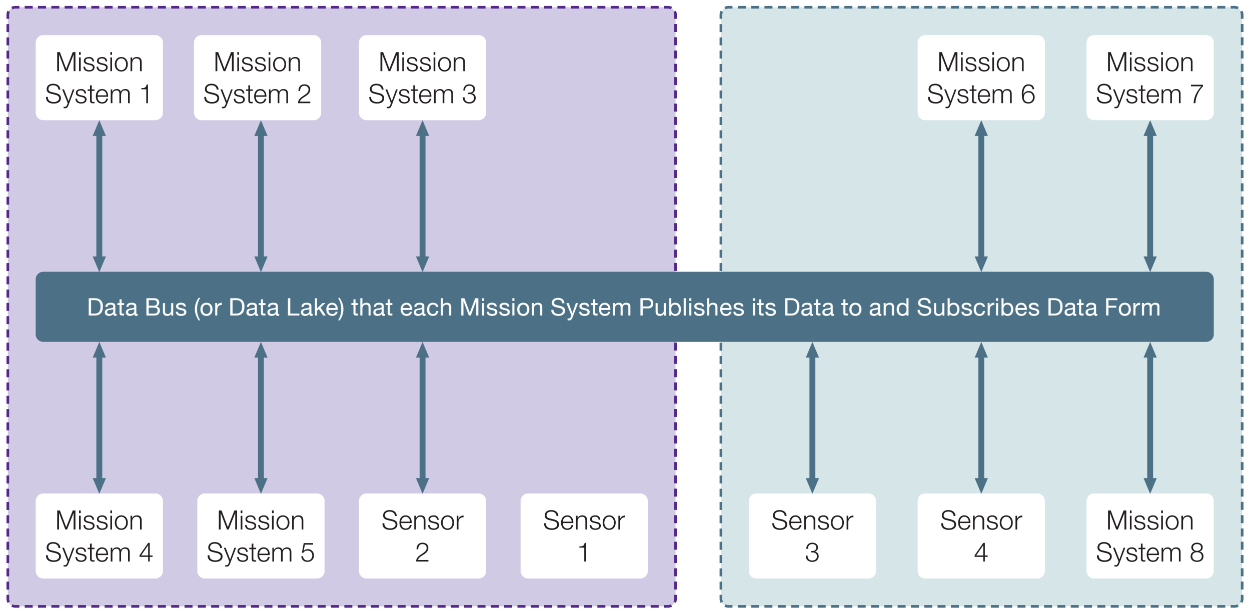
Putting Data at the Centre

If each Mission System (or Sensor/Effector) instead of sending or receiving its Data to/from each specific mission system, places (or Publishes) it into a common data-bus (or Data 'Lake') and requests (or Subscribes) from that data-bus (or Data Lake), THEN each Mission System no longer relies on specific links and interfaces.

- Any new Mission Systems can Subscribe to Data already in the Data Lake and also Publish its own Data.
- Data is Distributed – each mission system is a node, so loss of one part is not fatal to the whole. There is no single point of storage (and failure).
- This allows for increased flexibility and Capability Change through life.
- It also allows for greater design freedom and efficiencies – i.e. we can reduce the number of 'parasitic' components that don't add value, only cost – GPS receivers are a good example. Most mission systems need a GPS signal input, but do most systems need their own GPS receiver? Or just the input.

An example may be a single GPS receiver publishing onto the Data Bus rather than several GPS Receivers for each Mission System (see diagram on page 12).





How Do We Create a Data Centric System?

For this system to operate effectively, we need:

- A Publish and Subscribe Middleware.[1]
  - This 'Receives' the data (published) from the Mission Systems/Sensors.
  - This also 'Sends' the data (subscribed) to the Mission Systems/Sensors/Effectors.
  - The key idea is that the Mission system does not know any information about the source it only knows about the data.
- A common, Known and Open Interface and Data structure.
- The LOSA Concept, with Generic Vehicle Architecture (GVA), Generic Soldier Architecture (GSA) and its associated data models under the Land Data Model (LDM) prescribes the Approach and minimum viable requirements in order to achieve this.
- GVA (and GSA) uses DDS Middleware, an open-source software to provide and control the Data Bus (or Data Lake).
  - The DDS Software additionally allows rules for data to be introduced further tailoring and controlling how data is distributed.
- The Data Structure (or Data Dictionary – "speaking the King's English") is provided by the Land Data Model in the form of the GVA Data Model or the GSA Data Model.
  - This data model defines and prescribes all common interfaces.
  - It is developed wholly with international Industry.
  - It is designed to be Technology Agnostic – using Model Driven Architecture principles and the Universal Modelling Language (UML).

[1] Middleware in this context refers to a networking middleware that simplifies complex network programming. It implements a publish–subscribe pattern for sending and receiving data, events, and commands among the nodes. Nodes that produce information (publishers) create "topics" (e.g., temperature, location, pressure) and publish "samples".

Benefits of LOSA

LOSA benefits – or what does LOSA do for us – can be broken down into x3 areas; the Tactical (or immediate benefits to the Army / land forces), the Technical (or associated benefits to the military and procurement) and the Industrial (or associated benefits to design and manufacturing of our equipment).

Tactical benefits

These are the benefits the army could see almost immediately.

- Decision advantage. Data enables decision advantage – we can seamlessly pass data around our 'systems' (whether soldier, tank, vehicle or other 'platform') with minimal human inputs (i.e. the human error factor!) and achieve superior situational awareness than currently. Note the CR3 vignette at the Force level for a worked example – See the Vignettes section, page 25 onwards.
- DLoD efficiencies. The table on page 15 provides a snap-shot view based on the LOSA needs and benefits analysis paper (2016). The Training DLoD presents an immediate opportunity for efficiency & effectiveness, through 'commonality'. The adoption of a standardised Human Machine Interface (HMI) i.e. layout and functionality, will reduce through life conversion costs and time. The adoption of a standardised HMI can also benefit the Logistics DLoD by simplifying the number of 'HMIs' in the supply chain. This will build in resilience, where we 'shape' the HMI requirement to be pan platform – i.e. a couple of screen 'types' can be used in multiple platforms.

Primary Benefits	Sub-Benefits						
Improved Operational Effectiveness	Improved Interoperability	Faster Re-Role Stand-up (Readiness)	Better Information Collation	Better Visibility of Platform/ System/Asset Configuration	Reduced User Conative Demand	Improved System Safety	Improved Agility
Platform Flexibility	Greater Flexibility in Platform Manning	Adaptable & Scalable Force	Reduced Time to Configure Asset	Simplified System Modification			
Training & Personal Administrative Burden	Reduced Loss of Asset hours due to Training	Reduced loss of Man-Hours due to Training	Reduced Demand for Training Infrastructure	Less Skill Fade More Targeted Training	Reduced Support manning		
Improved Equipment Development	More Efficient setting of Requirements	Greater Standardisation of Interfaces	Less Complex Specification development	Better Understanding of Platform Obsolescence	More Competitive Supply Chain	Wider Supplier Base	
Improved Sustainment and Support (Logistics)	Improved Reconfigurability	Improved Understanding of Fleet Status	Improved Data Exchange Across Platform and Land Environment	Simplified Supply Chain	Improved Time to Combat readiness	Increased Platform and Systems Availability	Reduced logistics Footprint

Brigade Level	Platform & Brigade Level	Platform Level

Technical benefits

The technical benefits overlap with the tactical and flow into 'how' we procure of equipment and is part of the broader LOSA approach and 'philosophy'.

- **Data Interoperability:** An open systems architecture makes it easier for different systems to communicate with each other, because the 'systems' have been designed from the outset to be able to share / communicate data by using common standards and protocols. This is the LDM.
- **Modular Design:** The Open systems architecture is modular, which means that it is made up of independent components that can be easily replaced or upgraded – i.e. think of a radar head. This makes it easier to maintain and update the 'capability' through simpler and cost-effective changes, supporting the 'update, upkeep and upgrade' approach.
- **Scalability:** Open systems architecture is scalable, which means that it can be easily expanded to meet the needs of the organisation. This enables smaller, more timely capability insertions (i.e. update & upkeep) through life. The simplest update may be SW driven – i.e. for operations on Op HERRICK, the RN Merlins had a SW patch applied to their engine management system to 'tweak' their performance to make them more suitable for operating 'hot & high'.
- **Cost-effectiveness:** Open systems architecture can be more cost-effective than proprietary systems. This is because the systems are based on open standards and protocols, which means that we are not locked into specific vendors. This would be demonstrable through life as the Army / Defence could make choices on what to upgrade and when, either as the capability need is identified or as new technology becomes available (i.e. obsolescence management). The choice to not go back to the original manufacturer may provide levers to make a 'competition' a more viable option, thereby reducing the cost of upgrade through a competitive process.

Industry Benefits

The benefits to the design and manufacturing help both industry as well as capability designers (whether DE&S or Army HQ).

- **Product re-use.** Products designed in accordance with a 'standard' (i.e. mission systems – such as the Trail Blazer TI sight) can be more readily moved from platform A to B. This is not 'plug & play' – this is 'plug, reconfigure, play', but the time frames are significantly reduced, and the product 'range' will in theory be larger; providing more choice.
- **Software changes.** One of the fundamental shifts in 'mentality' is the benefit associated with SW changes. These can be done more rapidly than HW, they can simply benefit the Force with minimal 'intervention' and importantly, reduced costs.
- **Product development and upgrade.** The use of open standards should incentivise product innovation by Small and Medium Enterprises. The SME's will know that even if they were unable to get their product onto a 'soldier' in 'year 1', there will likely be a procurement activity (e.g. obsolescence management) in 'year 5' – so the SME will remain incentivised to continue their product development. This also has an implied benefit of reducing the 'feast and famine' of our current 'big bang' procurement approach.

Benefits of the broader LOSA approach

The Land Data Model

The Land Data Model (LDM) sits at the heart of the LOSA approach. Together with middleware (typically a Data Distribution Service, DDS), it enables reliable data exchange and wider interoperability across land platforms, soldier systems and related capabilities. The LDM enables Data Centricity – data at the heart of the system and as a usable, common resource.

Any Land Vehicle, Soldier System (or any other System) is made up of a variety of components and systems - sensors, actuators, controllers: a radio, a battle management application, an artillery fire control system, a logistics database.

In isolation, these systems often struggle to share information cleanly. Data is frequently translated, reformatted, or re-entered by people and bespoke gateways, which wastes time and introduces avoidable risk. To operate as an integrated whole, these components need a shared understanding of the data they exchange.

The LDM provides that shared understanding. It is a common set of agreed definitions, structures and standards for information (or, language, if you will). It answers basic but vital questions such as:

- What do we mean by a “unit”, a “vehicle” or a “target”?
- How do we describe a location, a route, a threat or an effect?
- How do we represent time, uncertainty, permissions and ownership?

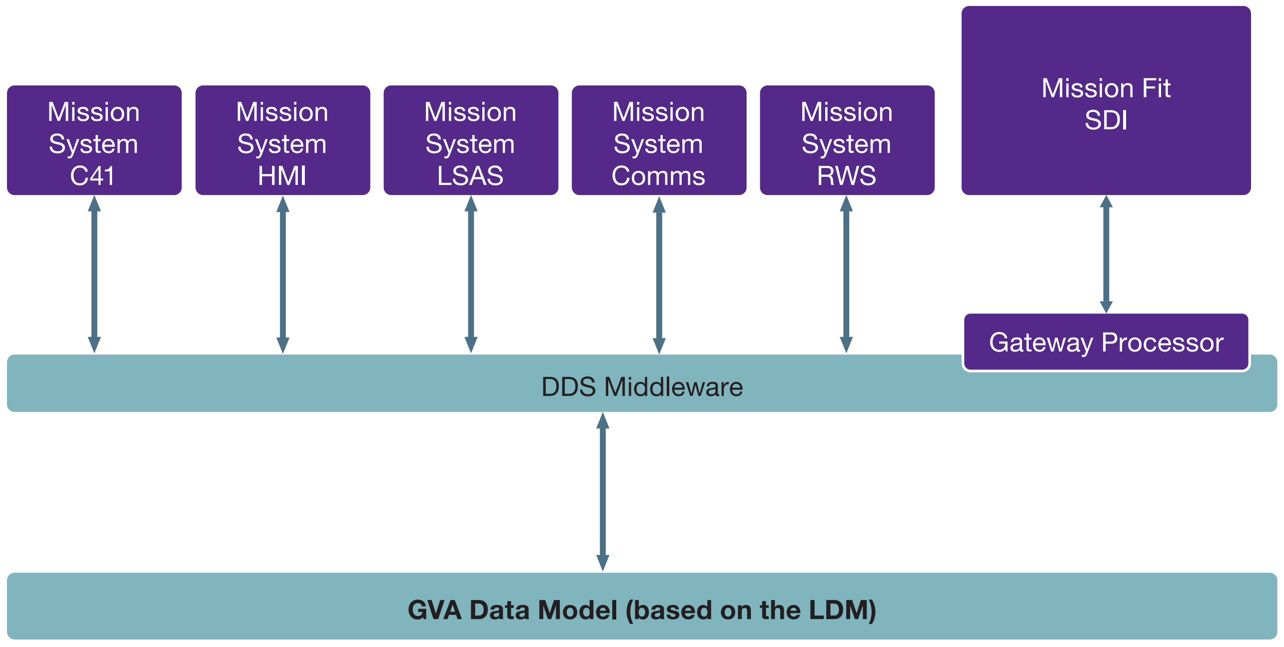
By agreeing this common language once, we can reuse it many times across projects, programmes and nations. This reduces integration effort, improves coherence between systems, and supports through-life change — directly contributing to the “Upgrade, Upkeep & Update” proposition.

In practical terms, the LDM defines the Key Data Exchanges that enable mission system integration and upgrades. The LDM standardises how data such as sensor outputs, effector status, platform state, positional information and messages are represented — and how those data types relate to each other.

In effect, the LDM ensures all mission systems and components use a common data/information structure, they speak “the King’s English”, rather than dialects or other languages and acts as the data golden thread, enabling the pull through of information and its sharing across domains.

Use of the LDM will enable the ambition of connecting ‘on’ platform sensor data with ‘on’ platform effectors to ‘off’ platform sensors and effectors – realising the ‘sense decide effect’ proposition.

The Land data model



GVA Compliant Vehicle Architecture

The LDM underpins data exchange between Mission Systems and supports integration onto any platform (vehicle or human) that conforms to GVA or GSA, or via a gateway. It is designed to support future development while maintaining backward compatibility.

The LDM is the reference information model. The GVA and GSA Data Models are applications of that reference model for vehicles and soldier systems respectively. They reuse the same domain concepts, tailored to the needs and constraints of each environment (for example, GSA may implement a reduced subset of a domain such as Navigation).

The LDM is organised into Domains (for example, Navigation). Each Domain is defined in a technology and software-agnostic way (using UML). The LDM Together with The GVA and GSA Data Models) are the minimum set of key and common models and data, it is a live, continuously growing and evolving, model.

Platform or project-specific requirements can introduce additional models, usually defined by the OEM, prime, or platform integrator. The resulting physical implementation is an amalgam of the LDM (and applicable GVA/GSA profiles) plus any approved project-specific extensions, realised in deployed hardware and software interfaces. This is illustrated on page 22.

The open-source Data Distribution Service (DDS) is used in conjunction with the GVA/GSA data models and is a middleware with a Data Centric approach that supports publish/subscribe communications: each system Publishes Data and other systems can Subscribe to receive it. This allows data to be distributed efficiently across the platform and beyond it. Used together, LDM defines what the data means and how it is structured, while DDS provides a mechanism to distribute that data. This pairing is central to LOSA's data-centric approach.

This concept of all data being available to all is key to the utility of any LDM based network and is fundamental to LOSA's Data Centricity.

The LDM is more than the model itself. It includes the wider ecosystem — documentation, user guides, working groups, governance, tooling and reference artefacts — that together maintain the LDM as a foundation for system design and integration.

The Land Data Model is designed to evolve. It can absorb new concepts (such as emerging platforms, effects or data sources) without being rebuilt from scratch. It supports modern data-driven approaches, including analytics, AI and decision support, through well-structured and well-governed data. It is reusable across programmes so that new capabilities are born interoperable, rather than being retrofitted later. In this way, the LDM is not only a record of how we operate today — it is a tool that helps us adapt to how we must operate tomorrow.

DE&S and MOD work closely with industry to secure adoption and buy-in from primes and equipment manufacturers.

The Land data Model is in active use Globally, particularly with ABCANZ and NATO.

The LDM is not just the Domains and Models, which are described using UML, in the wider LDM 'ecosystem', there is documentation, user guides, working groups, software tools and other elements which together maintain the LDM as the basis for Systems Design and Integration.

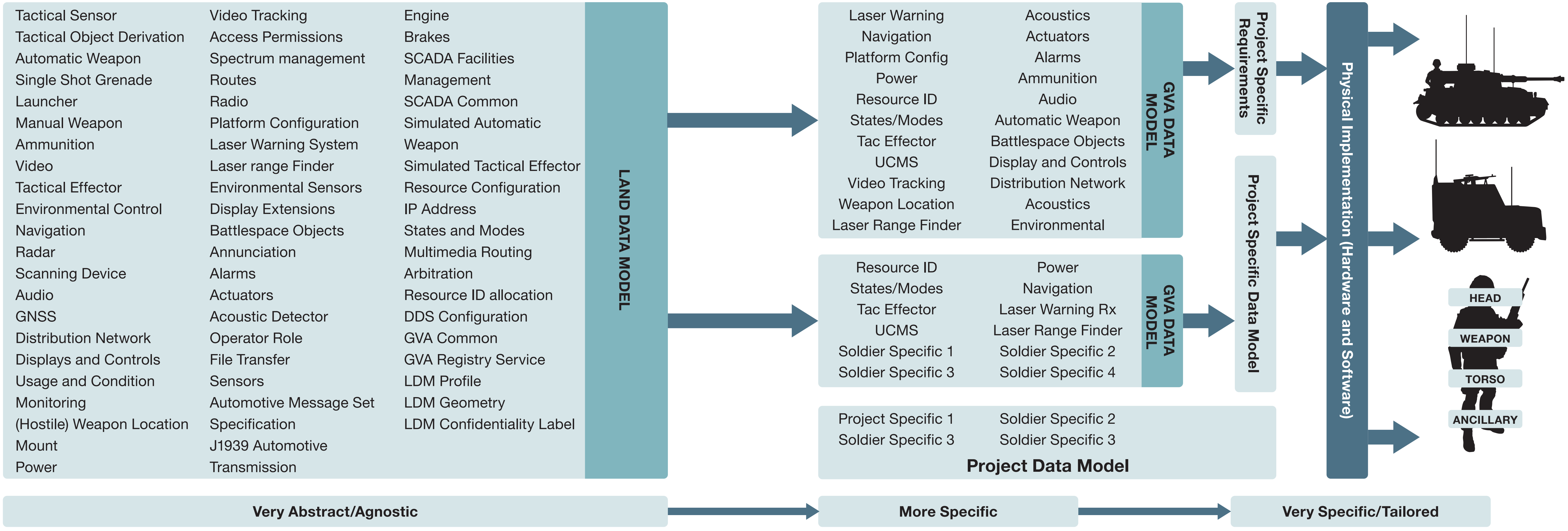
The Land Data Model is designed to evolve:

- It can absorb new concepts – for example, emerging types of platforms, effects or data sources – without needing to be rebuilt from scratch.
- It can support modern, data-driven approaches such as analytics, AI and decision support tools, by providing well-structured, well-governed data.
- It can be shared and reused across multiple programmes, ensuring that new capabilities are born "interoperable" rather than having to be fixed later.
- It can support new, emerging and evolving technologies.

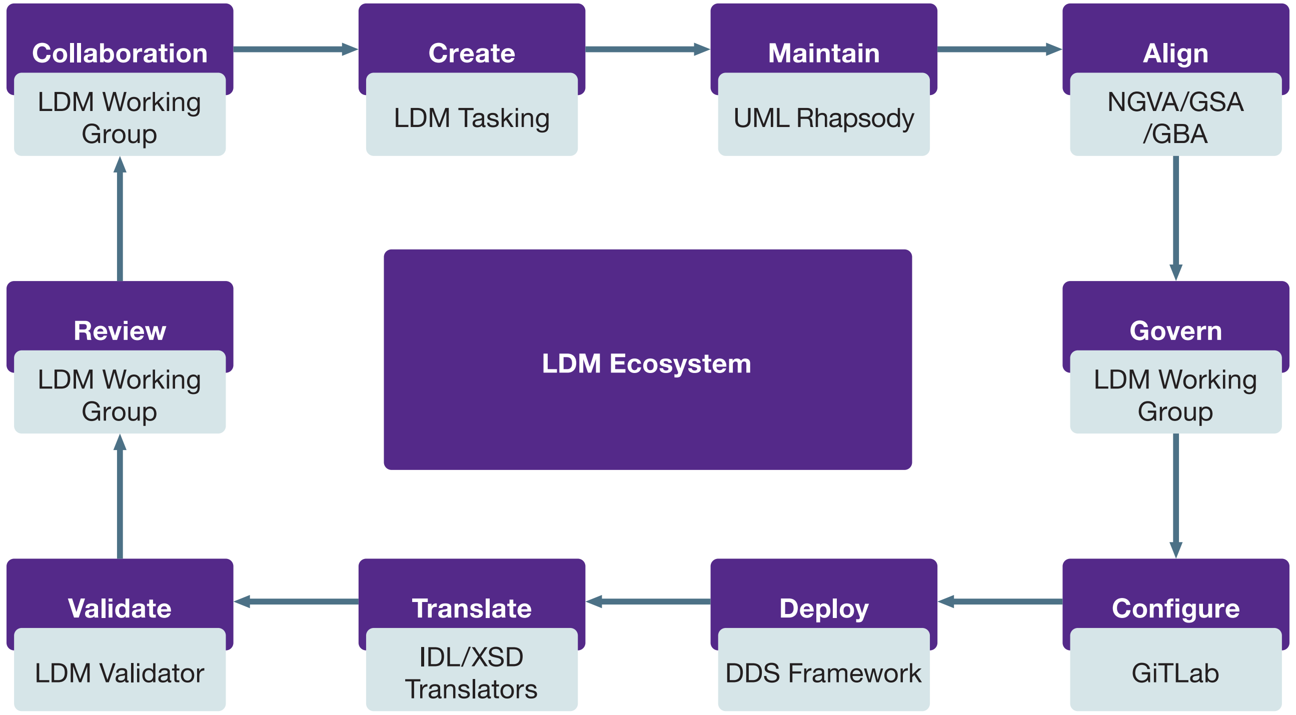
In this way, the LDM is not just a record of how we operate today. It is one of the tools that will help us adapt to how we must operate tomorrow. DE&S and MOD collaborate effectively and closely with Industry to gain wide adoption and buy-in from Primes and equipment manufacturers.

Use of the LDM will realise the ambition of connecting 'on' platform sensor data to 'on' platform effectors and is the key aspect of the LOSA approach as it provides the core interface capability (as shown on page 24).

The Land data model as explained on page 18.



Example of LDM use as described on page 21.



Illustrations and Vignettes of LDM Use

Here are some examples of how the LDM and DDS can be used in the digital battlespace.

A **Tank Commander** will be using the Land Data Model, together with DDS, to receive real-time Situational Awareness Data from the vehicle's own sensors, such as an Electro-Optical device, a Counter Battery Radar, or Laser Warning Receiver to pass this information to other effectors which can be tasked to bring Fires.

A Soldier would use the LDM and DDS to get real-time data from the battlefield, such as the location of friendly forces and enemy threats. This data could be used to make better decisions about where to move and how to engage the enemy.

A joint **command centre** could use the LDM and DDS to share data between different units, such as the air force, the navy, and the ground forces. This data could be used to coordinate operations and to ensure that all units are working together effectively.

As technology develops, the LDM, as a technology agnostic model, keeps pace and continues to provide a consistent baseline and format in which to take advantage of new technologies and capabilities.

Command centre

A Soldier

Tank Commander

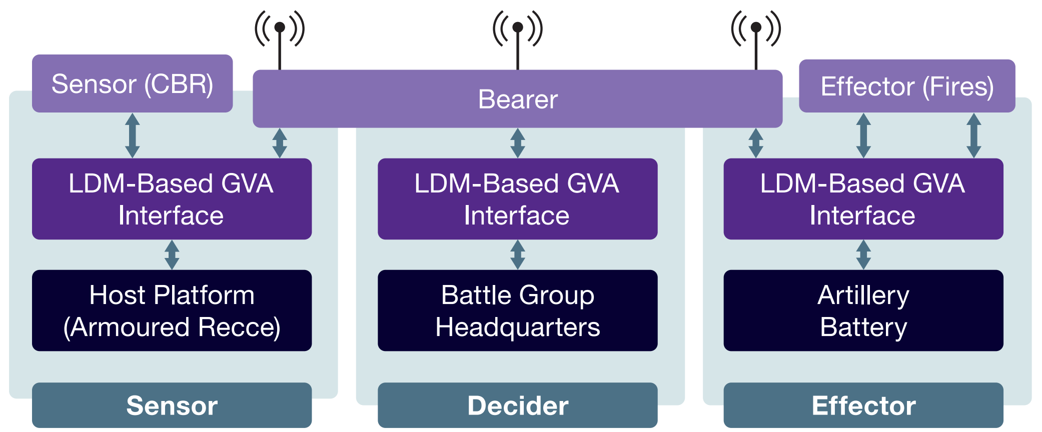
Sensor to Decider to Effector Illustration:

This diagram (see below) represents a forward-deployed Armoured Reconnaissance Vehicle using a Counter-Battery Radar to detect the location of a hostile Firing Position. The Sensor is integrated to the vehicle using a LDM-derived version of the Generic Vehicle Architecture, and the Messaging Structure is LDM-compliant, because we have a "Weapon Location" Domain.

The Vehicle communications system is also connected using compliant GVA interfaces to a radio Bearer, which gives the commander the option to send the Target Location off-platform.

Another Bearer able to receive this data is located at the BGHQ. The Local Command structure can then task an Effector which may be many miles away to bring Fires onto the location of the enemy Firing Position. Using the same Bearer, or even a different one which uses LDM-compliant message structures when defining the Weapon Location, the co-ordinates of the Target to be engages are sent to an artillery battery for Engagement. Throughout, real world 'things' are handled as correctly formatted, and mutually understood, data with standard characteristics and format, irrespective of the 'box' or system that handles/processes it.

Representation of a forward-deployed Armoured Reconnaissance Vehicle using a Counter-Battery Radar to detect the location of a hostile Firing Position.



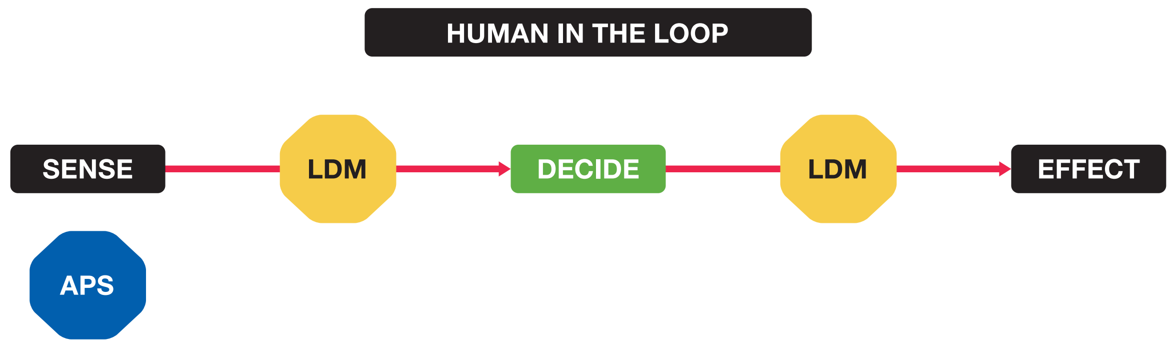
Integrated Survivability: Data as a Weapon – AFV Vignette

The LDM is the facilitator for data sharing that could be exploited for 'off' platform target engagements.

We must transform data into actionable information – algorithmic warfare and AI enabled decision making means we must keep our advantage in the data domain, with data now widely accepted as a weapon in itself (see diagram below).

When decisions to fire or not fire are measured in milli-seconds, it is possible to remove the human from the loop – this is what an Active Protection System allows. In a 'platform' centric vignette it enables a rapid 'slew to POO' (Point of Origin). In this instance, the 3rd-party APS (i.e. provided by a specialist systems manufacturer) provides threat point of origin target information to enable a rapid defeat of the threat. Evidence from ISR strongly proves the validity of this vignette and the survivability benefits therein.

However, the APS is likely to be a 'closed' system (i.e., a black box) – so it is right to ask – how do we share information so the Force benefits? How do we update & adapt this bespoke system through life, at a challenging rate of relevance (& affordability)? This is where the Bearers need a gateway to enable 'on platform' generated mission system data to be exported 'off platform' so the Force can benefit. The LDM and the Open Architecture approach provide the basis for this opportunity. Our inability to do this currently is a process problem, not a technological one.



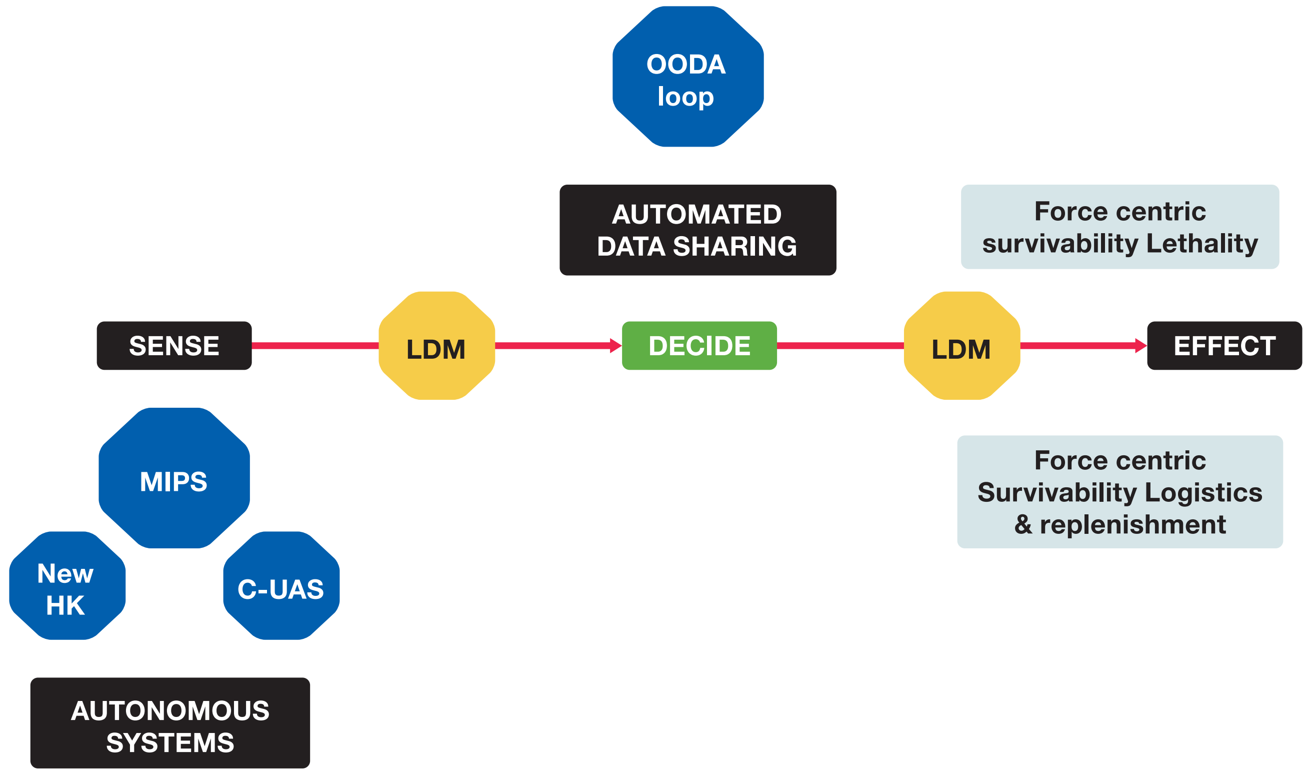
Integrated Survivability: A Force Vignette

LOSA enables information advantage, which contributes to survivability. Agility & rapidity of decision making through data sharing is no longer a luxury, it is a necessity to obtain and retain decision advantage.

In the simplified vignette on page 29, again we can see that the LDM is key to having force-wide situational awareness and C2 across distributed assets using a variety of bearers. LDM Data is.

- Used in a local situation to sew together various assets to sense and monitor threats.
- Used to cohere situational awareness to develop a coherent & comprehensive common operating picture (COP), which enables a Decider to make pre-emptive decisions: Decision Advantage.
- Automated data sharing expedites the passage of information and retains the tempo, again, decision advantage – enabled through the LDM. Data can be used, without change (i.e. human input or human error), to share intelligence and other information back to support elements and long-range fires.
- The Decider can confirm from the ‘COP’ which Effector is best placed to achieve the appropriate effect. Making faster decisions than a peer or near-peer adversary is key to winning the fight, data centric warfare means that data is a weapon.
- Handling data as a weapon means getting it right, and the LDM gives our data ‘lethality’ through commonality, openness and integrability. Making the force more lethal, less vulnerable.

LDM is key to having force-wide situational awareness and C2 across distributed assets using a variety of bearers.



Generic Vehicle Architecture

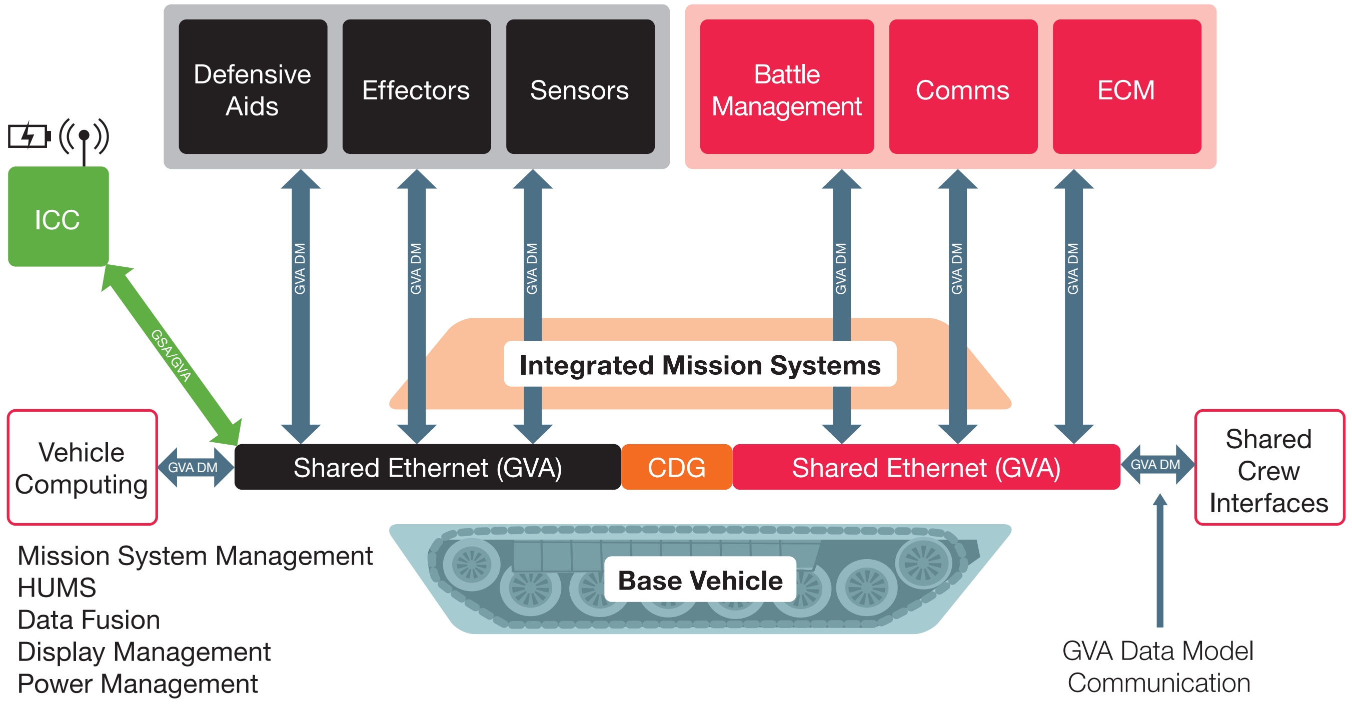
GVA is a design approach to achieve standardised, open, modular and scalable military vehicle mission systems.

GVA traces its roots to the UK's Vetronics research programmes that started in the 1980s. Today, that research is vested in a wide and diverse international supplier community – via the GVA Technical Working Group – who advise LOSA on how emerging technologies and standards can be incorporated. Many of these suppliers have extensive background in providing components, sub-systems, whole electronic architectures and entire vehicles and vehicle families.

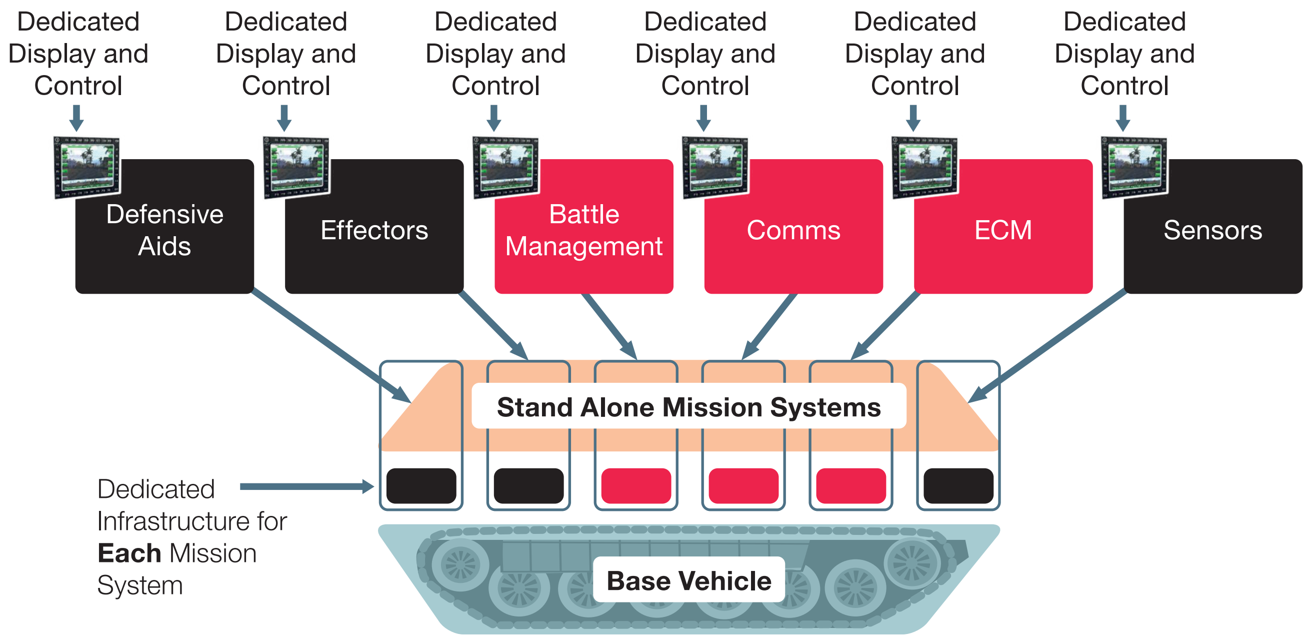
21st Century – Integration by design. GVA is about the integration of mission systems (e.g. a Remote Weapon Station or an Active Protection System) to ensure those mission systems can share information through a shared ethernet data network (i.e. be more efficient) and present information to the User in the most effective manner, via the Human Machine Interface 'Today', the GVA 'rules' enable mission system integration to enable exploitation of mission system information in the most efficient manner. 'Tomorrow' those same rules will enable **rapid upgrades** and more effective & affordable **updates** to be undertaken through life (see diagram on page 31).

20th Century – Stove-piped installation. Historically, mission systems were 'installed into' vehicles using **dedicated** (even bespoke, which equals expensive) infrastructure and interfaces, affecting the User's ability to do their job effectively (i.e. multiple screens, with multiple information feeds & input methods, see diagram on page 32).

21st Century – Integration by design



20th Century – Stove-piped installation



Key Features of a GVA Conformant Vehicle Electronic Infrastructure

GVA is:

- **An Approach.**
- The design principles and rules that underpin delivery of an "integrated" vehicle mission system.
- The rules for a "Multi-Role, Multi-function" crew display and control system.

GVA is not:

- The actual vehicle "mission system" or its component parts.
- A prescriptive design.

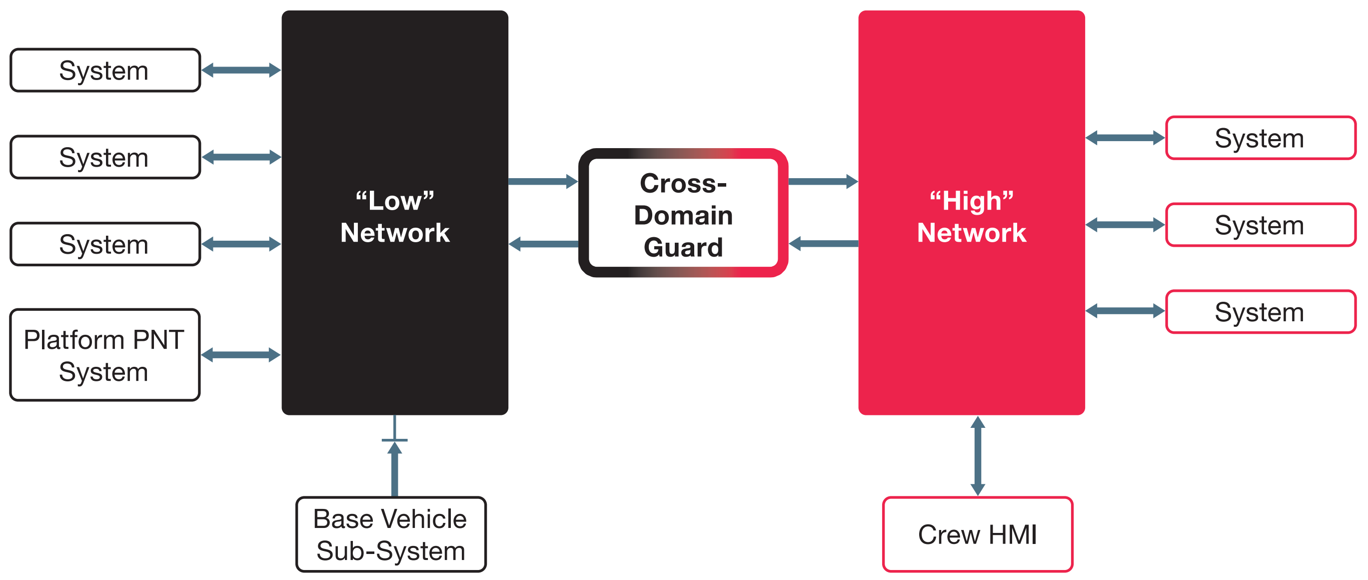
GVA enables:

- Agile, affordable and efficient "supplier independent" integration.

GVA could be seen as analogous to The Building Regulations for an Interoperable Open Architecture.

- Multi-function, multi-purpose, multi-role crew terminal] "One Glass"
- Human Machine Interface Framework] UI Framework
- GVA shared data infrastructure] Data Interface Standard
  - Standardised data interfaces (GVA Data Mode)
  - Standardised data communication (Data Distribution Service – DDS)
  - Standardised data communication (IP networking)
  - Standardised infrastructure media (Ethernet)

  ] Data and Network Standards
- Vehicle software services (PNT, HUMS, Intercoms, Alerts, Power Dist)] Shared Services



Middleware (the 'glue') and the GVA Data Model. Within a GVA Vehicle Electronic Architecture (VEA), DDS middleware is the software layer that lies between the operating system and applications. The middleware and the GVA Data Model – the language of communication – enable the various components of a system to communicate and share data, allowing software developers to focus on the specific purpose of their applications, rather than the mechanics of passing information between applications and systems. The DDS Middleware and the GVA Data Model are essential elements for GVA Conformance

GVA standardises the Human-Machine Interface, reducing the need for dedicated HMIs associated with each integrated mission system.

Many suppliers, UK and worldwide, can provide GVA Multi-Function Displays which conform closely to the GVA HMI standard. Many of the Army's current vehicles have a similar HMI, but often there is a mixture of mission system integrations – some are integrated, and some have their own HMI.

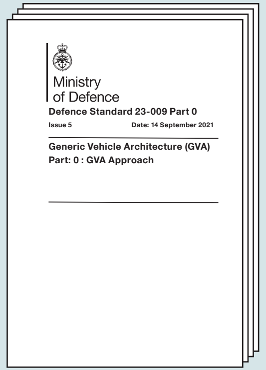
The standardised HMI is **not** a 'one size fits all', it is fully customisable to suit the need of the mission system and user.

The **GVA Defence Standard, Def Stan 23-009**, covers the minimum viable aspects of vehicle electronic architecture design, including the approach, the infrastructure technologies, the Human-Machine Interface, and requirements for HUMS. A further 'GVA' Defence Standard – Def Stan 00-082 – deals with how the infrastructure is used for streaming video, audio and acoustic data.

The GVA Defence Standard is written for use in contracts. The standard provides the Minimum Viable Requirements for a system to be considered GVA conformant. The Standard must be applied as a whole; 'cherry-picking' aspects of the GVA standard whilst selectively ignoring other aspects will not result in the appropriate and desired level of Openness and modularity being achieved and the resultant benefits that could have been obtained in Capability enhancement.

Through-life benefits. The GVA standard sets expectations for the delivery of Openness, Modularity and Scalability, which deliver to MOD the 'freedom of action' to maintain the vehicle's capabilities through life (i.e. update, upkeep and upgrade) in a cost effective way. Potential suppliers provide Open Systems Artefacts, which initially bound and scope the open architecture to be delivered. Later in the project lifecycle, the contractor delivers the 'finalised' artefacts, to ensure the 'earlier' delivery promises are met. The Open Systems Artefacts required by Def Stan 23-009 Part 0 are:

- Open System Architecture Management Plan.
- Open System Architecture Case.
- Interface Description Documents.
- Deployed System Build Set (i.e., how the reference GVA Data Model has been deployed).


Ministry
of Defence
Defence Standard 23-009 Part 0
Issue 5 Date: 14 September 2021
Generic Vehicle Architecture (GVA)
Part: 0 : GVA Approach

Part 0: GVA Approach
Introduces the GVA principles and sets the GVA approach which vehicles and mission systems projects shall follow.

Part 1: Infrastructure
States which network, cabling and communications standards and protocols are to be used within the vehicle electronic infrastructure and mandates the GVA Data Model and DDS Middleware.

Part 2: HMI
Sets the design principles and functional characteristics against which the GVA Human Machine Interface (HMI) shall be designed. This includes definition of the GVA Multi-Function Display (MFD), GVA Functional Areas, hard control panels, lighting, use of colour, approach for alarms and threat alerts.

Part 3: HUMS
Defines the design constraints on platform Health and Usage Monitoring System (HUMS) and requirements for data collection and export.

Generic Soldier Architecture

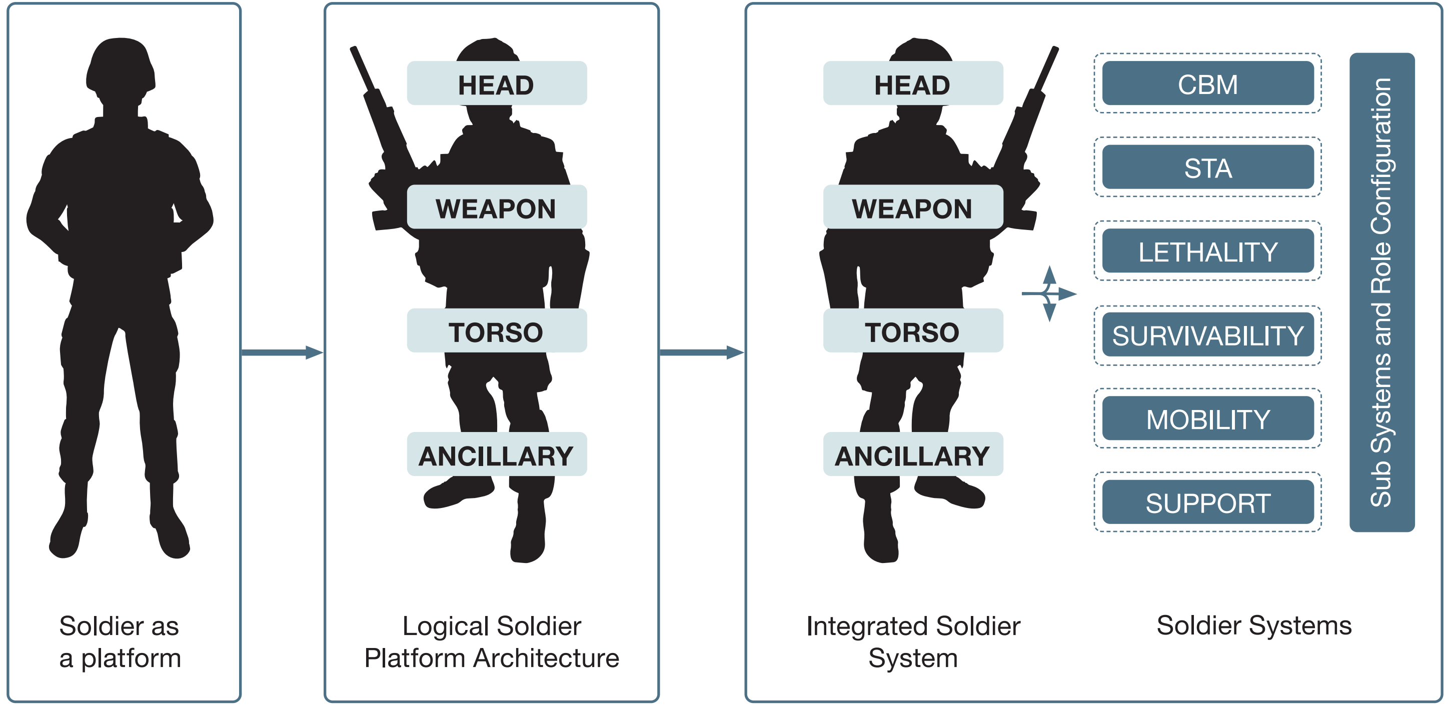
Integration on a Soldier Platform

Generic Soldier Architecture (GSA) is a purposeful, open systems, approach taken by the MOD and industry to an individual Soldier Platform.

Primarily focused on the Dismounted Close Combat (DCC), Light Infantry capability to achieve a flexible and "integrable" by design soldier platform that can sustain military advantage and win in battle, in the information and digital era. The approach (minimum viable architecture) encompasses design principles, rules, and key defined interfaces. With attention on the integration and interoperability of soldier equipment ensemble on the logical architecture which is interfaced with the power, electronic and physical architecture.

GSA is an approach to open architectures to provide modularity, scalability, openness and flexibility. This provides a route to achieving Army's:

- **Mission System Integration (MSI).** Integration by design of the Soldier Platform through open architectures. This allows for Soldier systems to be user-specific, flexible, configuration dependent on operational needs.
- **Force Centric Capability Management (FCCM)/ Soldier Platform.** Part of the FCCM approach; Integrated soldier system will manoeuvre and communicate, detect and engage threats, survive, fight and win in battle, in the information and digital era.

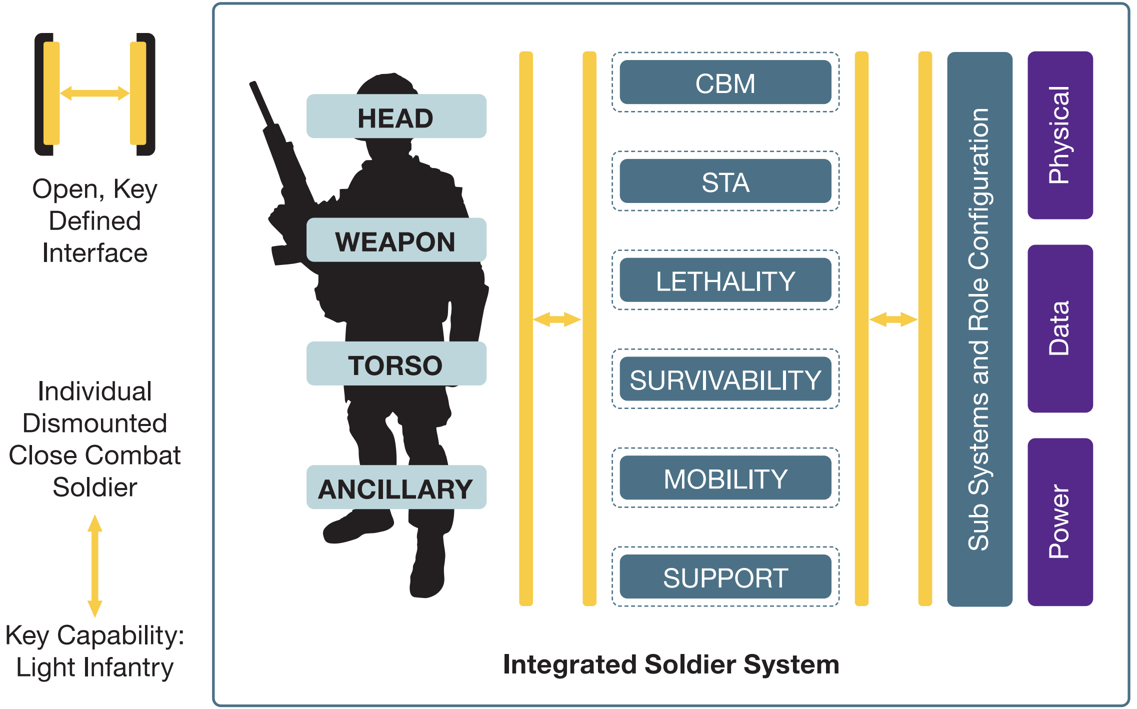


GSA approaches to a Soldier platform that is Integrable by design

The **key principles** pertaining to open systems for a Soldier Platform are:

- **Modular** decomposition; breaking the system into components.
- **Scalable** system; ability of the system to adapt to addition components.
- **Open** Interfaces; based on open and widely adopted standards.
- Defined **key Interfaces**; Not all interfaces need to be open at any one level of the design, only those that are required to meet capability.

GSA is a synergised approach within Land Open System Architecture (LOSA) which covers systems integration standards for soldiers, vehicles, and bases.



Soldier Equipment (modular) Ensemble which is located on the logical architecture and interfaces (connects on the soldier in a scalable configuration) with the Power, Electronic or Physical architecture.

Soldier Platform Physical Integration

The logical architecture will house physical interface points for power and data architecture including soldier equipment, role configuration, ensemble to be attached.

NATO Accessory (backward compatible with Picatinny Rail – STANAG 4694

Soldier Platform Power Integration

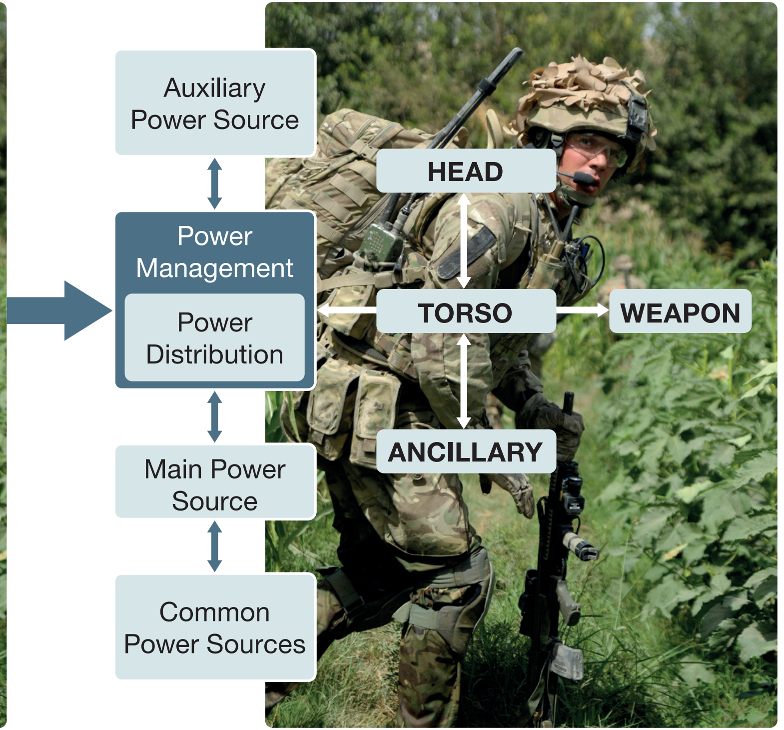
- **Power Architecture.** The proliferation of battery sources had led to unacceptable burden to the Soldier and wider logistical support. To minimise the burden, distributed power architecture is used to provide and manage power to interfaced devices. **Power Management;** System Management Bus (SMBus); provides a lightweight communication protocol for system and component power management.
- **Infrastructure;** Universal Serial Bus (USB); common infrastructure for power and data.
- **Connector.** Standardised Power Connector, STANAG 4695; Assigned Pin allocation.

Today's Power Integration

Isolated & uncommon Power Sources –
Reduced Space, Increased Weight and Supportability

GSA Approach Power Integration

Distributed Power and Common Power Source –
Increased Space, Reduced Weight and Supportability



Soldier Platform Information Integration and Interoperability

Electronic Architecture. Soldier systems are continuously growing in complexity with increasing dependency on information exchange between software-dependant systems, that utilise various system and application software. GSA defines methodology and technical positions to address the integration and interoperability of information across the soldier architecture, exploiting open and widely adopted standards to overcome complexity of systems:

- **Data Interfaces;** Conform to **GSA Data Model;** Provides the key common data sets for (Soldier systems data) integration & interoperability.
- **Data Communication;** Data Distribution Service (DDS); Publish-Subscribe, middleware technology that allows different system and application software to communicate with each other.
- **Network & Infrastructure Communication;** Universal Serial Bus (USB). Infrastructure media; Universal Serial Bus (USB); **Standardised Power and Data Connector,** STANAG 4851; assigned pin allocation. Devices requiring connection to the soldier power and data system.

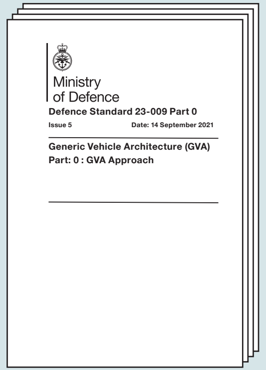
GSA Defence Standard, 23-012, provides the fundamental aspects for a **Minimum Viable Architecture (MVA)** for open systems integration and interoperability aspects of a Soldier platform, electronic, power and physical architecture and interfaces to mission systems.

Today's Information Integration

Disconnected Mission Systems – Non exchanged data and Increased Cognitive load

GSA Approach Information Integration

Connected Mission Systems – Shared, exchanged data and Reduced Cognitive load


Ministry of Defence
Defence Standard 23-009 Part 0
Issue 5 Date: 14 September 2021
Generic Vehicle Architecture (GVA)
Part: 0 : GVA Approach

Part 0: GSA Approach
Introduces the GVA principles and sets the GSA approach which soldier and mission systems projects shall follow.

Part 1: Power and Data Infrastructure
Power and Data standards and protocols used within the soldier electronic infrastructure.

Part 2: Physical Standards
How the soldier electronic infrastructure, logical sub-systems (torso, head and weapon) and equipment will physically integrate and connect to the soldier platform.

Part 3: Human Factors Integration
Human Factors Integration of soldier equipment, including best practice processes and procedures to further encourage human centred design solutions, reduce the issues encountered in integrating equipment together and minimise soldier burden both physically and cognitively.

Part 4: E3 Integration & Spectrum Management
E3 Integration and Spectrum Management of soldier worn equipment.

Generic Base Architecture

Generic Base Architecture (GBA) is the approach taken by the MOD and industry to standardise the interfaces and protocols for systems in Bases, which are physically integrated and enable Facilities Management, to improve overall effectiveness and efficiency. Underpinning the whole approach is the concept of a modular systems architecture based upon open standards. GBA is an integral part of the Land Open System Architecture (LOSA) which covers systems integration standards for bases, soldiers and vehicles.

GBA applies to bases of all sizes and duration, from a short-term checkpoint to a long-term main operating base, providing the architecture for both manoeuvre and static bases. They will use different implementations of the Core Infrastructure Services according to need but the critical interfaces will remain the same. GBA supports Modular design and construction so that system and components can be easily replaced to allow bases to grow or contract as needed while remaining efficient and effective in operation.

GBA makes Facilities Management possible by enabling the collection of data necessary to manage the Core Infrastructure Services effectively. For example, accurate and consistent data can be collected about power generation, storage, distribution and usage in the base. This enables the system to be efficiently managed as a whole, resulting in reduced use of resources and improved system availability.

An example of a GBA

- Reduced proliferation – standardising the interfaces between systems enables systems to be added or removed from the base without needing to replace all the connected components.
- Reduced logistic burden – utilising spare (power, water, waste, fuel) capacity reduces the quantity of consumables and the variety of spares required in comparison to providing dedicated, exclusive services to each system.

- Reduced support burden – standard interfaces enable systems to be integrated by the personnel already on the base rather than relying on specialist troops or contractors.
- Reduced training burden – standardising the interfaces reduces the breadth of training required and moves towards All Arms training for common activities.
- Open standards – allow designers (Capability planners, DE&S and RE designers and developers of bases) to identify and use COTS and MOTS technology options earlier in the lifecycle, allow manufacturers to propose innovative implementations to the MOD and potentially reduces obsolescence management issues through availability of replacement components.

GBA provides the architecture for the base infrastructure consisting of **data, power, water, waste** and **fuel –** the Core Infrastructure Services. This is there to support all the functions provided by the base in fulfilling its role, such as accommodation, laundry, medical, repair, base protection and ISTAR – the Platform Services.

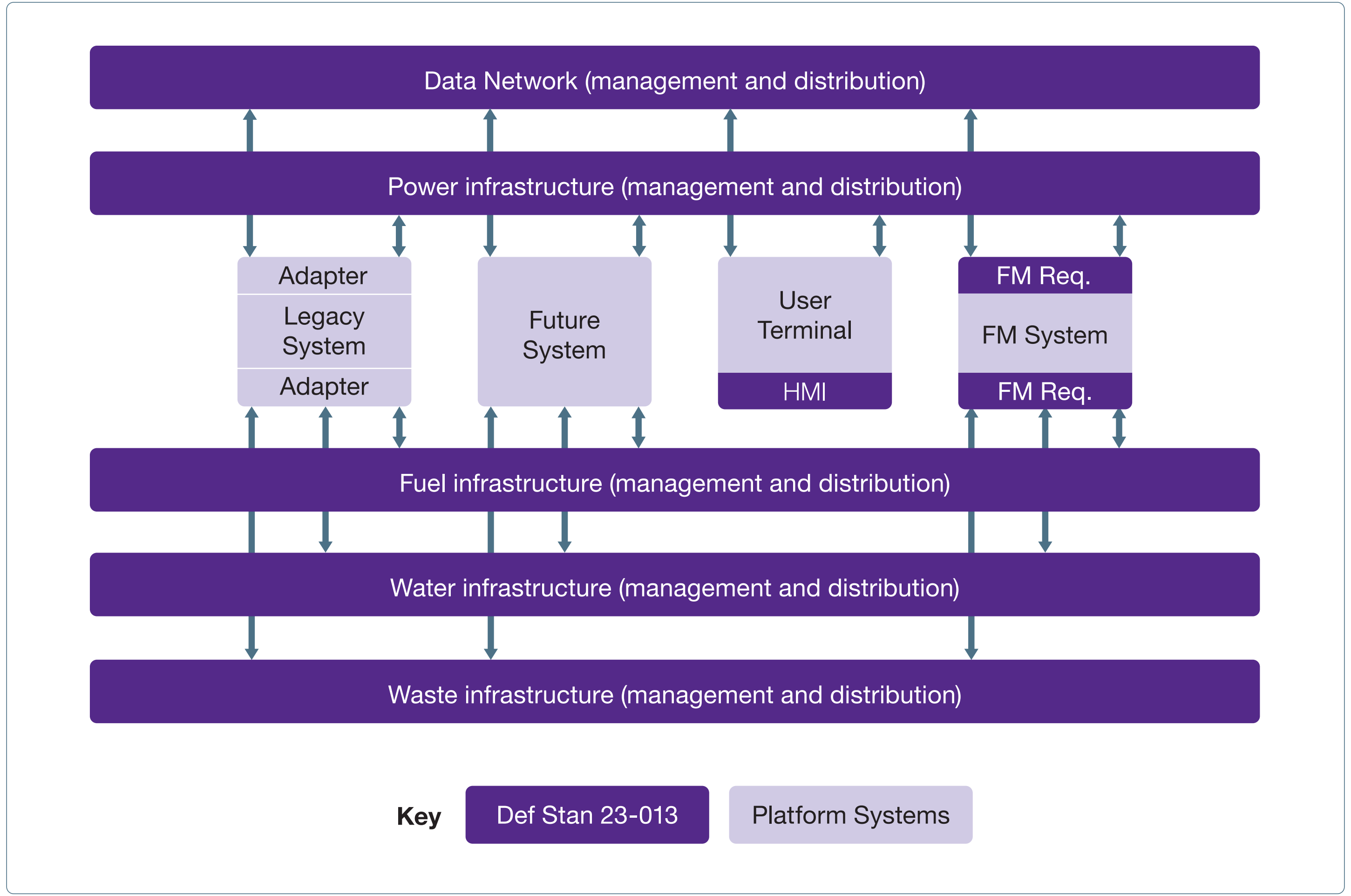
Def Stan 23-013 defines the interfaces between:

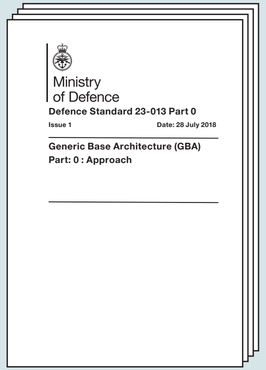
- The components of the systems themselves, and
- The infrastructure and equipment or facilities that use the infrastructure.

These interfaces are controlled by LOSA through the definition of specific open standards, data models and the use of Interface Control Documents (ICDs).

GBA is mandated across all Base Equipment projects in the Land Environment. This mandates each project to develop a GBA Implementation Strategy, detailing how GBA will be applied throughout the project's lifecycle. The strategy forms part of the Systems Engineering documentation set for the Concept phase and should be reviewed and updated throughout the project lifecycle.

The GBA Defence Standard, Def Stan 23-013, is owned and mandated by the MOD through the Operational Infrastructure team in DE&S. It is complementary to the appropriate Manual of Military Engineering on base design and integration published by Engineer-in-Chief (Army). Def Stan 23-013 consists of 8 parts.




Ministry
of Defence
Defence Standard 23-013 Part 0
Issue 1 Date: 28 July 2018
Generic Base Architecture (GBA)
Part: 0 : Approach

Part 0: GBA Approach
Introduces the GBA principles and sets the GBA approach.

Part 1: Facilities Management and HUMS
Enablers for facilities management and health and usage monitoring systems (HUMS)

Part 2: Power
Interfaces and common features required to build a microgrid from legacy and new battlefield equipment and electrical infrastructure solutions.

Part 3: Water
Guidance to create a system for producing, treating, storing, distributing, issuing, monitoring and managing water that is palatable for human consumption and other uses.

Part 4: Waste
Waste architecture to create a system for collecting, sorting, treating, storing, preparing for onward transmission, monitoring and managing waste in all its forms.

Part 5: Fuel
Fuel architecture is to support the concept of a single fuel.

Part 7: Containers
Guidance and definitions for Military Containers, including general freight containers, specialist-role containers, and platform-based containers.

Part 8: Manoeuvre Infrastructure
Guidance and definitions for Military Shelters.

Further Information

References and Further Reading

Land Industrial Strategy. MOD 2022
https://www.gov.uk/government/publications/land-industrial-strategy

Digital Strategy for Defence. Delivering the Digital Backbone and unleashing the power of Defence's data, MOD, 2021
https://www.gov.uk/government/publications/digital-strategy-for-defence-delivering-the-digital-backbone-and-unleashing-the-power-of-defences-data

National Security Through Technology: Technology, Equipment and Support for UK Defence and Security, Cm 8278, February 2012
https://assets.publishing.service.gov.uk/media/5a75b74840f0b67f59fcf0ed/cm8278.pdf

JSP 906, Defence Principles for Coherent Capability

Army Industrial Engagement Framework. Advantage Through Industry, ADR007574
https://assets.publishing.service.gov.uk/media/5d70e70e40f0b609275263e1/ADR007574_industrial_engagement_FINAL2_WEB.pdf

Defence Open Architecture Initiative. Implementation in the Land Environment, 8 Nov 2018

Mission System Integration Strategy. Establishing MSI as Business-As-Usual, Version 1.0, 27 May 2021

Useful Links

Defence Standards (GVA, GSA, GBA etc) should be obtained from UK Defence Standardisation:

STANMIS MOD toolset, for MOD and industry users with MOD Core Network (MCN) access:
http://stanmis.gateway.isg-r.r.mil.uk/

Defence Standards Index via Defence Gateway, for Industry users:
https://www.dstan.mod.uk/toolset/ListOfStandardSeries.html

The Land Open Systems Portal contains the Land Data Model, GVA Data Model, GSA Data Model, Service Specifications etc:
http://landopensystems.mod.gov.uk

Knowledge in Defence (via Defence Gateway) contains guidance on LOSA, GVA, GSA etc:
www.kid.mod.uk

Contact LOSA

For any advice or guidance on any parts of LOSA, please contact the LOSA Office at
DES-LELCA-PI-EngLOSA@mod.gov.uk