

Follow-up written evidence submitted by Lockheed Martin UK

1. As part of its inquiry on *Progress in delivering the British Army's armoured vehicle capability*, the Defence Select Committee expressed interest in whether the British Army's armoured fighting vehicles (AFVs) will have a standardised 'plug-and-play location' or 'ubiquitous anchor point' for incorporating other on-platform capabilities, such as complex weapons and unmanned aerial vehicles.¹ In an oral evidence session on 6 October 2020, Lockheed Martin UK highlighted the benefits of the Generic Vehicle Architecture (GVA) for the integration of other capabilities onto the Army's upgraded AFVs.
2. This submission provides additional information on GVA, including practical examples of GVA successfully being used to integrate a wide range of systems and subsystems onto the digital turrets of AFVs. The examples are based on Lockheed Martin UK's experience as prime contractor for the Warrior Capability Sustainment Programme (WCSP) demonstration contract and Turret supplier for the AJAX programme, as well as its export pursuits in a £7 billion medium calibre turret market.
3. In addition, this submission provides further information on the inherent capacity built into WCSP, to enable future capability growth and spiral development.
4. Finally, since the Committee's inquiry began, there has been speculation about when the technical baseline and configuration for the CT40 Cannon System, which is mandated as the primary weapon system for WCSP and provided as a Government Furnished Asset (GFX), was confirmed. The technical baseline and configuration were expected to be stable upon award of the WCSP demonstration contract in 2011 but continued to change until 2016. The Ministry of Defence (MoD) confirmed the final technical baseline and configuration for the Cannon System in late 2016, which was formalised through a contract amendment shortly thereafter.

Generic Vehicle Architecture (GVA)

5. GVA refers to the open, modular, and scalable approach that is applied to the design of vehicle platforms by the MoD. It sits within the MoD's broader Land Open Systems Architecture (LOSA). LOSA brings together architectures for all aspects of the land domain, including vehicles, dismounted soldiers, static bases, fires, tactical communications and Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR). GVA is an essential component of LOSA, and many of the standards developed and mandated in GVA are directly applicable to other areas within LOSA.
6. GVA has, at its core, a Defence Standard (Def Stan). Def Stan 23-09 includes open standards, developed jointly by the MoD and industry, for the following aspects of all vehicle fleets:-
 - a. Physical interfaces, including mechanical mountings and connectors;
 - b. Electronic infrastructure;
 - c. Power infrastructure;
 - d. Human-Machine Interfaces (HMI);
 - e. Health Usage and Monitoring Systems (HUMS); and

¹ Defence Committee, *Oral evidence: Progress in delivering the British Army's armoured vehicle capability*, HC 659, 6 October 2020 (published 9 October 2020), Q60, and HC 659, 20 October 2020, Q153.

- f. Command, Control, Communications, Computers, and Intelligence (C4I).
7. Mandating the design and implementation of these open standards across the hardware and software of AFVs is designed to improve system agility, by providing the ability to integrate additional sub-systems and upgrade technologies from a wide range of suppliers more quickly and affordably. The approach avoids vendor lock-in, which has been prevalent in past AFV programmes.
8. Lockheed Martin UK is a founding member of the GVA community and continues to collaborate in the development and roll-out of standards. Recently, it helped develop the Land Data Model (LDM) as part of the GVA Data Technical Working Group. LDM enables different electronic systems on a battlefield to communicate with each other. It can be thought of as a common language used between devices from different vendors and is a key enabler of GVA, LOSA, and Multi-Domain Integration. LDM is currently being extended for use across the Land domain through the Land Environment Tactical Communications and Information Systems (LE TacCIS) programme, which will deliver the next generation of tactical military communications in the land environment.
9. Lockheed Martin UK is also involved in the development of the next generation, GVA-compliant Electronic Architecture and platform software known as the Modular Mission System (MMS). This platform software is being used by Defence Equipment & Support (DE&S) as a Virtual Reference Vehicle (VRV) across multiple MoD programmes, including MORPHEUS (which will deliver the future tactical communications system for the ARMY, as part of LE TacCIS), CRENIC (which will deliver electronic countermeasures and force protection for the Army and ground elements of the Royal Navy and Royal Air Force), and SAPIENT (which will integrate sensors and sensor data on the battlefield).
10. Finally, Lockheed Martin UK supports the MoD at NATO, using UK experience to develop an aligned NATO Generic Vehicle Architecture (NGVA, or Standardisation Agreement 4754). NGVA/STANAG 4754 provides a basis for greater commonality, interoperability, and interchangeability of electronic subsystems between the military vehicles of Alliance members.

Examples of capability integration using GVA

11. In Lockheed Martin UK's experience, the physical (mechanical) integration of capabilities onto AFVs is relatively straightforward, provided sufficient space and spare vehicle weight capacity is available. Software and electronic interfacing between a vehicle and other capabilities can be more challenging, if the capabilities are developed using different standards.
12. As part of its internal Research & Development (R&D) programme and potential export opportunities for AFVs, Lockheed Martin has demonstrated the integration of other systems and capabilities onto AFV platforms, using the GVA digital turret and fire control systems developed for WCSP and AJAX. As part of this, Lockheed Martin UK has integrated GVA compliant equipment from other companies. For example:-
 - a. Anti-Tank Guided Missile (ATGM) missile launchers, including Javelin and Hellfire (see Figures 1 and 2 for an example of the integration of the FGM-148 Javelin ATGM with the Boxer and AMV 8x8 vehicles (using the digital turret developed for WCSP and AJAX), and Figure 3 for the integration of Hellfire into the Patria AMV vehicle);²

² Lockheed Martin UK believes there is greater scope for UK-US collaboration on complex and disruptive weapons. There would

- b. Remote Weapon Stations and situational awareness;
- c. Unmanned Aerial Vehicle (UAV) control stations;
- d. Electronic Countermeasures (ECM);
- e. Cyber Electromagnetic Activities (CEMA) systems;
- f. Smart (multi-function) armour and Active Protection Systems; and
- g. Battle Management, Command, Control, Communications, Computers and Information (BMC4I) systems.



Figure 1: FGM-148 Javelin ATGM integration and firing with Lockheed Martin UK turret on a KMW Boxer 8x8 base vehicle platform for a potential export customer (2014-15)



Figure 2: FGM-148 Javelin ATGM integration with Lockheed Martin UK turret on a Patria AMV 8x8 base vehicle platform for a potential export customer (2015-17)



Figure 3: AGM-114 Hellfire (Helicopter Launched Fire-&-Forget Missile System) integration and firing with Lockheed Martin UK turret on a Patria AMV 8x8 base vehicle platform for a potential export customer (2014)

WCSP capacity for future growth/spiral development

be significant operational and economic benefits from co-production or co-development of these.

13. A key determinant of an AFV's capacity for future growth and spiral development is its onboard power, to support additional capabilities and functions.
14. WCSP generates approximately three times more electrical power compared to the in-service Warrior AFV. Whilst more power is required by WCSP to accommodate additional electrical demand (such as the cannon stabilisation) and the overall weight increase of the turret, approximately 50 per cent of the increased power generation is reserved for future growth. The WCSP's Auxiliary Power Unit (APU) also has the ability to generate power.

4 November 2020