Future Combat Systems

A typical future battlefield scene as envisioned by Giat

In 2014, it will have taken some two-and-a-half decades after the fall of the Iron Curtain for some of the major Western armies to gear up to the new World Order. At least four major programmes are currently underway to meet tomorrow's new challenges.

Eric H Biass and Ian Kemp

The most comprehensive overhaul comes from America in the form of the Future Combat System, more generically known under the (confusing) FCS acronym. Planned to enter service from 2014 hence, the FCS project will completely equip approximately 43 active and reserve brigades with a 'system of systems' comprising manned ground vehicles, unmanned ground vehicles, unmanned air vehicles and unattended munitions. Senior service officials have summarised the aim of the FCS project as combining «the lethality and survivability of the heavy force with the deployability of the light force».

Unlike the American project which encompasses the systematic replacement of virtually all systems from main battle tanks, via howitzers down to armoured personnel carriers, the three European programmes are more focused on light infantry equipment. This is not too surprising because a number of their heavier key elements such as tanks and howitzers are of more recent technology than say, the Abrams or the M-109, and are thus more intrinsically apt for network-centric integration.

Interestingly, Sweden was the first to run a programme aimed at defining a family of modular tracked and wheeled armoured vehicles, actually before the takeover of Hägglunds by BAE Systems. Known as the Sep, this programme is intended to create a family of air-transportable fighting vehicles to enter service early in the next decade. These will support the Swedish Army's heavy combat vehicles – the Leopard 2S tank and the CV90 combat vehicle – that are expected to remain the backbone of its combat capability for another 30 years. In a first stage the army is seeking to acquire 540 vehicles to replace its oldest tracked personnel carriers.

In Britain, and paradoxically given BAE Systems' deep involvement in the FCS programme, the situation is still in a blur. A number of armoured vehicle studies had been launched and dropped for various reasons, and with Hägglunds now in the BAE fold various ideas that have emerged from the Sep could flow into the Fres and vice versa. In its Single Statement of User Need for the Fres the Ministry of Defence defines that «the user requires a system of medium land forces able to conduct sustained, expeditionary, full-spectrum operations in combined-arms, joint and multi-national contexts, in a wide range of future operating environments». The Fres project will deliver a medium weight capability that will complement, not replace, the army's heavy forces. The collaboration between Sweden and Britain on a joint Sep/Fres project could result in the largest armoured fighting vehicle programme in Europe – and the FMV has not ruled out other partners. The organisation has already handed over to the European Defence Agency a document explaining the potential for collaboration with other European nations.

The last project comes from France with the Boa programme, which involves Thales, Giat and Sagem and, at a later stage, MBDA. Launched in June 2004 and sanctioned by a development contract in December 2005, the study «will introduce new concepts of network-centric warfighting as a response to the close combat needs of the French Army over the coming decades. It combines the key assets in the air-land theatre – mounted and dismounted combat elements supported by unmanned ground and air vehicles – to increase the operational tempo, improve the effectiveness of units on the ground and provide them with better protection, and allow commanders to be in control in all situations».

Cover

The cover of this supplement, courtesy of Sagem, illustrates French Felin soldiers in action as they would be as part of the Boa concept, complete with their helmet-mounted monitors, tactical displays, the Odin mini-drone and a reconnaissance robot.

The American Future Combat System

Northrop Grumman is developing the MQ-8B Fire Scout into the FCS Class IV drone

The Future Combat System is the largest programme ever launched by the US Army. It is estimated to be worth $ 161 billion over the life of the project and aimed at replacing a wide spectrum of vehicles beginning in 2014.

Ian Kemp

The army's present heavy force is equipped with M1A2 Abrams tanks, M2A3 Bradley fighting vehicles, M109A6 Paladin 155 mm self-propelled howitzers, M113 family armoured personnel carriers and M88A2 recovery vehicles. Designed independently in separate programmes over several decades, these vehicles have different levels of operational capability and survivability. Moreover, there is no logistics compatibility across this fleet. The FCS will replace these disparate vehicles with a modular fleet of combat vehicles.

In a significant change as a result of the lessons learned in Iraq the army has decided all eight manned FCS vehicles will incorporate an active protection system instead of the four vehicles originally planned. «In a 360-degree fight everything needs protection», said an Acquisition, Logistics and Technology official.

Industrial Set Up

On 6 February 2006 the Bush Administration asked Congress to approve a $ 439.3 billion defence budget for fiscal year 2007 (FY07). Despite media speculation that funding for the FCS might be reduced the administration is requesting $ 3.7 billion to continue the SDD phase next year and plans to spend $ 22.4 billion on FCS by 2011. Rejecting criticism that the FCS is not suited for the 'global war on terrorism' the Army's budget documents state «the FCS will provide full spectrum warfighting capability to deter, contain, stabilize or fight».

Boeing and SAIC are jointly serving as the Lead Systems Integrator (LSI) for the FCS programme. The Tank-Automotive and Armaments Command formalised the FCS Systems Development and Demonstration (SDD) contract in December 2003. The agreement established an upper limit of $ 14.78 billion for SDD through December 2011, although this figure has since become meaningless, as the army has restructured the project, in part to bring elements of FCS technology into service early with the legacy force.

The team assembled by the LSI included no fewer than 362 companies across 35 states in September 2005 when the annual FCS public briefing book was last published. This figure will grow before the next edition is released. At this stage there are 23 Tier 1 members of the 'FCS One Team' including General Dynamics Land Systems and BAE Systems, who are developing the manned vehicles.

The Army's networked system of systems (18+1+1) will consist of a C4ISR backbone, the soldier system and 18 'core FCS systems' in three categories:

- manned ground vehicles
- unmanned air vehicles and
- unmanned ground robotic vehicles.

Within the FCS family there will be eight MGVs, each with a top speed of 90 kmh and a range of 750 km.

Quarterly figures presented by the Department of Defense to Congress on 30 September 2005 stated that the FCS programme costs increased $ 62.541 billion (+63.3%) from $ 98.878 billion the previous quarter to $161.420 billion, due to programme restructuring (+$ 54.270 billion) and the stretching of the schedule by four years (+$ 8.270 billion). Under the

The FCS will replace fuel guzzlers like the M1 tank seen here, but also other 'generation-staggered' vehicles like the Bradley and the Paladin. (General Dynamics)

As an example of how the FCS will be optimised for operations such as those now underway in Iraq, the US Army points out that the BAE Systems Infantry Combat Vehicle (ICV) will dismount two more men than the M2 Bradley Infantry Fighting Vehicle which only carries a seven-strong squad. (US Army)

revised FCS acquisition strategy announced in July 2004 the army is delaying the introduction of the manned vehicle family while accelerating the introduction of more mature FCS technologies. The idea is to expand the scope of the programme's system development and integration phase by adding four discrete 'spin outs' of capabilities. Spin Out 1 will be fielded in 2008 and consist of prototypes delivered to the Evaluation Brigade Combat Team. Following successful evaluation, production and fielding of Spin Out 1, equipment to the current force will begin in 2010. This process will be repeated for each successive spin out.

FCS technology will be incrementally fielded from 2008 in spirals, initially to an experimental brigade combat team. The first spiral is expected to include rocket- and missile-launchers and robotic ground sensors, and development of the Nlos-C will be expedited to allow its fielding in FY08. The second spiral should introduce a new tactical communications system and drones in FY10. The third spiral is expected to field autonomous ground robots in FY12. The fourth spiral in FY14 should see the FCS battle command system turn operational and the first experimental brigade unit of action equipped with FCS vehicles two to four years later than planned. Beginning in 2012 the Army will order sufficient vehicles each year to equip two brigades.

Eye of the Needle

Since the inception of the FCS project the 'eye of the needle' driving the design of the manned ground vehicles was the requirement that each vehicle had to fit inside a US Air Force's C-130 Hercules aircraft for redeployment within a theatre of operations. In practical terms this meant a vehicle weight of less than 20 tonnes. However, there's been an evolution in thinking in the army on transportability. The real requirement is three FCS vehicles in a C-17. This shift in thinking will allow the weight of an individual FCS vehicle to reach 24 tonnes. Commanders in Iraq did not take the Stryker vehicles from Mosul to Baghdad in a C-130 because they would have had to do some disassembly. They just got on the highway and zoomed down there.

GDLS is developing the FCS Command and Control Vehicle (C2V) which will be deployed within headquarters at each company, battalion and brigade level. (US Army)

Key Performance Parameters

The complete FCS system of systems specification contains more than 10,000 technical requirements. All of these are derived from seven Key Performance Parameters (KPP) that the Army has stipulated the FCS must achieve:

- KPP 1 Joint Interoperability: The FCS must be jointly interoperable
- KPP 2 Networked Battle Command: The FCS network must enable battle command and provide situational awareness to the manned platform and dismounted soldier level
- KPP 3 Networked Lethality: The FCS must be capable of jointly-networked lethal and non-lethal effects that achieve overmatch – out of contact and in contact – at a tactical standoff range as well as in close combat to defeat the specified target sets
- KPP 4 Transportability: The FCS must be transportable worldwide by air, sea, highway and rail modes to support inter-theatre strategic deployment and intra-theatre operational manoeuvre
- KPP 5 Sustainability/Reliability: The FCS must maximize available combat power while achieving significant logistics footprint reductions and personnel efficiencies in the area of operations through reduced demand for maintenance and supply
- KPP 6 Training: The FCS must have an embedded individual and collective training capability that supports live, virtual and constructive training environments
- KPP 7 Survivability: The FCS must provide essential protection to mounted and dismounted soldiers through the best combination of ground and air systems.

They will be able to do the same thing with the FCS.

Manned Ground Vehicles

The Command and Control Vehicle (C2V), a General Dynamics Land Systems affair, will be deployed within headquarters sections at each echelon of the BCT down to the company level, replacing the M577A3 armoured command post. The C2V will have a crew of two, carry four command staff and be armed with a 12.7 mm machine gun or Mk 19 40 mm automatic grenade launcher for self-defence. The vehicle will carry an integrated command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) suite.

The Reconnaissance and Surveillance Vehicle (RSV), also from General Dynamics, will replace the M3 Bradley Cavalry Fighting Vehicle, have a two-person crew and carry four scouts. According to the programme description the vehicle's suite of advanced sensors will enable it to detect, locate, track, classify and auto-

The US Army's Benét Laboratories is developing the XM360 lightweight 120 mm gun as the main Los/Blos armament for the MCS. Firing tests began at Aberdeen Proving Ground in November 2004. (US Army)

matically identify targets from increased standoff ranges under all climatic conditions, day or night. Included in this suite are a mast-mounted, long-range electro-optic infrared sensor, an emitter mapping sensor for radio frequency (RF) intercept and direction finding, remote chemical detection capabilities, and a multi-function RF sensor. The RSV will also be equipped with unattended ground sensors, a small unmanned ground vehicle and two unmanned aerial vehicles, or drones. As the vehicle will rely upon stealth to gather information it will only be armed with a 12.7 mm machine gun or Mk 19 40 mm grenade launcher.

The Infantry Combat Vehicle (ICV), under the auspices of BAE Systems, will be fielded in four versions to replace the M2 Bradley Infantry Fighting Vehicle:

- ► Company Commander
- ► Platoon Leader
- ► Rifle Squad and
- ► Weapons Squad.

Each infantry platoon will be equipped with one Platoon Leader, Rifle Squad and one Weapons Squad variant. All variants will appear identical on the exterior. Whereas the M2 has a three-strong crew and dismounts seven men the ICV rifle squad vehicle will be operated by a crew of two and carry a nine-strong infantry squad. The vehicle's primary armament will be an ATK Mk 44 30/40 mm Bushmaster cannon.

The Mounted Combat System (MCS), the replacement for the M1 tank from General Dynamics Land Systems, is intended to provide both line-of-sight (Los) and beyond line-of-sight (Blos) fire capability. It will have a crew of two and possibly carry two passengers. Under a co-operative research and development agreement between General Dynamics and Ardec the US Army's Benét Laboratories is developing the XM360 lightweight 120 mm gun as the main armament.

A prototype Los/Blos 120 mm gun began firing tests at Aberdeen Proving Ground in November 2004. Following successful testing the weapon is ready for integration into the SDD phase. Under the present plans nine guns will be delivered between 2007 and 2009 for further testing and six guns will be delivered between 2009 and 2010 for integration into pre-production vehicles. The weapon will have the capability to destroy targets at ranges up to eight km. The vehicle's secondary armament will consist of a 12.7 mm machine gun and a 40 mm grenade launcher.

The Non Line-of-Sight Cannon (Nlos-C) from BAE Systems is the replacement for the M109A6 155 mm Paladin. It will also be a 155 mm weapon but will provide multiple-round simultaneous impact capability and a superior sustained rate of fire. A high level of automation will reduce the crew to only two members. It will have a 12.7 mm machine-gun or a Mk 19 40 mm grenade launcher for close-in defence. The concept technology demonstrator developed by United Defense (now BAE Systems) fired its first round at the Army's Yuma Proving Ground in Arizona on 26 August 2003 and passed the 1000-round milestone in mid-2005. This mounts the M776 39-calibre ordnance of the BAE Systems M777 towed 155 mm howitzer on a 20-tonne chassis and employs an automated loading system. The M776 ordnance is being replaced by a lighter 38-calibre barrel. In 2008 six Increment 0 prototypes are scheduled to join the test SDD programme. These will be followed in 2010 by three Increment 1 prototypes based on the objective chassis.

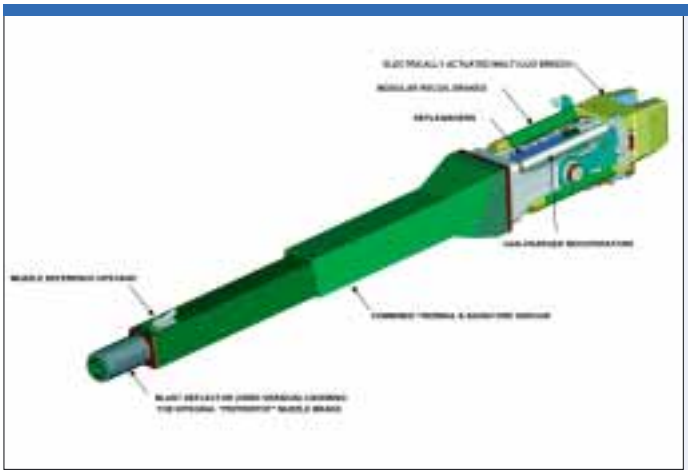
Non Line-of-Sight Mortar (Nlos-M), also from BAE Systems, will have a crew of four and be armed with a turreted 120 mm smoothbore mortar and a 12.7 mm machine-gun or 40 mm grenade launcher. It will replace the M1064 vehicle that fires its 120 mm mortar through an open hatch. Besides standard ammunition the Nlos-M will also fire the Precision Guided Mortar Munition. The mortar platoon will retain 81 mm lightweight mortars for operations in 'complex terrain'.

Medical and Evacuation Vehicle: these BAE Systems vehicles will be produced on a common chassis with two mission modules: treatment (MV-T) and evacuation (MV-E). It will replace the M577 ambulance. The objective is to «provide advanced trauma life support within one hour to critically injured soldiers». The MV-E will carry a four-strong crew and be able to evacuate up to four litter patients from the point-of-injury. The team aboard the MV-T will provide advanced trauma management and trauma life support treatments. Both MV mission modules will use networked telemedicine interfaces.

Common Manned Vehicle Components

- ► *Front engine with hybrid electric drive*
- ► *Close Combat Armament System*
- ► *EO/IR sensor*
- ► *Active protection system*
- ► *High voltage batteries*
- ► *Suspension*
- ► *Band track*
- ► *External communications*

One of the largest technical challenges of the FCS project will be giving the 25-tonne General Dynamics Mounted Combat System (MCS) an equal or better level of survivability as compared to the 70-tonne M1A2 tank that it is intended to replace. (US Army)



The XM 360 includes a gun mount with a modular recoil mechanism, an electrically actuated multi-lug breech, a cannon tube with integral pepperpot muzzle brake, a blast deflector and a gun tube shroud to mitigate the effects of environmental conditions. (US Army)

Maintenance and Recovery Vehicle (MRV), from BAE Systems, will have a crew of three with additional space for three recovered crew. The MRV will be able to perform field maintenance requirements beyond the capabilities of the crew chief/crew, more in-depth battle damage assessment and repair and limited recovery operations. It will be armed with a 12.7 mm heavy machine-gun and a 40 mm automatic grenade launcher.

Unmanned Ground Vehicles

BAE Systems is leading the Phase 1 engineering study effort to design and develop the Armed Robotic Vehicle; the largest of the unmanned vehicles. There will be two variants: the ARV-RSTA that will perform reconnaissance, surveillance and target acquisition (RSTA) missions, and the ARV-Assault (ARV-A) variant that will undertake direct and indirect fire missions.

They will share a common 6 × 6 chassis powered by a six-cylinder diesel engine developing 217 hp. As an alternative an electric drive hybrid motor can be fitted. The ARV will be capable of accelerating from 0 to 48 kph in ten seconds, achieve a top road speed of 90 kph and have a range exceeding 400 km. The vehicles will be fitted with a similar turret capable of traversing 180 degrees. The target weight of 8.5 tonnes will enable two vehicles to be carried by a C-130 Hercules or one inside a CH-47 Chinook transport helicopter.

The BAE Systems Non-Line of Sight Mortar (Nlos-M) will be the first breech-loading 120 mm mortar in US Army service. Each will also carry an 81 mm lightweight mortar for dismounted operations. (US Army)

The ARV will operate ahead of manned vehicles that will act as control platform, such as the RSV. Dismounted troops will also be able to direct the robots.

The BAE Systems 155 mm Non-Line of Sight Cannon (Nlos-C) is expected to be the first FCS Manned Ground Vehicle to enter service and Congress may put pressure on the army to further expedite the project in the wake of the Crusader cancellation. The concept technology demonstrator, mounting the M777's 39-calibre ordnance, passed the 1000 round milestone in mid-2005. (BAE Systems)

According to an army statement the ARV-R will «remotely provide reconnaissance capability in urban military operations and other battlespace; deploy sensors, direct fire weapons and special munitions into buildings, bunkers, tunnels and other urban features; act as a communications relay; and assess battle damage». The ARV-R will have a five-metre telescopic mast mounting an electro-optical/infrared/laser sensor package, a multi-function Ka-band radar and a nuclear, biological and chemical warfare sensor. The ARV-R will be able to deploy unattended ground sensors from a launcher mounted on the turret roof. The vehicle will be armed with the XM307 25 mm Advanced Crew Served Weapon, now being developed by General Dynamics, and carry 150 to 250 rounds of ammunition.

The AVR-A will «remotely provide reconnaissance capability; deploy sensors, direct-fire weapons, and special munitions into buildings, bunkers, and other urban features; locate or by-pass threat obstacles in buildings, bunkers, tunnels and other urban features; assess battle damage; acts as a communications relay; support the mounted and dismounted forces in the assault with direct fire and anti-tank weapons; and occupy key terrain and provide over-watching fire», according to the army statement. It will be armed with an ATK Mk 44 30/40 mm cannon and a pod of four beyond line-of-sight Common Missiles. The missile pod can be retracted into the turret for protection.

The company will deliver the first prototypes in 2010 while fielding to the first FCS-equipped team is scheduled for the 2012 to 2014 timeframe. A typical team will operate approximately 45 armed robotic vehicles.

In April 2005 United Defense received a $ 30.9 million contract from the US Army's Tardec to integrate state-of-the-art unmanned platform technologies leveraged from army and commercial developments into a representative armed robotic platform and test them in a series of demonstrations in September 2006 and March 2008.

The Mule (Multifunction Utility/ Logistics and Equipment) is a 2.5-tonne, 6 × 6 robotic vehicle being developed by Lock-

Unlike the army's present vehicle generation the BAE Systems FCS Maintenance and Recovery Vehicle will have the same level of mobility as the combat vehicles that it supports. Improved logistics, including maintenance and repair, is a major objective of the FCS project. (US Army)

heed Martin that will provide support to infantry units. It has three major components: a common chassis, an Autonomous Navigation System (ANS) and a Dismounted Control Device (DCD) – and is available in three mission variants.

The Transport Mule is designed to carry equipment and supplies to support two dismounted infantry squads. It will also be suitable for casualty evacuation.

The Armed Robotic Vehicle – Assault (Light) will be armed with a small-calibre gun and four missiles to support dismounted infantry soldiers.

The Countermine variant is designed to detect and neutralise mines and mark cleared lanes through minefields. The Mule's success is dependent upon «superior mobility».

It will feature an advanced 6 × 6 independent articulated suspension coupled to in-hub motors powering each wheel. This will allow it to climb a 1.5-metre step, cross a 1.5-metre gap, traverse slopes greater than 40%, ford water to a depth of 1.25 metres and cross obstacles as high as 0.5 metres. In June 2005 Lockheed Martin received a $ 61 million 'plus-up' to its 2003 SDD contract; this phase is expected to be worth more than $ 290 million. The modification increases the number of prototypes from 17 to 19, with the first prototypes scheduled for delivery in the third quarter of 2010 with final deliveries by June 2011.

The Sugv (Small Unmanned Ground Vehicle) developed by iRobot to conduct RSTA missions in tunnels, sewers, caves and so forth will be the smallest FCS platform and will be the man-portable. It will be a smaller, lighter more capable successor to iRobot's PackBot series, comprising the Explorer, Scout and EOD models, which is already in US service in Afghanistan and Iraq. In May 2005 the company had its funding boosted from $ 37.3 million to $ 51.4 million to expedite development.

The Sugv target weight is less than 13.6 kg, with a modular 'plug-and-play' payload of up to 2.72 kg. It should have an endurance of six hours and navigate up to 1000 metres from its operator above ground and up to 200 metres away in tunnels. The Sugv's articulated 'flipper' design gives it a high level of mobility in difficult terrain and enables it to self-right.

Unmanned Aerial Vehicles

The system sees four classes of Unmanned Aerial Vehicle (UAV) to provide a capability from platoon to brigade level.

The Mav (Micro Air Vehicle Mav) being developed by Honeywell under a two-phase Darpa advanced concept technology development contract is the preferred Class I drone to provide an RSTA capability at the platoon level by day and night. The Class 1 will have an endurance of 50 minutes over an area of eight km carrying either electro optical or infrared sensors. The system, including two air vehicles and a control unit, weighs about 18 kg and will be carried by one soldier. A ducted fan design allows the Mav to take-off and land vertically. The Mav is programmed for autonomous flight and navigation. After completing more than 200 flights the Mav reached technology readiness level 6 in October 2005, meaning that it is ready to transition to the FCS

BAE Systems is leading the design and development of the Armed Robotic Vehicle. The ARV-RSTA (left) and the ARV-Assault ARV-A are designed to be controlled by troops on the ground or in manned ground vehicles. Under present plans each FCS brigade will include 45 ARVs. (BAE Systems)

The BAE Systems Medical and Evacuation Vehicle will be produced with a mission module for treatment (MV-T) and another for evacuation (MV-E). The vehicle and networked telemedicine interfaces are designed to provide a level of treatment further forward on the battlefield than is now possible. (US Army)

Lockheed Martin is developing the 6 × 6 Multifunction Utility/Logistics and Equipment (Mule) unmanned ground vehicle in three variants: the Armed Robotic Vehicle – Assault (Light) (left), a Countermine variant (centre) and the Transport Mule (right). The Mule's success is dependent upon an advanced 6 × 6 independent articulated suspension coupled to in-hub motors. (Lockheed Martin)

programme. Under a separate December 2004 contract, worth almost $ three million, Honeywell conducted a systems engineering analyses leading to a System Functional Review in March 2006; which could lead to a development contract from Boeing. Following a successful review Boeing intends to award an SDD contract to Honeywell.

The Class II drone is vehicle-mounted and intended for company level use and will have twice the endurance and a wider range of capabilities than the Class I. It will have the capability to designate targets in day, night and adverse weather, thus allowing the company commander to employ line-of-sight, beyond line-of-sight and non-line-of-sight fire. The UAV is intended to have an endurance of 120 minutes over a 16 km area. The system is to be portable by two soldiers.

The Class III will be employed for recce missions to support battalion level operations. The army is seeking an aircraft that can remain on station for six hours over a 40 km area and take-off and land without a dedicated airfield. In addition to the capabilities of the two smaller aircraft the Class III types will also provide communication relay, mine detection, chemical, biological, radiological and nuclear detection as well as meteorological survey.

In July 2005 Boeing awarded four contracts, each worth from $ three to $ five million, to three companies to participate in the first phase of Class II and Class III development. Piasecki Aircraft will develop its Air Scout system to meet the Class II requirement while for the Class III AAI will develop its Shadow III, Piasecki its Air Guard and Teledyne Brown Engineering its Prospector.

iRobot is building upon the experience of is successful iRobot Pacbot series to develop the man-portable Small Unmanned Ground Vehicle. Unmanned vehicles will be critical in contributing to the improved situational awareness at the heart of the FCS. (US Army)

Development will be carried out in three phases with the LSI and Darpa developing different technologies in tandem until a final candidate system is selected for both drone classes. Darpa is conducting the Organic Air Vehicle II (OAV II) programme, which is focused on ducted fan technology for the Class II solution while the LSI is evaluating an alternative non-ducted fan approach. Darpa is investing rotorcraft technology for the Class III while the LSI is examining gyrocopter and fixed-wing designs. The ten-month Phase 1 includes requirements assessment and risk reduction trade studies that are intended to lead to selection in mid-2006 of one candidate for the Class III system and a decision on how to proceed with Class II development. The selected LSI and Darpa candidates will then be evaluated during a 24-month concept maturation phase that will culminate in a flight assessment of the developmental prototypes in 2008. A selection will then occur for the final system development and demonstration phase when the LSI, Army and Darpa will select the best-value solutions for each class of drone. Deliveries for system-of-systems testing will occur in 2010, with fielding of both classes scheduled for 2014.

The Class IV comes in the form of the MQ-8B Fire Scout (see title picture) being developed by Northrop Grumman for employment at the brigade level. In addition to RSTA missions the Army has specified unique missions including "dedicated manned and unmanned teaming with manned aviation, emitter mapping, wideband communication relay across 150 to

Honeywell Aerospace awarded AAI a contract in February 2006 to deliver a further 55 Micro Air Vehicle (Mav) airframes for use in the Advanced Concept Technology Demonstration. The man-packable Class 1 UAV is so far the smallest UAV in the FCS project. (US Army)

These poor quality computer-generated images depict the Piasecki twin-rotor Class II (left) and gyrodyne-configured Class III projects. (Piasecki)

175 km and standoff chemical, biological, radiological, nuclear and energy detection with on-board processing". The objective is an aircraft that can take-off and land without a dedicated airfield and conduct 72 hours of continuous operations.

Northrop Grumman is building eight prototypes for the Army and, under a separate project, is building four Fire Scouts for the US Navy. In July the Fire Scout successfully fired 2.75-inch rockets at Yuma Proving Ground and demonstrated its ability to deliver 'hundreds of pounds' of cargo carried in external bins and fly back to base. The following month it completed data and image relay, video transmissions and supplied delivery to a remote location during a series of tests and demonstrations that culminated with a fully autonomous flight demonstration for senior FCS officials. The missions were flown using the Army's One System ground control station. Northrop Grumman has offered to accelerate the Fire Scout's delivery for FCS from 2014 to between 2010 and 2012. Outside of the FCS programme the company has also proposed delivering Fire Scouts to the Army as early as FY07 for operational employment.

AAI is to develop a version III of its Shadow (here seen at Baqubah in Iraq) to meet the requirements of the Class III. (AAI)

The Intelligent Munition System (IMS) is the responsibility of General Dynamics who is developing an unattended system to provide both «offensive battlespace shaping and defensive force protection capabilities». The IMS will integrate lethal and non-lethal munitions with communication devices, sensors and seekers. IMS components can be hand-emplaced, remotely delivered or launched from a dispenser module carried on manned or unmanned ground vehicles. Once deployed the IMS will report its location to the Battle Command Mission Execution, one of the FCS command and control applications. This will allow the IMS to be turned off to allow the passage of friendly forces and then rearmed. Its munitions will be effective against personnel, light armoured vehicles and tanks. An initial operational capability will be available in 2009.

The Non Line-of-Sight (Nlos-LS) is developed by NetFires – a unit formed by Raytheon and Lockheed Martin. The weapon will be delivered to the Army in Spin Out 1 in FY08. The Nlos-LS will consist of the deployable, platform-independent Container Launch Unit (CLU), with self-contained tactical fire control electronics and software for remote and unmanned operations, which can be used to launch either Raytheon's Precision Attack Missile (Pam) or Lockheed Martin's Loitering Attack Missile (Lam). Each CLU will consist of a computer, communication system and 15 missiles. The Pam will have a range of about 40 km, is designed to defeat heavy armoured targets and can be launched on a fast-attack direct-fire trajectory or a boost-glide trajectory. The missile will receive target information prior to launch and respond to target location updates during flight. The Pam can be used in the laser-designated, 'laser-anointed' and autonomous operation modes. The missile will be capable of transmitting near-real-time target imagery prior to impact.

It will employ both a ladar seeker and automatic target recognition. In January Raytheon announced that the Lam's Multiple Explosively Formed Penetrator warhead, being developed by Aerojet-General, had successfully completed another eight tests following the first four-test series reported in July. The warhead is configured to deliver 24 fragments in an expanding geometric pattern.

The Unattended Ground Sensors (UGS) is in the hands of a team formed by Textron Systems and Honeywell. The project is divided into two major subgroups: the Tactical-UGS, which includes the intelligence, surveillance and reconnaissance, and the Chemical, Biological, Radiological and Nuclear; and the Urban-UGS.

NetFires, a limited liability company established by Lockheed Martin and Raytheon, is working under a $ 1.1 billion contract for system design and development of the Non Line-of-Sight – Launch System (Nlos-LS). The weapon will be delivered to the army in Spin Out 1 in FY08. (Armada/EHB))

The UGS can be deployed by soldiers or robotic vehicles both inside and outside buildings to perform missions such as perimeter defence, surveillance, target acquisition and CBRN early warning.

Navigation

In May 2005 General Dynamics Robotic Systems, received from SAIC a $ 50.7 mil-

Powered by a turbojet engine and fitted with wings the Lam will have a cruise endurance of at least 45 minutes, enabling it to attack targets to a maximum range of about 200 km or loiter for about 30 minutes at a range of 70 km. (Lockheed Martin)

Boeing received the first delivery of Joint Tactical Radio System Cluster 1 radios produced for the FCS program in late December. The seven pre-engineering development model radios were produced by FCS team members BAE Systems and Rockwell Collins. (Boeing)

lion modification to its $ 186 million base contract for the FCS Autonomous Navigation System increasing its total value to approximately $ 237 million. The contract to develop the navigation system ground vehicles was awarded in December 2003 and the recent modification extends work from September 2009 to March 2013.

General Dynamics is responsible for the design, development, manufacture, integration and testing of a system that is capable of autonomously controlling the Mule, the Armed Reconnaissance Vehicle and the Manned Ground Vehicles. The new funding will cover additional Mule prototypes, development of the ARV and FCS Recovery and Maintenance Vehicle (FRMV) prototypes and will increase involvement in FCS Spin Out 3 to insert early technology capabilities into the field sooner.

Research in the robotics area benefits from additional Department of Defense funding. Last October General Dynamics Robotic Systems received a three-year funding extension from the US Army Research Laboratory, worth approximately $ 28 million, to continue its leadership of the Robotics Collaborative Technology Alliance (CTA) through FY09. Launched in 2001, the Robotics CTA is a consortium of academic, industrial and government partners focusing on the core autonomous systems capabilities that can be applied to the FCS ANS and projects such as the Mobile Detection and Response System. The company received an initial $ 42 million earmarked for robotics research, with an additional time and materials agreement that capped at $ 60 million for transitioning research products.

The Robotics CTA focuses on three key areas: perception technologies enabling robots to see and understand the environment, intelligent control architectures allowing autonomous planning and execution in tactical environments and human-machine interfaces capable of effectively tasking robots while minimising operator workload.

Survivability

Arguably the greatest challenge of the FCS project will be providing 20 to 24-tonne combat vehicles with a level of protection equal to that of the 70-tonne M1A2 or 35-tonne M2A3 Bradley IFV. The holistic approach to vehicle survivability being developed for FCS includes:

- ► a situational awareness capability that will enable US units to detect and identify an enemy before FCS units are at risk
- ► direct and indirect fire weapons with sufficient range to destroy the enemy before an FCS unit is detected
- ► signature reduction materials and coatings to reduce the risk of FCS vehicles being detected
- ► obscurants, jammers and signature reduction so the enemy cannot acquire the FCS
- ► active protection, jammers, decoys and obscurants to deflect enemy fire;
- ► armour systems – possibly including active, passive, reactive, electromagnetic and smart armour – to prevent the FCS being penetrated and
- ► protection measures including 'munitions response', 'shock response', fire suppression and personnel protection to ensure the survival of FCS crew members if a vehicle is penetrated.

Powerpack

In August 2005 the Detroit Diesel 5L890 engine was selected by General Dynamics to power the entire MGV family. Since 2003 the US Army Tank-Automotive and Armaments Command has been evaluating two 6V 890 engines ordered the previous year to determine the type's suitability. Detroit Diesel will deliver 47 engines through 2011 and provide test support through 2015. Detroit Diesel is a DaimlerChrysler company along with MTU, which developed the core engine on company funds. The manufacturers describe the High Power Density engine as being only half as heavy and half as big as other modern diesels with the same power output. MTU is developing a complete propulsion system based on the Series 890 engine for the German Army's Puma, which is significantly heavier than the planned weight of FCS vehicles.

The Detroit/MTU engine will be a version of the MTU Series 890 V6 yielding up to 750 bhp with a maximum torque of 1235 Nm at 4250 rpm for a dry weight of only 470 kg. (Armada/EHB)

Fort Bliss to Lead

Boeing and US Army officials opened the $ 35 million Systems of Systems Integration Laboratory (SoSIL) in Huntingdon Beach, California on 28 January 2005. The SoSIL is a 140,000-square-foot testing and simulation lab that allows technicians and soldiers to develop, test and evaluate the FCS network that connects vehicles and warfighters on the battlefield. The facility is able to link suppliers and subcontractors across the United States in real time. The first models of simulators for the 18-FCS component were delivered in 2005, allowing the first 'full up' integration test to begin in October. This will culminate in spring 2006 with a mission test allowing soldiers to evaluate the effectiveness of the FCS in a simulated battle.

Field testing moved a step closer when the army announced in December 2005 that the FCS Evaluation Brigade Combat Team will be formed at Fort Bliss, Texas. Fort Bliss was chosen because it is the Army's largest post with a 1.2-million-acre training area and because it is close to White Sands Missile Range and Biggs Army Airfield. These combined facilities provide a large area of unrestricted airspace.

The British Future Rapid Effects System

The Ahed during trials in June 2005

In mid-2005 British Ministry of Defence officials indicated that £ 14 billion would be spent on the Fres to enable the acquisition of between 3500 and 3775 medium weight armoured vehicles in a multi-phase production programme that could extend to 2030. Lieutenant Colonel Alistair Roxburgh, the SO1 for mounted close combat within the Ministry, suggested at IQPC's Light and Medium Armoured Vehicle conference that the choice will be between an off-the-shelf vehicle, a current development programme or a mix of the two.

Ian Kemp

The Army's need for a new armoured vehicle family is acute as three projects over the past 15 years – the Future Family of Light Armoured Vehicles, the Tactical Reconnaissance Armoured Combat Equipment Requirement (Tracer) and the Boxer – were cancelled or collapsed leaving elderly or inadequate vehicles such as the Combat Vehicle Reconnaissance (Tracked), FV 430 series and the 4 × 4 Saxon armoured personnel carrier to soldier on. The Fres Phase 1 is intended to replace the Saxon in service with mechanised infantry battalions by 2014. The service's FV430 series and the CVR(T) series will not be replaced until the Fres Phase 2 – sometime after 2020.

Under the Warrior Lethality Improvement Programme Technology the IFV is expected to be fitted with a new turret mounting the CTA International 40 mm Cased Telescoped Weapon System (CTWS). This weapon is likely to arm some Fres variants and also the French Army's projected Engin Blindé Médian medium armoured vehicle. (BAE Systems)

Within the Future Army Structure the British Army's operational brigades will consist of:

- Two heavy brigades equipped with Challenger 2 tanks, Warrior infantry fighting vehicles and the AS90 155 mm self-propelled howitzer. Variants of the Fres family will replace FV 430 specialist vehicles deployed within divisional and brigade headquarters and within the heavy battle groups. It will also replace the CVR (T) in the reconnaissance role. Under present plans the Fres vehicle will represent 56% of the armoured vehicle fleet within the heavy force
- Three medium brigades will be equipped primarily with Fres vehicles. However, as result of recent experience in Iraq the Army has decided that one Warrior battalion will be retained in each brigade to provide a heavier capability. The Fres vehicles will form 77% of the medium force
- 16 air assault brigades
- One light infantry brigade.

Early in the decade it was hoped that the Fres project could be implemented with a speed comparable to the best equipment projects of the Second World War. It was then hoped the first Fres variants would enter service in 2007 or 2008.

The Ministry's revised strategy was to hold a competition to select a systems house independent of the vehicle industry to evaluate the technical options and risks, and determine the best way forward. In November 2004 the engineering consultancy firm Atkins was awarded a 24-month contract to serve as the systems house for the Fres initial Assessment Phase, the broad aims of which are:

- To further define the Fres capability required within the developing medium-force and network-enabled operational concepts and develop a series of affordable options for meeting Fres requirements
- To develop optimum procurement and support strategies for future phases
- To manage technology and supplier risk to acceptable levels.

As a consequence of the protracted delay in developing a procurement strategy and also as a result of a more realistic assessment of the technical challenges the Fres in- service date has slipped to between 2012 and 2014. Some industry and service sources believe further slippage is likely. The revised Fres timetable has major implications for the Army's legacy fleet. With the out-of-service date of the FV430 fleet

BAE Systems received an £ 85 million contract in December 2005 to upgrade 500 FV430 series vehicles to extend their service life beyond 2020. Originally these were to be replaced by the Boxer Multi-Role Armoured Vehicle. Now they will be replaced by the Fres. (BAE Systems)

Before coming under the BAE Systems fold Alvis released this graphic rendition of the Fres vehicle. (Armada files)

extended from 2014 to beyond 2020 the DPA awarded BAE Systems Land Systems an £ 85 million contract in December 2005 to upgrade 500 vehicles. These will be returned to service from August 2006 until early 2009. The out-of-service date for the Challenger 2 and Warrior have been pushed from 2025 to 2035. Technology being developed for capability enhancements to these vehicles, such at the CTA International 40 mm Cased Telescoped Weapon System planned for the Warrior Lethality Improvement Programme, are expected to be incorporated into Fres.

Royal Air Force. Brigadier Lamont Kirkland, Director Land Warfare, said in January, that the Ministry's planning assumption is that a "small brigade headquarters and a medium battle group" could be moved by air in a period of seven to ten days. Once in theatre a Fres battle group is expected to deploy up to 500 km without resupply.

He noted that as a result of the American-led global war on terror the importance of physical protection has been elevated to the characteristic of strategic projection, which was the original purpose of the medium force.

The CTA International cased telescoped ammunition offers not only gun compactness but also better munition handling, as the projectile cases are shaped like beer cans. (Armada/JK)

Both the ministry and industry are hoping to 'pull through' some of the technologies developed for the Tracer. These include electric drive, electric armour and the CTA cannon. Atkins awarded the first two technology demonstrator programme contracts in May 2005 to Dstl to examine capacity and stowage and to Åkers Krutbruk to assess the value of a hard kill defensive aids suite (see Sep chapter).

On 31 August teams led by Lockheed Martin and Thales received an Electronic Architecture contract. The Electronic Architecture will integrate with the Bowman communication system and the Bowman Combat Infrastructure and Platform – Battlefield Information Systems Application programme, providing seamless com-

The Advanced Hybrid Electric Drive

In August 2005 General Dynamics UK was awarded the first of two technology demonstrator programme contracts to examine chassis technologies. During this 18 month period GD is using its 8 × 8 Advanced Hybrid Electric Drive (Ahed) chassis to provide a baseline for its work. The vehicle was presented at the British Army's Armour School at Bovington in June 2005. At that point the vehicle had already completed more than 4200 km of testing in America – another 4500 km of testing will be conducted under the technology demonstrator programme. Development of the Ahed began in 1999 to examine technology applicable to the US Army's FCS project. The vehicle is driven by eight Magnet Motor 20-inch, oil-cooled, in-hub permanent magnet motors each rated at 110 kW. Power is provided by a 500 hp MTU diesel with 350-kW generators mounted on the engine. Electrical power can be routed to any or all of the wheel motors or stored in lithium-ion batteries in the vehicle's belly. According to General Dynamics the Ahed provides 30% more internal volume than the company's 8 × 8 Stryker and a 70% reduction in external volume. At present the Ahed only carries 60 gallons of fuel, but this will be increased by an additional 80 gallons during the technology demonstrator programme. The independent suspension enables the vehicle's ground clearance to be raised or lowered from 13 to 58 cm in seven seconds while an articulated armoured skirt on either side of the vehicle bends when the wheels turn. Tracks may be placed around the front and rear pairs of wheels on each side to reduce ground pressure and improve mobility.

Although the exact Fres mix will be determined during the assessment phase variants are likely to include APC, IFV, direct-fire platform, command and control, communications, reconnaissance and surveillance, mortar, logistic support, medical and repair and recovery. The service has identified 17 roles and sub-roles although rationalisation is expected to see this number reduced.

The Ministry of Defence has always accepted that the heavier Fres variants could not be carried by the C-130 Hercules, therefore a more realistic target of transportability by the Airbus Military A400M has been set. Britain is buying 25 of these larger and more capable aircraft for the

While General Dynamics UK is demonstrating the potential to develop its 8 × 8 Ahed demonstrator to meet the Fres required under an 18-month programme, BAE Hägglunds is developing an 8 × 8 version of the Sep that will form part of its rival Chassis Concept TDP. (BAE Hägglunds)

munications with all combat, support and combat service support systems.

In early January 2006 Atkins awarded four technology demonstrator contracts to:

- BAE Systems to conduct a Chassis Concept technology demonstrator programme and a Gap Crossing technology demonstrator programme
- UK, teamed with Boeing, for an Integrated Survivability technology demonstrator programme
- Lockheed Martin UK, teamed with Insys, for an Electric Armour technology demonstrator programme.

In early February the Thales team asked expressions of interest from companies who have either conventional or innovative technologies that could enhance platform survivability. The survivability of Fres platforms will be assured by a combination of on-platform technologies, including defensive aids systems, armour and signature management, in combination with shared situational awareness and tactics, techniques and procedures – or doctrine. Ministry officials are hopeful that this layered approach will deliver a vehicle with better protection than the Warrior.

Although the completion of the iAP technology demonstrator programmes is scheduled for completion in mid-2007, Fres project leaders will conduct a preliminary fleet review in December 2006.

The advent of the Airbus Military A400M will simplify the work of vehicle designers and deploying forces alike. (Eads)

Fres Technology Demonstrator Programmes

Awards to Date

Title	Contractor
Stowage & Capacity	Dstl
Hard Kill Defensive Aid System	Åkers Krutbruk
Chassis Concept TDP 1	General Dynamics
Chassis Concept TDP 2	BAE Systems
Electronic Architecture TDP 1	Lockheed Martin
Electronic Architecture TDP 2	Thales
Electric Armour	Lockheed Martin/Insys
Integrated Survivability	Thales
Gap Crossing	BAE Systems

notes: TDP = Technology Demonstrator Programme

The Swedish Splitterskyddad Enhets Platform

Originally developed by Hägglunds the tracked Sep has been undergoing trials since 2002

In Sweden the Sep programme was started before the turn of the millennium by Hägglunds. The project is now handled by BAE Systems Land Systems Hägglunds for the Swedish Army through the Försvarets Materielverk (FMV). An Implementing Arrangement between the Swedish and British governments was signed in November 2003 on sharing Fres/Sep information and exchanging project personnel.

Ian Kemp

From 2010 the Swedish Army needs to replace several families of ageing vehicles: the Pbv 302 APC, Pbv 501 (BMP 1) IFV, the Pbv 401 (MTLB) APC,

Under present plans the first production Sep vehicles will be delivered to the Swedish Army in June 2011 and a full battle group will be operational by 2014. (Swedish Army)

the Lvrbv 701 air defence vehicle, the Pvrbv 551 anti-tank missile carrier, the Bv206 all-terrain vehicle and various wheeled logistics vehicles. Conceptual work on the replacement project began both within the army and Swedish industry in the early 1990s and progressed to a number of studies later that decade which examined the merits of wheeled versus tracked vehicles. Although the army preferred tracked vehicles it was decided both for operational and cost reasons to acquire a modular fleet of wheeled and tracked vehicles.

Sep Key Requirements

Flexibility
Tracks and wheels in the same concept
High load capability
C-130 air transportability
Low through-life costs
Network adaptation

The selected B13 design concept from Hägglunds involves three modules: a tracked or wheeled chassis, a crew module and a mission module. To achieve modularity all vital vehicle systems are located in the front of the vehicle where there is also room for a two-person crew, sponsons are used to house the automotive subsystems, and located behind the crew compartment is space for a drop-in mission module that is identical for both wheeled and tracked variants.

Present plans call for APC, logistics, command and control, ambulance, repair, recovery, radio link and Arthur radar vehicles to be produced in Series 1. The next series would include Amos mortar, reconnaissance and surveillance, anti-tank and electronic warfare variants to enter service in 2013. Later in the decade Series 3 vehicles would include heavy APC, air defence, CBRN defence, mine clearance, mine laying and other variants.

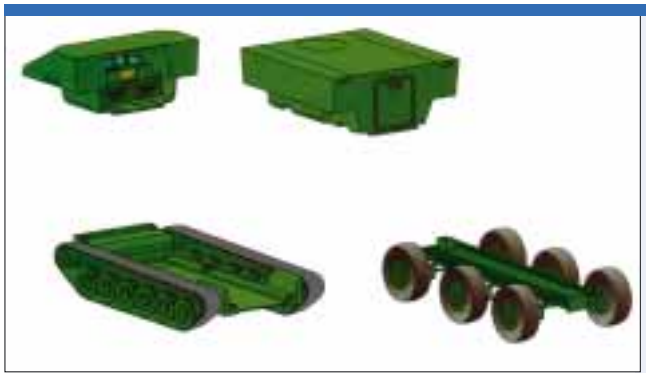
The vehicle's high hardness steel hull is designed to offer shell fragment and small arms protection enhanceable using a three-level modular protection system developed by IBD of Germany. The first level provides protection against 14.5 mm armour-piercing attack through a 360° arc and protection against blast mines. The second is intended to defeat 14.5 mm armour-piercing and rocket-propelled grenades through a 360° arc and improves the mine protection to defeat anti-tank explosively-formed penetrator mines. The third level is expected to also defeat medium-calibre armour piercing, fin stabilised, discarding sabot ammunition across the frontal arc.

The FMV has collaborated with Germany's BWB defence procurement agency in the Vetec (Vetronic Architecture Integration Project) project and a prototype installation developed by Hägglunds and Diehl of Germany was successfully tested in the first tracked Sep prototype. According to Hägglunds the Vetec architecture is based on an open scalable, fault-tolerant databus which manages all the on-board systems and crew interfaces including the weapons systems, battlefield management, defensive aids suite, built-in test system, digital radio communications and other mission- or role-specific systems.

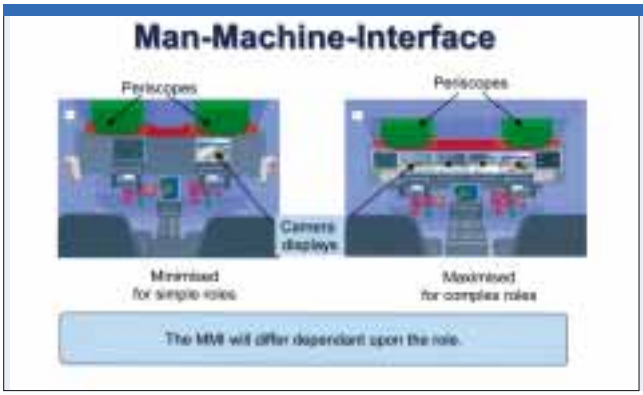
For combat or other complex roles, up to six flat-panel displays in the crew module can show images from cameras covering the front, sides and rear of the vehicle while three computer screens display digital information from the vehicle's systems, other vehicles and headquarters. For simpler roles this could be limited to two flat-panel monitors and a computer screen.

The first Sep-Tracked prototype was delivered to the Swedish Defence Material Administration in 2002 and was joined in 2004 by the first wheeled variant (W1). This is a 6 × 6 with an electric transmission and electric motors in the wheel hubs, which began 2000 km of endurance testing early this year. Hägglunds formally handed over the second tracked prototype (T2) on 22 November 2005 at the cmpany's Ornskoldsvik facility. The company's managing director, Sven Kagevall, cited three essential improvements incorporated in T2: a new-generation electric drive that improves the steering qualities, improved signature management and the replaceable role module. Prototype T2, like W1,

The basic platform weight is 9.5 tonnes allowing a further eight tonnes for the mission module, personnel and protection. Inside the mission module there will be 7.33 metres³ of volume and a further 2.53 metres³ in the sponsons on either side of the module. Both the wheeled and tracked variants fit inside a C-130. (BAE Hägglunds)



The FMV has analysed no fewer than 24 different role modules that can be indifferently mounted on either chassis. (BAE Hägglunds)



The Sep's modular electronic architecture allows the displays in the twin-crew module to be configured for a specific role. (FMV)

incorporates an electric transmission coupled to Magnetic Systems Technology permanent magnetic motors, and also features band tracks from Soucy that are lighter, quieter and have a longer operational life than steel tracks. T2 is undergoing 2000 km of endurance testing.

Continuing studies are focused on a single engine concept, a Y-drive system and advanced armour. Lindström disclosed at IQPC's Light and Medium Armoured Vehicle conference that BAE Systems is developing an 8 × 8 Sep prototype with Y-drive as a private venture. The rollout is scheduled to take place in Sweden on 29 December 2006, after which the chassis will be shipped to Britain to marry up with an APC role module built by BAE Systems. The module will have the same dimensions as for the tracked and 6 × 6 chassis but the larger 8 × 8 chassis, will allow the vehicle's total weight to be increased to 26 tonnes. The performance of this 8 × 8 chassis in comparison with the Ahed chassis will be closely examined.

Åkers Krutbruk is developing a sensor-activated protection system to detect and defeat incoming shaped-charge and kinetic energy threats before they can impact the vehicle. A prototype system, weighing about 500 kg, has been installed on a CV 90 for trails and work is underway on integration into the Sep.

FMV expects to sign a contract with Hägglunds by the time these lines are printed (April) for Sep Development 1A. This will cover the development of two tracked and two wheeled chassis, three mission modules, a load-handling system for a cargo variant and four weapon stations. These prototypes are scheduled to begin extensive trials from 2008. Under present plans the first production vehicles will be delivered on 30 June 2011. The Swedish government has pledged to a have a battle group equipped with 128 vehicles available for European Union military operations by 2014.

A C-130 will be able to carry one wheeled or tracked Sep vehicle while the A400M will be able to carry two. An 8 × 8 chassis is planned to be rolled out in December. (FMV)

The French Bulle Opérationnelle Aéroterrestre

The Felin soldier will be the first modern component of the Boa

France has provisionally determined the shape of its 'Army 2025'. The service will retain its two armoured brigades at the heavy end of the spectrum and its airborne and army aviation brigades at the light end. In the middle its two mechanised and light armoured brigades will be standardised as four light armoured brigades.

Eric H. Biass and Ian Kemp

How this army will operate will be determined by the Bulle Opérationnelle Aéroterrestre (air-land operational bubble) networked air-land warfare concept.

The Délégation Générale Pour L'Armement (DGA) awarded a Thales-led team a € 129 million contract on 8 December 2005 to develop a Boa concept demonstrator over the period between 2006 and 2012. The team has two layers, with Thales, Sagem and Giat at the top and mainly MBDA and other Thales concerns beneath. The contract had been expected; Defence Minister Michèle Alliot-Marie announced at Eurosatory in June 2004 the government's intention to award the contract and the industry consortium was formed prior to the exhibition.

The contract covers three primary components:

▶ The establishment of France's first integrated battlelab, Laboratoire Technico-Opérationnel, a collaborative devel-

This study shows that a wheeled EB2X is also being considered. It features hybrid propulsion and a remotely operated turret. (Giat)

opment tool that will be used by the DGA, industry and the French Army to analyse the latter's future missions

► A system of systems engineering study to identify advanced architectures and technologies for the army's future armoured fighting vehicles and other systems such as unmanned ground and unmanned air vehicles

► The design and development of the Tactic (Technologies et Architectures du Combat aéroTerrestre Info-valorisé au Contact) network-enabled architecture and technology demonstrator.

The Boa will integrate equipment now in service, such as the Leclerc tank, equipment soon to enter service, such as the Eurocopter Tiger helicopter, and equipment expected to be fielded in 2020.

Felin

Building from the soldier up the army will soon introduce the first version of the Felin integrated soldier system. Sagem is the prime contractor for the € 796 million project to deliver 31,600 Felin sets to equip 20 infantry regiments and support armoured cavalry, artillery and engineer units. In June 2006 Sagem is scheduled to deliver 358 Felin V1 sets to equip two infantry companies for evaluation and trials. Delivery of production sets is set to begin in mid-2007 with the goal of equipping two-thirds of the infantry by the end of 2008. In approximately 2015 the army will begin fielding an improved Felin V2 that will be fully integrated into the service's Boa network-enabled warfare concept. This includes a miniature Bertin-based, electrically powered ducted fan drone (see cover picture). Called the Odin; now undergoing tests.

The Felin schedule mirrors the army's two-phase transition. In the period between 2005 and 2015 the service will concentrate primarily on upgrade projects. Work is already underway on upgrading 256 AMX 10RC reconnaissance vehicles, 160 ERC 90 armoured cars and a portion of the 3900-strong VAB armoured personnel carrier fleet. From about 2010 upgrade work will begin on the Leclerc tank. The service's only significant fighting vehicle acquisition project in this period is the Giat 8 × 8 VBCI. Giat is scheduled to deliver the first production VBCI in 2008.

Oddly enough no real photo of the electric propulsion DPE demonstrator is available, yet the vehicle was delivered by Giat to the DGA in December 2005. (Giat)

The Army has ordered 550 infantry fighting vehicles (designated the Véhicule de Combat d'Infanterie), 150 command vehicles (Véhicule Poste de Commandement) and is planning specialist variants including anti-tank, mortar, engineer and mobile gun systems. The fielding of the VBCI and Felin V1 will be conducted in parallel providing the first elements of the army's future networked capability. France will also field the Eurocopter Tiger Helicoptère d'Appui Protection in this period.

EB2X

In the 2015 to 2025 timeframe France will give priority to new vehicles to replace the AMX-10RC and Vab used by the medium brigades, as well as the ERC 90, Vabs and VBLs in service with light forces. The Engin Blindé Médian/Contact (EBM/C) is planned to replace the AMX 10RC from 2015. Under the designation EB2X, Giat has undertaken concept work for the DGA over the past several years. Initial studies examined a 6 × 6 16-tonne vehicle armed with the 40 mm Case Telescoped Weapon System and a 24-tonne 8 × 8 armed with a 105 mm electro-thermal chemical gun in a two-person turret. These designs have morphed into the 25-tonne (maximum) 6 × 6 EBM/C armed with a 40 mm CTWS, missile pods and an active protection system. The army tentatively plans to complete project definition in 2007 and begin a development programme that could lead to production in 2015.

Projected to enter service in 2020 to replace 1000 Vabs is the EBM/P; this is projected to weigh 20 tonnes and carry five personnel or up to two tonnes of cargo.

MBDA is working on a common missile core, the MCT, for ground- and air-launch applications. (Armada/EHB)

While the most important characteristics of the EBM/C will be protection and lethality the key characteristics of the EBM/P will be modularity and payload. To replace 160 ERC 90s the army wants a ten-tonne vehicle, named Brams, that could carry five personnel or up to two tonnes of cargo.

During this second modernisation period the army expects to field the more capable Felin V2 ensemble and the Tiger Hélicoptère Appui Destruction variant. The army plans a new short-range missile to replace the AT4CS and Eryx, a new medium-range missile to replace the Milan 3 and a new long-range missile to replace the Hot. Thus by 2025 the French Army hopes to have modernised its light, medium and heavy forces that will be fully networked to work across the spectrum of conflict both on national and multi-national joint operations. ◘

Wheels or tracks? Maybe both. This EB2X model features, inter alia, a hybrid powerplant (red generator at the back), a drone launcher, an active self-protection sensor atop the turret and a robot exiting via a rear-mounted ramp. (Armada/EHB)