GROUND COMBAT SYSTEMS

Program Executive Office Ground Combat Systems (PEO GCS) manages the development, systems integration, acquisition, testing, fielding, modernization and sustainment of the U.S. Army's ground combat systems to provide world-class, affordable and relevant capabilities to soldiers and marines. Systems include the Abrams main battle tank, Bradley Family of Vehicles (FoV), self-propelled howitzers, Armored Knight FoV, M113 armored personnel carrier, M88 HERCULES, armored multipurpose vehicle, Stryker FoV, ground combat vehicle, robotics and unmanned ground systems. PEO GCS operates with a multibillion-dollar annual budget and retains more than 1,200 military and civilian employees, including three board-selected Army project managers and one U.S. Marine Corps joint project manager.

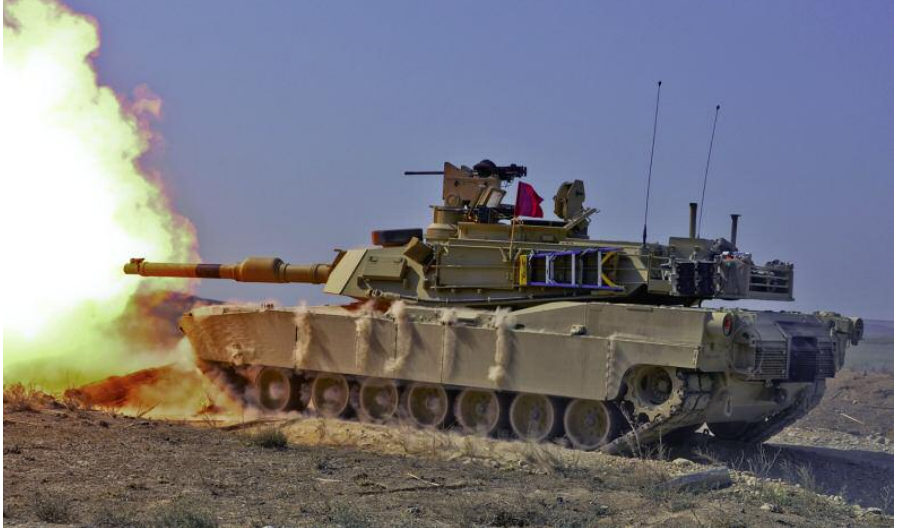
Project Manager Armored Brigade Combat Team (PM ABCT)

The PM ABCT serves as the life-cycle manager for the Army's armored combat vehicle programs, including the Abrams tank, M88 HERCULES, Bradley fighting vehicle, M113 armored personnel carrier, Paladin, field artillery ammunition supply vehicle (FAASV), Armored Knight FoV and the armored multipurpose vehicle.

Product Manager Abrams

The **Abrams Tank** provides soldiers with the mobility, firepower and shock effect to successfully close in and destroy enemy forces on the complex, integrated battlefield. It is the only weapon system that can withstand the impact of high-energy warheads and remain lethal in full spectrum operations. The 120 mm main gun on the M1A1 Situational Awareness (SA) and M1A2 SEPv2, combined with the powerful 1,500-hp turbine engine and special armor, make the Abrams tank suitable for attacking or defending against large concentrations of heavy armor forces on a highly lethal battlefield and for roles that require shock effect, wide-area surveillance, combined arms maneuver, and mobile direct firepower to support Army mission requirements.

While every vehicle is designed to have a space, weight and power (SWaP) margin for incremental improvements, recent upgrades made to the Abrams M1A2 SEPv2 have left little margin for future improvements. To alleviate these SWaP constraints, the Army launched the **Abrams engineering change proposal (ECP) 1 program**, which is designed to buy back SWaP by redesigning and modernizing many elements of the tank. This program is a modification to the system that leaves the essential capability unchanged. The Abrams ECP1 program will help ensure that the Army can



M1A2 SEPv2 Abrams Tank

seamlessly incorporate future upgrades into the Abrams without degrading operational performance.

The centerpiece of the ECP1 upgrade will be to restore lost power margin through the integration of a larger generator, improved slip ring, battery management system, and a new power generation and distribution system. The modified slip ring on the turret will provide the ability to transmit larger amounts of data into the turret, in addition to providing more power. Overall, these efforts will improve protection, sustainment and power generation for the vehicle.

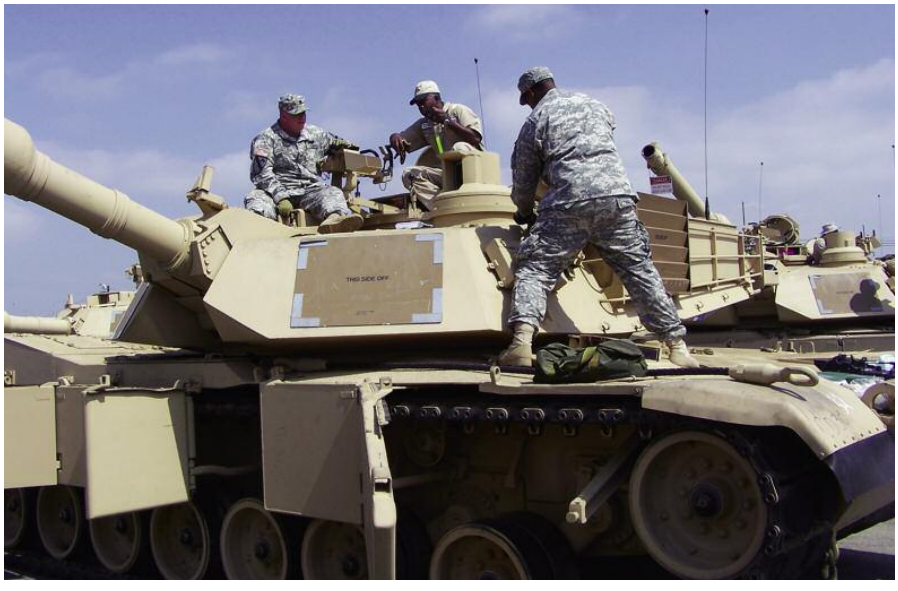
The ECP1 upgrade will ready the tank to accept the Army network components in the short term, while building the necessary margin to accept future capabilities in the decades to come. The communications package will integrate the joint tactical radio system (JTRS)-handheld, manpack, and small form-fit (HMS) into the Abrams, replacing the single-channel ground and airborne radio system (SINCGARS). To address these network requirements, the Abrams will integrate a gigabit Ethernet data bus to allow greater data processing and transmission.

While the Abrams remains the dominant vehicle on the battlefield, the ECP1 program will make it more formidable by including a new armor package for increased protection, an ammunition data link connecting the fire control system to the main gun, and an auxiliary power unit (APU) designed for use in mounted surveillance operations. It also will replace line-replaceable units with line-replaceable modules, improving the onboard electronics and commander's display. This electronic upgrade will mitigate impending obsolescence issues and provide the ability to quickly diagnose and replace card level failures. In addition, an updated version of the counter-remote-control improvised explosive device electronic warfare (CREW) system will be incorporated during the recapitalization process.

The **Abrams Integrated Management (AIM) Configuration Process** is used for recapitalization of the tank fleet. Under AIM, tanks are completely disassembled and many of the components are refurbished at the Anniston Army Depot, Ala. The assemblies are then shipped to the Joint Systems Manufacturing Center (JSMC) in Ohio, where General Dynamics Land Systems reassembles the tanks to a zero-time/zero-miles standard. AIM also serves as the venue to apply modifications and upgrades like embedded diagnostics, improved line-replaceable units, and redesigned hull and turret network boxes in conjunction with the recapitalization program. Upgraded, digitized M1A2 SEPv2 tanks are planned for production through December 2014. The M1A1 upgrade program produced its last vehicle in July 2011. Fielding of the M1A1 SA tanks will continue through the summer of 2014.

The **Abrams M1A2 SEPv2 (System Enhancement Program)** has a digital command-and-control system that provides situational awareness updates to other tanks within the unit. Vetronics architecture ties all electronic components in the tank together and provides increased survivability and supportability. The commander's independent thermal viewer (CITV) provides a hunter-killer capacity, allowing the M1A2 SEPv2 to engage one target while simultaneously tracking another. Improved onboard diagnostics allow the tank to self-diagnose faults without any additional special tools or equipment. The M1A2 SEPv2 also has integrated C4ISR capabilities, which incorporate Force XXI Battle Command Brigade and Below (FBCB2) to provide real-time command and control and situational awareness. The sights use a second-generation forward-looking infrared (FLIR) thermal-imaging system for increased lethality and survivability. The SEPv2 package also includes a computerized mass-memory unit and color maps and displays. A thermal management system increases electronic reliability and decreases crew fatigue.

The **Abrams M1A1 SA** includes the gunner's primary sight, with second-generation FLIR technology and the stabilized commander's weapons station (SCWS). Other technologies include Blue Force Tracker (BFT)—a digital command-and-control system that gives commanders information about their location relative to friendly forces—and the power-train improvement and optimization program (total integrated engine revitalization and improved transmission), which provides more survivability and durability. Survivability technologies include frontal armor and turret side armor upgrades.



Abrams tank undergoing ECP1 upgrade

Product Manager Bradley/Armored Knight

Product Manager Bradley/Armored Knight manages approximately 6,452 M2/M3 A2, M2/M3 A2 Operation Desert Storm (ODS), and M2/M3 A3, as well as 334 M7A3 Bradley fire support team (BFIST) vehicles and 465 M707/M1200 Knight FoV.

The **Bradley M2A3 Infantry/M3A3 Cavalry Fighting Vehicle (IFV/CFV)** facilitates enhanced command-and-control capabilities, provides mobile protected transport of infantry to critical points on the battlefield, and performs cavalry scout and other essential missions. Upgrades in this program include advanced technology in the areas of command and control, lethality, survivability, mobility, and sustainability required to defeat current and future threat forces while remaining operationally compatible with the main battle tank. The M2/M3 vehicle armament includes the 25 mm M242 Bushmaster cannon, the TOW II missile system and a 7.62 mm M240C machine gun.

The M2/M3 A3 provides overwatching fires to support dismounted infantry and to suppress and defeat enemy tanks, reconnaissance vehicles, IFVs, armored personnel carriers, bunkers, dismounted infantry and attack helicopters. The IFV version (M2) of the A3 Bradley fighting vehicle is used most often to close with the enemy by means of fire and maneuver. The primary tasks performed by the CFV version (M3) as part of a troop and/or squadron are reconnaissance, security and guard missions.

The A3 is a digitized platform with core electronics architecture and an improved target acquisition system that includes a full ballistic fire-control package with hunter-killer functionality via a commander's in-

dependent viewer. Optical improvements include two second-generation FLIRs and day television cameras, which display information to the soldiers in the back of the vehicle and significantly improve the real-time situational awareness for the entire dismounted or mounted crew.

The A3 integrated command-and-control package incorporates the Army's digital command-and-control suite of automated messages, overlays and friend-or-foe graphics that meet the Army's objectives for a fully digitized force. This same digital command-and-control capability was incorporated into the A2 Operation Desert Storm.

The A3 variants reflect the latest iterations of a fighting vehicle family that includes the Bradley M2/M3 A0, A1, A2, A2 ODS, BFIST vehicles and M2A2 ODS engineer vehicles.

M3A3 Bradley Fighting Vehicles

The Bradley Operation Desert Storm-Situational Awareness (ODS-SA) M2/M3 A2 conversion implements a digital architecture to mitigate obsolescence and provide commonality. The M2/M3 A2 ODS-SA system consists of a modified A2 ODS turret and chassis. The A2 ODS-SA electronic architecture is based on a dual redundant serial data bus. All major turret system units are linked through this bus for signal and data transfer.

The A2 ODS-SA systems have the improved Bradley acquisition subsystem (IBAS) for the gunner that replaces the Bradley eye-safe laser rangefinder integrated sight unit in the A2 ODS. The sight has a day television and a FLIR channel, both with narrow and wide fields of view. The sight images are displayed as video images to the gunner and commander on cathode ray tube-based biocular virtual image displays. The IBAS also has a gunner's monocular direct-view optics port for the day view channel and a laser rangefinder for target ranging. The line of sight is inertially stabilized. The M7 BFIST SA (M7 SA) vehicle is the FIST version of the Bradley ODS-SA and was first unit equipped to the 81st Brigade Combat Team, Washington National Guard, in October 2010.

To ensure the vehicle can enable the Army's network investment and incorporate other Army programs of record without further degrading operational performance, basic improvements will be made in two iterations as part of the upcoming **Bradley ECP program**. ECP1 is designed to address the weight growth of the vehicle and includes four capabilities: extended

life; heavyweight track designed to handle larger vehicle weights; heavy weight torsion bars, which will restore ground clearance lost to increased weight, improving cross-country mobility and underbelly blast protection; and improved durability road arms and shock absorbers, designed to reduce operating costs and maintenance intervals at increased vehicle weights. ECP2 is focused on meeting electric-power generation and computing requirements for network systems.

The **M7A3 Bradley Fire Support Team (BFIST)** program is executing to the Army Campaign Plan and completed modularization of the force in fiscal year (FY) 2012 with 255 A3 BFIST vehicles and 79 M7 BFIST SA vehicles. BFIST vehicles are required to conduct various mission scenarios including reconnaissance and surveillance, reporting of enemy activity in the area of operations, reporting of hazards and obstacles to movement, and the coordination of indirect-fire support. Both versions have equivalent mobility, survivability, signature and night-vision capability, and they use common repair parts with the maneuver force they support. Target designation for all available laser-guided munitions is required, including those delivered by mortars and airborne platforms.

The **M7 SA BFIST** is one of the two models that replaced all M981 (FISTV). The M7 SA integrates both existing and improved FIST mission equipment packages (MEP) onto an M3A3 chassis. Features incorporated from the M3A3 chassis include the 25 mm gun, 7.62 mm coaxial machine gun, precision lightweight defense advanced global positioning system (GPS) receiver (DAGR) and the Bradley eye-safe laser rangefinder. The current M7 SA BFIST uses the stand-alone computer unit, the ruggedized handheld computer (stowed) and the forward observer system, with full interoperability with advanced field artillery tactical data system fire support networks. The inertial navigation system provides navigational capability based on a blended inertial/GPS solution.

The second model that replaced the M981 (FISTV) is the **A3 BFIST**. It incorporates the FIST MEP with a digitized M3A3 chassis. Features incorporated from the M3A3 chassis include the commander's independent viewer with 360-degree traverse and the IBAS, both second-generation FLIRs, to improve target acquisition and engagement; the 25 mm gun; the 7.62 mm coaxial machine gun; DAGR; and digital command-and-control enhancements. The first unit equipped for the M3A3 BFIST was the 4th Infantry Division in 2003.

The Fire Support Sensor System (FS3) is being integrated into both BFIST configurations. The FS3 is composed of two subassemblies: the long-range advanced scout surveillance system (LRAS3) and the laser designator module (LDM), which will soon be replaced by the diode-pumped laser designator module (DLDM). When the LRAS3 and LDM are integrated into the BFIST vehicle, it becomes known as the FS3.

LRAS3 provides twice the amount of target detection over the IBAS, while targeting and designating under armor from the gunner's position. This capability meets the 2004 heavy/light ordnance objective. The BFIST with FS3 will allow the fire support team to detect, identify and designate targets for precision munitions at greater ranges while remaining protected by the vehicle's armor. The new ranges meet the requirements and allow for laser-guided smart munitions, laser-guided bombs, and missiles for rotary- and fixed-wing aircraft. The first unit equipped with the A3 BFIST with FS3 was the 1st Brigade Combat Team, 2nd Infantry Division, in August 2011.

M1200 Armored Knight

The **M1200 Armored Knight** is fielded to combat observation lasing teams in armored brigade combat teams (ABCTs), infantry brigade combat teams (IBCTs), Stryker brigade combat teams (SBCTs) and battlefield surveillance brigades as well as FISTs in IBCTs. M1200s are used to perform terrain surveillance and target acquisition and provide precise day-and-night far-target location capability in support of fire-support missions.

The MEP of the Knight family of vehicles—including the M1200 Armored Knight and its predecessor, the M707 Knight—consists of an FS3 laser designator, rangefinder and thermal imager, a digital command-and-control system that includes a blended inertial/GPS navigation and targeting capability, and a self-defense weapon. First fielded in 2008 after successfully integrating the MEP onto a modified armored security vehicle (ASV) chassis, the M1200 Armored Knight's precision targeting system provides computational capability for very precise self-location and far-target location and laser designation capability for using conventional ordnance, laser-guided munitions, and precision-guided projectiles such as Excalibur.

The 465th and final M1200 Armored Knight was produced in the second quarter of FY 2013, and almost all have been fielded or are scheduled to be fielded. In addition, 154 of these M1200s have returned from Iraq and Afghanistan and have gone through reset. Block I and Block II modification work order installations are scheduled for FY 2014, and these modifications will ensure a pure M1200 fleet and ensure the commonality of all M1200 Armored Knights into sustainment.

Product Manager Armored Multi-Purpose Vehicle (AMPV)

In 2007, the Army terminated the M113 armored personnel carrier program, citing inadequate force protection, the inability to incorporate future technologies, and the inbound Army network because of space, weight, power and cooling.

The **armored multipurpose vehicle (AMPV)** program was created to replace approximately 3,000 M113-series platforms in the Army's ABCTs—approximately one-third of the entire ABCT fleet. AMPV is primarily a vehicle integration program, not a developmental program. It will incorporate existing M113 MEPs into already established platforms.

AMPV must be affordable and based on proven technical solutions with a high degree of commonality with existing ABCT systems. Force protection, mobility and power requirements continue to be critical performance drivers for the program.

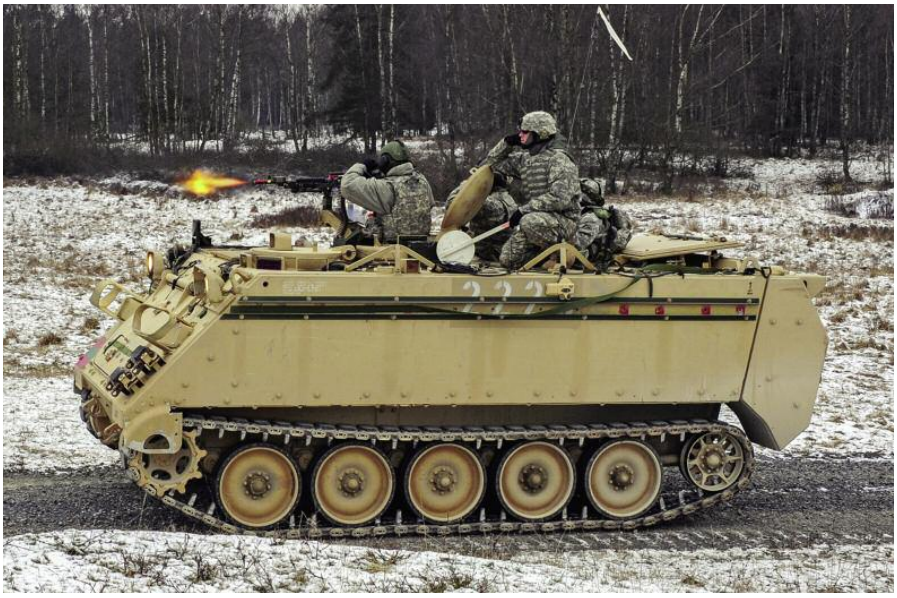
AMPV will replace the M113 in five mission roles: general purpose, Mission Com-

mand, mortar carrier, medical evacuation and medical treatment.

Product Director Mounted Maneuver Support Systems

The **M113 FoV** provides a highly mobile, survivable and reliable tracked-vehicle platform that, with upgrades, is able to keep pace with Abrams- and Bradley-equipped units and is adaptable to a wide range of current and future battlefield tasks through the integration of specialized mission modules. Although not presently in production, the more than 10,000 M113 FoV systems in Army vehicle inventories constitute a significant percentage of present and future heavy division assets.

The latest A3 models provide various derivatives within the FoV, with major performance improvements in mobility, reliability and survivability through installation of a 275-hp 6V53T engine with an X-200-4A transmission. Coupled with reconfiguration of the driver's station and several other vehicle subsystems, these improvements provide battlefield mobility commensurate with the supported Abrams/Bradley maneuver force and permit a range of enhanced survivability options.



M113A2 armored vehicle

The **M88A2 Heavy Equipment Recovery Combat Utility Lift and Evacuation System (HERCULES)** is a fully tracked, heavy-armored vehicle developed to accomplish safe, effective and independent battlefield recovery operations. It implements swift and effective combat evacuations through the battlefield recovery operations of towing, winching and lifting. HERCULES is the primary recovery support for the 70-ton M1 Abrams tank, the Wolverine and other heavy combat vehicles.

The M88A2 includes a 1,050-hp engine; a 35-ton boom; overlay armor; a 140,000-pound, single-line, constant-pull main winch; and a 3-ton auxiliary winch for deploying the main winch cable. When compared with the M88A1, these upgrades improve towing power by 25 percent, lifting capability by 40 percent and winching abil-

ity by 55 percent. The system is in full-rate production and deployment. Fielding began in July 1997.

Product Manager Self-Propelled Howitzer Systems

Product Manager Self-Propelled Howitzer Systems manages approximately 1,168 platforms including the M109A6 Paladin, M992A2 field artillery ammunition supply vehicle (FAASV) and Paladin/FAASV integrated management (PIM) vehicles, which consist of the self-propelled howitzer and carrier ammunition tracked vehicles.

The **M109A6 Paladin** 155 mm self-propelled howitzer provides the primary indirect-fire support to modular ABCTs. Like the earlier M109 models, the M109A6 Paladin is a fully tracked, armored vehicle. The enhanced Paladin configuration is achieved through extensive modifications to existing M109A2/A3 vehicle hulls and the subsequent introduction of an entirely new turret structure.

The Paladin includes an onboard Paladin digital fire-control system (PDFCS), a vehicle location/navigation system, secure radio communications systems, an improved M284 cannon and M182A1 gun mount, automotive improvements, improved ballistic and nuclear-biological-chemical protection, driver's night-vision capability, and built-in test equipment. Additional chassis upgrades include a remotely actuated travel lock (for quicker site occupation and displacement), larger torsion bars (to help support the additional weight) and a low-heat rejection engine with an improved cooling system. The Paladin has improved responsiveness, survivability, lethality and reliability compared with the earlier M109s.

A parallel U.S. Army recapitalization effort was seen in the **M992A2 Field Artillery Ammunition Support Vehicle (FAASV)**. The basic M992A0 FAASV emerged from an industry research and development project designed to provide self-propelled field artillery units with a ballistically protected vehicle capable of performing critical resupply and support functions. The FAASV system was type-classified and entered production in 1983. Based on an M109 howitzer chassis that provided the resupply asset with mobility and survivability characteristics commensurate with the supported cannon element, the system is paired on a one-for-one basis with the Army's M109A6 Paladin self-propelled howitzer.

The **Paladin/FAASV Integrated Management (PIM)** program is a modernization program engineered to improve readiness, force protection and survivability, and to increase sustainability of the M109A6 Paladin and the M992A2 FAASV platforms through 2050. PIM will leverage fleet commonality for vital components including the Bradley engine, transmission, final drives and suspension. PIM uses the existing M109A6 main armament and recently designed chassis structure, while replacing outmoded chassis components with advanced components from the Bradley fighting vehicle, to increase sustainability and commonality across the ABCT. PIM also incorporates select technologies from the non-line-of-sight cannon, including a (modified electric) projectile rammer and modern electric-gun drive systems to replace the current hydraulically operated elevation and azimuth drives that were designed in the early 1960s.

The M109 FoV platforms will be fitted with BFT capability to ensure interoperability with other platforms. These upgrades and better communications technology will significantly improve situational awareness on the battlefield and reduce the logistics footprint within the ABCT. The new electric-gun drives and rammer components, as well as a microclimate air conditioning system, will be powered by the common modular power system (CMPS), utilizing a 600-volt onboard electrical system. Once delivered to the field, the PIM vehicles will give ABCT commanders a more capable and sustainable vehicle, providing them with increased confidence in their artillery fleet.

Project Manager Stryker Brigade Combat Team

The **Project Manager Stryker Brigade Combat Team (PM SBCT)** develops, produces and sustains the full range of safe, reliable, supportable and effective Stryker vehicle systems—a diverse fleet of medium-weight vehicles capable of being rapidly deployed to trouble spots around the world.

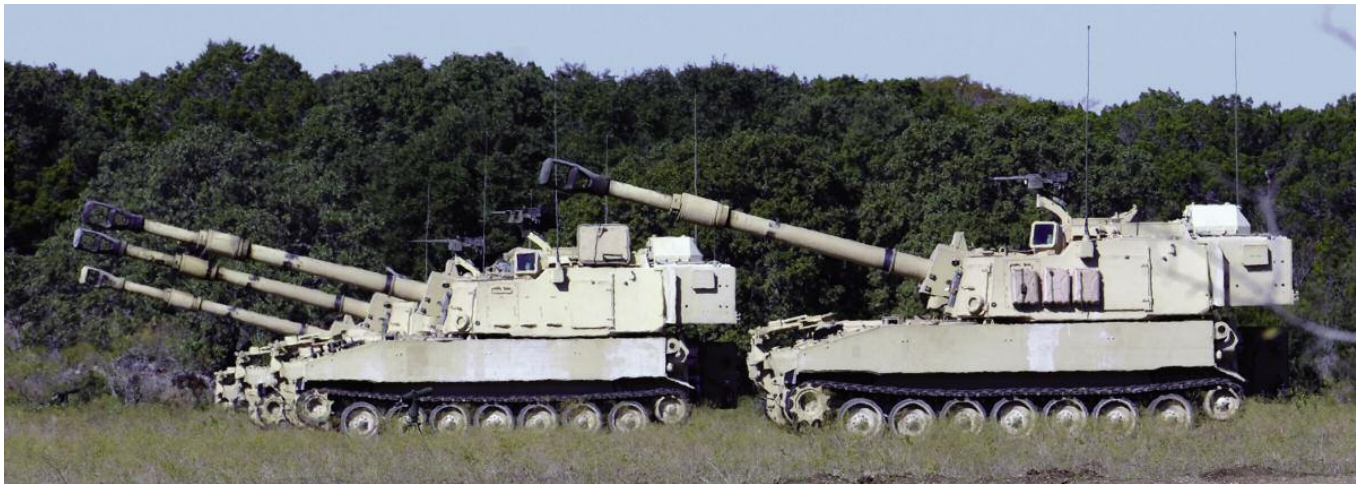
The **Stryker Family of Vehicles (FoV)** consists of 10 unique mission equipment packages incorporated into the eight-wheeled, common combat vehicle platform configurations.

The Army's responsibility to satisfy 21st-century requirements for effective full spectrum operations required an improved capability for the rapid deployment of highly integrated combined arms forces, possessing overmatch capabilities, exploiting the power of information and human potential, and combining the advantages of both light and mechanized forces across the full range of military and nonmilitary operations. As a result, the Army invested in the Stryker FoV.

In 2000, the Stryker became the first new combat vehicle to be acquired by the Army in more than 20 years. Its procurement emerged following the challenge presented in 1999 by then-U.S. Army Chief of Staff GEN Eric K. Shinseki: "We must provide early entry forces that can operate jointly without access to fixed forward bases, but we still need the power to slug it out and win decisively."

Strykers have accumulated more than 30 million combat miles in Operation Enduring Freedom and Operation Iraqi Freedom. There are 17 Stryker variants.

In March 2010, the Stryker underwent a game-changing transformation when the Army took lessons learned from theater and incorporated an improved hull design

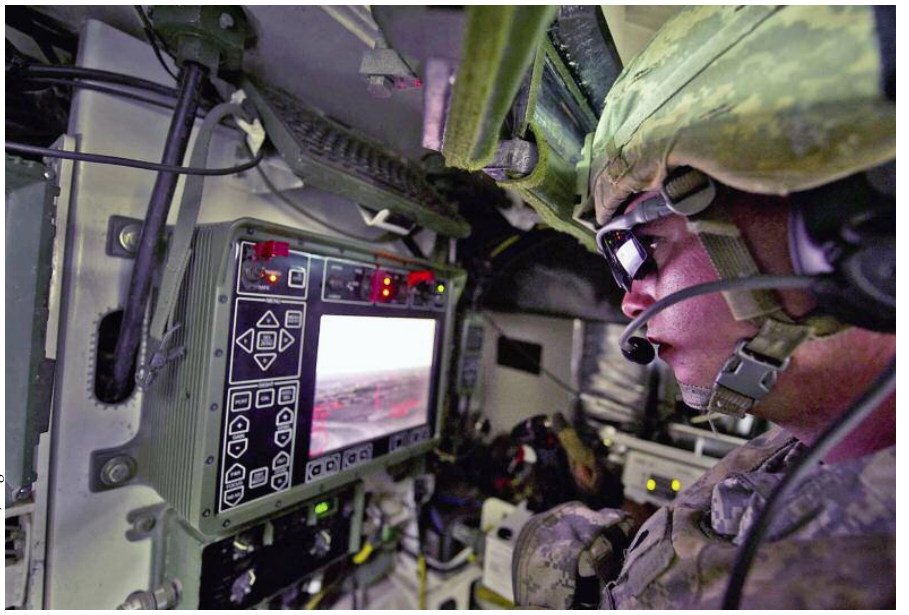


M109A6 Paladins

to protect soldiers from improvised explosive devices (IEDs) and roadside mines. These production vehicles were delivered in January 2011.

This new underbody design, known as a **double-V hull (DVH)**, was based on proven technology similar to that found on MRAP vehicles, which deflect blasts away from the vehicle and the soldiers inside. This rapid engineering effort went from conception to production in less than one year and debuted in Afghanistan in early summer 2011.

The M1126 infantry carrier vehicle (ICV) is a troop transport vehicle capable of carrying nine infantry soldiers and their equipment and requires a crew of two—a driver and a vehicle commander. The ICV is armed with a remote weapons station that supports the M2 .50-caliber machine gun or the Mk 19 automatic grenade launcher, the M6 countermeasure device (smoke grenade launcher) and an integrated thermal weapon sight. The other nine flat-bottom variants consist of the M1130 commander's vehicle, the M1127 reconnaissance vehicle (RV), the M1131 A1 fire support vehicle, the M1129 A1 mounted mortar carrier, the M1134 antitank guided missile vehicle, the M1132 engineer squad vehicle, the M1133 medical evacuation vehicle and the M1135 nuclear-biological-chemical reconnaissance vehicle. The M1128 mobile gun system is based on the ICV but modified to incorporate a 105 mm turreted gun, an autoloader system and a crew of three.



U.S. Air Force/TSgt. Michael R. Holzworth

Fire-control system inside an M1126 Stryker infantry carrier vehicle

The addition of the DVH provides improved blast protection for the Stryker crew and is currently being fielded in Afghanistan. Based on the unique operating environment encountered there, DVH ICVs (ICVVs) were provided in lieu of DVH RVs because the ICVV's remote weapon station afforded greater protection and lethality and carried more personnel. To continue to perform scout missions, a kit was developed that will facilitate the installation of

the RV's unique mission equipment package into ICVVs.

The Stryker supports communications suites that integrate the single-channel ground and airborne radio system (SINCGARS) radio family, enhanced position location reporting system (EPLRS), Force XXI Battle Command Brigade and Below (FBCB2) or BFT, global positioning system (GPS), high-frequency (HF), multiband very high frequency and ultrahigh frequency (VHF/UHF) radio systems and computer workstations using command post of the future software.

The Stryker is also in the midst of an ECP upgrade program. The goal of the **Stryker ECP Program** is to address current space, weight, power and cooling deficiencies and lay the foundation for the success of future improvements to the platform. Specifically, the ECP program will allow the platform to accept the Army's communications network and provide the flexibility to accept unknown future upgrades. Some but not all ECP upgrades will be made to both the DVH and flat-bottom hull variants.

Ground Combat Vehicle Project Management Office

The **Ground Combat Vehicle (GCV)**, managed by PM GCV, is the centerpiece of the Army's overall combat vehicle modernization strategy. The GCV is the Army's replacement program for the infantry fighting vehicle (IFV) in ABCTs, which will develop and deliver an affordable and effective IFV by focusing on affordability and program risk reduction through the use of established technology and prudent performance trades.

The need for the GCV is driven by compelling current and emerging threats and a critical need for better force protection. Soldier input, informed by more than a decade of war, identifies clear requirements for an IFV that can safely deliver a full nine-soldier squad to the battlefield in an IED environment under armor. No single vehicle available today can provide that combination of capabilities. The Army remains firmly committed to the success of the GCV program to provide needed protection and mobility to soldiers.

In the technology development (TD) phase, the Army has executed a three-pronged strategy that uses contractor-developed, best-value designs, technical and operational studies of existing vehicle platforms, and continued analysis of existing alternatives to assess GCV requirements against cost and schedule benchmarks.

Competitive development efforts from the two TD phase contractors' efforts supported three main objectives: completing preliminary design reviews for each contractor's design, testing selected subsystem prototypes to reduce risk, and informing designs while maturing the draft design and performance specification.

In support of a fully informed Milestone B, the Army fully resourced and executed a GCV IFV analysis of alternatives (AoA) dynamic update in accordance with approved GCV IFV AoA dynamic update guidance issued in October 2011. The AoA dynamic update consolidated information from the parallel nondevelopmental vehicle assessment and TD design concept efforts to produce a more comprehensive understanding of requirements, trade space and system-level alternatives. The overall approach produced results to inform capability development document requirements maturation and identify affordable alternatives for the GCV IFV program. The final report was issued in May.

Throughout 2012, the Army conducted a nondevelopmental vehicle (NDV) assessment with a combination of live testing and engineering analysis that evaluated domestic and international vehicles. The assessments confirmed that currently fielded vehicles are optimized for performance within their expected operating environments but are limited compared with specific GCV capability performance areas. Although all assessed NDVs met some critical GCV requirements, none met the minimum requirements without needing significant redesign.

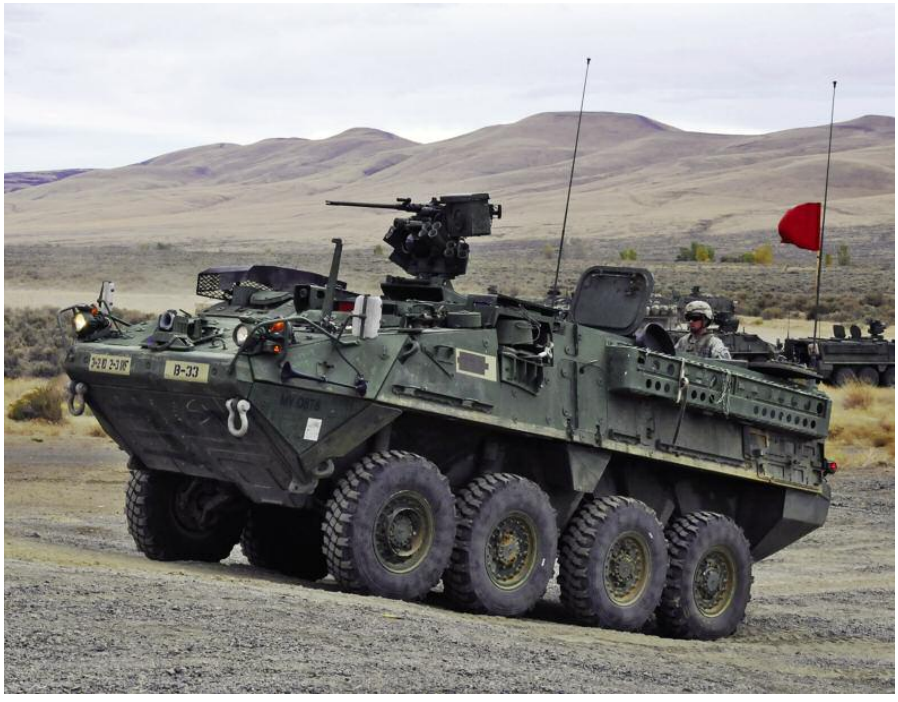
The nearly completed successful GCV TD phase has satisfied the Army's intended purposes, validating that the developmental path is viable by doing cost and operational effectiveness analyses, reviewing preliminary designs, and accomplishing selected subsystem testing. These efforts will support a Milestone B in mid-2014. The Army expects to award engineering and manufacturing development (EMD) contracts in the fourth quarter of FY 2014.

Robotic Systems Joint Project Office

The **Robotic Systems Joint Project Office (RS JPO)** takes a joint services perspective in managing the development, acquisition, testing, systems integration, product improvement and fielding of robotic systems that will form the backbone of the combat force of the future. RS JPO manages the M160 antipersonnel mine clearing system, the PackBot family of systems, the TALON family of systems and the ultra-light reconnaissance robot (ULRR) Systems.

The **M160 Anti-Personnel Mine Clearing System**, Remote Control, is a 6-ton tracked robot designed for tele-operation from either mounted or dismounted positions to perform area clearance of antipersonnel mine-sown areas. The M160 detonates or destroys antipersonnel mines in a 66-inch-wide path through the action of a rotating chain and hammer flail system. It fills the light flail mission in the area-clearance family of systems.

M160 system improvements are implemented via an engineering change process. Multiple engineering change proposals have been approved and integrated into the M160 design to enhance the robot's utility for the soldier or marine. These improvements include transportability certification, software version updates to allow vehicle maintainers to troubleshoot and isolate causes of failures at the vehicle control panel, and updated marking requirements. The M160 was originally procured as a commercial off-the-shelf (COTS) item, but it has made the transition to a program of



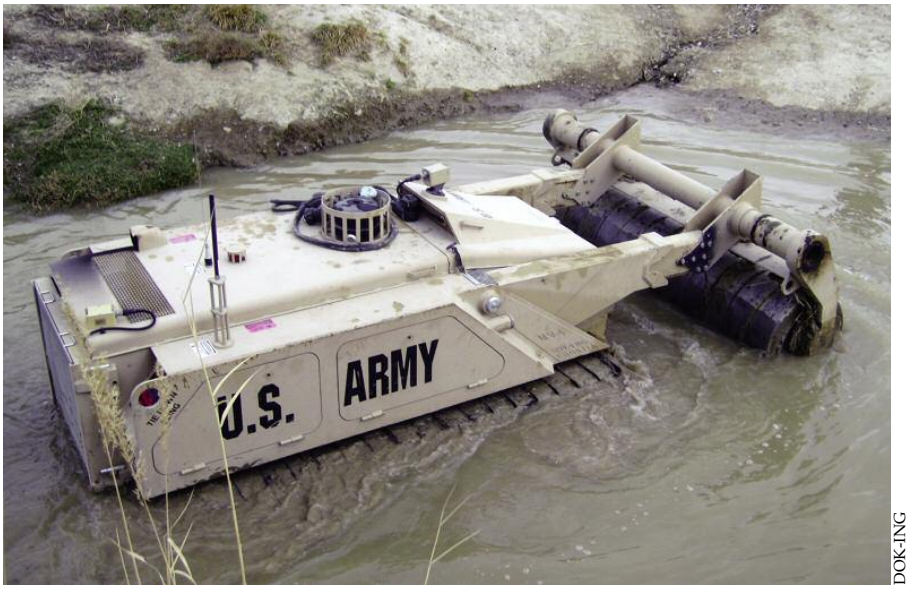
Stryker vehicle with M2 .50-caliber machine gun

record and is currently in production.

The **Route Clearance and Interrogation System (RCIS) program** is developing and integrating an appliqué system on two existing platforms: Type 1 and Type 2. The RCIS Type 1 will allow the tele-operation of the high-mobility engineer excavator (HMEE) and its capabilities, enabling soldiers to interrogate, classify and excavate deep-buried explosive hazards, IEDs and caches in a wide range of road surfaces and soil conditions. This capability is designed to remove soldiers and expensive route-clearance vehicles and equipment from the blast effects of explosive hazards. The RCIS Type 2 will allow the tele-operation of the RG-31 and its capabilities, enabling soldiers to semi-autonomously control the mine detonation roller, debris blower, and trip/command wire detonating device and prevent threat forces from using concealed locations and reseeding routes with explosive hazards by clearing routes of trash and debris. The materiel development decision is expected in the fourth quarter of FY 2013, with Milestone B planned a year later.

The **Husky Mounted Detection System (HMDS)** is a two-increment program, with Project Manager Close Combat Systems heading the program and primarily responsible for increment A, which is the development and integration of ground-penetrating radar and deep-buried detection payloads. In increment B, RS JPO is responsible for the development of semi-autonomy capability (SAC) and total system integration. The Husky SAC will enable an operator to semi-autonomously control all functions of a Husky and its payloads in an unmanned mode from inside a control vehicle at standoff and will remove the operator from the proximity of the effects of explosive hazards. The operator will be able to deactivate the SAC capability and operate the Husky in the manned mode. Milestone B for increment A is scheduled for 2013. Milestone B for increment B is scheduled for FY 2015 and is reliant upon the outputs from increment A.

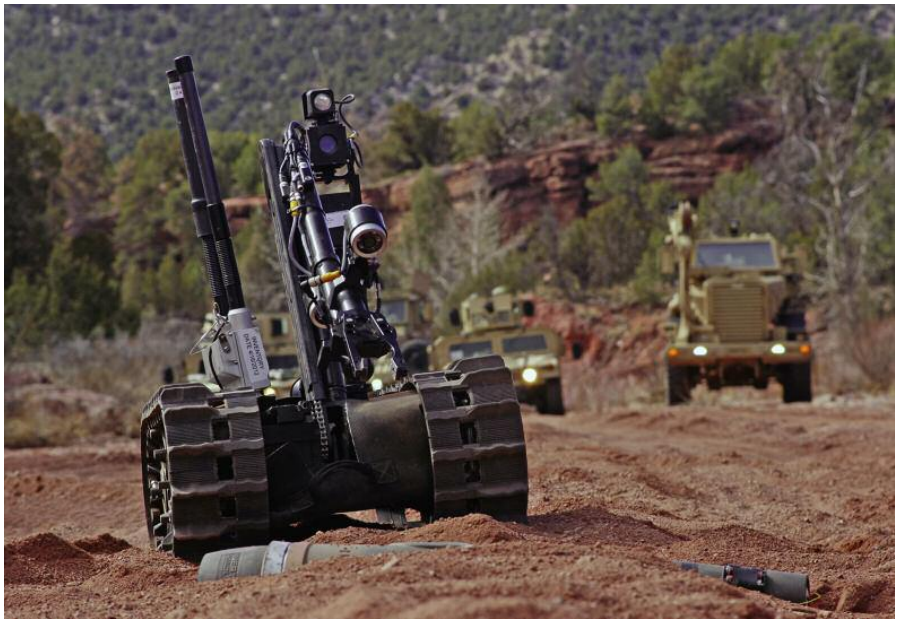
The **Man-Transportable Robotics System Increment II (MTRS Inc II)** provides a standoff capability for soldiers and marines to detect and confirm presence, identify disposition, and counter hazards by providing an unmanned platform for payloads in support of current and future mission requirements. The system is intended to be vehicle-transportable and capable of being carried by two soldiers. The system will be highly mobile and used in mounted and dismounted operations. MTRS Inc II will be a multimission modular system that can be reconfigured by adding or removing sensors, manipulator arms, and mission module payloads, allowing this capability to operate together with these sensors through the operator control unit (OCU). The program reached pre-materiel development decision in June, with an approved capability production document.



DOK-ING

M160 Anti-Personnel Mine Clearing System

The MTRS Inc II system will perform in all types of operations, provide protective maneuver for soldiers and marines and the dismounted assault, and be employed in all environments, including asymmetrical and military operations in support of conventional war, explosive hazard detection, combating terrorism, peace enforcement, and peacekeeping operations. This capability will also be used to confirm or deny the presence of weapons of mass destruction (WMD) in support of WMD eliminations, WMD interdiction, and the capability to re-



TALON robot

spond to hazardous material events or accident and consequence management response.

The **PackBot** is a COTS, small, tele-operated, tracked robotic platform. The system is modular and easily reconfigured. Basic mission packages include an articulated arm with a gripper, a color surveillance camera with ultra low-light and zoom capabilities, and a rugged game-style controller for the common, ruggedized laptop operator control unit. Two different styles of manipulator arms are available within the PackBot family. The first is a small arm manipulator with 42-inch extension and a lifting capacity of 5 pounds throughout the full range of motion. The second is a three-link arm that can extend 80 inches and lift 30 pounds close to the chassis and 10 pounds at full extension.

Multiple variants of the PackBot have been fielded, including the PackBot 500 explosive ordnance disposal, PackBot 500 FIDO chemical sniffer, and PackBot 510 FasTac. A recent software upgrade on the PackBot 510 platform enhances plug-and-play interoperability of all 500 and 510 series payloads on the FasTac chassis.

The SUGV 310 is a lighter member of the PackBot family that has been procured to assist the explosive ordnance disposal (EOD) community. The Mini-EOD (SUGV 310) is a COTS, lightweight, manportable, tracked robotic vehicle. The Mini-EOD is composed of a manipulator arm with camera, lights and a chassis with four drive cameras. The user wears a monocle to see what the robot sees and operates the vehicle with a small handheld device similar to that used in common gaming systems, both attached to a wearable operator control unit.

The Mini-EOD can navigate various types of terrain including rocky, sandy and uneven surfaces. Its low-light capabilities enable it to perform day and night. The pivoting manipulator arm is capable of extending up to 2 feet and can lift up to 15 pounds close in and 7 pounds fully extended.

RS JPO utilizes feedback from units using the Mini-EOD in theater and U.S. training sites to develop enhancements and solutions for improved performance, reliability, and operational effectiveness for the soldier or marine. More than 1,900 PackBot family robots have been supporting operations in theater.

The **TALON Family of Systems** is a COTS, vehicle-transportable, tele-operated, multiterrain tracked system that has the operational flexibility for a variety of missions. The TALON provides standoff protection during remote reconnaissance and surveillance. The gripper attached to the control arm can support explosive ordnance disposal as well as additional engineer support activities that may not involve interrogation of IEDs. The systems include three cameras and a modular design that allows for plug-and-play upgrades.

The TALON family of systems has undergone various improvements through user feedback to enhance operator protection, system endurance, camera resolution, situational awareness, radio communication and mission data storage. Additional improvements being developed and evaluated include an increase in manipulator arm dexterity, improved communication range in urban and covert scenarios, and increased drive motor torque to improve system mobility.

The TALON family is supporting soldiers and marines with explosive ordnance disposal, route clearance engineer support, and reconnaissance and surveillance missions. Approximately 800 TALON systems were fielded in Operation Enduring Freedom and Operation New Dawn. Approximately 450 systems are supporting various training requirements in the United States and abroad.

The **Ultra Light Reconnaissance Robot (ULRR)** systems answer a requirement for small, throwable robots. Currently, two COTS systems have been selected to proceed for limited fielding to meet an operational need.

The DR-10 is a lightweight, compact, multimission remote platform, developed for supporting small dismounted military units and patrols. Using a wearable controller, the warfighter sends the DR-10 in first to gain situational awareness and take action. The DR-10 OCU is a portable and wearable self-contained control unit using three major components: the OCU radio unit, the battery and the hand controller. For maximum load-out flexibility, the major components of the OCU are housed in soft pouches designed with modular lightweight load-carrying equipment.

The 110 FirstLook is a small, rugged, lightweight, throwable robot designed to be the eyes and ears of the frontline soldier. Its primary function is to provide the operator with hasty situational awareness in dangerous and challenging environments. Situational awareness is provided on four sides of the robot by the four day/night color cameras with LEDs in the front and the rear, providing a 360-degree field of view. The 110 FirstLook is ideal for a range of infantry missions and special operations, including building clearing, raids and other close-in scenarios. It provides the warfighter with the ability to investigate areas during secondary searches, such as tunnels, culverts and Karez systems, while reducing exposure to threats in these confined environments.