Ensuring the Army Maintains Its Technological Edge

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Today's operational environment, with increasingly sophisticated asymmetric threats, urgency of needs and rapid technological advances in potential solutions, presents significant challenges in solving materiel systems integration issues under compressed time schedules. At the same time, technology for these solutions must be programmed into the Army's materiel solutions for future equipment that is fully supported by complementary doctrine, requirements, organization structure, leadership and training. To manage and focus this complex effort, the U.S. Army Research, Development and Engineering Command (RDECOM) has established a Deputy Commanding General for Systems of Systems Integration (DCG SOSI), who works collaboratively with all RDECOM labs and centers to coordinate the best-integrated technologies and solutions for both the Current and Future Force. Many of these organizations have successfully transitioned technology and several are involved in ongoing technology development in survivability and networks.

Soldiers from the 725th Ordnance Co. (Explosive Ordnance Disposal (EOD)) deploy a remotely controlled EOD robot near Al Iskandariyah, Iraq, March 26, 2005, to incapacitate/detonate an IED. New S&T breakthroughs such as this robot are enhancing Soldier survivability on the battlefield. (U.S. Air Force photo by Airman 1st Class Kurt Gibbons III.)

Survivability

The integrated Survivability Science and Technology (S&T) program is improving the protection of Soldiers, weapons, vehicles and supplies, while simultaneously deceiving the enemy and avoiding detection. It has addressed proposed and existing programs to enhance survivability for current operations vehicles and personnel. Key Current Force survivability S&T programs include the four recently fielded items described below.

- **Armor Survivability Kit (ASK).** Humvee ASK development and fielding was in response to a U.S. Central Command-issued Operational Needs Statement requesting an increase in survivability against small-arms fire. An armored solution to the cloth and plastic door versions of the Humvee was required because of the change in its use in reconnaissance, military police activities, convoy escort and resupply missions. RDECOM organizations designed an armored survivability lifesaving kit that included armored doors, fortified windows and armored rocker and rear panels in only 3 months. Originally intended as a temporary solution to threats in Iraq, the kit has become a standard stocked item in the Army inventory.
- **Warlock.** RDECOM organizations were instrumental in providing equipment to defeat improvised explosive devices (IEDs), supporting Warlock fielding. Warlock emits a radio frequency that jams the communications signals used to detonate IEDs. In less than 3 years, more than 3,000 Warlock systems were fielded by a dedicated RDECOM and Program Executive Office (PEO) Intelligence, Electronic Warfare and Sensors/Product Manager Crew-Served Weapons (PM Crew) engineer and support staff that has grown from 5 to 80 personnel. PM Crew, supported by RDECOM engineers, manages the development and fielding of more than five different systems in parallel production and research and development (R&D), with the Joint Spectrum Center

The well-cam system (see inset) reduces risk when Soldiers look for hidden weapons or munitions caches in wells or irrigation tunnels. The well-cam provides a 360-degree view of the well's interior, alerting Soldiers to potential booby traps or mines. (U.S. Army photo.)

providing test support. RDECOM and the Rapid Equipping Force have just completed a fast-track risk-reduction development and test program of an advanced jammer for PM Crew Spiral 2 production. It demonstrated an enhanced survivability in a smaller, lighter, lower prime power and lower cost system. To support the aggressive R&D program, the Communications-Electronics Research, Development and Engineering Center (CERDEC) has created two specialized exploitation and test facilities at the Intelligence and Information Warfare Directorate, Fort Monmouth, NJ. An A Co., 458th Engineer Battalion, specialist commented recently, "We know the Warlock system works, we don't go outside the wire without it. We are members of the Combat Engineers Road Clearance team, and [we] rely on our Warlock just as we rely on our weapons when we are out clearing the roads of mines and IEDs."

- **Lightweight Counter Mortar Radar (LCMR).** Our forces in Iraq must contend with the enemy's widespread mortar use, which can easily be emplaced, fired and moved. The LCMR was needed to counter enemy mortar fire. Stringent design criteria resulting from weight and size constraints and the need for exacting performance created an engineering challenge for RDECOM. By leveraging advances in lightweight materials, RDECOM met the challenge and delivered approximately 30 man-portable LCMRs.
- **Vehicle Body Armor Support System (V-BASS).** Survivability engineers responded to a need to protect truck crews from small-arms fire and IED fragments. Initially, they sent 112 V-BASS units to the theater for operational evaluation. They then leveraged a Congressional plus-up program to quickly develop the V-BASS body armor for use in the M915 Family of Vehicles (FoV). V-BASS body armor is strapped to a vehicle seat and remains there until moved or consumed. The vehicle seat absorbs most of the armor weight so wearers experience less than 2 pounds of spine loading.

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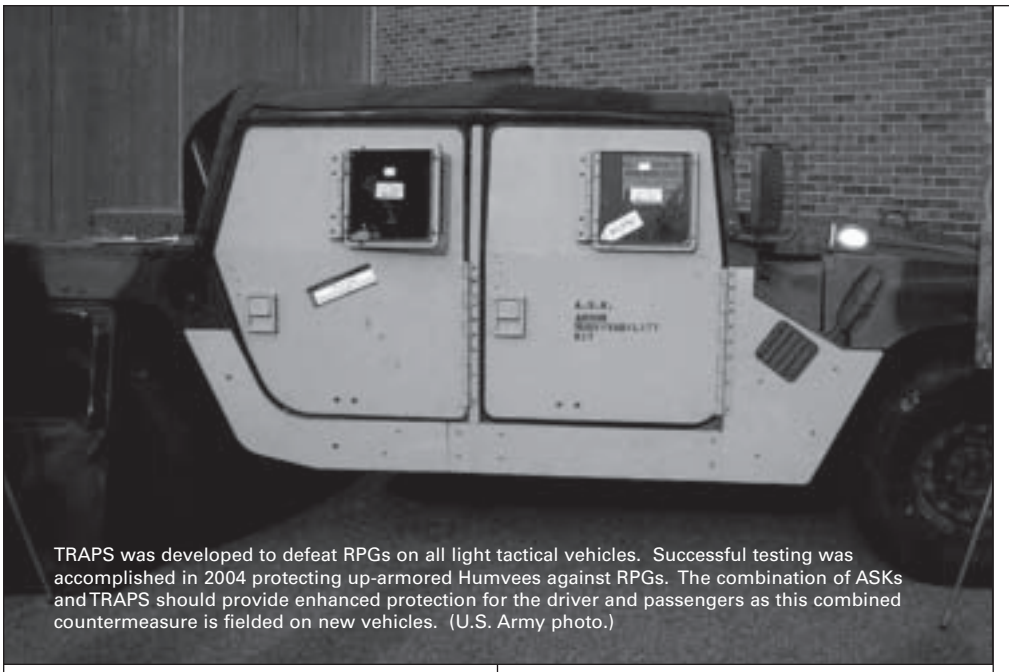
Future Force Survivability

For Future Force support, the survivability team is working on integrated survivability technologies that include signature management, advanced armors, electronic warfare sensors/countermeasures and hard-kill active protection systems (APS). These technologies will be integrated onto a vehicle and tested as part of the Army's Integrated Survivability Advanced Technology Demonstrator program. The team has supported PM Future Combat Systems Unit of Action (FCS UA) and PEO Ground Combat Systems with technology road mapping for worldwide APS. It provided data on the systems and developed road-mapping tools to help determine what system could be spiraled into Current and Future Force vehicles as follows:

- **Integrated Army Active Protection System (IAAPS).** The IAAPS uses soft-kill electronic sensors and countermeasures (jammers and decoys) and a hard-kill APS (physical interruption) to protect a vehicle from direct-fire chemical energy and top attack threats. It also has growth potential for kinetic energy threat defeat. The IAAPS was built and put through its first subsystem level tests in FY01. In August and September 2002, it was integrated on a Ground Combat Vehicle for a series of static/moving system-level end-to-end threat defeat tests against anti-tank guided missiles (ATGMs), rocket-propelled grenades (RPGs) and tank-fired high-explosive anti-tank (HEAT) threats. Static defeat had a 62 out of 71 shots (87 percent) success rate. On-the-move defeat had an 11 of 13 attempts (85 percent) success rate. The system has undergone numerous improvements and upgrades — most notably, the MK-2 energetic interceptor integration. The IAAPS is a perfect 3 for 3 against ATGMs during testing with the new interceptor. Final IAAPS validation testing to provide hemispherical protection against RPGs, top attack munitions and tank-fired HEAT rounds will continue during FY05.
- **Full Spectrum Active Protection Close-In Layered Shield (FCLAS).** The FCLAS provides active hemispherical protection to ground combat and tactical vehicles against multiple threats encountered at short range. The FCLAS concept has three main components: the countermunition, launcher and display and controls. Self-contained within each munition is a search sensor, proximity fuze, signal processor, countermeasure and propellant, which pushes the round out of the dispenser. These elements provide the ability to detect, track, classify and destroy an incoming threat. The launcher design is flexible and can be adapted to meet the needs of each platform integrating FCLAS. Tubes can be aimed with tight angle separations for more overlap of coverage



TRAPS was developed to defeat RPGs on all light tactical vehicles. Successful testing was accomplished in 2004 protecting up-armored Humvees against RPGs. The combination of ASKs and TRAPS should provide enhanced protection for the driver and passengers as this combined countermeasure is fielded on new vehicles. (U.S. Army photo.)

from countermunition to countermunition or wide angles to reduce the number of countermunitions needed for 360-degree coverage. The system controller maintains control over the FCLAS launchers and countermunitions. Exclusion zones can be set up if the vehicle crew knows where supporting dismounted troops or friendly vehicles will be operating relative to the vehicle. Each component processes data and communicates with the other pieces of the system. Onboard processing at each component spreads the computational load across multiple processors. This allows for parallel processing of critical functions, such as threat tracking, while other processing can still occur, such as handling user commands. The system has undergone a series of RPG defeat tests with more than 10 successful engagement defeats. Additionally, the system has undergone a series of upgrades including decreasing the interceptor's size. Final FCLAS validation testing will continue during FY05.

- **Tactical RPG Airbag Protection System (TRAPS).** TRAPS was developed to defeat RPGs on all light tactical vehicles. Successful testing was accomplished in 2004 protecting up-armored Humvees against RPGs. TRAPS uses inexpensive radar to detect the threat and initiate the counteractions. The radar feeds data to the processor that controls the deployment of the countermeasure via an inflatable airbag. The deployed countermeasure covers the side of the vehicle and defuses the threat so the shaped charge does not form. The inflated airbag ultimately catches the defused RPG's carcass and keeps the threat from harming the vehicle or the occupants. Therefore, the threat is defused before it hits the Humvee door. This represents the least expensive countermeasure for protecting the Humvee against the RPG threat. The door absorbs the threat's energy, eliminating penetration into the crew's compartment. The threat then collapses upon itself, jamming the time-out fuse and causing no problems or door penetration. The TRAPS tested at the Socorro, NM, Test Range has shown to be very effective in proof-of-concept component-level testing.
- **Electromagnetic Armor (EMA).** Defeat of incoming threats was demonstrated in live-fire testing of an EMA package fully integrated on a hybrid-electric drive combat vehicle demonstrator. The EMA package successfully defeated a shaped-charge threat during live-fire testing Feb. 22, 2005, at Aberdeen Proving Ground, MD. The successful completion of EMA package live-fire testing on a hybrid-electric vehicle demonstrator illustrates the type of multi-hit capability that can be integrated into vehicle systems at significantly lower weight to provide a protection level similar to that of reactive packages. EMA technology can significantly enhance the vehicle systems' survivability as part of a layered approach ultimately aimed at increasing Soldier protection. EMA uses high voltages and currents to defeat shaped-charge warheads such as those from RPGs. Research in reliable power management and delivery at lower volumes and weights for pulse forming networks allows the system-level EMA integration, experimentation and demonstration on a combat vehicle.

Networks

The Network S&T program focuses on command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) technologies for rapid transition to acquisition programs, conducting comprehensive assessments of current and proposed C4ISR S&T programs and evaluating technical performance of commercial technologies via live demonstrations. A major thrust is to ensure that proposed and current programs can be integrated and interoperable with current and future architectures.

Current Force transitions include the following:

- The well sensor camera (well-cam) was created to meet a specific need in

Afghanistan. The enemy was using irrigation tunnels ending in wells to move around the area of operations. Sending a Soldier down the well on a rope many feet below the surface to investigate was extremely dangerous. Thus, RDECOM developed a lightweight device that is lowered into the well and provides a 360-degree view of the well casing's interior, thereby reducing Soldier risk.

- The high operational tempo during *Operation Iraqi Freedom* strained existing ground combat and control systems. As a result, RDECOM and PM Ground Combat Command and Control worked closely to develop and field an advanced suite of decision aid software tools that enables collaborative mobile command and control — the Combined Arms Planning and Execution Monitoring System.
- The U.S. Army Night Vision and Electronic Sensors Directorate has developed a Change Detection Workstation (CDWS) to help find IEDs, one of the leading causes of casualties in Iraq. The U.S. Marine Corps purchased five CDWSs during FY04, one of which was recently shipped to Al Asad Air Base, Iraq. The CDWS works on the principle that a human analyst can readily identify changes by comparing before and after imagery of the same location. If a road has been safely used recently, the analyst can focus on only the changes and assess each change to determine if it is a potential IED. When the IED threat developed in Iraq, this capability was evaluated for its IED detection effectiveness. The CDWS will help Marines find IEDs by rapidly processing imagery collected from an F-18 Advanced Tactical Air Reconnaissance System sensor, and by allowing the analyst to compare the most current imagery with imagery collected at an earlier date. The CDWS has also been successfully demonstrated with several other manned and unmanned aircraft platforms and various visible and infrared sensors.

V-BASS, initially designed for the M915 FoV, protects truck crews from small-arms fire and IED fragments. (U.S. Army photo.)

Analysis of network communications requirements for the UA and Unit of Employment has resulted in modifications of existing programs to better address performance predictions and critical technology shortfalls. RDECOM's Multifunctional On-the-Move Secure Adaptive Integrated Communications program successfully demonstrated and transitioned mobile communications technologies such as bandwidth management and adaptive protocols for infrastructure mobility. These protocols will assist in meeting technology shortfalls in the command, control, communications and computers area for future networks. Additional S&T efforts include:

- Developing a robust voice and data communications Soldier Radio Waveform to support sensor-to-shooter tactical linkages for the Future Force Soldier.
- Using the Head Tracked Sensor Suite program to provide FCS vehicle commanders with a rapid day-and-night quick-reaction dome of situational awareness coverage in both urban and complex terrain, permitting long-range target acquisition while on the move.
- Developing a capability for a highly mobile and transportable medium- to long-range, ground-based, multimission radar for air defense, field artillery, mortars, rockets and weapons location for fire control and air traffic control.

Transitioning RDECOM organizations' survivability and network technologies to the Current Force has made our Soldiers safer. RDECOM has met and continues to meet its goals of collecting and analyzing information and data on technologies and products that can improve our Army's capability. The resulting recommendations from assessments and integration provide a firm and timely basis for acquisition and fielding decisions.

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