

# Active Protection Systems (APS) — Future Force Capabilities to Meet Current Force Needs

COL Charles G. Coutteau, LTC John E. Long and MAJ Thomas F. Bentzel

**J**une 23, 2018, 1953 hours local time. SSG Jones, B Co., 22nd Infantry Regiment vehicle commander, is finishing what's left of his meal, ready-to-eat. It's one more edgy day, like most others during this long stability mission. Most days are uneventful, and today is no exception. He answers a call from the dismounted patrol — still nothing to report. Most locals are off the street by now. He sits in overwatch at a key bridge just outside of town.

Future threats and the Future Force's requirements for mobility, transportability and protection are driving research and development now to provide active protection that armored platforms can't always fulfill. Lessons from ongoing operations make it clear that Current Force vehicles are not as well protected as they could be for urban and nonconventional operations. Consequently, PM UA is developing an integrated hit-avoidance suite to provide protection to MGVs. Here, an M1A1 Abrams Main Battle Tank from 1st Battalion, 185th Armor Regiment, 81st Infantry Brigade, rumbles through Mosul, Iraq, during a security patrol. (U.S. Army photo by SGT Jeremiah Johnson.)



*Without warning, the silence is shattered by a thunderous explosion. His display flashes and the vehicle's APS has automatically activated, firing one shot to intercept the rocket-propelled grenade (RPG) fired at his vehicle. His radio is now alive with rapid chatter from his wingman and the squad on the ground. He instinctively presses the "slew to cue" command and the vehicle's sight and main weapon are*

*now sighting the location from which the attack occurred.*

*He fires up the vehicle, still not fully aware of what has happened outside. He sees several individuals running over a hill, away from his vehicle, and they disappear around a pile of rubble. A quick tap of the laser range finder and that location has now been sent to the patrol. He and his vehicle are ready to*

*continue the mission, even though he has just been fired upon by a team of insurgents. Damage to the vehicle: none. Crew casualties: none. The APS has done its job.*

### **Responding to Soldier Needs**

Future threats and the Future Force's combined requirements for mobility, transportability and protection have made it clear that armor alone can no



Current Force APS capability needs are derived from the survivability requirements of combat vehicle systems such as the Stryker vehicle depicted here. In addition to slat armor, PM SBCT is sponsoring an integration experiment that might lead to APS solutions for these Soldiers from the 2nd Squadron, 14th Cavalry Regiment, patrolling the Iraq-Syria border near Rawah, Iraq. (U.S. Army photo by SSG Kyle Davis, 55th Signal Co. (Combat Camera).)

longer fulfill our Army's platform protection needs. At the same time, lessons from ongoing operations make it clear that Current Force vehicles are not as well protected as they could be for urban and nonconventional operations. Consequently, Program Manager Unit of Action (PM UA) is developing an integrated hit-avoidance suite to provide protection to Manned Ground Vehicles (MGVs). This hit-avoidance suite will work in concert with other networked survivability measures to protect the Future Combat Systems (FCS) UA during full-spectrum operations. The APS comprises systems that sense incoming threats and employ countermeasures to physically intercept and defeat them.

As of 2004, PM UA judged APS technology to be capable of defeating certain short-range threats such as RPGs with minimal added development. Meanwhile, insurgents armed with RPGs presented a known threat to Current Forces operating in Southwest and Central Asia. Therefore, at the end of

FY04, PM UA and Program Executive Officer Ground Combat Systems (GCS) initiated a coordinated effort to accelerate and provide the Stryker platform with a short-range Army APS solution — a subset of the FCS APS and the FCS hit-avoidance suite — based on capability needs identified in both the FCS Operational Requirements Document (ORD) and the Stryker ORD.

This coordinated development effort is being led by PM UA, with PM Stryker Brigade Combat Team (SBCT) in support. It is based on a unified APS acquisition strategy for both Current and Future Forces, tailored to address current short-range threats while focusing on the full-spectrum future threat environment. This article describes that strategy to synchronize FCS, Stryker and other Army programs that require active protection.

**Capability Needs**

The driving force behind PM UA's APS development effort is the set of capability needs identified for the FCS-equipped Future Force. Simultaneously, Current Force APS capability needs derive from the survivability requirements

of current Army combat vehicle systems such as the Stryker. While the PMs for both FCS and Stryker have identified active protection as the technical solution that best meets their requirements, no APS solution is likely to be optimally suited for all platforms. Consequently, PM UA has prioritized FCS requirements over Stryker requirements. While this approach may not provide the optimal APS solution to Stryker, PM UA is committed that the solution provided will satisfy Stryker's essential requirements, with minimal sacrifice in cost, performance or technical characteristics.

APS is a hit-avoidance system providing defense against threat munitions by intercepting the threat munitions prior to them making physical contact with the platform.

To jumpstart doctrine development for the short-range system, PM SBCT is sponsoring an integration experiment that began in 2005, even before the MGCV's system maturation work begins. This concept demonstration, integrating and testing Redstone Arsenal's Close-In APS prototype system, will generate early lessons learned and user feedback that will be used to adjust the concept architecture, as well as provide a basis for initiating training support development.

Stryker is not the only Current Force platform to which APS could be applied. Other Army programs have survivability requirements that could also be met by an APS solution, and other programs have expressed interest in the APS acquisition that FCS and Stryker are pursuing. However, at this time, the FCS ORD provides the primary documentation for the Army's comprehensive future APS requirements, while survivability requirements in the Stryker ORD provide the basis for fielding a short-range incremental capability to the Current Force.

## System Description

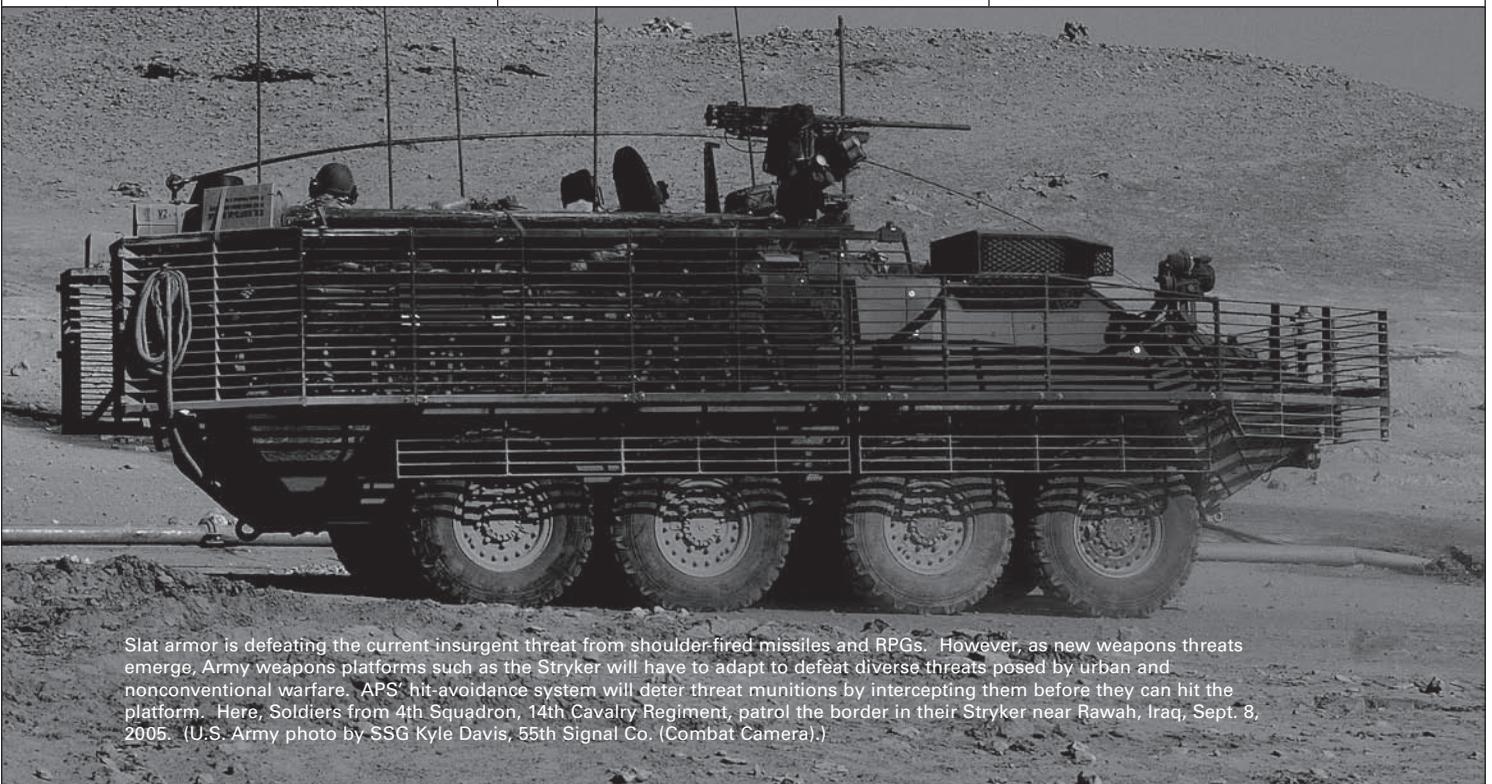
APS is a hit-avoidance system providing defense against threat munitions by intercepting the threat munitions prior to them making physical contact with the platform. Conceptually, an APS can improve survivability by defeating incoming anti-tank guided missiles, RPGs, tank-fired high-explosive anti-tank missiles, tank-fired kinetic energy rounds, indirect fire — including bomblets and mortars — and guided top-attack threats. APS does not totally supplant armor. Vehicle armor must still provide protection against threats that cannot be addressed by the APS. These threats include small arms, mines and explosive fragments, including the residual shrapnel effects resulting from an active protection engagement.

A generic APS comprises a sensor subsystem, a countermeasure subsystem

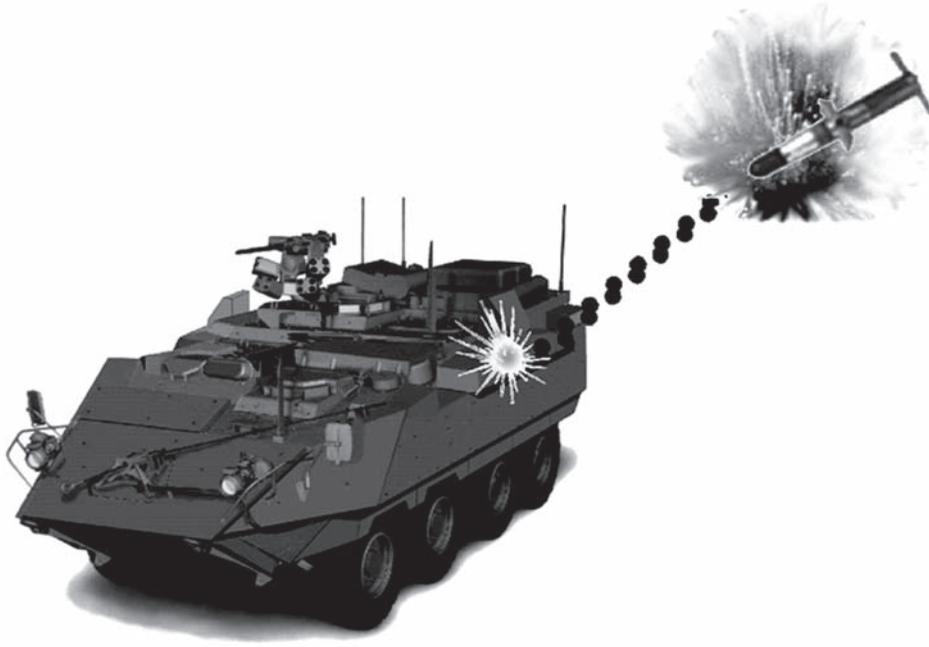
and data processing. A typical sensor subsystem includes a threat warner, or cueing sensor, and a tracking sensor. The threat warner identifies a threat and then, through data processing, hands it over to the tracking sensor. The tracking sensor then determines the incoming threat's size, shape and vector. Data processing uses this tracking data to determine the appropriate countermeasure, calculate the firing solution and deploy the countermeasure as depicted by Figure 1. The countermeasure physically intercepts the incoming threat and typically consists of an interceptor launcher and interceptor munition.

APS's first increment consists of a short-range hard-kill APS that can be integrated onto Current Force GCS to defeat current short-range, man-portable threats.

The objective full-spectrum FCS APS will employ a full suite of hit-avoidance sensors and countermeasures as depicted in Figure 2. The accelerated short-range APS will employ a more limited set, focused on short-range,



Slat armor is defeating the current insurgent threat from shoulder-fired missiles and RPGs. However, as new weapons threats emerge, Army weapons platforms such as the Stryker will have to adapt to defeat diverse threats posed by urban and nonconventional warfare. APS' hit-avoidance system will deter threat munitions by intercepting them before they can hit the platform. Here, Soldiers from 4th Squadron, 14th Cavalry Regiment, patrol the border in their Stryker near Rawah, Iraq, Sept. 8, 2005. (U.S. Army photo by SSG Kyle Davis, 55th Signal Co. (Combat Camera).)



**Figure 1. An APS-deployed countermeasure intercepts an incoming missile.**

simultaneously identifying the inter-relationships between APS and our warfighting tactics, techniques and procedures. The plan for the APS spin-out to Stryker is to award a system maturation contract in early 2006 and enter initial production in 2010 followed by full production in 2011.

The second objective seeks to minimize wasteful duplication in system development, production, training and support costs. This objective establishes the full-spectrum APS as an upgrade to the short-range system, rather than as a replacement. Conceptually, the full-spectrum effort subsumes the short-range effort, rolling them both together into the threshold FCS APS solution.

Both APS program aspects — short-range and full-spectrum — are aggressive in terms of both schedule and technology. The accelerated short-range APS timeline is driven by a Stryker program requirement to field add-on armor to all Stryker units in the field. The full-spectrum APS schedule parallels the FCS MGVI Increment 1 project schedule, which forecasts an initial operational capability consisting of fielding to elements of an FCS UA by the end of 2014.

current threats. A typical short-range APS, with respect to the system's primary elements, is defined as:

- Threat warners.
- Tracking sensors, such as tracking radar.
- Data processors.
- Interceptor launchers.
- Interceptor munitions.
- Countermeasure warheads.

**Acquisition Approach**

The FCS program has adopted an evolutionary acquisition strategy consisting of technology insertions, and the APS strategy is consistent with this approach. APS's first increment consists of a short-range hard-kill APS that can be integrated onto Current Force GCS to defeat current short-range, man-portable threats. The second increment is a full-spectrum APS that will be an integral element of the FCS Increment 1 MGVI hit-avoidance suite, designed to defeat a variety of both short- and long-range threats. Therefore, the short-range APS is a subset of the full-spectrum APS, with interim

components added as necessary to make it operate independently on the Stryker platform. As APS technologies mature, they will be incorporated into the full-spectrum design to make the objective APS more capable and suitable.

The two acquisition strategy objectives for the APS provided to Stryker are:

- Seize an opportunity to transfer useful FCS capabilities to the Current Force while reducing risk with regard to integrating and proving out new technologies.
- Achieve commonality among the Army's APS solutions for the Current Force's combat vehicles and the Future Force's MGVs.

The first objective centers on fielding the APS capabilities prior to the first MGVI increment, proving their value to the Army's warfighters, while

The plan for the APS spin-out to Stryker is to award a system maturation contract in early 2006 and enter initial production in 2010 followed by full production in 2011.

**Program Management**

APS is managed through the FCS Program's Integrated Product and Process Development (IPPD)-based distributed management structure, with a government management structure overseeing the efforts of a defense industry

Lead Systems Integrator (LSI). Structurally, APS is a responsibility of the Hit-Avoidance Integrated Product

Team (IPT), reporting to the MGVI IPT within PM UA and the LSI. The Hit-Avoidance IPT will directly coordinate with other FCS IPTs in pursuit of a fully integrated hit-avoidance suite.

The Hit-Avoidance IPT — chaired by PM UA, PM SBCT and FCS LSI representatives — provides functional leadership for APS acquisition. PM UA and the LSI are permanent team leaders, while PM SBCT's leadership is limited to issues dealing with the short-range APS, and will revert to simple membership once Stryker's short-range APS is fielded. In addition to these three organizations, any other vested organizations are welcome to participate as team members using the IPPD model.

**Test and Evaluation (T&E)**

T&E is a key component in controlling APS acquisition. Testing will begin early in the short-range APS maturation and continue through full-spectrum system development and

APS combines the advantages of armor and mobility by protecting fighting vehicles from enemy fire without overburdening them. FCS' APS initiative exploits emerging and mature technologies, incrementally delivering APS solutions to suit both Current Force operational requirements and Future Force capability needs.

demonstration, eventually transitioning to follow-on testing to validate the performance of future technology insertions.

The short-range APS will start testing very early, almost immediately after an award is made. Post-award testing will be conducted to gauge the chosen contractor's precise technological readiness status. This information will enable PM UA to accurately validate the adequacy of the initial cost and schedule baselines.

Following the accelerated testing to qualify APS on Stryker, the full-spectrum APS acquisition effort will follow a test program that is closely synchronized with the FCS MGVI development program. A sequence of individual systems and component testing will be followed by integrated testing on the MGVI platform.

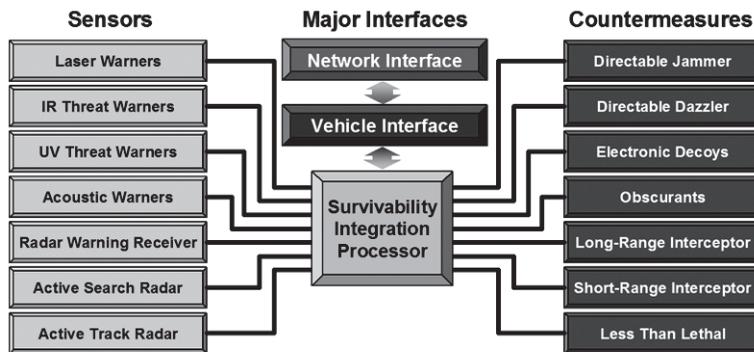
U.S. forces must be able to deploy quickly and survive once they arrive

on a rapidly changing, continuously fluid battlefield. APS combines the advantages of armor and mobility by protecting fighting vehicles from enemy fire without overburdening them. FCS' APS initiative exploits emerging and mature technologies, incrementally delivering APS solutions to suit both Current Force operational requirements and Future Force capability needs. By delivering key FCS technologies, including active protection to the Current Force, the Army fills a critical operational gap now, and supports FCS program maturation through the continuous improvement of its system designs based on early testing and operational use.

**COL CHARLES G. COUTTEAU** is the Project Manager Manned Systems' Integration, PM UA. He has a B.S. from the U.S. Military Academy, an M.S. in defense systems analysis and acquisition from the Naval Postgraduate School, and he is a graduate of the Industrial College of the Armed Forces, Marine Corps Command and Staff School and the Program Manager's Course.

**LTC JOHN E. LONG** is the Product Manager for PM UA's Manned Systems Integration-Common Systems. He has a B.A. in management from the University of Oklahoma and an M.S. in administration from Central Michigan University. His military education includes the Army Command and General Staff College and the Defense Program Manager's Course.

**MAJ THOMAS F. BENTZEL** is the Assistant Product Manager for FCS Common Systems. He has a B.S. in business administration from Shippensburg University, an M.B.A. in systems acquisition management from the Naval Postgraduate School and is an Army Command and General Staff College graduate.



**Figure 2. A notional hit-avoidance architecture with full-spectrum APS capability.**