

DTIC Online Access Controlled Web Site Launched

DEFENSE TECHNICAL INFORMATION CENTER (SEPT. 21, 2009)

FORT BELVOIR, Va.—The Defense Technical Information Center (DTIC®) has unveiled DTIC Online Access Controlled—the newest addition to DTIC’s Suite of Services, which provides a gateway to Department of Defense (DoD) unclassified, controlled science and technology (S&T) and research and engineering (R&E) information. This new Web site contains the resources from the Research and Engineering (R&E) Portal, while providing access to the Total Electronic Migration System (TEMS), Private Scientific and Technical Information Network (STINET), and DoDTechipedia.

DTIC Administrator R. Paul Ryan said, “As defense S&T information advances, so does the unique community to which it belongs. This new integrated interface allows for a more user-friendly, wide-ranging information collection and delivery platform, creating an optimal experience for the user, while utilizing the best technology solutions.”

The DoD community will benefit from this new Web site where users can access congressional budget information, DoD S&T planning documents, the Biomedical Research Database, the Militarily Critical Technologies List, over two million technical reports, research summaries, and numerous other resources. New features include a broader search collection, home page customization, and Common Access Card (CAC) login convenience.

To use the new DTIC Online Access Controlled you must register at <www.dtic.mil>.

DTIC is a DoD Field Activity aligned with the Director, Defense Research and Engineering (DDR&E). The premier provider of DoD scientific and technical information, DTIC has served the information needs of the defense community for more than 60 years.

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Wire Medicine Rewired at Detainee Combat Hospital

115TH COMBAT SUPPORT HOSPITAL (OCTOBER 2009)

Army Capt. Ken Sturtz

CAMP BUCCA, Iraq—Checkpoints, concertina wire, and guard towers canvas the horizon at the largest internment facility throughout the U.S. Central Command (CENTCOM), Camp Bucca, Iraq. So why are things looking up for doctors and nurses at Bucca, despite their grim surroundings? The answer lies in three miles of newly entrenched fiber optic cables that save them hours of work at the end of their 12-hour shifts.

Spanning one square mile and located at the southern border of Iraq, Camp Bucca encompasses 29 independent compounds that can hold as many as 15,000 detainees at once. Since the beginning of Operation Iraqi Freedom, more than 100,000 detainees have been held at this location.

Not apparent from its formidable surroundings, Camp Bucca houses a state-of-the-art medical facility, the 115th Combat Support Hospital (CSH), which provides the highest level of care on a non-stop basis to a diverse detainee population.

“Our patients usually do not speak English, so we have to utilize the services of translators so we can communicate with each other,” said Sgt. 1st Class Robert Callahan, noncommissioned officer in charge of wire medicine for the 115th CSH. “Our patients are escorted by guards and they also have primary care medical issues. It’s not the typical mission our medics are trained to support before they arrive here.”

The term “wire medicine” was originally coined to describe the medical care administered to insurgents, which included a wire fence separating medical personnel and patients. While a fence no longer exists between patient and medical personnel, additional barriers have made care difficult.

EVOLUTION FROM PAPER TO ELECTRONIC RECORDS

Originally, wire medicine at Camp Bucca was captured on field medical cards—the same paper forms that were first used on the battlefield during World War II. The problem with any paper medical record, regardless if the patient is a detainee or servicemember, is that the information can easily be lost while an individual is in transit to another facility for additional care. The lack of information delays the health-care process, requiring staff to conduct repeated tests and procedures to determine a patient’s malady.

Regardless of who was receiving care, a commitment was made to digitally document patient data using the same system used to chart medical information for U.S. servicemembers in combat—the Army’s Medical Communications for Combat Casualty Care (MC4) system.

To lighten the workload, MC4 handheld devices were introduced, reducing the amount of typing required by the medical staff. Instead, medics could record information into their PDA and synch it with an MC4 laptop, transferring records into a centrally available location.

“When we took over the mission at Camp Bucca, we used more than 100 handheld devices to capture and upload thousands of patient encounters within a few months of our arrival,” said Spc. Robert Callahan Jr., medic with the

115th CSH. "We really liked the handhelds. They're easy to use. We were able to enter the information quickly, and our young soldiers were familiar with them since the devices are similar to handheld organizers used in CONUS."

SHIFT FROM WIRELESS NETWORK TO FIBER

While the use of MC4 handhelds in a wireless network setting bridged the change from paper to computers, the network could not handle the workload, and handhelds posed unforeseen challenges.

The network was not robust enough to transmit patient encounter tasks in an efficient manner, thus causing delays in detainee care. The handheld devices would not allow providers to co-sign notes initiated by medics. Additionally, at the end of a long shift, medical personnel were unable to determine if every encounter had transmitted to the network.

The 115th CSH realized that the use of the handhelds and transferring data via the wireless network was not making the grade. The infrastructure needed to be upgraded.

After months of planning and hundreds of hours of hard work, more than three miles of fiber optic cable was added to the network infrastructure. The 115th CSH coordinated permission to dig and run the cable throughout the internment facility, after procuring, configuring and installing more than 30 fiber switches so that the new network could efficiently carry patient data throughout the facility. Ultimately, a large portion of the data that traveled over the NIPR network at Camp Bucca was transitioned over to the MC4 network, improving the overall performance of the network.

Upon switching to a fiber optic network, the handheld devices were removed from the compound treatment rooms and replaced with new MC4 laptops. Today, medical personnel throughout Camp Bucca have access to the full suite of medical applications on the MC4 systems without the concern of bandwidth restrictions.

"Technology played a central role in the evolution of health-care at Camp Bucca," said Lt. Col. Stephen Wooldridge, deputy commander for administration for Task Force 115 South. "Under the direction of our commander, Col. John McGrath, we have transitioned our efforts from paper documentation to electronic records. We took on this role from the moment we assumed this mission."

Replacing handhelds with more MC4 laptops has since provided medical personnel with an unexpected benefit. The 115th CSH is able to track the medical care detainees receive as they move throughout the numerous compounds, as well

as at other medical facilities for follow-on care. By using laptops instead of handhelds, users have a type of patient visibility not possible with the handhelds.

The 115th CSH has overcome a number of changes since taking on the mission at Camp Bucca and, in the process, significantly improved the network infrastructure used to collect patient data. As a result of their efforts, they have enabled the medical team to rapidly treat and diagnose thousands of detainees every month, improving the level of care administered at Camp Bucca.

For more information on how medical information is being captured and shared on the battlefield, visit <www.mc4.army.mil>.

Sturtz is the hospital information management officer, 115th Combat Support Hospital, Camp Bucca, Iraq.

Army Establishes Program Executive Office Integration to Support Modernization

DEPARTMENT OF DEFENSE NEWS RELEASE (OCT. 2, 2009)

The Department of the Army announced today that it established the Program Executive Office (PEO) Integration to support current and future acquisition programs. This office supports the April 2009 Secretary of Defense decision to cancel Future Combat Systems (FCS) and restructure the program in accordance with guidance by the Defense Acquisition Executive to the Army outlined in the June 2009 Acquisition Decision Memorandum.

PEO Integration will oversee several project and product management offices, which focus on the Ground Combat Vehicle, the Network, and Brigade Combat Team (BCT) modernization.

"It is important for the Army to establish a new PEO," said Acquisition Executive and Acting Assistant Secretary of the Army for Acquisition, Logistics and Technology Dean G. Popps. "We are moving forward with efforts to improve our ability to equip brigade combat teams, and to modernize the Army consistent with the Army force generation model. PEO integration will enable better portfolio management."

As part of the Army's transition to a new modernization strategy, this new PEO will enhance the Army's ability to develop and deliver improved warfighter capabilities needed in current and future contingency operations, such as identifying threats from standoff positions; gathering and disseminating real-time intelligence, surveillance, and reconnaissance information down to the soldier level; removing soldiers from potential danger by using unmanned systems;

and providing the BCT with a 40-kilometer precision-strike and all-weather capability.

For more information, contact Maj. Jimmie Cummings, Army Public Affairs, at 703-697-7591.

Future Weapons Need to be Adaptable, Cost Less

AMERICAN FORCES PRESS SERVICE (OCT. 7, 2009)

Fred W. Baker III

WASHINGTON, Oct. 7, 2009 - Future U.S. military weapons are going to have to be relevant, adaptable, and affordable, the nation's second highest-ranking military officer told defense contractors here today.

Gone are the days of spending millions of dollars on technology and equipment that is all but obsolete by the time it is fielded to troops, Marine Gen. James E. Cartwright, the vice chairman of the Joint Chiefs of Staff, said at the annual Association of the United States Army.

And no longer can the United States afford to cut out large chunks of its defense budget for weapons systems that provide only a niche capability, he said.

The prolonged wars in Iraq and Afghanistan have fundamentally changed the construct of the force that for decades was built on the idea of having to fight two large enemies at the same time.

"[Iraq and Afghanistan were] not on anybody's list as peer competitors. Not on anybody's list to last more than 30 days in conflict. And here we are now approaching the ninth and 10th year [at war]," Cartwright said.

Now, weapons systems are going to have to be adaptable enough to fight across several fronts, and cheap enough to be fielded in large numbers, he said.

As an example, Cartwright cited the unmanned aerial vehicles now in high demand in combat. During the Cold War, air superiority was paramount in defense spending, but the large, costly fighter jets and bombers have proven less effective in today's counterinsurgency fight.

"Compared to a fixed-wing aircraft ... [a UAV] takes about a tenth of the gas for about 10 times the flight time. It's always there when you need it," Cartwright said. "It does incredible things and has incredible leverage for nowhere near the cost."

Cartwright said he has not yet met a commander on the ground who doesn't want more of the unmanned aircraft.

In fact, the aircraft cannot be produced fast enough in the United States to fill the demand overseas, he said.

"We're trying to figure out how to open more [production lines]," he said.

Because of the speed of today's technological advancements, the general said that any system built has to be flexible enough to incorporate the latest technology.

Cartwright heralded recent progress made in tying old and new networks together for a broader missile defense shield, making the system more adaptable. The system can now tie into radars that were built in the 1970s, he said. And newer command and control systems are able to tap into these radars, expanding their range and flexibility.

But, no matter how good a weapon system is, it has to be affordable, Cartwright said.

"You can have the world's greatest idea, [but] without resources, it's an hallucination," he said.

Cartwright predicted minimal growth and tight funds in the department's future.

"The growth that we've had over the last eight to 10 years is a thing of the past. And so hard decisions are going to have to be made," Cartwright said.

What worries him, the general said, is that the trend in defense building is toward developing top-of-the-line products at very large costs.

Cartwright cited the escalating costs of building today's bombers. The department bought more than 700 of the B-52 Stratofortress, a long-range bomber used by the Air Force since 1955. They cost about \$53 million each in 1998 dollars, according to the Air Force. The B-1B Lancer bomber was introduced in October 1986 costing more than \$283 million each in 1998 dollars. The Department bought about 100 of them, Cartwright said. The newest most advanced bomber, the B-2 Spirit, introduced to the Service in April 1997, cost nearly \$1.16 billion. The department stopped production at 20.

"I can't afford one [plane] on each coast, one ship on each coast, because that's all I can afford," Cartwright said.

"Think about the next generation bomber. We need hundreds of them. Not two," he said.

Cartwright said the value of the niche capabilities of a weapons system have to be weighed against the value of having more capabilities.

"Competition has got to find us a way to get to scale," he said. "If we don't, we're going to be sorely disadvantaged."

"We've got to find a way to get this affordability equation to work in our favor," he said.

Acquisition Reform Requires Balance, Under Secretary Says

AMERICAN FORCES PRESS SERVICE (OCT. 8, 2009)

John J. Kruzel

WASHINGTON—As the Defense Department reforms its buying process, the Pentagon's top acquisition official seeks to strike a balance between improving the system and keeping it efficient.

Speaking to the NATO Allied Command Transformation Industry Conference, Ashton B. Carter, the under secretary of defense for acquisition, technology, and logistics, said improvements to the Pentagon's acquisition apparatus aim to better serve U.S. taxpayers and troops.

"In my position, it's important for me to try to keep the balance between better controls, on the one hand, and continued effectiveness on the other," he said. "We're going to do better by the taxpayer, but we're also going to do better by the warfighter at the same time."

The Weapon Systems Acquisition Reform Act of 2009, which garnered unanimous support in the House of Representatives and Senate, sought to increase government oversight, save taxpayer dollars, and spend defense funding more efficiently when President Barack Obama enacted it in May.

At the time of the signing, Obama echoed Defense Secretary Robert M. Gates, saying that a dollar of wasted defense spending is a dollar not spent on supporting U.S. troops, preparing for future threats, or protecting the American people.

"Secretary Gates, working with our military leadership, has also proposed a courageous set of reforms in our defense budget that will target waste and strengthen our military for the future," Obama said. "In taking on this enormously difficult task, he's done a tremendous job."

Carter, who assumed his current role in April, reflected on his early days on the job when Gates described infighting at the Pentagon that could derail efforts to support troops down range.

"[Gates] spent the first 18 months or so on the job finding that ... things wouldn't happen in support of the troops in Iraq and Afghanistan unless he personally showed an interest in it," Carter said, joking that the onus to take personal interest has shifted from Gates to him.

One area related to reform that both Obama and Gates have attached importance to is export control, which Carter described as a "mysterious and obscure" set of criteria that can lead to arbitrary decisions on the manner in which U.S. equipment is exported.

"It's a burden under which we all suffer when trying to work across boundaries," Carter told the international audience.

Carter has also cited as a chief concern the need to balance today's wars with tomorrow's requirements. As top national security officials debate U.S. strategy in Afghanistan, Gates has committed to remain responsive to urgent needs there, an approach Carter endorsed.

The acquisition chief mentioned rapid fielding of vehicles designed to protect troops from deadly roadside bombs—with the first wave of an influx arriving in Afghanistan last week. The mine-resistant, ambush-protected all-terrain vehicles—known as M-ATVs—are a countermeasure to the deadly improvised explosive devices, or IEDs, that still cause the most casualties in the war.

The fielding of the vehicles, which are smaller and more maneuverable on Afghanistan's arduous terrain, came only three months after the contract was awarded.

Carter credited the free-flow of information and intelligence among NATO allies as one reason why such rapid procurement efforts have been effective.

"That's been very productive to us and productive for our allies," he said of the cooperation efforts.

The legislation Obama signed in May came after the Government Accountability Office last year examined 95 major defense programs and found cost overruns totaling \$295 billion.

Another way Carter and other defense officials have suggested improving the acquisition system is by attracting more talent to the workforce.

Deputy Defense Secretary William J. Lynn III told Congress that a lack of critical skills is a major consideration while the

department reforms its process for purchasing weapons and defense systems.

Ahead of Obama's signing of the landmark legislation, Lynn said department officials want to increase acquisition jobs by 20,000 over the next five years, with associated funding factored into the Pentagon's budget.

But defense officials advocating reform proposals often acknowledge the challenge in attempting to enhance a system as complex as defense purchasing, noting that nearly 130 studies of acquisition reform have been completed since World War II.

Carter today echoed Gates' remark that there is no "silver bullet" that will solve all the systemic woes, yet he did strike a note of optimism, noting bipartisan support for reform.

"In this country, we are in a relatively fortunate situation because I have a president and a secretary of defense that are very interested in what I do," he added. "They want me to do it better, but they're interested in what I do, and that's a great start."

New Bomb Has 'Important Capability,' DoD Official Says

AMERICAN FORCES PRESS SERVICE (OCT. 8, 2009)

Gerry J. Gilmore

WASHINGTON—The Defense Department is developing an advanced "bunker-buster" bomb that should be ready for deployment this summer, senior Pentagon officials said. The department has been "working on technology that allows us to get at deeply buried, hardened targets" since 2004, Pentagon spokesman Bryan Whitman told reporters.

Development of the bomb has taken longer than originally envisioned because of variables in the budget process, Whitman said, adding that it is now back "on track."

Pentagon Press Secretary Geoff Morrell yesterday told reporters that the department is developing a massive penetrator bomb designed to pulverize underground facilities that may store weapons of mass destruction and related systems.

At a hefty 30,000 pounds, the new penetrator bomb weighs almost 4 tons more than the U.S. military's former heavy-weight champion, the nearly 22,000-pound massive ordnance air blast conventional bomb, known by the acronym MOAB.

The massive penetrator bomb will be in a class by itself and represents a unique capability, Whitman said.

"We don't have any other 30,000-pound bombs," he said.

The late Iraqi dictator Saddam Hussein had used underground facilities to hide and protect some of his military technology, Whitman pointed out to reporters. Some other countries, he said, have emulated this technique.

The existence of hardened, underground military facilities "is not a new phenomena, but it is a growing one," Whitman said.

Therefore, he said, the department decided to develop a new penetrator bomb, which should be ready by next summer.

Although there was no "urgent" reason to develop the new bomb, defense planners recognized the need to obtain it, Whitman said.

Such a weapon is "an important capability to have," he said.

DARPA Works Toward DoD Energy Independence

SPECIAL TO AMERICAN FORCES PRESS SERVICE (OCT. 9, 2009)

Ian Graham

WASHINGTON—Scientists are working to create energy self-sufficiency for the Defense Department, the nation's largest single consumer of energy, a defense expert said.

"Energy has always been an important point in the military. You can go back into history and look at fodder to feed the horses in the Napoleonic Wars, and you can look at today in Afghanistan where energy is a key enabler, or in some cases, a key limitation," said Barbara McQuiston, special assistant for energy at the Defense Advanced Research Projects Agency.

McQuiston discussed the agency's research and development efforts aimed at tactical energy independence during an Oct. 6 webcast of "Armed with Science: Research and Applications for the Modern Military" on Pentagon Web radio.

DARPA's goal is to generate cost-effective, alternative energy technologies for the military by addressing energy generation, conversion, control, and conservation from sustainable sources, she said.

The military consumes an average of 60 to 75 million barrels per year in jet fuel alone, she said. DARPA is looking at creating new opportunities that could be "game changers"

in the field of sustainable energy sources to help satisfy the military's critical need for fuel.

"I think Peter Drucker always said it well ... 'If you want to control the future, you need to create it,'" McQuiston said. "So DARPA invests in science and technology to make these changes.

"When we looked at energy, what we were looking at was the diversification of energy sources and moving away from a reliance on fossil fuel to create better energy security for ourselves now and in the future," she added.

While many agencies—particularly the Department of Energy and Advanced Research Projects Agency-Energy—are researching alternative fuels and working toward energy independence on a broad civilian level, DARPA focuses purely on military applications, McQuiston said.

For instance, DARPA is exploring the possibility of creating bio jet fuel from sources—including a variety of nonfood crops—using rich oils such as camelina sativa and algae, and cellulose and hemicelluloses, which are biomass and biowaste materials. Two companies working for DARPA are looking into converting algae directly into jet fuel in a scalable and cost-effective way for military applications.

"Biofuel is a huge area [of DARPA's research]," McQuiston said. "Again, jet fuel is 60 to 75 million barrels per year of JP8 [jet fuel] that powers both the jets and the generators. Being able to get JP8 from a renewable source means you can generate JP8 anywhere in the world independently."

As in its previous endeavors—including projects that brought the Internet and Global Positioning System to life—DARPA wants its fuel research to drastically change the landscape of military fuel consumption, she said.

McQuiston said advancing technology in conversion is key to that goal. Algae conversion is showing efficiency that potentially could lead to renewable jet fuel that costs less than \$1 per gallon. The current efficiency of jet fuel converted from cellulose and rich oils likely will dictate a cost below \$3 per gallon, she added.

"At DARPA we're looking at things that are high risk but have high benefits for the future," she said. "What are some of these aspects we can push out to really enable a different future? In the area of energy, the hard part is to identify and demonstrate ways to efficiently harness and convert the flow of energy.

"There's energy all around us in abundance," she added. "Can we convert what's around us into a form of energy that can be used for the military to create tactical energy independence?"

Agencies Work to Field, Support M-ATVs

SPECIAL TO AMERICAN FORCES PRESS SERVICE (OCT. 16, 2009)

Kathleen T. Rhem

OSHKOSH, Wis.—With the first shipment of the newly designed all-terrain mine-resistant, ambush-protected vehicles fielded in Afghanistan, several government agencies are now working with the manufacturer to ensure proper maintenance of the critical vehicle.

Defense Logistics Agency officials were among those who met here yesterday with Oshkosh Defense leaders to get a closer look at the M-ATVs, as the vehicles are known, and the way forward in keeping them operational.

The Defense Logistics Agency will provide parts for the new all-terrain version of the armored vehicles designed to protect troops from deadly roadside bomb attacks in Iraq and Afghanistan.

DLA Director Navy Vice Adm. Alan Thompson and several other senior agency officials visited Oshkosh Defense, a branch of the Oshkosh Corp. The company has been tasked with building several thousand of the new vehicles.

Thompson noted during the visit that senior defense leaders—including Defense Secretary Robert M. Gates and Ashton Carter, under secretary of defense for acquisition, technology, and logistics—"view this program as so important to the safety and operational effectiveness of forces in Afghanistan."

M-ATVs are lighter and more maneuverable than standard MRAPs, so they can better traverse Afghanistan's rugged terrain and keep servicemembers off more established routes that make them more vulnerable to attacks.

DLA is working to ensure the vehicles can be sustained with repair parts throughout the life cycle of the platform. Most of this coordination is going on through the agency's Defense Supply Center in Columbus, Ohio. DSCC Commander Army Brig. Gen. Thomas Richardson and several officials from DSCC met Thompson at Oshkosh for the day.

The first seven M-ATVs arrived in Afghanistan earlier this month, and 10 others are in Europe for testing and training of crew, Oshkosh officials said.



Army Lt. Col. Coll Haddon, right, M-ATV program manager with the Joint Program Office for Mine Resistant Ambush Protected vehicles, in Warren, Mich., points out unique features of the new all-terrain version of mine-resistant, ambush-protected vehicles to Defense Logistics Agency Director Navy Vice. Adm. Alan Thompson during the admiral's visit to Oshkosh, Wis., Oct. 15, 2009. DoD photo by Kathleen T. Rhem

Kenneth Juergens, M-ATV program director for Oshkosh Defense, explained to Thompson and the other visitors that the new vehicles had to meet three key performance parameters:

- Weight. Each of the vehicles needed to be less than 25,000 pounds.
- Seating. Each had to fit four troops in the cabin plus a gunner.
- Survivability. They needed to meet the same survivability specifications as full-sized variants of MRAP vehicles.

Juergens also outlined some of the vehicles' other features. For instance, the C-7 370-horsepower engine "works great on slopes," he said.

This engine power was demonstrated a short while later when Thompson and Richardson drove M-ATVs up and down 50 percent slopes in the rain at the company's test and development center.

Richardson praised the vehicle's power in comparison to the stalwart Humvees, long used as the military's tactical workhorses. But as roadside bombs became the weapon of choice for insurgents in Iraq and Afghanistan, the need

to weigh Humvees down with armor made them sluggish in rough terrain.

"The key here is the ability to punch it and get out of there," the general said as he put the vehicle through its paces on a hilly, muddy, and rutted test range. "If you hit an ambush or something else, the responsiveness is key."

Meanwhile, Thompson marveled at the vehicle's relative comfort compared to other tactical vehicles.

The M-ATV also features an environmental control unit that includes heat and air conditioning, as well as separate automated fire-extinguishing systems for the crew and engine compartments, Juergens said.

The MRAP's signature V-shaped hull was carried forward in this newer version. This directs the power of explosions away from the "protective cocoon" of the crew compartment, said Army Lt. Col. Coll Haddon, M-ATV program manager with the Joint Program Office for mine-resistant, ambush-protected vehicles, in Warren, Mich.

The M-ATV also was designed with "logistics commonality" in mind, Haddon said. For example, it uses the same independent suspension as the Marine Corps' medium tactical

vehicle replacement. The dashboard also is identical to that on the MTRV, which limits the training needed, Haddon said.

In addition, the engine is the same as that used in Stryker combat vehicles and the Army's family of medium tactical vehicles.

"Because of this commonality across the board, we already have many of the parts in the system," he said.

Still, providing for the vehicle's sustainment poses several challenges, officials said. Planners across multiple agencies are using lessons learned from the rapid fielding of earlier MRAP variants to build a supply pipeline for both consumable and repairable spare parts.

"Now we're trying to determine what the diameter of that [supply] pipeline needs to be," said Scott Bannach, Oshkosh's manager for MRAP logistics support.

He said Oshkosh officials and the MRAP program manager have worked closely to determine these needs. "We had, right from the get-go, an open and clear discussion about what the expectations were for the M-ATV," he told visiting DLA officials in a briefing.

And as testing and fielding progress, changes are being made to the vehicle even as more are being built.

"More parts are being added as the platform matures," Bannach said.

In July, 1,594 parts were associated with the M-ATV, he said. Today there are 2,301.

This rapid fielding—roughly 90 days from the time the contract was awarded until the first vehicles were delivered to the Defense Department—and continuous changes to the specifications are made possible through close cooperation and synergy among all parties, said Army Col. Jose Baez, commander of the Ground Systems and Munitions Division at the Defense Contract Management Agency's Chicago branch.

"Some people may think this looks easy, but it's all because of synergy," he said. "There's a lot of team playing."

Thompson agreed.

"There's a long-standing and very positive relationship between DLA and Oshkosh," Thompson said at the end of the

visit. "I think it's a particularly important time for all of us to be aligned on effort and focus."

Rhem works in the Defense Logistics Agency's strategic communications office.

DARPA Program Brings Sci-fi Capability to Warfighters

AMERICAN FORCES PRESS SERVICE (OCT. 16, 2009)

Donna Miles

WASHINGTON—Moviegoers were captivated as they watched a metallic assassin morph before their eyes in "Terminator 2." The villain turned to liquid before assuming new forms capable of squeezing through narrow openings and transforming its arms into bladed weapons and solid metal tools.

Scientists at the Defense Advanced Research Projects Agency were wowed too. Now they're working to deliver that same kind of technology to support the good guys: warfighters on the battlefield.

Mitchell R. Zakin, program manager for DARPA's Programmable Matter division, said he's convinced the concept depicted for decades in blockbuster movies and comic books has real-life applications.

He's leading up the effort to develop "programmable matter," which he calls "the ultimate adaptable material." It will be capable of changing size and shape and taking on new properties for one use, he explained, then adapting to a whole different form for another use.

Zakin clarified that he's not out to change warfighters themselves, just the equipment they use, the clothing they wear, and the loads they carry.

"Warfighters carry an incredible amount of stuff and they don't have any more room to carry more," he said. "Yet they are facing much more complicated battlespaces. They're going into caves and working in cities. They need more sophisticated tools to deal with these environments, yet they can't carry them."

The logistical challenge of getting equipment to remote areas such as Afghanistan exacerbates the problem, he said.

Enter the concept of programmable matter, a convergence of the fields of chemistry, information, mathematical theory, and engineering.

Zakin envisions a day when warfighters will be able to reach into their kit, pull out a lump of programmable matter, and form it into whatever they need.

Think of it as carrying a paint can with a bunch of particles inside, he advises anyone struggling to understand how it all would work. The particles could be different shapes and sizes, be made up of different materials and have different functions.

Depending on the requirement, the warfighter would instruct the particles to become whatever was needed at the moment—a wrench, a hammer, a spare part. The particles would then organize themselves to form it. After using the device, the warfighter would return it to the bucket, where it once again would become a bunch of particles until instructed to become something else.

The same principle would work for uniforms, which could change their thermal insulating properties according to the climate: the deep freeze of the Afghan mountains, the blast furnace of summertime in the Middle East.

Fantastic as this all sounds, it's on its way to becoming a reality.

Five university-led teams are participating in DARPA's Programmable Matter program, and by the middle of next year, at least one is expected to emerge with a demonstration project. Halfway through the program's second and final phase, all five teams are making convincing progress that it's all possible.

The teams began the first phase of the program doing computer modeling, but got so excited by the project that they jumped headfirst into the second phase and began building actual prototypes, Zakin said.

By the end of the second phase, they're expected to demonstrate that they can take a single set of building blocks and create five different geometric shapes with the strength of engineering plastic.

"Everyone is making progress toward meeting these goals in a very meaningful way," Zakin said. "I'm confident that most, if not all the teams, will succeed."

The ultimate benefit to warfighters would be mind-boggling. "Imagine the possibilities: an entire toolbox originating from a single material form, or flexible clothing or equipment that can adapt to the immediate and changing needs of the warfighter, perhaps even 'smart' bandages embedded with di-

agnostic sensing capabilities," Zakin said. "The possibilities are endless."

In the simplest terms, programmable matter would bring warfighters "maximum capabilities with minimum carry weight," he said. "It would give them the ability to carry a little amount of stuff and do a lot with it. It creates a whole new paradigm in flexibility for the warfighter."

But the implications go far beyond warfighting, Zakin said. Aircraft wings built of programmable matter could change in flight to provide the best aerodynamic properties. Everything from computers to televisions to cars could be programmed to automatically update themselves with the newest features and configurations. Clothing could morph into the latest fashion styles.

In a nutshell, nothing would ever have to become obsolete.

"This is not fantasy, actually," Zakin said. "Aspects of this already are being done in this project."

Programmable matter also has the potential of turning the entire manufacturing process on its head. No longer would one design and one manufacturing process be needed for every single consumer product.

"Personal manufacturing" could take over. Consumers could go online, buy a blueprint for whatever they need, download the instructions, then feed them into a personal assembler that makes the product before their eyes, he said.

In some ways, Zakin said he's been preparing for the Programmable Matter program since he first saw as a young boy the concept depicted in the 1950s sci-fi movie, "The Blob."

"Most of my programs come out of the movies or comic books," he said. "It's what I do for a living."

Decades later, he said, it's gratifying to be at DARPA, where he's on the leading edge of helping bring fantasy to life.

"It allows us to do something very, very important, and something no one else has ever done before," he said. "It's very DARPA-like."

Army Says Body Armor Safe, Despite GAO Report
SPECIAL TO AMERICAN FORCES PRESS SERVICE (OCT. 16, 2009)
C. Todd Lopez

WASHINGTON—Despite testing anomalies cited in a Government Accountability Office report on body armor

released Oct. 16, the program executive officer for the organization that fields new equipment to soldiers said the armor plates in question are safe.

At a Pentagon news conference just hours after release of the GAO report, Army Brig. Gen. Peter Fuller said the 85,000 "X Small Arms Protective Inserts" of interest in the report have not been fielded to soldiers and are in storage, and that the plates now in use are safe.

"We have the best body armor by far," Fuller said. "And we appreciate the oversight we get from organizations such as GAO, because what they do is ensure we provide the very best to our soldiers."

Fuller said the Army has worked closely with GAO and other organizations to improve testing and evaluation in the acquisition process, and that the Army has, in fact, made improvements. The GAO report, he said, points out pains the Army has had with improvements in its evaluation and testing processes.

"The challenge we are having with this GAO audit report is they are challenging our processes, and I think what we are really identifying is we have had an evolution of processes and we need to better articulate what we are doing there," he said.

The 85,000 inserts in question are ceramic plates that fit into tactical vests for wear by soldiers to provide protection against projectiles and fragmentation. The GAO report questions the Army's adherence to some testing protocols when evaluating the plates.

"Overall reliability and repeatability of the test results are uncertain," the report said.

Fuller said the Army is conducting additional testing on the plates to document their safety in compliance with standards. Phase II testing, he said, already has been conducted, and Phase III testing will start in November.

"We told GAO [and] we told the Hill yesterday, we are interested in taking all this data, the Phase II testing, Phase III testing, the additional surveillance testing—wrap it all up in one report and provide it back to the Hill," Fuller said.

Fuller said he hopes to articulate to both GAO and Congress that although Army testing protocols have experienced challenges, the armor is, in fact, safe. Phase II testing on both plate designs in question have shown a "very high statistical confidence interval," the general said.

"They are fantastic plates," he added.

Lopez writes for Army News Service.

Office Seeks Balance Supporting Current, Future Warfighters

AMERICAN FORCES PRESS SERVICE (OCT. 29, 2009)

Jim Garamone

WASHINGTON, Oct. 29, 2009 - It's a fine balancing act for the office of the Pentagon's director of defense research and engineering: how does the department fulfill the needs of today's warfighters and the needs of servicemembers a generation from now?

The office has several functions, director Zachary Lemnios said during an interview with American Forces Press Service. One is to prepare for an uncertain future by investing in science and technology across the department. Another function is to find ways "to take early results from the science and technology community and quickly transition them to the warfighter," he said. A third function, he added, is to improve early technology testing activities to control cost, schedule, and risk in Defense Department acquisition programs.

"My mantra for this organization is innovation, speed, and agility. We're trying to innovate at speed with a lot of agility," Lemnios said.

This signifies a cultural shift in the organization, which in the past focused more on future capabilities.

"Everyone wants to get capability into the hands of those in theater as fast as possible," he said, "but the building doesn't always work on those coordinates, and we're trying to work it in that direction a bit."

The effort has the absolute endorsement of combatant commanders and the secretary, Lemnios said, and brings together the Service science and technology community and agencies such as the Defense Advanced Research Projects Agency.

The office cannot stand by when servicemembers are putting their lives on the line fighting two wars, and the director called getting new capabilities to warfighters "a contact sport."

"We need to find ways to work with acquisition and science and technology organizations inside and outside the department to identify those core capabilities and find ways to transition them to use," he said.

The classic example is the mine-resistant, ambush-protected vehicle. The vehicle went from a combatant command request in 2004 to fielding more than 16,000 vehicles by 2008. Industry ramped up production to 1,200 vehicles a month, and is still projected to produce 1,000 MRAPs in December.

"It's a stellar program," Lemnios said, "because it brought the science and technology community together with the combatant commands together with skill sets we had in department to build an entirely new vehicle."

The MRAP is a V-hulled vehicle that mitigates the effects of a roadside bomb. The office worked closely with the Marine Corps Combat Development Center, the Army Tank Automotive Research, Development, and Engineering Center, and with Aberdeen Proving Ground to validate the concepts, the director said. "We shortened the acquisition time [and] went through all sorts of new lanes to make that happen, so it didn't take five years to make," he said.

Now the organization is heading a new effort to get all-terrain versions of MRAPs— known as M-ATVs— to Afghanistan. This is an entirely new design with much of it done in-house—a break from past practices of taking designs from the private sector. The first M-ATVs arrived in Afghanistan this month, with many more coming.

Another example of getting technology to the warfighters is the recommendation to send A-160 Hummingbird autonomous helicopters to Afghanistan to handle resupply missions to remote forward operating bases. These unmanned helicopters belong to the Defense Advanced Research Projects Agency. The A-160s are capable of delivering 1,500-pound cargos and flying 1,700 miles.

A third effort looks to reduce the energy footprint of forward operating bases in Afghanistan. The office sponsored a team in the region to perform an energy survey. "If we can cut down on the number of fuel and water truck drivers, we would help a lot," Lemnios said.

Listening to and dealing with combatant commanders is imperative for the science and technology communities, Lemnios said. "We've got to be cognizant of the needs in the field," he said.

The office must be responsive when combatant commanders submit joint urgent operational needs statements. These are needs that they see as life-threatening or have a significant near-term impact.

"We vet all of those and match what the [combatant commanders] need with what we understand from the [acquisition and science and technology] community," he said.

The office "translates" each community to the other. Lemnios also manages the Joint Rapid Acquisition Cell, which matches the combatant commanders' needs with private technologies.

Lemnios has met with five combatant commanders to try to understand the seminal needs that they want to see in place. He asks them what capabilities they would like to have in a perfect world. They need to get beyond the processes, he explained, and look to those capabilities without self-censorship.

The office has connected with the 65 science and technology advisors working for the combatant commands, Lemnios noted. And while the office is working to help warfighters today, it also has a responsibility to maintain the U.S. military's technological edge for the future.

Lemnios' office oversees DARPA, and coordinates research work by the Army, Navy, and Air Force laboratory commands. "The role for this office is to [assemble a coherent] strategic plan for the entire scope of investments—that's people and ideas for the strategic future," he said.

The fight against terrorism will take years. "The key is to find a way to use advanced technology as a force extender and a lever," Lemnios said. It also is about identifying potent new technologies, he added, noting the value of unmanned aerial vehicles on today's battlefields.

"There was no requirement for UAVs 20 years ago," he said.

The organization is working to take core ideas and move them out of the science and technology realm and into acquisition. The budget for science and technology is growing by a few percent each year, Lemnios said. "The growth is healthy and appropriate," he said.

The office stood up a systems engineering directorate targeted at helping major defense programs through the milestones. These experts also will study the early architectural trades for a system.

"Seventy to 75 percent of a system's cost is determined before Milestone A," Lemnios said. "Once you lock down the system architecture, you've essentially nailed the program cost."

"It's like building a home," he continued. "You want to spend a lot of time with the architect and the builder up front so you minimize the changes downstream. Every one of those change orders costs you a bundle."

Lemnios opined that the next big technology breakthrough may have to do with "our ability to communicate with systems in a very natural way."

"We will be building systems that really do have cognitive abilities to understand the user—whether it is a computer system or whether an information system or a robotics system," he said.

Some systems already approach the ability to mimic human language understanding, and in some cases learning and reasoning, he said. "So you can think of, for example, a computer that you can have a conversation, and it will respond to you in the correct tone, or even perhaps with gestures."

This technology exists to some extent today, he said. "Within five to 10 years, you will see robotics systems you actually interact with at the human scale," he predicted. "That's going to be a revolution."

Managing vast amounts of information is another problem technology must address, Lemnios said.

"So if you look in theater today ... it is trying to manage enormous sensor data, working with multinational troops and do it in a way that is time critical, that is persistent across large areas," he said. "Trying to manage that info and find the hidden features in large data sets. If we could really build information systems that allow the analyst to interoperate with that data in a natural way, it would have a huge impact."

Army Testing XM-25 'Smart' High-Explosive Weapon For Soldiers

ARMY NEWS SERVICE (NOV. 10, 2009)

Army Lt. Col. Christopher Lehner

FORT BELVOIR, Va. —A soldier successfully shoulder-fired a "smart" High Explosive Airburst, or HEAB, round for the first time Aug. 11 from the XM-25 weapon system at Aberdeen Test Center, Md.

The Army plans on purchasing more than 12,500 XM-25 systems starting in 2012, which will be enough to put one in each Infantry squad and Special Forces team, according to officials at Program Executive Office-Soldier.

At first glance, the XM-25 looks like something out of a Sci-Fi movie. It features an array of sights, sensors, and lasers

housed in a Target Acquisition Fire Control unit on top, an oversized magazine behind the trigger mechanism, and a short, ominous barrel wrapped by a recoil dampening sleeve.

Unlike a Hollywood prop, however, this weapon is very real and designed to accurately deliver an explosive round that neutralizes targets at distances of up to 700 meters—well past the range of the rifles and carbines that most soldiers carry today.

"What makes this weapon system truly revolutionary is the ability to target the enemy, pass on this information to the sensors and microchips of its 25mm HEAB round, and have that round detonate over the target," explained Maj. Shawn Murray, a Soldier Weapons assistant product manager in PEO Soldier, the organization responsible for developing the XM-25.

"When the HEAB round explodes, the target is peppered with fragmentation," Murray said. "Our studies indicate that the XM-25 with HEAB is 300 percent more effective at incapacitating the enemy than current weapons at the squad level."

Because of the XM-25's unique T AFC and HEAB round, Soldiers will be able to engage enemy forces located in the open and "in defilade"—behind cover, such as walls, rocks, trenches, or inside buildings. The semi-automatic weapon's magazine holds four 25mm rounds and can be employed at night or during inclement weather thanks to the XM25's built-in thermal sight.

After only five minutes of instruction at the Aberdeen Test Center, Sgt. Logan E. Diveley from the 180th Infantry Regiment was able to put his first HEAB round through a building's window and take out an enemy mannequin at 200 meters.

When asked what he thought of the weapon, Diveley responded, "I've been in over nine contacts with the enemy during my two tours in Iraq. Their ambushes were usually initiated with an IED and followed up with small arms fire from behind walls and buildings, places where it was hard for us to get at them. The XM-25 would have taken care of things and made our jobs much easier."

Once downrange and in the building where the defeated enemy mannequin lay, Maj. Murray noted the limited collateral damage associated with the XM-25.

"Because of its pinpoint accuracy and relatively small warheads, the XM25 can neutralize an enemy without the need

to destroy a whole building," Murray said. "For our counter-insurgency operations to be successful, it is important to keep collateral damage to a minimum and to protect the civilian population. I think the XM-25 will prove itself many times over in Afghanistan," Murray said.

The XM-25 is being developed by PEO Soldier, the Army acquisition organization responsible for nearly every piece of equipment worn or carried by Soldiers. This includes items ranging from socks, to weapons, to advanced sensor and communication devices. PEO Soldier bases much of its work on the feedback from individual soldiers, developing or procuring solutions to meet those needs.

The development of the XM-25 is one such a program, designed to provide soldiers a solution for dealing with enemies in the open and behind cover that is more precise, quicker to employ, and more cost-effective than mortar, artillery, or airstrikes.

Lehner writes for PEO Soldier—Soldier Weapons.

Logistics Chief Lays Out Challenges in Afghanistan

AMERICAN FORCES PRESS SERVICE (NOV. 23, 2009)

Jim Garamone

WASHINGTON—Everything in Afghanistan—including combating improvised explosive devices—is made more difficult because the nation is at the end of a long and complicated logistics trail, Under Secretary of Defense Ashton B. Carter said Nov. 23.

Carter, who is in charge of acquisition, technology, and logistics, provided insight about his office during a Pentagon roundtable meeting with reporters. He said there is no higher mission than devising ways to counter the IED threat.

"Getting things into Afghanistan, which we need to do as quickly as we possibly can do it, is very difficult," Carter said. "Next to Antarctica, Afghanistan is probably the most in-commodious place to be trying to fight a war. It's landlocked, rugged, the road network is much thinner than Iraq, and it has fewer airports."

Added to the challenge of supplying Afghanistan is the need to get military materiel out of Iraq on deadline, making for an incredibly complicated process.

Some of the things that have worked well in countering roadside and car bombs in Iraq—intelligence, surveillance, and reconnaissance aircraft; mine-resistant, ambush-protected vehicles; and additional infrastructure—are more difficult to get into an austere environment like Afghanistan.

"It's not a matter of just make it and fly it over there," Carter said, citing the MRAP vehicles' need for concrete slabs as an example. "There's no place to get concrete in Afghanistan; you have to get it from Pakistan," he said. "We can produce MRAPs faster than we can introduce them to soldiers and Marines."

The soldiers and Marines need to get the vehicles, learn to drive them, learn their strengths and weaknesses, and then get into the fight with them. "For want of a nail—everything is like that in Afghanistan," Carter said, noting the old proverb that underscores how lack of even the smallest things makes Afghanistan a challenge.

Carter and Marine Lt. Gen. John Paxton, director of operations for the Joint Staff, are in charge of the Pentagon's new Counter IED Task Force. "When I was offered this job by Secretary [Robert M.] Gates, he said the troops are at war, the building is not and especially acquisition, technology, and logistics," he said. "I've tried to change that."

Carter noted that Gates wants more efficiency in countering IEDs—the leading killer of U.S. forces in Afghanistan. "The secretary would like the department as a whole to quickly get up to the learning curve that took a number of years in Iraq," he said. "That means to bring together all the pieces that are already working on the problem."

This includes the Joint Improvised Explosive Device Defeat Organization; the Intelligence, Surveillance, and Reconnaissance Task Force; the MRAP Task Force; various organizations in theater, and the Service labs and operators, Carter said.

"All are doing good work, but the charge is to get them all together and make the whole greater than the sum of its parts," he said.

There is no silver bullet against IEDs, the under secretary said, and there is no one material solution. His group is looking at anything and everything that can be effective—now. "It's a six-month effort," he said. "So it is intense, and won't do something that will make us better in two years, but two, four or six months from now," he said.

The logisticians have done a great job in supplying American troops with what they need, when they need it, DoD officials said, but the next months will challenge them. Between 50,000 and 60,000 U.S. soldiers and their equipment will leave Iraq after national elections there next year. By the end of 2011, all American forces are to be out of Iraq.

Among the logistics questions that need to be answered is, does the equipment come back to the states to reconstitute the Army? Does it go to the Guard and Reserve? How much should go directly to Afghanistan? How much should stay in pre-positioned stocks in Kuwait? How much should go to Iraqi security forces?

It is not as simple as loading it aboard a ship or plane and taking it away, Carter said.

"It's quite a challenge," he said. "You have to figure out where everything goes that is going out."

Progress Continues for Joint Light Tactical Vehicle

AMERICAN FORCES PRESS SERVICE (NOV. 24, 2009)

Donna Miles

WASHINGTON—A program to develop a new family of light tactical vehicles for Army, Marine Corps, and special operations forces is moving ahead at full steam, almost halfway through its technology development phase.

The joint light tactical vehicle is an Army, Marine Corps, and U.S. Special Operations Command program to replace the Humvee with a family of higher-performing, more survivable vehicles able to carry greater payloads, said Kevin Fahey, Army program executive officer for combat support and combat service support during a recent interview.

The goal, he explained, is to fill a critical capabilities gap while developing a family of vehicles capable of performing multiple missions and sharing common components.

The Army, lead agent for the program, announced just over a year ago that it had awarded three contracts valued at about \$166 million for the program's 27-month technology development phase. The three contractors are BAE Systems Land and Armaments, Ground Systems Division; General Tactical Vehicles, a joint venture between General Dynamics Land Systems and AM Genera; and Lockheed Martin Systems Integration.

During this phase, each of the three competing contractors is developing prototype vehicles in three different payloads configured for specific operational missions, Fahey said.

Category A is intended for general-purpose mobility and would carry the lightest payload, about 3,500 pounds. Category B models would transport infantry troops or weapons, serve as platforms for command-and-control and reconnaissance missions, and carry payloads in the 4,000-to-4,500-pound range. Category C models would serve as

shelter carriers, prime movers and ambulances, and would carry payloads just over 5,000 pounds.

The vehicles are being designed with an "open architecture" concept to accommodate extra armor, sensors, radios, or other equipment, as required, without sacrificing power or payload, Fahey said. In addition, the vehicles will have a digital architecture incorporated into their design to support current networking requirements, as well as on-board diagnostics so they're easier to maintain.

As a unique twist to past development programs, the contractors are developing prototype companion trailers along with the tactical vehicles, with both meeting the same standards. "In the past, we rarely developed a trailer with its vehicle," Fahey said. "So the focus of this program is to demonstrate the maturity of the technology in an integrated platform."

By the year's end, the three contractors are expected to provide the vehicles and associated equipment for performance and reliability testing. Joint warfighters will provide their personal assessments.

The trick, Fahey said, is to avoid the pitfall of adding new requirements along the way that's plagued many past development programs.

"Our system very much opens the door up to, 'Wouldn't this widget be neat?'" he said. "This is the phase where we need to prove that the technology is mature and can be integrated. ... We continue to emphasize to them that it has to be integratable, because when we make a decision at the end of this phase, we are going to execute."

When that decision is made, Fahey said, he feels confident it will be based on proven performance that demonstrates it can meet delivery goals. A production decision is expected by the end of 2014, with full-rate fielding to begin in 2016.

Fahey emphasized the benefit of designing the next-generation light tactical vehicles from the ground up for their specific use rather than simply being adapted to meet operational requirements.

The military's fleet of Humvees, estimated at about 160,000, was developed in the 1970s and delivered in the early 1980s with a focus on Cold War threats rather than on today's needs, he noted.

When the vehicles proved vulnerable to roadside bombs in Iraq and, increasingly, in Afghanistan, the military responded



A technology demonstrator for the joint light tactical vehicle, developed by the Office of Naval Research, was among possible replacement vehicles displayed at the Nevada Automotive Testing Center outside Carson City, Nev., in March 2008.

U.S. Marine Corps photo by Marine Cpl. Eric C. Schwartz

by adding heavy armor plating. The typical Humvee was designed to weigh a maximum of about 12,000 pounds, but now weighs closer to 18,000 pounds.

"It's way overweight, so it is underpowered, and mobility is lacking," Fahey said. "Another problem is [that] they don't have the payload they used to."

Mine-resistant, ambush-protected vehicles, in contrast, were purchased essentially as quickly as they were built to meet a wartime requirement quickly.

"With the MRAP, the thought was, 'I need a more survivable truck that is available today to save soldiers' and Marines' lives,'" Fahey said. "We made the requirement meet what was available."

Fahey is quick to note that there's really little about the MRAP that's "light," but he recognizes that MRAPs are being used in the combat zones for missions typically conducted by light tactical vehicle crews.

Fahey welcomes the deliberate process and long-term focus being dedicated to the joint light tactical vehicle's development.

"Unlike MRAP, which we basically bought off the shelf and tested as we fielded it, we are designing [the joint light tactical vehicle] from the start with a focus on reliability and maintainability and commonality," he said.

Although the Army is leading the program, it's done "a fantastic job of integrating Marine Corps management" into the effort, said Bill Taylor, executive officer for the Marine Corps' land systems programs.

The biggest challenge in a joint program, Fahey said, is agreeing to a common set of requirements. The Marine Corps puts the highest emphasis on making the vehicles lightweight to meet its mobility requirements. The Army tends to focus more on troop protection.

"But I think we can come to that balance because of the way the program is structured," Fahey said. "After all, the bottom line is we all are in the same fight."

The program has received a lot of international attention, too. Australia and India both signed agreements to provide development support and share the associated costs, and other countries have expressed interest in participating as well.

"Everyone is interested," Flahey said. "When you go around the world, everybody has this capability gap that we are focused on: the light tactical vehicle that brings a balance of performance and protection."