

versions of integrated UGS such as BAIS, autonomous UGVs such as the Mobile Detection Assessment Response Systems (MDARS) and remotely operated unmanned weapons systems. Block upgrades to the MDARS UGV platform will provide an autonomous capability to patrol, detect, assess and respond to tactical security threats. Advanced imaging sensors with targeting capabilities, improved UGS and unmanned aerial vehicles (UAVs) will all be networked to deploy, detect, monitor and report enemy intrusions.

Future Force Protection (FY12+)

Beyond FY12, TFP will be the fully integrated systems architecture that will plug into the Future Force's C4ISR systems architecture. A single soldier will be able to control multiple force protection unmanned systems/sensors to detect, assess and respond to enemy activity in a fully autonomous mode. Robotics platforms such as MDARS will employ smaller UGVs in military operations on urbanized terrain and other tactical operations to search for enemy snipers, booby traps

and unexploded ordnance. UAVs will provide aerial force protection over vast battlefield areas and will be linked to UGVs on the ground. Unmanned systems will be used to autonomously respond to enemy security intrusions with both lethal and nonlethal force. This futuristic approach is designed to protect the force, reduce TFP manpower requirements and allow Soldiers to focus on their wartime mission requirements.

We have a long way to go to stop the force protection threat that our Soldiers face every day. The strategic pause ended after September 11, 2001. Our Nation is at war, and we are transforming the Army to become more lethal, deployable, agile, versatile, responsive and sustainable regardless of where the mission takes us. To accomplish this, we must provide the best available force protection technology and systems to Soldiers today while we continue developing and refining the total TFP package for the future. The Army is investing heavily in GWOT. We must do everything possible to reduce the risks associated with combat operations. TFP provides Soldiers

with an affordable and operationally effective means to protect themselves while also reducing casualties and conserving manpower.

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Army Science and Technology – Working for Soldiers

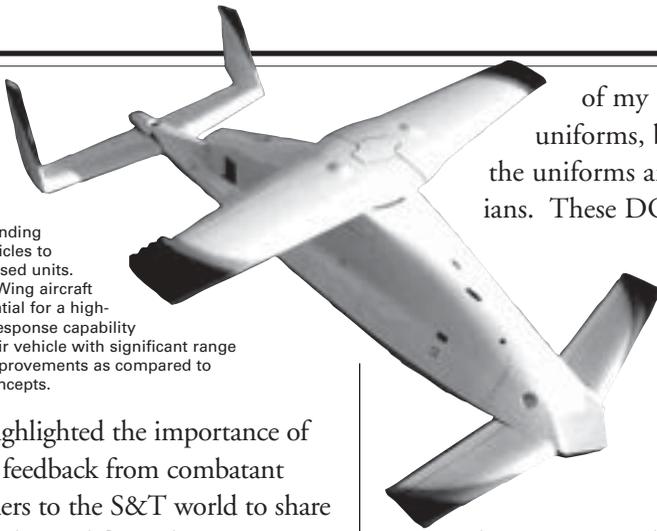
MAJ Dennis Ellison and Meg Williams

The Association of the United States Army Winter Symposium and Exhibition, held in Fort Lauderdale, FL, March 3-5, 2004, devoted its first day to "Science and Technology (S&T) for the Current and Future Force," marking S&T's strategic importance to warfighting now and in the future. Following are highlights from the presentations and panel discussions.

GEN Paul J. Kern, Commanding General, U.S. Army Materiel Command (AMC), discussed how AMC is working to integrate S&T efforts into better materiel for Soldiers — from improved batteries and sensors and lighter protective gear to increased human performance through better training.

Kern discussed how AMC is working more jointly, integrating feedback from sources other than the Army and searching worldwide for leaps in technology.

The Army, Navy, Air Force and Marine Corps need affordable, survivable, vertical take-off and landing (VTOL) air vehicles to support dispersed units. Canard Rotor/Wing aircraft offer the potential for a high-speed, rapid-response capability from a VTOL air vehicle with significant range and stealth improvements as compared to other VTOL concepts.



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"Success is not measured in dollars and contracts," Kern cautioned. "Success is measured in terms of Soldiers coming back and telling us that we got it right."

Rebalancing the Army

GEN Kevin P. Byrnes, Commanding General, U.S. Army Training and Doctrine Command (TRADOC), described the strategic thought behind the Army's redesigned transformation plan. Key to these changes is that the Army is at war. "When the Nation goes to war, the operational side of the Army leads change," said Byrnes. "We are incorporating lessons learned from Iraq and we are accelerating processes."

He also highlighted the importance of funneling feedback from combatant commanders to the S&T world to share the lessons learned from their successes and failures in field and urban operations environments. AMC has initiated agreements with other countries to capture advancements their technologists have made in S&T. Through AMC's Research, Development and Engineering Command, research and development is being coordinated in the Army's own laboratories as well as at partnership universities. The Rapid Equipping Force (REF) and the Agile Development Center both have teams working with combatant commanders to get products into the field faster.

"Our single purpose is to get the right technology into the hands of Soldiers as quickly as we possibly can," Kern emphasized. "We know that today our processes take too long and we're working with all these organizations and with the testing community to compress the cycle time from 2 to 10 years to 6 months."

"Equipment and gear must pass one overarching test. Does it work for Soldiers? Human engineering must be considered at the beginning of the design process. We have to design for the Soldier first," said Kern. "How we react with them, not just in the field but also in the development cycle, determines how we retain our Soldiers."

Kern also spoke of his staff's pride in working for deployed Soldiers. "Most

the optempo. The feedback we're getting from them when they come back from deployment is absolutely phenomenal," Kern remarked.

Further, Kern advised that the future will bring new equipment such as the XM-8 rifle and improved batteries, truck robotics, the TSV-1X (the high-speed catamaran the Army leases to move equipment and materiel) and new protective gear. He mentioned the Lead Systems Integrator as a new way of purchasing items for the Army.

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The TSV-1X, shown above, is one of two high-speed catamarans being tested as a logistics support platform as part of the Army's transformation plan.



This UGCV prototype is designed for endurance, obstacle negotiation and transportability. These prototypes may include unique mobility configurations (traditional wheeled/tracked to organic-mimicking, i.e., walking/crawling), exceptional drive trains, advanced structures and composites, terrain and soil analysis, sensory exploitation and interaction with robotic control architectures.

slowing down our modernization effort. Now we have troops in harm's way every day and we're no longer going to risk the Current Force."

The rebalancing required the Army to look at technology investments that industry, allies, universities and Army research labs had made and whether these technologies were mature enough to bring them to the Current Force. That includes hardware, software, training and leader development. The force will become increasingly joint, network-centric and more modular. These modernized conventional capabilities will first be seen at the battalion level in 2010 and at the brigade level in 2012.

Future Force development will concentrate first on maintaining conventional superiority and maintaining state-of-the-art information technology. At the same time, the Army realizes that its enemies will not always be aligned to traditional state boundaries. There are conflicts that are tribal in nature and span thousands of years.

The operational concept that drives Future Force transformation is how the joint force commander will employ the land force and how the combatant commander will adjust spatial battle

space variations in the future while conducting simultaneous operations across the full spectrum of conflict.

"This is how we see the future — the injection of combat forces across the battlespace," Byrnes continued. "We can't afford the time to build up a few selected ports that can handle ships and large aircraft. We have to be able to insert our force into the white space and be able to attack the enemy's center of gravity and key nodes. We can't afford a sequential, long-duration operation. This operational concept really drives the design of Future Combat Systems [FCS]."

FCS consists of 19 systems, foremost among them the network. The Army's network development effort is called Land WarNet. The Army is working with a joint committee to develop linkages and connectivity that all combatant commanders will use.

Other information technology priorities are high-performance computing and modeling and simulation (M&S). Inherent challenges of these new technologies are being able to produce the software needed, software protection, finding a trusted foundry to complete this work and information assurance. "We want to distribute code

that runs only on the machines we want it to run on," explained Dr. Charles J. Holland, Deputy Under Secretary of Defense for Science and Technology. "Our adversaries will be coming after our network and we will have to spend a lot of energy on our technology and 'red-teaming' to understand the challenges we will face."

Transformational Technologies

Army Research Laboratory (ARL) Acting Director John Miller defined transformational technologies as those that enable transformation capability — technologies applied to new systems that result in transformational capabilities. The ARL is studying applications in the following areas:

Future Force development will concentrate first on maintaining conventional superiority and maintaining state-of-the-art information technology. At the same time, the Army realizes that its enemies will not always be aligned to traditional state boundaries.

- Biotechnology: Command and Control (C2) Network for FCS and viral agents for very controlled applications.
- Robotics: perception, intelligence and C2 and human marine interfaces.
- Advanced Computing: automated target recognition.
- Power and Energy: new sources.
- Pervasive Situational Awareness: flexible displays, bioinspired networks and disposable sensors.
- 3-Dimensional LADAR (laser and radar): can see through camouflage and foliage.
- Lightweight Survivability Armor: flexible armor and lightweight vehicular armor.
- Precision Lethality: advanced energetics, dynamic retargeting and an electromagnetic gun.



The A160 Hummingbird is a UAV with VTOL ability. The A160 concept is being evaluated for surveillance and targeting, communications and data relay, lethal and non-lethal weapons delivery, assured crew recovery, resupply of forces in the field and special operations missions in support of Army, Navy, Marine Corps and other DOD needs. It is being developed as a DARPA/Army FCS Program component.

- **Micro Adaptive Flow Control:** technology that enables control of large-scale aerodynamic flows using small-scale actuators.
- **Unprecedented Mobility:** LADAR vision, autonomous tactical behavior and cooperative unmanned ground vehicles (UGVs) with unmanned aerial vehicles (UAVs) painting the scene and providing new mapping data for UGVs.

Nanotechnology is another transformational technology being used to create materials and weapon systems with unprecedented utility. Institute for Soldier Nanotechnologies Director Dr. Edwin L. Thomas, Massachusetts Institute of Technology, spoke of research being conducted on protective gear that could safeguard Soldiers from bullets, blasts and nuclear, biological and chemical weapons. He also said that nanotechnologies built into protective gear could be used to monitor Soldier performance and help with wound triage and emergency treatment.

Even the motion picture industry is getting involved by helping the Army transform its training and simulation scenarios. Dr. William R. Swartout, Director of Technology at the University of Southern California's Institute for Creative Technologies (ICT), outlined the three-way collaboration with Hollywood, the Army and academia that is developing more effective and compelling simulation to facilitate training,

ICT creates training exercises that develop Soldiers' decision-making skills using artificial environments. One ICT project, "Critical Leadership Analysis Systems," uses the case study approach to provide leadership skills to company-grade officers and their Soldiers. ICT's "Mission Rehearsal Exercise" provides M&S training in which Soldiers must confront dilemmas and make decisions under stress. A third ICT training scenario, "Full Spectrum Warrior," engages Soldiers in squad-level urban maneuvers based on Microsoft® Xbox technology.

"ICT uses the capabilities of the virtual world to better train our Soldiers for situations they have never seen before, such

as new cultures and foreign languages," explained Kern.

Dr. Gary R. Graham, Deputy Director of the Defense Advanced Research Projects Agency's (DARPA's) Tactical Technology Office, said DARPA has worked together with the REF on force protection for convoys in *Operation Iraqi Freedom*. The REF has equipped convoy vehicles with a DARPA-led technology called "Boomerang." This vehicle-mounted shooter detection and location system helps alert convoy drivers to the exact location of incoming bullets. This enables Soldiers to quickly find the source and return fire.

Graham also outlined three transformational technology projects DARPA is researching. They are:

- **High-Energy Liquid Laser Area Defense System (HELLADS):** The HELLADS program is developing a high-energy laser system that weighs considerably less than current laser systems. HELLADS will be integrated onto tactical aircraft and UAVs, thereby increasing



Figure 1. HELLADS

engagement ranges compared to ground-based systems. See Figure 1.

- **Canard Rotor/Wing (CRW):** An affordable, survivable air vehicle capable of VTOL that supports dispersed units in littoral and urban areas.
- **WALRUS:** A heavy-lift air vehicle with 500 tons of lift capability. This vehicle is envisioned to transport a unit of action from “fort to fight.”

Graham also showcased these FCS-enabling technologies developed by DARPA:

- **Jigsaw:** A LADAR sensor that can produce high-resolution 3-D data by combining information from multiple sensors and perspectives. This sensor provides “the eyes” for FCS platforms.
- **A160 Hummingbird:** A UAV with VTOL capability and a 2,000-mile plus range. The A160 concept will be evaluated for surveillance and targeting, communications and data

relay and lethal and nonlethal weapons delivery.

- **Unmanned Ground Combat Vehicle (UGCV):** The UGCV program is developing vehicle prototypes that can negotiate obstacles, transport material and exhibit advanced endurance performance.

Global War on Terrorism (GWOT)

COL(P) Joseph L. Votel, Deputy Director, Information Operations, Office of the Deputy Chief of Staff, G-3, explained how S&T is helping to mitigate problems with improvised explosive devices in the field. Votel praised the acquisition community’s REF for quickly getting tools into the hands of Soldiers. “S&T, combined with our training and intelligence communities, will help address the GWOT,” Votel said.

COL Tom Stautz, Agile Development Center Director, U.S. Army Research, Development and Materiel Command,

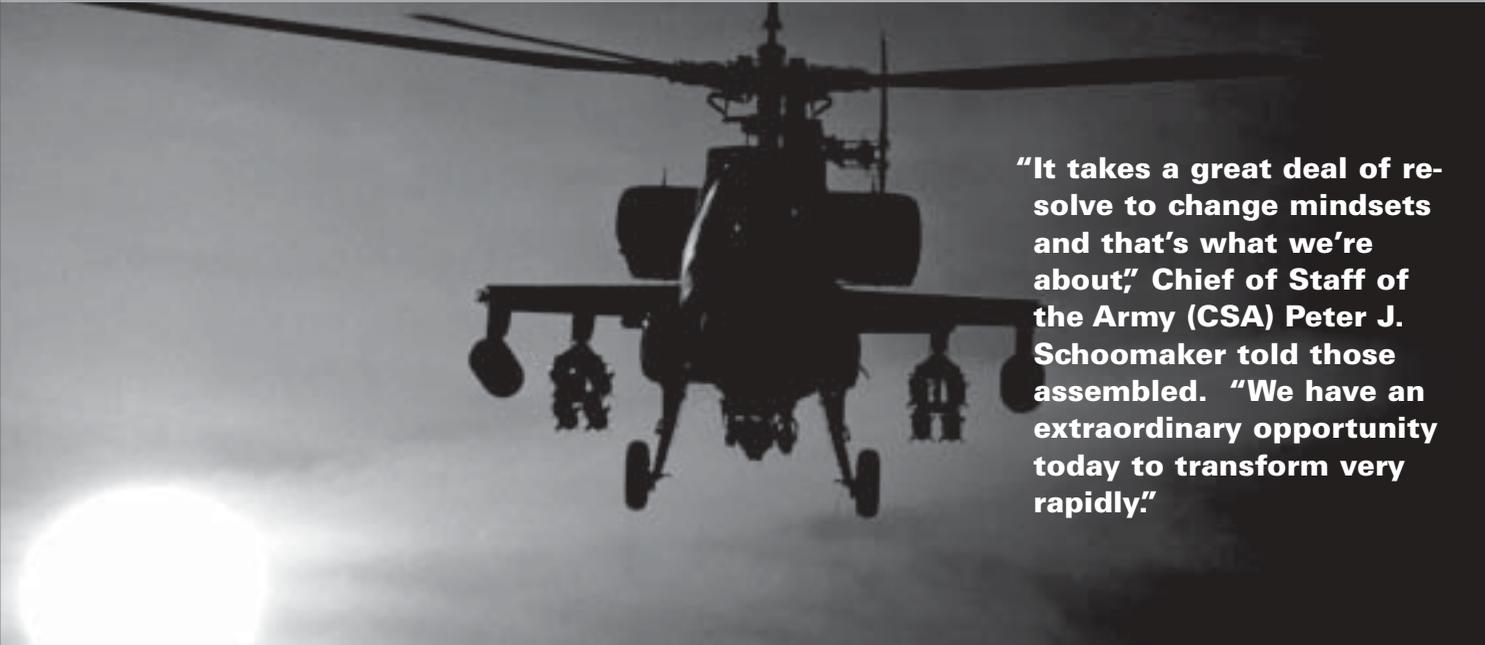
also praised the REF for its timely procurement of items such as slat bar armor for the Stryker, an expedient armor kit for the Humvee and the Phraselator, a compact device that translates phrases from one language to another.

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Transforming During Wartime – Making Tough Decisions for Army Aviation

MAJ Dennis Ellison and Meg Williams



“It takes a great deal of resolve to change mindsets and that’s what we’re about,” Chief of Staff of the Army (CSA) Peter J. Schoomaker told those assembled. “We have an extraordinary opportunity today to transform very rapidly.”