A wide range of items and systems provide today’s warfighter with contamination avoidance, protection, decontamination and obscuration capabilities. Several representative examples are provided below.

**Contamination Avoidance**

The United States has fielded several types of nuclear detection and monitoring systems to assist in contamination avoidance. A family of radioactivity detection indication and computation (Radiac) equipment is being fielded to U.S. forces to upgrade 30-year-old technology with digital equipment that incorporates advances in modern electronics.

Radiac provides soldiers and commanders with nuclear radiation detection equipment, allowing them to fight effectively and survive on the nuclear battlefield. It also minimizes nuclear radiation exposure of troops during such peacetime missions as peacekeeping, nuclear-accident response and recovery of vehicles and equipment containing radioactive material.

The AN/UDR-13 Radiac Set is a compact, handheld, pocket-size tactical radiation meter. It measures and displays gamma dose rate and total gamma/neutron cumulative dose in a battlefield environment.

A push-button pad enables mode selection, functional control and the setting of audio and visual alarm thresholds for both dose rate and mission dose. A “sleep” mode with automatic wake-up enhances battery life. A liquid crystal display provides data readout and warning-mode messages. As a replacement for the older IM-93/PP-1578, UDR-13 improvements include prompt dose measurement, including neutrons, alarms and measures rate, backlight display and stable readings and calibration. It does not need a separate charger.

The AN/VDR-2 Radiac Set detects and measures nuclear radiation from fallout and radioisotopes. The system replaces the older IM-174 and AN/PDR-27. It performs ground radiological surveys from vehicles or, in the dismounted mode, as a handheld instrument. The set can also provide a quantitative measure of radiation to help personnel, equipment and supply decontamination operations.

Components of the Radiac set include the Radiac meter IM-243, probe DT-616 and a pouch with strap. Kits are available as common table of allowances items for installation of the Radiac set in various military vehicles.

The set includes an audible and/or visual alarm that is compatible with vehicular nuclear-biological-chemical (NBC) protective systems in armored vehicles, and it also interfaces with vehicular power systems and intercoms.

The AN/PDR-75 Radiac Set measures the prompt and residual gamma doses and neutron doses stored on the DT-236 individual dosimeter from 1 to 1,000 centigray (cGy). The system provides a new operational capability to monitor and record the total dose exposure of individual personnel to gamma and neutron radiation. It measures total neutron and gamma doses from 0 to 1,000 cGy, and it responds to and measures prompt radiation from nuclear bursts. It will be used to calculate unit radiation status and to perform medical triage and assist in unit reconstitution.

The AN/PDR-77 Radiac Set detects and measures alpha, beta, gamma and X-ray radiation. The system replaces the older AN/PDR-56F and AN/PDR-60, which relied on aging technology and were not sensitive enough to accomplish the Army’s alpha detection mission.

The AN/PDR-77 incorporates commercially available measurement electronics, an alpha probe, beta gamma probe and X-ray probe. The set has a digital liquid crystal display, is auto-ranging and has settable audio and/or visual alarm thresholds.
This is the primary Radiac device to support the storage and movement of nuclear weapons, respond to nuclear accidents and maintain Army equipment containing radioactive materials.

Chemical Detection

The M21 Automatic Chemical Agent Alarm is the first standoff chemical agent detector approved for fielding to the soldier. It gives early warning of blister and nerve agents up to five kilometers, thus allowing field commanders to identify and maneuver around contaminated areas. An automatic scanning, passive infrared sensor, it detects agent vapor clouds by changes that the vapor causes in the background infrared spectra. Scanning a 60-degree arc, the M21 sounds a horn and illuminates either a blister or nerve light. It is currently being fielded. In addition to tripod-mounted configurations, the M21 is mounted on a mast on the M93A1 Fox NBC reconnaissance system.

The M22 Chemical Agent Alarm is an off-the-shelf alarm system capable of detecting and identifying standard blister and nerve agents. The M22 used the foreign comparative testing program for down-selection of the United Kingdom’s GID-3. The M22 system is manportable, operates independently after system start-up, and provides an audible and visual alarm.

The M22 system also provides a communications interface for automatic battlefield warning and reporting. The M22 is an improvement over the M8A1 automatic chemical agent alarm system in four major areas: it provides simultaneous detection and warning of nerve and blister agents; it is significantly more sensitive than the M8A1; it can operate in a collective protection environment; and it is much less responsive to interference, thus reducing false alarms. The M22 is currently fielded to the Army, Navy, Air Force and Marine Corps.

The Chemical Agent Monitor (CAM) and the Improved CAM (ICAM) provide a means of quickly locating the presence or absence of nerve- and mustard-agent contamination on personnel and equipment. CAM is a handheld device used by troops in full protective clothing after an attack or exposure to a contaminated area. It provides fast low-level detection of nerve and mustard vapors, differentiates between nerve and mustard agents, provides an indication of the relative magnitude of the hazard present and is not affected by most common forms of battlefield interference.

The use of the CAM on a chemical battlefield lowers the risk commanders may have to take when reducing the level of mission-oriented protection posture in a combat situation. CAM gives commanders the ability to quickly monitor for contamination, thereby allowing soldiers and equipment to remain engaged in their combat missions. CAM is also used to check the effectiveness of decontamination operations.

Like CAM, ICAM is a handheld, soldier-operated, post-attack device for monitoring chemical agent contamination. It detects chemical agent vapors by sensing molecular ions of specific mobilities (time of flight), and uses timing and microprocessor techniques to reject interference. The monitor detects and discriminates among nerve and mustard agent vapors. ICAM consists of a drift tube, signal processor, molecular sieve, membrane, confidence tester, dust filters, buzzer and battery pack. The monitor measures four inches x seven inches x 15 inches and weighs approximately five pounds. ICAM differs from CAM in its greater reliability (an estimated 300 percent improvement), faster start-up time (one-tenth of the time) and significantly reduced maintenance costs (an estimated $135 million cost savings over the life of the system).

The Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) is a new detection system designed to provide American 21st-century warfighters with state-of-the-art capability in detecting nerve, blister and blood agent vapor clouds. JSLSCAD is a fully automatic detection system that searches the surrounding atmosphere for chemical agent vapor clouds. It is the first chemical detection system to furnish 360-degree on-the-move coverage from ground-, air- and sea-based platforms at distances of up to five kilometers. JSLSCAD will provide warfighters of the four armed services with early warning to avoid contaminated battle spaces or, if avoidance is not possible, time to don protective masks and clothing.

JSLSCAD is a passive infrared (IR) system that detects the presence of chemical agent vapors by processing energy collected in the 8- to 12-micron region of the electromagnetic spectrum. It compares the collected IR spectra against a library of known agent spectra. When detection is made, JSLSCAD identifies the agent cloud and alerts the warfighter with audible and visual alarms.

Intended JSLSCAD applications include various ground vehicle, aerial, shipboard and fixed-emplacement platforms, including the following: M93A1 Fox vehicle; joint service light NBC reconnaissance system (JSLNBCRS); interim armored vehicle NBC reconnaissance system; Humvee C-130 aircraft; CH-53 helicopter; unmanned aerial vehicles; ships; and fixed-site installations. The design of the JSLSCAD provides for communication with the NBC joint warning and reporting network (JWARN) and the multipurpose integrated chemical agent detector (MICAD).

Biological Detection

The M31/M31A1 Biological Integrated Detection System (BIDS) mitigates the effects of biological warfare attacks during all phases of a campaign. As a corps-level asset, it is employed by a dedicated biological defense company to detect large-area biological attacks. The BIDS network provides the basis for warning and confirming that a biological attack has occurred. The system provides presumptive identification and produces a safety-configured sample for later laboratory analysis.

The M31/M31A1 detection system is made
up of a shelter (S788 lightweight multipurpose shelter) mounted on a dedicated vehicle (M1097 heavy Humvee) and equipped with a biological detection suite. The systems include a trailer-mounted 15-kilowatt generator (PU-801) to provide electrical power, a global positioning system (GPS) receiver (AN/PSN-11 PLGR), tactical and long-range communications equipment (SINCGARS and Harris HF radios) and a meteorological sensor.

The BIDS program development was initiated following the Persian Gulf War. To fill the urgent need for a biological detection system while at the same time fielding mature technologies, an evolutionary acquisition strategy was developed. Initially a nondevelopmental item (NDI), BIDS (M31), consisting primarily of off-the-shelf instrumentation, provided a limited manual detection and identification capability. This was followed by a preplanned product improvement (P1) BIDS (M31A1) with an expanded and semiautomated detection and identification capability. NDI BIDS was fielded in 1996 and the P1 BIDS in 1999 to reserve and active components, respectively.

BIDS uses multiple complementary technologies to detect various characteristics of a biological aerosol attack. BIDS integrates aerodynamic particle sizing, luminescence, fluorescence, flow cytometry, mass spectrometry and immunoassay technologies in a hierarchical, layered manner to increase detection confidence and system reliability. BIDS detects all types of biological agents and identifies specific agents of interest. The system can be easily upgraded or modified to identify other additional agents, based on changes in threat conditions. NDI BIDS will detect biological warfare agents in less than 15 minutes and identify any four agents, simultaneously, in less than 45 minutes. P1 BIDS will detect any eight agents in less than 10 minutes and identify them, simultaneously, in less than 30 minutes. Both systems collect a sample for confirmatory analysis and report detection and identification results by voice transmission.

The M93/M93A1 Fox Nuclear-Biological-Chemical Reconnaissance System (NBCRS), an upgrade to the existing M93 vehicle, detects, identifies and marks areas of nuclear and chemical contamination, and reports accurate information to supported commanders in real time.

The NBCRS provides not only an open architecture for upgrading the onboard NBC technical architecture will allow for expansion and upgrading the onboard computers at minimal cost. The Joint Services Lightweight NBC Reconnaissance System (JSLNBCRS) will provide point and standoff intelligence for real-time field assessment of NBC hazards.

The Joint Biological Point Detection System (JBPDS) is the first fully automated biological threat agent detection, collection and identification suite designed for employment by all four services.

The modular design of the JBPDS provides not only an open architecture for upgrade insertion, but also the capability to remain in operation even if one of the components fails.

The JBPDS is available in four different configurations (portable, shelter, shipboard and trailer) to provide a common detection and identification capability for joint interoperability and supportability. JBPDS integrated platforms include biological integrated detection system (BIDS), Stryker reconnaissance vehicle (RV), surface ships and joint service lightweight nuclear biological and chemical reconnaissance system (JSLNBCRS).

JBPDS also supports homeland defense operations.

The M31E2 JBPDS-BIDS is an Army variant composed of an S788 lightweight multipurpose shelter mounted on a dedicated vehicle M1097 or M1113 Humvee with digital communication (FBCB2) and an on-board generator. It is a corps-level asset employed by a dedicated biological defense company to detect large-area biological attacks.
The BIDS network provides the basis for warning and confirming that a biological attack has occurred. The JBPDF has undergone numerous developmental tests and operational trials. In the end, the JBPDF still remains the top performer for biological detection.

**NBC Protection**

The M40/42-Series Protective Masks, a family of chemical-biological (CB) protective masks, provide respiratory, eye and face protection against chemical and biological agents, toxins, radioactive particles and battlefield contaminants. The M40/42 series replaces the M17, M25 and M9 masks. Features include an improved face seal for better protection and vision, flexibility at temperature extremes, increased useful life, weather and ozone resistance, improved soldier comfort, and ease of cleaning and maintenance.

M40/42-series masks are issued to soldiers, sailors and marines—the M42A2 to armored crews and the M40A1 to the balance of the force and U.S. Army Materiel Command surety sites.

The M40A1 and M42A2 masks have a silicone rubber face piece with an inverted peripheral face seal and binocular rigid-lens system. The basic mask, the M40A1, includes a face-mounted canister with NATO standard threads (gas and aerosol filter) that can be worn on either the left or right side; a drinking tube; and clear and tinted lens “outserts.” When the canister is attached to a connection hose and equipped with a canister carrier, larger mask carrier and detachable microphone, the mask becomes the M42A2, which is used by all combat-vehicle crew personnel. The interchangeability also allows the repair of masks using a face piece assembly while retaining other existing, undamaged parts instead of a total replacement. This advance saves significant money and time.

The M45 Chemical-Biological Protective Mask replaces the M24 and M49 mask system. The M45 mask supports the Land Warrior program, as well as Joint Special Operations Command requirements, and serves as the mask for Army, Navy, Air Force and Marine personnel who cannot be fitted with the standard M40 / M40A1, M42/M42A2 or MCU-2A/P protective masks.

The M45 mask provides protection to face, eyes, head, neck and respiratory tract from chemical-biological (CB) agents and radioactive particles without the aid of forced ventilation air, while maintaining compatibility with rotary-wing aircraft-sighting systems and night-vision devices.

The M45 mask consists of close-fitting eye lenses, front and side voice-mitter for face-to-face and telephone communication, a microphone pass-through for aircraft communications, a drinking tube pass-through, a low-profile canister interoperable hose assembly to allow both hose and face-mounted configurations, interchangeable nose cups, a rubber face piece with an in-turned peripheral seal, and a second skin and hood.

Protection is provided by the agent-resistant face piece and second skin and hood.

Although all three components protect the soldier against CB agents in gaseous form, the second skin and hood provide increased liquid agent protection. The Land Warrior configuration does not include the hose assembly, hood, canister baffle, microphone or microphone cable.

The mask is available in four sizes, and the interchangeable nose cups come in five different sizes to improve fit, comfort and vision. A different nose cup configuration is available for left-hand firing. Vision-correction inserts can be fitted inside the face piece.

Close-fitting eye lenses are shaped to improve peripheral vision and are compatible with most optical sighting and night-vision devices. Easy use of a drinking system permits intake of liquids.

The XM50 Joint Service General Purpose Chemical-Biological Protective Mask (JSGPM) program will provide the next-generation mask for all U.S.-joint service ground forces.

The JSGPM requirements include meeting existing and new threats posed by both chemical and biological agents and selected toxic industrial materials/chemicals that American forces may face in the future.

Other key performance parameters include a focus on reduced weight and bulk (smaller logistical footprint), compatibility with current and emerging equipment, improved reliability and an overall improved mission performance for soldiers, aircrews, marines and sailors. The cradle-to-grave acquisition approach will also focus on reducing the total ownership cost for all services by replacing the five existing general-purpose protective masks with this one item.

The system design goals call for significant improvement (50 percent) over the M40 in the areas of breathing resistance, weight and bulk, compatibility with current and future systems, maintenance (50 percent fewer parts), and agent and toxic industrial chemical filtration included in the filter design. Production is planned to run through FY 2015 for a U.S. acquisition objective of approximately 2.2 million masks.

The M43/M48 Chemical-Biological Aircraft Protective Mask provides CB protection for Apache aviators and was designed for compatibility with the AH-64 Apache Helicopter’s integrated helmet and display sighting system (IHUDS) and optical relay tube.

The M43 mask has a form-fitting butyl rubber face piece with lenses that mount close to the eyes; an integrally attached CB hood and a skull-type suspension system; an inhalation air distribution system for regulating the flow of air to the oronasal cavity; lenses and hood; and a pressure-compensated exhalation valve assembly for maintaining overpressure in the mask and hood. The overpressure is maintained by a portable blower/filter system that operates on battery or aircraft power and which filters air through a pair of C2 canisters.

The M43-type I mask has a notched right eye lens to allow interface with the helmet display unit of the IHUDS equipment. The mask was specifically designed for compatibility with the subsystems of the AH-64, and it provides protection for the head, face, eyes and respiratory systems against field concentrations of all
chemical and biological agents in liquid and aerosol forms, and against toxins and radioactive fallout particles. Vision correction is accomplished via contact lenses. In addition, the mask provides external voice communications and a drinking tube assembly.

M43 is type-classified limited production-urgent and is currently fielded to all Army Apache pilots.

The M48 mask, chemical-biological Apache aviator, is an improved M43A1-series mask (M43-type I), that is used by Apache helicopter pilots.

The M48 mask replaces the existing M43 blower with a portable lightweight motor blower (LWMB) that provides blown and filtered air for breathing, lens defogging and head cooling, thus enabling the aircrew to perform its mission in a NBC environment both inside and outside the aircraft.

During flight operations, the LWMB will be mounted in the Apache cockpit in the same location as the M43 blower and can be quickly removed during an emergency egress procedure. The M48 was type-classified Standard A in June 1996.

The Chemical-Biological Protective Shelter (CRPS) replaces the M51 collective protection shelter. It consists of a lightweight multipurpose shelter mounted on an expanded-capacity variant Humvee and a 300-square-foot airbeam supported soft shelter.

The CRPS provides 72 hours of contamination-free, environmentally controlled working area for medical, combat service and combat service support personnel to obtain relief from the need to continuously wear chemical-biological individual protective clothing. Medical equipment and crew gear are transported inside the LMS and additional medical equipment is carried on a towed high-mobility trailer.

An engineering change (EC) is being implemented to replace the hydraulic powered environmental support systems (Model 1) components and eliminate the need to use the Humvee engine. The EC will incorporate a self-powered electromechanical environmental support system (Model 2). A contract option has been exercised to procure 26 CRPS (Model 2) systems.

Chemically Protected Deployable Medical Support (CP DEPMEDS) is a containerized set that provides Army DEPMEDS combat support hospitals with a capability to sustain operations in an NBC environment.

This modular system integrates environmentally controlled collective protection elements into the hospital to reduce casualties and enhance combat effectiveness. CP DEPMEDS uses M28 collective protection (CP) equipment, power, waste, and latrine management assets to provide an extended hospital capability.

The M20A1 Simplified Collective Protection Equipment (SCPE) provides a clean-air shelter for use against chemical and biological warfare agents and radioactive particles. The SCPE is an inflatable shelter which allows personnel to perform duties without wearing individual protective equipment. It can be used as a command, control, communication and intelligence shelter or as a soldier rest and relief facility.

Decontamination

The M291 Skin Decontamination Kit consists of a wallet-like carrying pouch containing six individual decontamination packets, enough to do three complete skin decontaminations. Each packet contains an applicator pad filled with decontamination powder.

Operating temperatures range from minus 50 to 120 degrees Fahrenheit, and storage temperatures are from minus 60 to 160 degrees Fahrenheit. Users can decontaminate their skin completely through removal, absorption and neutralization of toxic agents with no long-term harmful effects. It is for external use only and may slightly irritate eyes or skin.

Decontamination is accomplished by applying a black decontamination powder contained in the applicator pad. Application to skin exposed to contamination is explained in the technical manual. The M291 is a fielded item and replaces the M258A1 skin decontamination kit.

The M100 Sorbent Decontamination System (SDS) is another decontaminating agent. It is a free-flowing, reactive, highly absorptive powder manufactured from aluminum oxide. The sorbent system was adopted in April 1999 after passing a rigorous peer review by a team of independent nongovernment evaluators and representatives from the Army, Navy and Air Force.

The M100 SDS replaces the M11s and M13s currently used in spray-down operations associated with immediate decontamination. Each SDS consists of two 0.7-pound packs of powdered reactive sorbent, two wash-mitt-type sorbent applicators, a case, straps and detailed instructions. An additional chemical-resistant mounting bracket is available. The system uses powdered sorbent to remove chemical agents from surfaces. Using the SDS decreases decontamination time and eliminates the need for water. Each SDS weighs 4.2 pounds and fits into a 5½-inch x 6-inch x 14½-inch space. The SDS mounting bracket is designed to fit M11 mounting holes, allowing easy replacement of the M11.

Future developments include toxicology testing on the sorbent system to assess its...
acceptability to the Food and Drug Administration for use in skin decontamination and on open wounds. In addition, the SDS program will consider providing capability for contamination avoidance by providing protection of sensitive equipment. The sorbent system will also be tested against biological contaminants.

DF200 Foam is a nontoxic, noncorrosive aqueous solution with enhanced physical stability for the rapid mitigation and decontamination of chemical and biological warfare (CBW) agents and toxic hazardous materials. DF200 foam is primarily designed for suited personnel and their equipment. The foam formulation is based on a surfactant system to solubilize sparingly soluble agents and increase rates of reaction with nucleophilic reagents and mild oxidizing agents. The formulation also includes water-soluble polymers to enhance the physical stability of the foam.

DF200 was developed at Sandia National Laboratories.

DF200 can be deployed as a foam or liquid spray, with foam application being preferable in most instances. Foam application provides an easy visual reference for application coverage, an expansion of formulation to enhance area coverage per gallon, and allows the formulation to adhere to surfaces and maintain required wet contact time with the agents being decontaminated.

Components for the DF200 foam are mixed in a five-gallon bucket prior to use, then poured into the tanks and applied. The way the foam is applied can be modified by changing the tips on the 20-foot application hose. Once mixed, the foam solution has an eight-hour shelf life. The unmixed components for the foam solution have a two- to five-year shelf life.

DF200 is attractive for civilian and military applications for the following reasons: It can be used for both chemical and biological toxicants; it can be rapidly deployed; mitigation of agents can be accomplished in bulk, aerosol and vapor phases; there is minimal health and collateral damage; it requires minimal logistics support; it has minimal run-off of fluids and no lasting environmental impact; and it is relatively inexpensive.

The Fixed-Site Decontamination System (FSDS) is a truck mounted, slip-on compressed air foam (CAF) unit. It features an advanced, modular-designed component compartment with control panel and a self-contained rotary screw air compressor. Also known as the Falcon™, the FSDS is designed for durability, multipurpose use and low maintenance. The FSDS will fit in the standard bed of a pickup truck. A foam concentrate tank is built into the water tank, allowing for quick system activation and accurate foam application. Foam cell capacity is adjustable to fit specifications. Foam streams can be projected to 110 feet (34 meters) with a 1½-inch hand line and optional compressor. The FSDS is compressor-driven, with choice of gas or diesel engine.

The Multipurpose Decontamination System (MPDS) module is a follow-on development of the NATO high-pressure cleaning and decontamination system. Kärcher HDS 1200 BK, which is being used worldwide by more than 40 armed forces. Because of its modular construction, the MPDS is of universal use, either as an independent single unit or incorporated in a more complex system. The main components of the module are integrated in an aluminum frame. These are: engine drive, high pressure pump and heat exchange unit.

The MPDS module operates at temperatures from -30 to +60 degrees Celsius. For optimal functioning under arctic conditions, oil and air are preheated. Water is supplied through a self-suction siphon to a height of four meters from creeks, rivers, hydrants or water tanks. The supply with chemicals via the high-pressure pump is variable up to 60 liters per hour (16 gallons per hour). All functions are controlled by a central control panel. Temperature is variable from 0 to 210 degrees Celsius and the unit can produce cold water, hot water and wet or dry steam.

An air-cooled diesel 4.2 kilowatt engine drives the high-pressure pump, supplying the module with electric energyvia a topped generator. The engine is automatically started by a maintenance-free battery. If necessary, it can also be started manually. The fully automatic burner system operates at reverse current and is heated by diesel fuel. The temperature control regulates the burner.

The Joint Service Sensitive Equipment Decontamination (JSSED) System will provide the ability to decontaminate chemical and biological agents from sensitive equipment (avionics, electronics, electrical) and environmental systems and equipment, aircraft and vehicle interiors (during flight/ground/shipboard operations) and associated cargo.

NBC Integration Into the Army Battle Command System (ABCS)

As part of Army transformation, the U.S. Army Soldier and Biological Chemical Command (SBCCOM) develops capabilities and products for the ABCS to ensure soldier survivability, force protection and weapons of mass destruction situational awareness. The goal is to network all battlefield NBC sensors and instantly transmit NBC warnings and reports through the ABCS to minimize the effects of hostile NBC attacks or incidents on U.S. forces.

To accomplish this goal the project manager for nuclear, biological and chemical defense systems has two working projects: multipurpose integrated chemical agent alarm (MICAD) and the joint warning and reporting network (JWARN) system.

MICAD interfaces with battlefield NBC sensors, such as the advanced chemical agent detection alarms and the M93A1 NBCRS (Fox). It remotely collects data from these sensors and automatically generates NBC messages that are then transmitted to the Force XXI Battle Command Brigade and Below (FBCB²) and maneuver control systems.

The second system, JWARN, is a software application that resides on the maneuver control system (MCS). This computer program receives NBC sensor data from the battlefield and allows the user to conduct detailed NBC analysis quickly and send this information out through the MCS to Army commanders and other service components, providing decisive information to maintain information superiority and maneuver dominance.

To enhance NBC integration in the future, the Army has initiated a project
The Multipurpose Integrated Chemical Agent Alarm (MICAD) is an integrated nuclear, biological and chemical detection warning and reporting system to be used in area warning, combat and armored vehicles, and tactical van and shelter mission profiles. MICAD automates the currently laborious NBC warning and reporting process throughout the battlefield. It automates the gathering of NBC contamination data from fielded NBC detectors and sensors and automatically formats and transmits alarms and reports up the chain of command throughout the battlefield.

MICAD provides a communications interface to NBC sensors, provides warnings of chemical and nuclear attacks throughout the battlefield and automatically generates NBC-1/NBC-4 reports over existing tactical communications. It operates with the M22 and an AN/VDR-2 Radiac set. It interfaces with GPS vehicle navigation systems and modular collective protection equipment; it automates NBC report preparation (NBC-1/NBC-4) and transmission, and it communicates via single-channel ground and air radio system, FBCB2 or JWARN. Its flexible design allows its use in an area warning role with telemetry link radio.

The Joint Warning and Reporting Network (JWARN) is based on a commercial off-the-shelf software package developed by Bruhn New Tech. JWARN hazard prediction warning and reporting procedures for NBC attacks are based on standard NATO Allied Technical Publication (ATP)-45 procedures. JWARN was designed to allow warfighters to determine and display NBC hazard areas resulting from the use of NBC weapon systems and dissemination devices. JWARN has the ability to provide hazard estimates of onset times and duration of hazard. JWARN also provides database management to store information used to warn units and can generate the standard ATP-45 message set and overlays. The program operates in exercise and operational modes.

**Obscuration**

Smoke and other obscurants have been used in wars dating back to the ancient Greeks. On today’s battlefield, smoke can counter new generations of smart weapons. Smoke is used as camouflage, as blinding smoke laid directly on enemy positions and as a decoy to confuse and mislead enemy forces. These basic smoke applications are used to increase survivability, buy maneuver time for the attacker and protect forward-assembly areas and high-priority rear areas for the defense.

Smoke particles scatter or absorb radiant energy used by troops and smart weapons for target acquisition and for weapon guidance and control. Smart weapon sensors operate in three main parts of the electromagnetic spectrum: visible; near-, mid- and far-infrared wavelengths; and millimeter wavelengths.

The most effective scattering smokes are aerosols that are the same size as the operating wavelengths of the sensor to be defeated. The best smoke for the visible spectrum may be transparent in the far-infrared area. The entire chain of electro-optical, infrared and millimeter-wave devices linking a smart weapon to a target is susceptible to smoke and other obscurants. In addition to absorbing light, some smokes emit heat, which can cover or clutter the thermal images of targets.

The reflection of laser or radar beams from smoke clouds can produce false targeting information for smart weapons, which can be blinded and defeated by smoke. Battlefield obscurants allow combatants to take advantage of technology overmatch. In Operation Desert Storm, U.S. ground forces used infrared-viewer technology at night to achieve dramatic results.

The Army uses several models of smoke-generation systems, including: the M56 Coyote, the M58 Wolf, the M157A2 Lynx and the M1059/ M1059A3 Lynx. In addition, the M6 countermeasure discharger provides self-screening protection to individual combat vehicles.

The M56 Coyote Smoke-Generation System (SGS) provides large-area obscuration in the visual and infrared spectra. It is a Humvee-mounted, large-area, smoke-generator system. In addition to providing enhanced spectrum coverage, the M56 system provides smoke generators with a new wheeled-vehicle platform. The system is mounted on the new expanded-capacity M113 Humvee and provides greater payload capacity and higher mobility for supporting smoke units.

Six M56 Coyotes form a smoke platoon. They support light and airborne maneuver units by disseminating smoke on the move or from stationary positions to defeat enemy sensors and smart munitions, such as tank thermal sights, guided munitions, directed energy weapons and other systems operating in the visible through far-infrared regions of the electromagnetic spectrum. The system is modular and uses a gas turbine engine to disseminate obscurants. The visual screening module is capable of vaporizing fog oil at a rate equal to the M157 smoke generator for up to 90 minutes.
The infrared screening module can disseminate particulate material to provide 30 minutes of screening. M56 program planners cite the expanding global use of infrared targeting and sight devices for prompting development of the M56 Coyote, the Army’s first large-area smoke system capable of generating visible and infrared blocking screens.

The M56 Coyote was type-classified “standard” in September 1994 and was followed by an initial production contract award for 296 systems in March 1995. First-article and production verification testing were successfully completed in September 1996.

By the end of February 2000, 231 systems had been fielded to U.S. Army Training and Doctrine Command (TRADOC), U.S. Army Forces Command (FORSCOM) and U.S. Army Reserve Command (USARC). Fielding continues to FORSCOM and USARC.

A materiel change program to add a millimeter-wave module began in FY 2001 to provide extended spectral coverage to defeat threat weapon systems operating in the millimeter regions of the electromagnetic spectrum.

The fielding of new M56 Coyotes pushed older M157 SGs down to lower priority units. The last chemical unit with the aging M3A4 smoke-generation systems received M56 Coyotes in the first quarter of FY 2002.

The M58 Wolf Smoke-Generation System places the capabilities of the M56 on a derivative of the tracked M113 armored personnel family. In addition to its current multispectral obscurant screening capabilities, planned materiel changes will allow the addition of a millimeter-wave (MMW) obscuration module, providing the capability to counter the threat arising from the wide proliferation of advanced visual and infrared sensors and future MMW sensors.

The chemical smoke platoon consists of seven M58 vehicles. Six of these are organized into two squads of three and the smoke platoon leader leads in the seventh vehicle.

Missions include providing static and mobile visual and/or infrared screening (haze, blanket and curtain) to conceal ground maneuver forces, and supporting breaching and recovery operations.

The M58 Wolf was type-classified in August 1995. Following a successful production verification test, the Wolf received materiel release approval in the first quarter of FY 1998 and has since been successfully fielded. It was fielded to Army Reserve units, along with training, late in FY 2000.

The M157A2 Lynx Smoke-Generation System lets Army forces on the move produce large-area visual smoke screens. The system uses dual-pulse engines operating on standard Army fuels to produce large clouds of fog-oil vapor to defeat visual range observation and tracking methods, including lasers.

Its major components are two M54A2 smoke generators, an air compressor assembly, a 120-gallon fog-oil tank, a fog-oil pump assembly and a remote-control panel. The entire package is mounted on the rear of an M1037/M1097 Humvee with an M284A1 mounting kit.

The M157A2 effort emerged through a post-Operation Desert Storm integrated product team approach that targeted the earlier M54 engine on the M157 system for both operational cost reduction and simplified logistics.

Although the earlier M54 engines relied on unleaded gasoline only, the new M54A2 pulse jet engines burn any mid- to high-viscosity Army fuel—including diesel, JP4, JP8 and motor gasoline—to produce a thick white smoke cloud. Each engine is capable of vaporizing 40 gallons of fog oil in a one-hour mission.

The M1059/M1059A3 Lynx Smoke-Generator Carrier is an M113A2 armored personnel carrier modified to transport a single M157 smoke-generating set. The two generators, mounted on the roof of the vehicle under armor, are remotely controlled from inside the vehicle. A 120-gallon fog-oil tank located within the vehicle can generate smoke for approximately one hour without refueling. The Army initially fielded approximately 200 M1059 systems between 1988 and 1990. Many of these vehicle systems have now been converted to the M1059A3 configuration with the capability improvement for selected equipment power upgrade.

The M6 Countermeasure Discharger is a four-tube smoke grenade launcher that enables combat vehicles to conceal themselves from hostile surveillance, target acquisition and weapon guidance systems. The M6 can fire all Q-STAG 401 conforming grenades (66 mm) and interfaces with vehicle integrated defense systems.

The M1 Series Abrams Tank provides the Army with mobile, protected firepower and will remain the cornerstone of the Army’s counterattack and containment forces as the Army transforms to the Future Force. The Abrams tank provides soldiers with the lethality, survivability and staying power to successfully close with and destroy enemy forces on the integrated battlefield. The 120 mm main gun on the M1A1 and M1A2, combined with the powerful 1,500-hp turbine engine and special armor, make the Abrams tank particularly suitable for attacking or defending against large concentrations of heavy armor forces on a highly lethal battlefield and for other roles that require shock effect and mobile direct firepower to support Army mission requirements.

Two major programs maintain and recapitalize the Abrams fleet: the M1A2 systems enhancement program (SEP) and the M1A1 Abrams integrated management (AIM) program.

The M1A2 program provides the Abrams with the necessary improvements in lethality, survivability and fighting ability required to defeat advanced threats. It is the Army’s first digitized, direct fire, combat vehicle.

The M1A2 has a digital command and control system that provides situational awareness updates to all the other tanks in a unit. Votronics architecture ties all electronic components in the tank together and provides increased survivability and supportability. The commander’s independent thermal viewer gives it a hunter-killer capacity. The M1A2 also has improved onboard diagnostics that allow the tank to troubleshoot itself without any additional special tools or equipment.

Further M1A2 improvements, through
the SEP, are under way. The M1A2 SEP is the backbone of the Army’s first digitized division and the counterattack corps of the Army’s current force. It is the only weapon system that can withstand the impact of high-energy warheads and remain lethal in high-mobility and sustained operations. It has integrated combat command and control (IC3), which incorporates Force XXI Battle Command Brigade and Below (FBCB2) to provide command and control and situational awareness.

Its sights use the latest thermal-imaging system (second-generation forward-looking infrared or FLIR) for increased lethality and survivability. The M1A2 SEP tank takes advantage of computer/electronic industry advances by including improved electronics developed since the introduction of the M1A2. The SEP package includes a new computerized mass-memory unit and color maps and displays. A thermal management system increases electronic reliability and decreases crew fatigue.

Production deliveries of the M1A2 SEP tank began in September 1999. These vehicles were used extensively during OIF.

The Army must sustain the readiness and reduce the operations and support costs of approximately 4,300 older M1A1 Abrams main battle tanks in its active and reserve component units.

The Abrams Integrated Management Program is the recapitalization program for the M1A1 tank. Under AIM, M1A1 tanks are completely disassembled at Anniston Army Depot, Ala. The depot refurbishes many of the tank’s components. The assemblies are then shipped to the Joint Systems Manufacturing Center (JSMC) in Ohio, where General Dynamics Land Systems reassembles the tanks to a zero time/zero miles standard.

The AIM program has fielded tanks to units at Fort Hood, Texas, and in Germany. Annual production now stands at 135 tanks per year and will continue until 2012. AIM also serves as the venue to apply modifications and upgrades to the tank, including embedded diagnostics.

AIM also serves as a means to combat electronic obsolescence by introducing improved line-repeatable units (LRUs) for those that face technical obsolescence. The AIM process also incorporates redesigned hull and turret network boxes.

The Bradley M2A3 Infantry/M3A3 Cavalry Fighting Vehicle (IFV/CFV) facilitates enhanced command and control capabilities, provides mobile protected transport of an infantry squad to critical points on the battlefield and performs cavalry scout and other essential (Bradley-equipped fire support and Stinger teams) missions in the 21st century. Upgrades in this program include advanced technology in the areas of command and control, lethality, survivability, mobility and sustainability, required to defeat current and future threat forces while remaining operationally compatible with the main battle tank. The M2/M3 vehicle armament includes the 25 mm M242 Bushmaster cannon, the TOW II missile system and a 7.62 mm M240C machine gun.

The M2A3/M3A3 provides overwatching fires to support dismounted infantry and to suppress and defeat enemy tanks, reconnaissance vehicles, infantry fighting vehicles (IFVs), armored personnel carriers, bunkers, dismounted infantry and attack helicopters. The infantry version (M2) of the A3 Bradley fighting vehicle is used most often to close with the enemy by means of fire and maneuver. The primary tasks performed by the cavalry version (M3) as part of a troop and/or squadron are reconnaissance, security and flank guard missions.

The A3 is the consummate digitized platform with a core electronics architecture on a 1553 data bus and an improved target acquisition system that includes a full ballistic fire control package with hunter/killer functionality via a commander’s independent viewer (CIV). Optical improvements also include two second-generation FLIRs and day television cameras, which can be displayed to the squad members in the back of the vehicle via the rear-mounted squad leader’s display. This feature significantly improves the real-time situational awareness for the entire dismounted or mounted crew.

The A3 integrated combat command and control (IC3) package incorporates the Army’s digital command and control suite of automated messages, overlays and friend or foe graphics that meet the Army’s objectives for a fully digitized force. This same digital command and control capability was incorporated into the A2 Operation...
Desert Storm (ODS), including a squad leader’s display for messages and graphics. The new A3 variants reflect the latest iterations of a fighting vehicle family that includes the Bradley M2/M3A0, A1, A2, A2 ODS, IFV/cavalry fighting vehicle (CFV), Bradley fire support team (BFIST) vehicle and M2A2 ODS engineer vehicle. Additional Bradley variants, based on the associated tracked M270 multiple-launch rocket system (MLRS) chassis, range from command and control systems to armored medical treatment vehicles.

The M4 Command and Control Vehicle (C2V) program emerged from lessons learned during Operation Desert Storm. Based on the Bradley family’s MLRS chassis, the M4 C2V is a self-contained platform with onboard support subsystems capable of providing adequate power for mission equipment and NBC protection and environmental control.

Platform components include a primary power unit that can provide 21,000 watts of AC and 4,600 watts of DC power, an antenna compartment that supports a 10-meter nesting mast, a 579-cubic foot crew/mission equipment compartment, a biochem system (100/200 cubic foot per minute with 1.5 inches of water overpressure) and an environmental cooling unit (40,000 BTU per hour cooling).

A March 1994 engineering and manufacturing development contract was followed by three low-rate initial production awards that covered a total of 25 vehicles. The final vehicles covered under that contract were delivered in June 2001.

Although the M4 C2V program was terminated in December 1999 to provide funding for the Army’s new Stryker armored vehicle acquisition, the Army pulled the systems out of storage and issued most of them for combat use during Operation Iraqi Freedom.

The M7 Bradley Fire Support Team (BFIST) Vehicle provides an integrated Bradley-based fire support platform, based on the M2A2 ODS vehicle, that enables company fire support teams (FISTs) and company fire support officers to plan, coordinate and execute timely, accurate indirect artillery and mortar fires.

The M7 BFIST is equipped with an inertial navigation system, targeting station and lightweight computer units with the forward observer system (FOS), all integrated on a 1,553 data bus. These features provide the crew with a highly accurate point-and-click targeting capability, stationary or while on the move, day or night, under all weather conditions.

The M7 BFIST is also armed with a 25 mm automatic cannon and a 7.62 mm coaxial machine gun common to the Bradley fighting vehicle family. Force XXI Battle Command Brigade and Below (FBCB2) was fielded to M7 BFIST in FY 2003.

Combat engineer battalions in Army heavy divisions have historically traveled the battlefield in the venerable M113 personnel carrier. The M113 was the workhorse of the Army for decades and provided indirect fire protection for the soldiers assigned to ride in it and excellent cross-country mobility. The drawback to the M113 was that it could not provide sustained direct fire support nor could it maneuver with current infantry and armor weapon systems on today’s modern battlefield. In 2000, the Army made the decision to field the M2A2 ODS Engineer (ODS-E) Vehicle, which is the same as the Bradley infantry fighting vehicle variant except for the stowing of engineer-specific equipment.

With the advent of the M2A2 ODS engineer vehicle, the combat engineers now have the capability to maneuver with the infantry and armor combat systems and provide direct fire support to dismounted engineer soldiers from their own platform. The engineers will also have the onboard Force XXI Battle Command Brigade and Below (FBCB2) system that ties the engineers into the common digital picture and provides them real-time situational awareness and command and control. With the ODS-E and FBCB2, the combat engineers are able to provide even more combat power. It has been fielded to elements of III Corps at Fort Hood, Texas.

The M88A2 Heavy Equipment Recovery Combat Utility Lift and Evacuation System (HERCULES) is a full-tracked, heavy armored vehicle developed to ac-
complish safe, effective and independent battlefield recovery operations. It implements swift and effective combat evacuations through the battlefield recovery operations of towing, winching and lifting.

The HERCULES uses the M88A1 chassis modified to significantly improve towing, winching, lifting and braking characteristics. It is the primary recovery support for the 70-ton M1 Abrams tank, the Wolverine and other heavy combat vehicles.

The M88A2 includes a 1,050-horsepower engine; a 35-ton boom; a 140,000-pound, single-line, constant-pull main winch; and a three-ton auxiliary winch for deploying the main winch cable. When compared to the M88A1, these upgrades improve towing power by 25 percent, lifting capability by 40 percent and winching ability by 55 percent.

The system is in full-rate production and deployment. Fielding began in July 1997, and it achieved first unit equipped in July 1997. The first Army vehicle was delivered in January 1998.

The M113 Family of Vehicles (FOV) provides a highly mobile, survivable and reliable tracked-vehicle platform that, with upgrades, is able to keep pace with Abrams and Bradley-equipped units and is adaptable to a wide range of current and future battlefield tasks through the integration of specialized mission modules. Although not presently in new production, the 14,795 M113 FOV systems now in Army vehicle inventories constitute a significant percentage of present and future heavy division assets.

Recent activities within the M113 FOV focused on upgrading several models of the vehicles to meet or exceed the mobility characteristics of the supported maneuver force. The most recent upgrade to see wide fielding is the A3 reliability improvement for selected equipment (RISE). RISE provides various derivatives within the FOV with major performance improvements in mobility, reliability and survivability through installation of a 275-horsepower 6V53T engine with an X-200-4A transmission.

Coupled with reconfiguration of the driver’s station and several other vehicle sub-systems, these improvements provide battlefield mobility commensurate with the supported Abrams/Bradley maneuver force. Moreover, the increased performance provided by this and other upgrade packages permits a range of enhanced survivability options.

Six Army M113 derivatives have been targeted by the upgrade program to date: the M113A3 armored personnel carrier, the M577A3 armored command post, the M1064A3 self-propelled mortar carrier, the M1068A3 standard integrated command post system, the M58 smoke-generator carrier and the opposing forces surrogate vehicle (OSV).

By the middle of FY 1999, the Army had completed the planned upgrade program for the M1064A3. These upgrades, which were performed under a partnership arrangement between Anniston (Ala.) Army Depot and United Defense LP’s Steel Products Division, led to further upgrades of M113A3s and M1068A3s.

In a parallel organic upgrade program, the Army’s Alabama depot has been upgrading additional M113 systems. Recent system upgrade activities have focused on the M113A3, M577A3, M1068A3, M58 and the OSV.

The Army’s Opposing Forces Surrogate Vehicle (OSV) is designed to visually and tactically simulate the BMP-2 infantry fighting vehicle at the National Training Center (NTC) and in similar training environments. The simulation has been accomplished by adding a modified Bradley turret with other visual modifications to an upgraded M113A3 chassis (modifying former M901 improved TOW vehicles).

The OSV replaces the shrinking supply of aging and difficult to maintain M551s currently in surrogate use.

In addition to the OSV, a separate program is under way to convert excess M901A1 (M113 FOV) improved TOW vehicles (ITVs) to serve as opposing forces surrogate training system (OSTS)-main battle tank (MBT) vehicles. The OSTS-MBT is a tracked surrogate vehicle designed to operationally and visually simulate threat tanks during force-on-force training at the U.S. Army Combat Maneuver Training Centers at Fort Polk, La.; Fort Irwin, Calif.; and Hohenfels, Germany. The vehicle is an M113A3 chassis with an operational two-man turret equipped with simulated weapon systems and visual modifications.

The Small-Unit Support Vehicle (SUSV) is the U.S. Army designation for the Swedish Bv206 all-terrain personnel carrier. The SUSV is a full-tracked, diesel-powered, articulated vehicle in the one- to two-ton payload category. The vehicle’s unique steering mechanism involves articulation of the front and rear cars in relation to each other.

It is fielded in multiple configurations (M973A1 cargo carrier, M1065 command post, M1066 ambulance and M1067 flatbed) primarily to units serving in or deployed to regions with heavy snowfall. The SUSV, however, is amphibious, and is equally mobile in marshy or swampy terrain.

**WHEELED VEHICLES**

The versatile High-Mobility, Multipurpose Wheeled Vehicle (Humvee) provides a common, light tactical vehicle capability. The Humvee is the Army’s primary light wheeled vehicle for combat support and combat service support missions. The Humvee replaced the quarter-ton jeep, M718A1 ambulance, half-ton Mule, 1.25-ton Gamma Goat and M792 ambulance when it began fielding in 1985. Approximately 20,000 Humvees of all variants (including most up-armored Humvees) are currently deployed in support of operations in Iraq and Afghanistan.

The Humvee family of vehicles consists of multiple configurations built on a common chassis to support weapon systems, command and control systems and field ambulances and to provide ammunition, troop and general cargo transport. It is equipped with a high-performance diesel engine, automatic transmission and four-wheel drive. It is air transportable and low-velocity air drop (LVAD) certified (except for the maxi ambulance variants). The
Humvee can be equipped with a self-recovery hydraulic winch capable of up to 10,500-pound 1:1 ratio line pull capacity, and it can support payloads from 2,500 to 5,100 pounds (including crew and pintle loads), depending on the model.

The A1 model, which entered production in 1992, introduced upgraded driveline components, heavy-duty rear springs, an improved brake system, a high-ratio transfer and 2.73:1 front and rear differentials.

The subsequent introduction of the A2 configuration brought with it a new 6.5-liter, naturally aspirated diesel engine; an electronically controlled, four-speed automatic transmission; and a redesigned emissions system that met 1995 U.S. Environmental Protection Agency (EPA) standards. Other features focused on user comfort, vehicle maintainability and performance.

Further expansion of Humvee payload capacity has led to the development and introduction of the expanded capacity vehicle (ECV), M1113 and the M1114 up-armored Humvee (UAH). The ECV was produced in 1995 as a shelter carrier providing up to 5,100 pounds of payload. The M1114 UAH configuration provides protection for the driver and three crew members from small-arms fire, overhead fragmentation from artillery and mortar shells and underbody from antipersonnel/antitank mines. It has a rooftop weapon station which can accommodate an M60 machine gun, M2 machine gun, Mk 19 grenade launcher or the M240/M249 weapon. Kits are available to enhance internal survivability for the crew and gunner.

The newest variants of the Humvee family, the M1151 Armament Carrier and the M1152 Troop/Cargo/Shelter Carrier, began being delivered in late summer 2005. These variants are built on a slightly modified ECV chassis that enhances their payload capacity over the M1025 Armament Carrier and M1097 Troop/Cargo/Shelter Carrier. The M1151 and M1152 are being configured during production for either field installation of add-on armor packages as required by the mission or armor to be installed during production. At the same time, A0 and A1 variants of the Humvees are being recapitalized at three sites (Red River Army Depot, Letterkenny Army Depot and Maine Military Authority) to extend their useful life and improve their performance. These recapped Humvees are assigned an R1 designation for identification. Currently, recap lines are producing the M1097R1. Future plans will include all Humvee A0/A1 variants.

The Light Tactical Trailer (LTT) is the Humvee trailer. It has been tested and approved (materiel released) for use in accordance with the Humvee mission profile. The LTT comes in three variants: M1101 (LTT-L), M1102 (LTT-H) and heavy chassis (LTT-CH).

The M1117 Armored Security Vehicle (ASV) supports the military police missions of law enforcement, area security, battlefield circulation and enemy prisoner-of-war operations during wartime and operations other than war for corps-support MP companies. In addition, the ASV will serve as the convoy protection platform (CPP).

The vehicle system is a turreted, armored, all-wheel drive vehicle that provides increased ballistic and land mine protection. Its primary weapon is the Mk 19 automatic grenade launcher, but it can also mount the M2 .50-caliber machine gun. The fully enclosed turret includes a day/night sight for target acquisition. The vehicle provides all-around heavy machine gun protection for the crew compartment, weapon station and ammunition storage areas. The ASV provides overhead protection against mortars and underbody protection against mines. In addition, the armor provides overhead blast protection from IEDs and artillery. Other survivability enhancements include gas-particulate, ventilated face pieces, a multisalvo grenade launcher, a crew/engine fire suppression system, an intercom with radio interface, transparent armor and blackout capability.

The ASV production contract for 94 vehicles was awarded on March 30, 1999, with options for up to 132 vehicles. The first unit equipped was in October 2000. The contract was modified to include an additional 265 vehicles in FY 2005. A new production contract for 724 systems was awarded in June 2005. Currently 138 ASVs are deployed to Southwest Asia.

Stryker Family of Vehicles. "We must provide early entry forces that can operate jointly, without access to fixed forward bases, but we still need the power to slug it out and win decisively." This was the challenge in 1999 given by then-Army Chief of Staff Gen. Eric K. Shinseki. The response was brigade combat teams and the Stryker family of vehicles, the “vanguard for Army transformation.”

The Army’s responsibility to satisfy 21st-century requirements for effective full spectrum operations requires an improved capability for the rapid deployment of highly integrated, combined arms forces possessing overmatching capabilities, exploiting the power of information and human potential, and combining the advan-
tages of both light and mechanized forces across the full range of military and nonmilitary operations.

The Stryker was the first new combat vehicle to be acquired by the Army for more than 20 years. The primary design has two variants: the M1126 infantry carrier vehicle (ICV) and the XM1128 mobile gun system (MGS). The ICV is a troop transport vehicle capable of carrying nine infantry soldiers and their equipment and requires a crew of two, a driver and a vehicle commander. There are eight other ICV configurations with combat service and combat support roles. These configurations include the M1130 commander’s vehicle, the M1127 reconnaissance vehicle, the M1131 fire-support vehicle, the M1129 mortar carrier/XM1129A1 mounted mortar carrier, the M1134 antitank guided missile vehicle, the M1132 engineer squad vehicle, the M1133 medical evacuation vehicle and the XM1135 nuclear-biological-chemical reconnaissance vehicle. The Stryker brigade combat team (SBCT) will also be furnished with the mobile gun system. The MGS, now under development, will be based on the ICV but modified to incorporate a 105 mm turret gun, an autoloader system and a crew of three.

The ICV is armed with a remote weapons station that supports the M2 .50-caliber machine gun or the Mk 19 automatic grenade launcher, the M6 countermeasure device (smoke grenade launcher) and an integrated thermal weapon sight. The Stryker supports communications suites that integrate the single-channel ground-and-air radio system family (SINCGARS); enhanced position location reporting system (EPLRS); Force XXI Battle Command/Battle Group Area Support (FBCB2), global positioning system (GPS); and high-frequency and near-term data radio systems. The Stryker provides up to 14.5 mm of ballistic protection.

General Dynamics Land Systems produces the Stryker, which is powered by a 350-horsepower diesel engine, runs on eight wheels that possess a run-flat capability and has a central tire inflation system. It also incorporates a vehicle height management system.

The U.S. Army’s requirements for medium tactical vehicles (2.5 tons to five tons) are being met by a Family of Medium Tactical Vehicles (FMTVs) designed to eliminate medium fleet operational deficiencies long known but highlighted during the Persian Gulf War.

The medium truck fleet has historically accounted for more than half of the Army’s single-lift payload capacity. In redefining this vital fleet, Army planners took the opportunity to focus on a family approach; that is, to combine both 2.5-ton and five-ton payload classes into a single acquisition program that would yield a logistically significant degree of component commonality across all medium fleet variants.

The Army’s requirement for medium trucks now is more than 83,000 vehicles. These vehicles are required across the entire spectrum of combat, combat support and combat service support units. They must perform roles such as unit mobility, field feeding, water distribution, local and line-haul transportation, maintenance platforms, engineer operations, communications, medical support and towing artillery pieces. All medium vehicles must be capable of operating worldwide on primary and secondary roads, as well as on trails, and cross-country in weather extremes from -50 to +120°F.

The FMTV consists of light medium tactical vehicles (LMTVs) (2.5-ton payload) and medium tactical vehicles (MTVs) (five-ton payload) and comes in 14 different variants. There are cargo truck and van versions of the LMTV. The MTV line includes cargo, tractor, dump, expansible van, wrecker, long wheelbase cargo versions, materiel-handling equipped (MHE) variants, and with or without a midship-mounted winch. Companion 2.5-ton and 5-ton trailers (both airdrop certified) have received a materiel release with standard type classification and are currently being fielded to units worldwide. All FMTV variants are required to be capable of all-mode transport, including C-130 aircraft.

Cargo variants are Chinook helicopter sling-load-capable, and there are variants specifically designed to be deliverable by low-velocity airdrop to meet the needs of airborne operations.

The FMTV achieves extraordinary commonality by sharing many subsystems and components in the 4x4 (LMTV), 6x6 (MTV) and companion trailer configurations. The trucks share, for example, common engine assemblies (with different horsepower ratings), cooling systems, transmissions, intake and exhaust systems, front axles and suspension systems, tires and wheels, cab assembly, vehicle control gauges, self-recovery winches and much more. They differ primarily in number of axles (two versus three) and standard cargo bed size (12 feet versus 14 feet) to accommodate different payload ratings (2.5 tons versus five tons), as well as body styles.

The FMTV deviates from predecessor vehicle designs by having its tilt cab over the engine. This design approach contributes to the Army’s goal of significantly improving the deployability of units, since a typical FMTV vehicle is some 40 inches shorter than the vehicle it replaces, requiring less space aboard deploying aircraft or surface shipping. This reduced length also contributes to a shorter turning radius and better off-road mobility. Off-road mobility is further enhanced by a standard central tire inflation system (CTIS) and state-of-the-art suspension.

More than 4,000 FMTVs have been deployed to support Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). To address OIF/OEF survivability issues, bolt-on armor kits and low-signature armored cab replacement kits have been developed. These armor solutions were produced and installed on most mission-essential FMTVs in-theater.

The first multiyear production contract with FMTV designer Stewart & Stevenson covered approximately 11,400 vehicles (A0 models) with the first unit being equipped at Fort Bragg, N.C., in January 1996. Subsequent fielding has been with the Army’s highest-priority units, including those located at Forts Campbell, Drum, Stewart, Hood, Lewis, Leonard Wood, Huachuca, Carson, Benning, Gordon and Jackson, and the U.S. Army Pacific.

In October 1998, the Army signed a second multiyear contract with Stewart & Stevenson for approximately 7,800 FMTV A1 model trucks and approximately 1,600 trailers. Contract options have subsequently been exercised to acquire addi-
tional trucks at discounted prices. The FMTV A1s incorporate a higher horsepower, electronically controlled, Environmental Protection Agency-compliant engine with an exhaust brake to aid in braking and cold weather start-up. Also new is an antilock brake system (ABS) to improve upon an already stellar safety record, a Society of Automotive Engineers standard electronic data bus (J1939) to further facilitate platform digitization, and interactive electronic technical manuals (IETMs) to achieve “get it right the first time” fault diagnosis. The Class V IETM permits use of the Army soldiers’ portable on-system repair tool (SPORT) and newest maintenance support device (MSD) test equipment with compact disks to replace more than 28,000 pages of technical manuals that would otherwise be needed. The FMTV A1 first unit equipped (FUE) was the 10th Special Forces Group (Airborne), Fort Carson, Colo., in July 2000. Since FUE, more than 11,000 vehicles and 2,000 trailers have been fielded to units worldwide. FMTVs figure prominently in the design of the Stryker brigade combat teams (SBCTs), being second only to the Humvee in number of truck allocations. Contributing to this prominence are FMTV virtues like platform commonality, high reliability, ease of maintenance and added payload capacity with the new trailers. The FMTV trailers being fielded offer the same durability and reliability as the FMTV trucks and share payload capacities with their prime movers; that is, a five-ton truck can tow a five-ton trailer to double its payload while maintaining its substantial off-road mobility and agility. To further enhance the SBCT goal of reducing the logistics footprint, the FMTV trailers share many of the same features with FMTV trucks, including cargo bed dimensions (truck tarp and bows will fit the trailer), tire and wheel assemblies, suspension components and interchangeable sideboards.

The new FMTV Load-Handling System (LHS) 8.8-ton variant (FMTV-LHS) is functionally similar to the 16.5-ton palletized loading system (PLS) but will have a payload capacity more appropriate to other uses, such as the transport of 7.5-ton medical shelters without the need of a flatrack. The FMTV-LHS will include a companion trailer capable of being loaded by the LHS truck and of carrying the same payload. The LHS will include an onboard container-handling unit to permit self-loading and off-loading of 20-foot International Standards Organization (ISO) containers (both eight- and 8.5-foot tall) and be compatible with the Army’s standard flatbeds (M1, M1077 and M3) for other cargo types.

The FMTV chassis has also been chosen to serve as the platform for a number of other developmental systems like the high-mobility artillery rocket system (HIMARS) and the 10-ton dump truck that features an increased capacity chassis to handle increased weight and commercial dump body with a dual-cylinder, scissors-type hydraulic system.

In April 2003, Stewart & Stevenson Tactical Vehicle Systems was awarded the FMTV A1 rebuy contract, which covers 7,063 trucks and 3,826 trailers with 100 percent options. Production of these systems is expected to carry through FY 2008.

In addition to the FMTV, the Army has a large number of 2.5-ton and five-ton medium vehicles in its legacy fleet. Virtually all of the 2.5-ton trucks (pre-FMTV) in the Army were acquired during the Vietnam War. The five-ton fleet, by contrast, was in almost continuous production during the 1980s as the M939 series and is in better condition. The FMTV will eventually replace all these vehicles as resources permit.

The Army’s M915-Series Line-Haul Tractors operate on highways and secondary roads to transport bulk supplies and fuel to U.S. forces. The Army’s line-haul fleet consists of the M915, M915A1, M915A2, M915A3 and M915A4 vehicles. The latter three are based upon Freightliner’s commercial FLD120 tractors and incorporate transport industry technologies for safety, fuel efficiency and low operating costs per mile.

The M915-series fleet of vehicles is found primarily in active and reserve component transportation units that are responsible for the rapid, efficient transport of bulk supplies from ocean ports to division support areas within a theater of operation.

They are used primarily to transport the M871 semitrailer (flatbed, 22.5 tons), M872 semitrailer (flatbed, 34 tons), M967/M969 semitrailer (5,000-gallon tanker) and M1062 semitrailer (7,500-gallon tanker). The 915/916 series has a maximum gross combined vehicle weight (GCVW) of 105,000 pounds when operating with the M872 semitrailer.

The initial M915 and M915A1 line-haul tractors were delivered to the Army from 1979 to 1985. Both systems saw extensive use during Operation Desert Storm and thus far about 1,170 have been used in OIF. The Army supplemented its line-haul fleet in 1989 when it awarded a new contract for the M915A2 6x4 line-haul tractor and the M916A1 6x6 light equipment transporter. Those vehicles entered the Army fleet at the end of 1990. They were the first Army vehicles to include antilock brake systems (ABS).

In 1998, Freightliner worked with the Army to update the line-haul tractor configuration to incorporate current commercial components and technologies. The resultant M915A3 includes an electronically controlled Detroit Diesel Series 60 engine, an Allison World transmission, Freightliner’s proprietary “TuFTrac” (maintenance-free suspension for enhanced off-road mobility), air conditioning and an integrated collision warning system. The Army ordered 560 M915A3s and deliveries began in 2000.

Concurrent with the M915A3 design effort was an Army program to upgrade the aging fleet of M915 tractors that have entered their third decade of service. Working with industry, the Army adopted the commercial process of using glider kits as a cost-effective means of upgrading aging M915 tractors to the new M915A4 configuration. This program retains the original engine and rear-axle bogie from the M915 and installs them into the glider kit.

The resultant M915A4 line-haul tractor incorporates many of the M915A3 design features, including ABS, an Allison World transmission, air conditioning and an integrated collision warning system. A total of 845 M915A4 tractors were recapitalized from 2000-2003. This glider kit is being reprocured for the U.S. Army Reserve through a Freightliner contract award in June 2005 that will upgrade their remaining 500 M915 tractors to the M915A4 tractor configuration.

The M916A1, M916A2 and M916A3 Light Equipment Transporters are 6x6 tractors used primarily with the M870 semitrailer (40-ton lowbed) to transport engineer construction equipment in local, line-haul and maintenance evacuation missions under primary, secondary and off-road conditions. They have an onboard winch capable of pulling engineer construction equipment onto the M870 semitrailer. The maximum GCVW, when towing the M870 40-ton semitrailer, is 130,000 pounds. Freightliner has delivered more than 1,237 of these vehicles to the Army since 1990. Approximately 1,210 of the 916/916s are currently deployed and supporting Operation Iraqi Freedom.

In addition to these light and medium platforms, several types of heavy tactical wheeled vehicles are transforming to modular designs consistent with the Stryker brigade combat team. In FY 2004, the Army began to implement the modular design in its active component divisions. These initial conversions served as prototypes to help accelerate the modular re-design and fielding of the current and Future Force. The heavy expanded-mobility tactical truck (HEMTT) load-handling system (LHS), the container roll-in/roll-out platform (CROP) and the container-handling unit (CHU) reduce the logistics footprint of both modular Army units and the BCT. The 4th Infantry Division (Mechanized) became the first unit equipped with all these systems in late 2000.

The family of heavy tactical vehicles (FHTV) contract was awarded to Oshkosh...
Truck Corp. in March 2001. It combines HEMTT, HEMMT Recap (recapitalization), PLS and HETS production under one contract. Currently, add-on armor cab kits are being developed and produced for the HEMTT, PLS, HET tractor and the M915A2-A4 vehicles.

The Palletized Load System (PLS) is the primary component of the maneuver-oriented ammunition distribution system. Roughly 1,000 PLSs are being used in OIF. It also performs local-haul, line-haul, unit resupply and other transportation missions in the tactical environment. In addition, it is used as the prime mover for the M7 forward repair system (FRS) and various engineer mission modules (M917 dump truck, M918 bituminous spreader and M919 concrete mixer). The PLS is also the host chassis for the dry support bridge (DSB) launcher vehicle (M1975).

The PLS consists of a 16.5-ton payload tactical truck with a flatrack. It is a five-axle, 10-wheel drive vehicle with a 500-horsepower Detroit Diesel engine, an Allison automatic transmission and a CTIS. This combination provides a highly mobile system able to transport its payload in virtually any type of terrain or weather and maintain pace with the self-propelled artillery systems that it supports. The PLS comes in two mission-oriented configurations: the M1074 and the M1075.

The M1074 is equipped with a variable-reach materiel-handling crane (MHC) to support forward deployed field artillery units. The M1075, without MHC, is used in conjunction with the M1076 trailer to support transportation line-haul missions. Of the 3,500 PLS trucks that have been fielded to date, approximately 1,000 are in Operation Iraqi Freedom (OIF).

The M1076 PLS trailer is a three-axle, wagon-style trailer with a 16.5-ton payload capacity that is equipped with a flatrack that is interchangeable between truck and trailer. The combination of truck and trailer provides the combined payload capacity of 33 tons. The flattracks are lifted on and off the truck and trailer by a hydraulic-powered arm mounted on the truck, eliminating the need for additional materiel-handling equipment. The controls for the arm are located inside the cab, allowing the operator to load or unload the truck in less than one minute without leaving the cab of the truck. The trailer can be loaded or unloaded in less than five minutes using the remote-control arm.

The PLS can transport multiple cargo configurations by using a variety of flattracks. The M1077 and M1077A1 flattracks are sideless and used to transport pallets of ammunition and other classes of supplies. The M1 flatrack carries identical classes of supplies. It is ISO/CSC certified and suitable for intermodal transport, including transport on container ships.

Ammunition can be loaded on the M1 at depots, transported via container ship to theater, picked up by the PLS truck and carried forward without using any materiel-handling equipment. The walls fold inward when empty to facilitate stacking for retrograde. The M3/M3A1 container roll-in/out platform (CROP) is a flatrack that fits inside a 20-foot ISO container. The container-handling unit (CHU) is a kit installed on the PLS that allows the direct load, transport and unload of 20-foot ISO containers without an external flatrack.

The Heavy Expanded-Mobility Tactical Truck (HEMTT) is the workhorse of Army combat divisions. C-130 transportable, it is the key combat service support enabler for the SBCT. The 11-ton, eight-wheel drive family of vehicles is designed to operate in any climatic condition.

There are six basic configurations of the HEMTT-series trucks: the M977 cargo truck; M985 cargo truck with materiel-handling crane; the M978 2,500-gallon fuel tanker; the M983 tractor; the M984 wrecker; and the...
M1120 load-handling system (LHS). The HEMTT is used as a prime mover for the Patriot missile system, M7 forward repair system (FRS) and tactical water purification system (TWPS) and as the chassis for the M1977 common bridge transporter (CBT), M11428 tactical fire-fighting truck (TFFT) and XM1158 HEMTT-based water tender (HEWATT). The HEMTT is also compatible with the PLS trailer. A self-recovery winch is also available on all models. An electronic controller for the engine and a new electronic transmission were put into production in April 2002.

The HEMTT is augmented by the M989A1 heavy expanded munitions ammunition trailer (HEMAT) in the transport of multiple-launch rocket system family of munitions (MFOM). The HEMAT can transport four MFOM pods, each weighing approximately 5,400 pounds. The off-road capability of the HEMTT and HEMAT combination can transport eight MFOM pods. The M989A1 HEMAT is also required to transport six standard ammunition pallets (single stacked), two 600-gallon fuel pods, or two 500-gallon fuel bladders.

Approximately 13,000 HEMTTs have been fielded to date. Of the total fleet size, approximately 2,150 are currently in OIF. HEMTT production is funded through FY 2011.

The HEMTT was designated as one of the 10 original Army life-cycle pilot programs under Section 912c of the FY 1998 National Defense Authorization Act, intended to demonstrate reduced life-cycle costs through greater innovation throughout the product’s life cycle. The Army approved the HEMTT Recap program baseline in October 2001. The goal of recapitalization is the insertion of modern commercial technology to reduce operational and support costs, increase fleet readiness and meet regulatory requirements. As the benefits of these improvements are verified, they were phased into production and recap vehicles. The HEMTT recap program will recapitalize HEMTT vehicles to 0 miles/0 hours and to the A2 configuration, which consists of bumper-to-bumper recap of the entire truck with the following technology insertions: electronic engine, electronic transmission, air-ride seats, four-point seatbelts, bolt-together wheels, increased corrosion protection and an enhanced electrical package. The HEMTT Recap program is also capable of converting excess M977 cargo versions into M1120 HEMTT-LHS versions to address current shortfalls. The HEMTT Recap program is currently funded through FY 2020.

HEMTT A3 is an advanced technology insertion into the HEMTT vehicle that is under evaluation to optimize compatibility with C-130 aircraft capabilities and constraints.

The M1977 Common Bridge Transporter (CBT) is a modified M977 HEMTT cargo truck equipped with a load-handling system (LHS). The M1977 CBT was designed to support the Engineer Corps in transporting bridging assets in the multi-role bridge companies (MRBC). The M1977 CBT loads, launches and retrieves the ribbon bridge, improved ribbon bridge and the heavy dry support bridge using the bridge adapter pallet (BAP), equipped with a winch, which can be used to control launch bridge bays, but its primary use is to retrieve deployed bridge bays. The CBT is used as a prime mover for the rapidly emplaced bridge system (REBS), which supports the SBCTs. The CBT is equipped with a winch to assist in retrieving the deployed equipment.

The M1142 Tactical Firefighting Truck (TFFT) is a standard M977 HEMTT A2 configured chassis with an add-on commercial firefighting package. This integrated firefighting package provides the TFFT with a Class I major firefighting capability as defined by the National Fire Protection Association (NFPA) 1901 and 414 Standards. The TFFT has the same electronic engine, electronic transmission, air ride seats, four point seat belts, corrosion protection upgrade, and bolt together wheels as the A2/A2R1 HEMTT.

The TFFT operates at isolated military installations and sites worldwide to respond to, suppress and extinguish aircraft, wildland and structural fires.

The TFFT will be fielded to engineer firefighting detachments worldwide, and to the firefighting section of ordnance ammunition companies. The first unit was equipped in January 2005.

The Heavy Equipment Transporter System (HETS) deploys, transports, recovers and evacuates combat-loaded M1 tanks and other vehicles of similar weight to and from the battlefield. More than 2,300 have been deployed in OIF. The M1070 tractor and M1000 semitrailer replace the M911/ M747 as the Army’s latest model HETS.

The M1070/M1000 HETS was developed to accommodate the increased weight of the M1 Abrams family of main battle tanks. The M1070 provides line-haul, local-haul and maintenance evacuation on and off the road during tactical operations worldwide. Unlike previous HETS, the M1070 is designed to carry both the tank and its crew. Approximately 2,311 HETS have been fielded to date. Development design of full up-armored cabs for the HEMTT, PLS and HETS tractor is in progress.

The Future Combat Systems (FCS) equipped brigade combat team (BCT) is organized in combat configurations to be 100 percent mobile and completely self-sufficient for up to 72 hours of high-intensity contact upon delivery into the area of operations. Each FCS BCT echelon commander will have the combat leverage to make contact with and defeat numerically superior forces employing equal or better weapons systems. The brigade combined arms teams down to platoon level will possess systems that amplify their combat effectiveness: organic sensors, effects, intelligence, surveillance and reconnaissance (ISR) capabilities and communication links at each echelon to the joint command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) system. The FCS BCT model provides a communication connectivity that
enables the brigade commander to synchronize his deployed elements so that he can better shape the battlespace at the lowest levels. The FCS BCT will enable the commander to execute the battle with superior situational understanding, shape the battlespace with standoff precision fires and effects and ensure battlefield mobility. It will maximize the effectiveness of standoff while maneuvering on a noncontiguous distributed battlefield against an adaptive threat.

To meet the requirements of tomorrow’s warfighters, the Army’s FCS program is composed of a joint system of systems connected via networked architecture and operating together in support of every individual soldier.

**Sensors and Munitions**

**FCS Unattended Ground Sensors (UGS)** will provide a variety of remote-sensing capabilities intended to enhance the Future Force commander’s intelligence picture. As an integral component of the FCS layered sensor network, the remotely deployable UGS will provide enhanced threat warning, situational awareness and force protection in both tactical and urban environments for extended periods. The sensor family will be a self-webbing, self-healing network capable of target detection, location, tracking and aid in identification.

The FCS tactical UGS (T-UGS) will be tailorable groups of sensors using multiple sensing technologies. The UGS field will be capable of transmitting target or other information back to a remote operator and/or the common operating picture (COP) through the FCS BCT network. UGS will be used to perform various mission tasks including perimeter defense, surveillance, target acquisition and situational awareness, including chemical, biological, radiological and nuclear (CBRN) early warning and monitoring.

Urban UGS is a network-enabled, leave-behind reporting system that will bring force protection into an urban setting and provide residual protection for cleared areas or for other military operations in urban terrain (MOUT). Urban UGS will be hand-employed by soldiers or by small robotic vehicles to monitor and provide early warning and situational awareness in urban terrain.

The suite of **Sense Through the Wall (STTW) Systems** will detect, locate and “see” personnel that are hidden behind non-metallic walls, doors and other visible obstructions. Future capabilities will include concealed weapons and explosives detection. This capability has direct application to the U.S. Army, other services and Special Forces requirements for military operations in urban terrain, prisoner/checkpoint screening, or hostage recovery operations from both close-in and standoff distance. In addition, this capability is envisioned as technology that will support law enforcement organizations. The initial requirement for an STTW device is designated for it to be mounted on the FCS small unmanned ground vehicle (SUGV). Also, requirements for handheld and stand-off variants are emerging.

The **Intelligent Munitions System (IMS)** is an unattended munitions system providing both offensive battlespace shaping and defensive force protection capabilities for the Future Force.

**Non-Line-of-Sight Launch Systems (NLOS-LS)**

The Non-Line-of-Sight Launch System (NLOS-LS) is capable of providing precision non-line-of-sight fires for the U.S. Army’s modular and Future Force as well as special operations forces. NLOS-LS is an unmanned, platform independent, self-contained weapon system capable of autonomous or man-in-the-loop operations. Products under development include a precision attack missile, loitering attack missile and an autonomous container launch unit (CLU). Both missiles and the CLU contain “networked data links” enabling in-flight retargeting and mission updates. NLOS-LS will be interoperable with current and Future Force C2 systems.

NLOS-LS (PAM and CLU) have been accelerated by the Army and selected for inclusion in FCS “Spin Out 1” in 2008. NLOS-LS has joint service applicability and has been selected by the Navy for inclusion in the littoral combat ship (LCS) and unmanned surface vehicle (USV) weapon mission module concepts.

The **Precision Attack Missile (PAM)** is a direct attack missile that is seven inches in diameter and weighs about 120 pounds and will be effective against moving and stationary targets at ranges from 40 to 60 kilometers. It will include a variable thrust motor, dual-mode precision uncooled infrared/semi-active laser seeker and a large multi-mode warhead effective against both hard and soft targets.

The **Loitering Attack Missile (LAM)** is an expendable loitering, hunter-killer that is also seven inches in diameter and weighs about 120 pounds. It will be capable of searching a large area using a laser radar (LADAR) seeker with automatic target recognition. It will have a 30-minute loiter time at 70 kilometers capability using a micro turbojet engine and a warhead payload.

**Raytheon Missiles Systems Company** and **Lockheed Martin Missiles and Fire Control** formed the NetFires LLC, a limited liability company, to pursue missile and launcher development and production for the U.S. Army’s non-line-of-sight launch system, previously known as Net-Fires (DARPA). The founding companies will jointly manage the LLC. The NetFires LLC is under contract to the Army’s NLOS-LS Task Force, a part of PEO Missiles and Space of Huntsville, Ala., for SDD (system development and demonstration) of PAM, LAM and CLU. All elements have been successfully demonstrated under DARPA (Defense Advanced Research Projects Agency) contracts. Although the two missiles have significantly different mission profiles, they operate as part of a system that includes a common launcher.

**Unmanned Aerial Vehicle Systems (UAVS)**

The commander’s requirement for enhancing surveillance throughout the FCS BCT requires a strong suite of systems. These systems are organic to the unit and its subordinate organizations, functioning under a tiered approach. UAVs are part of this approach, enabling air-to-air, air-to-ground and ground-to-air teaming.

The tiered system is expressed in terms of the class of UAV that corresponds to the unit echelon they normally support: Class I UAV—platoon level; Class II UAV—company level; Class III UAV—battalion level; and Class IV UAV—brigade level.

The **Class I UAV** is controlled and operated at the platoon level within the FCS BCT and serves to provide the soldier situational awareness in diverse terrain. The Class I UAV is deployed as a system consisting of at least two air vehicles, an operator interface and all necessary equipment for operations, transport and routine maintenance. The Class I UAV consists of the unmanned aerial vehicle system, a support platform (legacy or future U.S. Army wheeled transport vehicle) and a command and control interface. In April 2004, the commanding general of TRADOC approved the requirement to field Raven or a Raven-like capability for the modular brigades and FCS-equipped UASs as an interim capability until micro air vehicle technology is available.

The **Class II UAV** is controlled and operated at the company level within the FCS BCT and serves to provide reconnaissance, security/early warning, target acquisition and designation for the infantry company and MCS platoon in support of line-of-sight/beyond line-of-sight (LOS/BLOS) and non-line-of-sight (NLOS) cooperative engagements. The Class II UAV consists of the UAS, as part of a FCS BCT vehicle with an on-board command and control interface. The Class II UAV is an integrated component of the FCS BCT weapon system. During assaults, the UAVs will be deployed or redirected in real time as required by the FCS BCT. Through UAVs control consoles, UAVs data will be linked.
through the existing C4I network to an extended group of users. The Class II UAVS is a vehicle-mounted system that will provide the infantry company with enhanced dedicated imagery. The Class II UAVS AV will have an operational endurance of one hour out to a range of six kilometers. In April 2004, the commanding general of TRADOC approved the requirement to continue development of an organic air vehicle to meet Class II UAVS requirements.

The Class III UAVS is a multifunction aerial system capable of providing reconnaissance, security/early warning, target acquisition and designation for precision fires, throughout the battalion area of influence by remotely over-watching and reporting changes in key terrain, avenues of approach and danger areas in open and rolling, restrictive and urban areas. The aerial system will provide information from operating altitudes and standoff ranges in both day/night and adverse weather. The aerial system will provide information from operating altitudes and standoff ranges in both day/night and adverse weather. The aerial system will be capable of communication relay, detecting mines, chemical, biological, radiological, nuclear (CBRN) detection, and meteorological survey for the non-line-of-sight (NLOS) battalion to deliver precision fires. All sensors do not have to be carried simultaneously as a package, with the exception of the meteorological sensor (embedded). The AV will, however, be capable of carrying an EO/IR package and/or target acquisition designation. A Class III UAVS consists of these basic elements: air vehicles (AV) with payloads, launch and recovery system, mobility platforms and transport containers for the systems. The Class III UAVS AV will have an operational endurance of six hours on-station at a range of 40 kilometers. In April 2004, the commanding general of TRADOC approved the requirement to use an increased capability Shadow UAV as threshold capability for Increment 1 FCS Class III UAVS.

The Class IV UAVS will provide the capability to impart reconnaissance, security/early warning, long endurance persistent stare, target acquisition and designation, and wide area surveillance that has the ability to team with air-ground forces throughout the FCS BCT. The aerial system will provide information from operating altitude and standoff range in day and night and adverse weather. The aerial system will be capable of acting as a communication relay, performing emitter mapping, performing CBRN detection, assisting with battle damage assessment (BDA) and performing meteorological surveys for the unit of action throughout the brigade’s area of influence.

The FCS lead systems integrator and the Army selected the Fire Scout RQ-8B as the Class IV UAV. The Fire Scout is a vertical take-off and landing (VTOL) UAV. The system will integrate a training sensor, humidity sensor, joint tactical radio system (JTRS) two-channel radio for aerial vehicle command and control, and the following plug and play mission equipment packages: EO/IR/laser designator rangefinder (LDRF), synthetic aperture radar (SAR)/moving target indicator (MTI), chemical, biological, radiological, nuclear (CBRN), signal intelligence (SIGINT) and communications relay. The RQ-8A model Fire Scout is an improved version of the basic RQ-8A model, which incorporates the following features: four-blade enhanced airfoil main rotor system, increased fuel capacity, upgraded gearbox rating and improved tail rotor. The RQ-8B Fire Scout is being integrated into the unit of action as part of the program’s system development and demonstration.

The RQ-8B Fire Scout air vehicle will be developed in a collaborative effort with the Navy. The Army will use the Navy’s contract to procure the air vehicles. Both services will have unique command and control integration contracts. FCS deliveries are scheduled to begin in FY 2007 with limited user test (LUT) starting in FY 2008 leading to an initial operational capability (IOC) in FY 2011.

NLOS Cannon

The Non-Line-of-Sight Cannon (NLOS-C) will provide networked, extended-range targeting and precision attack of point and area targets with a suite of missions that will include special-purpose capabilities. Cannon artillery remains the only immediate response, 24-hour all-weather fire support for ground forces, and recent combat experiences in Iraq and Afghanistan have reconfirmed this fact. As the Army reorganizes for the future, revolutionary cannon technologies, such as those found in NLOS-C, will make cannon artillery even more precise, mobile and lethal, and it will exponentially reduce the Army’s logistics tail.

Designed by BAE Systems, the NLOS-C is the lead manned ground vehicle of the Army’s FCS program. The development schedule calls for the first NLOSC Increment 0 prototypes to be delivered in 2008 for testing with the U.S. Army’s FCS BCT. During the first stage in NLOS-C development, BAE Systems designed and built the NLOS-C Concept Technology Demonstrator (CTD). The CTD is a fully automated, 24-ton, 38-caliber, 155-mm self-propelled howitzer test platform that has fired more than 2,000 rounds at Yuma Proving Ground, Ariz.

The CTD features a fully automated am-

The Shadow unmanned aerial vehicle system (UAVS) serves as threshold capability for Increment 1 FCS Class III UAVS.
munition handling system, with a magazine capable of holding 24 projectiles.

In November 2003, BAE Systems incorporated tactical software onto the CTD to integrate its robotic ammunition handling and auto-loading systems to create a fully automated 155 mm cannon system that enables a two-person crew to achieve what it takes five soldiers to accomplish on the battlefield. Within a month following integration, BAE Systems used the tactical software to successfully complete an eight-round fire mission at a rate of six rounds per minute, marking the first time a fully automated cannon had been fired using tactical software.

The CTD’s chassis uses band track propelled by a drive system with a diesel engine and hybrid electric propulsion system designed to improve mobility and reduce fuel consumption.

The CTD provided an early demonstration of the capabilities, performance and technologies that will be incorporated into the NLOS-C prototype and production vehicles. Throughout 2006, BAE Systems will make the transition from test firing the CTD to testing and integrating new hardware for the objective NLOS-C Increment 0 prototypes scheduled for delivery in 2008.

The NLOS-C firing platform, an early test asset for the common mission equipment, will be delivered to Yuma Proving Ground in late 2006 to begin testing and qualification of the ultra-lightweight cannon and breech.

NLOS Mortar
The Non-Line-of-Sight Mortar (NLOS-M) will provide close fire support of tactical maneuver that includes destructive and special purpose fires.

The NLOS-M is being designed by BAE Systems as a semiautomatic, single-tube, 120 mm smoothbore turreted mortar with a four-person crew in a quad-seating arrangement. The breech-loaded NLOS-M will have a range of eight kilometers, maximum rate of fire of 16 rounds per minute and a sustained rate of fire of eight rounds per minute.

With its 360-degree traversing turret and ability to carry 60 rounds in on board ammunition magazines, the NLOS-M will work as part of a NLOS-M battery, firing precision-guided mortar munitions and delivering lethal fires to destroy high pay-off and most dangerous targets and provide area suppression in support of maneuver companies and platoons.

The NLOS-M is being designed to maximize commonality with the NLOS-C chassis and mission equipment to minimize maintenance and logistics.

Ground Vehicles
The Armed Robotic Vehicle (ARV) will come in two variants: the assault variant and the reconnaissance, surveillance and target acquisition (RSTA) variant. The two variants will share a common chassis.

The Small Unmanned Ground Vehicle (SUGV) is a small, lightweight, portable UGV that will be capable of conducting military operations in urban terrain, tunnels, sewers and caves.

The Multifunctional Utility/Logistics and Equipment (MULE) Vehicle is a 2.5-ton unmanned ground vehicle (UGV) that will support dismounted operations. It will consist of four major components: mobility platform or common chassis; autonomous navigation system; operator control unit; and mission equipment packages.

The Mounted Combat System (MCS) will provide direct and beyond line-of-sight (BLOS) offensive firepower capability allowing FCS BCTs to close with and destroy enemy forces in support of the operations plan. The mounted combat system (MCS) will deliver precision fires at a rapid rate to destroy multiple targets at standoff ranges quickly and complement the fires of other systems in the FCS-equipped unit.

The Infantry Carrier Vehicle (ICV) will effectively employ weapon systems and rapidly maneuver during blackout, day and night operations, inclement weather and limited visibility periods. It will also deliver the dismounted force to the close battle and support the squad by providing self-defense and supporting fires. The ICV will consist of four platform versions: company commander; platoon leader; rifle squad; and weapons squad.

Reconnaissance and Surveillance Vehicles (RSVs) will feature a suite of advanced sensors to detect, locate, track, classify and automatically identify targets from increased standoff ranges under all climatic conditions, day or night. Included in this suite will be a mast-mounted, long-range electro-optic infrared sensor, an emitter mapping sensor for radio frequency (RF) intercept and direction finding, remote chemical detection, and a multifunction RF sensor.

The systems will also feature the on-board capability to conduct automatic target detection, aided target recognition and level one sensor fusion and will be equipped with unmanned ground sensors (UGS), a small unmanned ground vehicle (SUGV) with various payloads and two unmanned aerial vehicles (UAVs).

The Command and Control Vehicle (C2V) platform will provide for information management of the integrated network of communications and sensor capability within the FCS BCT and provide the tools for commanders to synchronize their knowledge of combat power with the human dimension of leadership.

The Medical Vehicle (MV) is designed to provide advanced trauma life support within one hour to critically injured soldiers.

The medical vehicle-evacuation (MV-E) platform will allow trauma specialists, maneuvering with combat forces, to be closer to the casualty’s point-of-injury and will be used for casualty evacuation while the medical vehicle-treatment (MV-T) version will enhance the ability to provide advanced trauma management/advanced trauma life support treatments and procedures forward for more rapid casualty intervention and clearance of the battle space.

The Recovery and Maintenance Vehicle (RMV) will contribute to sustaining and generating the combat power of the Future Force structure.