A Joint Publication for U.S. Artillery Professionals

March — April 2014 Edition

Fires

Deep Future: 2025 & Beyond

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Fires Conference 2014

Deep Future: 2025 & Beyond

Hosted by the

Fires Center of Excellence

Fort Sill, Oklahoma

May 5-7, 2014

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Fires

March - April 2014

On the cover:

Soldiers from 2nd Battalion, 44th Field Artillery, Fort Campbell, Ky., quickly reload the Counter-Rocket, Artillery and Mortar system during pre-deployment training at Fort Sill, Okla. (Photo by Marie Berberea, U.S. Army)

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Raymond T. Odierno, General, United States Army, Chief of Staff.

Official:

Gerald B. O'Keefe
Administrative Assistant to the Secretary of the Army, 1333701

Mark McDonald
Major General, United States Army Commanding General, Fort Sill, Okla.

PURPOSE: Originally founded in 1911 as the *Field Artillery Journal*, *Fires* serves as a forum for the professional discussions of all Fires professionals, both active and Reserve Component (RC); disseminates professional knowledge about progress, developments and best use in campaigns; cultivates a common understanding of the power, limitations and application of joint Fires, both lethal and nonlethal; fosters joint Fires interdependency among the armed services; and promotes the understanding of and interoperability between the branches, both active and RC, all of which contribute to the good of the Army, joint and combined forces, and our nation.

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POSTMASTER: *Fires* (USPS 309-010) (ISSN 1935-4096) is published bimonthly; periodical postage paid by Department of the Army at Lawton, OK 73501 and an additional mailing post office. Send address changes to *Fires*, P.O. Box 33311, Fort Sill, OK 73503-0311.

SUBMISSIONS: E-mail to the Editor, *Fires*, at fires.bulletin@us.army.mil; mail to P.O. Box 33311, Fort Sill, OK 73503-0311; overnight to Building 652, Room 203, Hamilton Road, Fort Sill, OK 73503; or call at DSN 639-5121/6806 or commercial (580) 442-5121/6806.

Editor-in-Chief: Shirley Dismuke

Managing Editor: Jennifer McFadden

Art Director: Rickey Paape, Jr.

Assistant Editor: Paul Jiron

The Deep Future of Fires

By MG Mark McDonald
Commanding General of the Fires Center of Excellence and Fort Sill, Okla.

The Fires Conference is upon us, and as both the theme of the conference and this publication would imply, we are dedicated to shaping our Fires Force through the year 2025 and beyond. The staff, from the Capabilities Development and Integration Directorate, Joint and Combined Integration Directorate, to the FCoE G3 is actively focused on providing a first-class conference experience. By gathering the best and brightest within the Fires profession, we can plot our trajectory for the coming decades, posturing our armed forces with the overmatch needed to secure our nation. Whether you attend in person or through Defense Connect Online, your time will be well spent and an investment in the future of the Fires Force.

While this year's theme, "The Deep Future of Fires," may provide a little drama and a lot of mystery, it forces us to consider a solid plan to get through the year 2025 and beyond. Even now we are drawing down forces, while simultaneously being charged with producing a future Army with equal or greater capabilities to what they possess today. Our requirement for a credible and capable force to truly prevent, shape and win conflicts in the years to come will not diminish. While there are too many variables beyond our control to get the future force perfect, we must strive not to get it completely wrong and lose the edge we possess to future adversaries. Our conference provides a significant step in avoiding this outcome and meeting anticipated requirements.

At stake is our ability to remain operationally decisive along our present trajectory. At our adversaries' current state of technological advance and our own rate of systems improvement, trends show our enemies could eventually surpass us in critical areas. This raises the concern that without innovation, our evolutionary approach will cause us to operate at a disadvantage within anticipated scenarios. To explore these concerns, the Army created a specific scenario for Unified Quest 2013: Deep Future Wargame

Exercise, providing an opportunity to view two outcomes for a scenario set in the year 2030. The scenarios involved the U.S. homeland being attacked with chemical weapons proliferated by 'non-state actors' working within a land-locked state in the midst of civil war and examined the outcomes of the Army's response to this contingency.

One outcome tested how the Army would perform its mission under conditions of steady-state, evolutionary improvements to our current systems with no 'game-changer' technologies fielded to the force. The second evaluated the same inputs but with advanced technologies (e.g., directed energy, vertical take-off and landing craft, and shallow-draft high speed vessels) fielded within the force that potentially shifted the advantages back to the U.S. forces' side. The two outcomes were dramatically different.

From a strategic standpoint, the course of action applying evolutionary modernization failed the mission. The rogue regime stayed in power, weapons of mass destruction were lost, and their scientists capable of manufacturing them remained unaccounted for—primarily due to lack of operational agility. The outcome shifted, however, under conditions where a more revolutionary approach to modernization was applied. An Army employing game-changing technology achieved both strategic and operational goals (all WMD either secured or fixed) primarily by achieving greater operational surprise using distributed maneuver and massing fires at decisive points. Both outcomes incurred risk, with the evolutionary approach demonstrat-

ing risk to the strategic mission and the innovative approach demonstrating tactical risk to isolated elements and sustainment.

This exercise fueled discussions at the November 2013, Senior Leader Seminar that included how to get the Army to become operationally decisive, arriving to the fight with 'speed and mass that matter.' Two key takeaways for the Fires warfighting function from these discussions were that mass still matters, though technology does allow a smaller force to 'punch above its weight,' and air and ground must be integrated with one common picture that a joint and ground integration center provides. Above all, it stressed the need to break out of our current paradigm of evolutionary improvement of our Fires systems despite the challenges of looming budget reductions.

It will be through a collaborative thought process at the Fires Conference that we begin to truly tackle the task of shaping our Fires Force. In an austere environment the most valuable and cost-effective resource is an idea that could change the way we do business. A quote often attributed to Winston Churchill, "gentlemen, we have run out of money. Now we must think." Though the quote was coined prior to World War II, the statement could just as easily emanate from the halls of the Fires Center or the Pentagon today. This means that pooling our intellectual resources and sharing ideas has got to be high on the priority list in order for the Fires Force to maintain superiority. Thinking is what we intend, as you'll see from this issue.

The 2014 Fires Conference will serve as the forum to bring together those with imagination and knowledge within the Fires community to discuss the future of fire power and manning the Fires Force. We will have members of the science and technology community discuss the possibilities associated with a revolutionary approach to modernization. Senior military leaders, including Fires, maneuver and joint, will have discussions that shape the future of Fires and our ability to support strategic land power. Registration for the conference will open soon, but begin preparing now to either attend in person if you receive an invitation or log in through DCO. We look forward to seeing and hearing from everyone on this critical issue.

Fires Strong!

CPT Rayman Billman, 1st Battalion, 204th Air Defense Artillery Regiment, Mississippi Army National Guard, writes down air traffic movements from data collected by their Air Battle Management Operation Center during a communications exercise at the Forest Multi Purpose Center, Forest, Miss. The exercise will lay the groundwork for the live-fire exercises they will conduct at their annual training this year. (Photo by SGT Tim Morgan, Mississippi U.S. Army National Guard)

The Future of Air Defense

By BG Don Fryc
Chief of the Air Defense Artillery and Commandant of the U.S. Army Air Defense Artillery School, Fort Sill, Okla.

Two years ago the Department of the Army developed the 2012 Air and Missile Defense Strategy with the intent to provide direction and guidance for the entire Air Defense Artillery force. Embracing the new strategy, we have continued throughout this past year to work on elements and initiatives that support the four lines of effort that were introduced: attain networked mission command, enable the defeat of the full range of air and missile threats, build partner capacity and maintain forward presence, and transform the AMD force. As the educational institution, we have been deeply involved with all four lines of effort as we work together with other Fires Center agencies to advance the concepts of Army Integrated Air and Missile Defense which underpin this strategy. At the upcoming Fires Conference, we will discuss these topics in much greater detail; for now, at the 'wavetop' level, I will address some of the ways we have executed various ways and means of the AMD Strategy to ensure we arrive at the desired outcomes of the four lines of effort.

Attain Networked Mission Command. Networked mission command is the foundation for AIAMD, and at its heart is the Integrated Battle Command System. The ADA community is continuing to develop operational concepts for that capability through working groups, demonstrations, and immersion days with industry. In October and November 2013, an extensive AIAMD demonstration afforded operators, as well as key

leaders, the opportunity to 'test drive' IBCS software and hardware prototypes, all of which were enthusiastically received by the participants. This demonstration provided valuable insights that the community is using to inform doctrine, organization, training, materiel, leadership and education, personnel and facilities working groups, and to develop initial doctrine and tactics, techniques and procedures for this emerging capability. Along these lines, an AIAMD Immersion Day is scheduled for March 17th at the Pentagon, which will afford senior Army, joint services, and Department of Defense leaders and staff the opportunity to see how ADA is approaching networked mission command.

Enable Defeat of Full Range of Air and Missile Threats. In the past year, the ADA branch has gained ground at both ends of the threat spectrum. With the fielding of the third Terminal High-Altitude Area Defense Battery (D-2 ADA) and the activation of the fourth THAAD Battery (B-2 ADA), our ability to counter the medium and short range ballistic missile threat set is greatly enhanced. We are also fielding the fifth forward based mode radar (AN/TPY-2). The lower end of the threat set, which includes rocket, artillery and mortars, now with greater firepower and longer range, will be countered with fully-fielded counter-RAM units. Fielding of the indirect fire protection capability / Avenger composite battalion is well underway, with 5th Battalion, 5th ADA being the first to undergo new equipment training and fielding. In FY15, 2nd Battalion, 44th ADA will undergo new equipment training and emerge similarly equipped and prepared to defeat RAM threats. In the meantime, the mission has not waited for fielding: 2nd Battalion, 6th ADA contin-

ues to provide the necessary training for units, both active duty and National Guard, that have been tasked to perform counter-RAM missions downrange.

Build Partner Capacity and Maintain Forward Presence. Currently, ADA forces are deployed across the globe and immersed in homeland defense. It is unrealistic to think that U.S. forces alone can counter all the global threats. We must build and enable our joint and coalition partners. To accomplish this goal, we must achieve better integration across all aspects of AMD operations. We also must assist our Patriot and THAAD partners in building and growing their professional AMD forces.

The critical means to accomplish enhanced integration is to expand our present foreign disclosure methods, increasing our common understanding of operations. Current foreign disclosure requirements and guidelines dramatically reduce the synergies that might be achieved between U.S. military and partner nations by limiting interoperability, training, and academic integration. Information releasability to a particular partner nation is based on the specifics of that nation's respective foreign military sales case. Due to this exclusion of release, many training courses or portions of courses are not available for foreign students. In the long run, this dramatically limits our ability to plan, train and operate efficiently with our partners.

Resolution of foreign disclosure issues is a major effort for the ADA commandant's office and FCoE today. We are working with the Army Air and Missile Defense commands, AMD office within the Army G-3, combatant command foreign disclosure officers, Office of the Secretary of Defense, Program Executive Office Missiles and Space, and the Lower Tier Project Office to expand information sharing. Once resolved, we will be able to focus on restructuring training programs of instructions to increase foreign student attendance and enhance partner capabilities and operational cooperation. One ongoing initiative involves the ADA Basic Officer Leader Course. BOLC is currently being modified to incorporate the existing German Patriot tactical control officer's course.

Transform the AMD Force. Much of force transformation involves the development and fielding of enhanced weapons, sensors, and mission command elements. We continue to expand Patriot capabilities, introducing new software via post-deployment builds, while sustaining recapitalization efforts. Avenger, Sentinel, and Stinger are being modified to avert obsolescence and add some new capabilities such as the Stinger proximity fuze. And, as mentioned above, development of an ADA common, network-centric mission command system, AIAMD – the ADA branch's number one priority – is ongoing.

AMD transformation also includes the institutional training base. Our evolving approach to institutional training calls for the use of embedded training and training aids, devices, simulators and simulations wherever and whenever possible. Given ongoing budgetary constraints and operational demands for tactical equipment, maximizing the use of TADDS just makes sense. The primary means to train Patriot and THAAD within the institution is now and will continue to be 'left of live.' A case in point is the manner in which THAAD will be taught at Fort Sill, Okla. In May 2014 the new $25 million THAAD training facility will be completed, with instruction beginning in October 2014. Virtually all THAAD training will be conducted using TADSS.

In preparation for our materiel transformation, we are also working to revise AMD gunnery. ADA gunnery programs do not adequately provide the relevant focus or required flexibility to support a full range of highly diverse and complex global AMD operations. Neither do these programs fully address the collective employment of our branch's diverse and sophisticated weapon systems; they are overly restrictive and prescriptive in their execution. Furthermore, current gunnery limits a commander's flexibility to incorporate new technologies and combatant command-specific warfighting concepts into a unit's gunnery process. My intent in standardizing ADA gunnery is to balance the live, virtual, constructive and gaming approach with the current and more costly training and qualification methods to provide focus on our core AMD competency – air battle management. This approach will also ensure flexibility that allows for growth and adaptation as we incorporate new systems. This effort will require full support and engagement from the field at the officer, warrant officer, and noncommissioned levels. I encourage you all to remain decisively engaged with the FCoE and ADA commandant's office throughout this process.

As we have done in our past and will do in our future, the ADA force remains on point, committed to defense of our nation and its allies.

First to Fire!

Soldiers from A Battery, 2nd Battalion, 44th Air Defense Artillery, 101st Airborne Division (Air Assault), load ammunition into a land-based Phalanx Weapon System during early December 2013, at Fort Sill, Okla. (Photo by 1LT Lee-Ann Craig, U.S. Army)

The Future of Field Artillery

By BG Christopher F. Bentley
Chief of the Field Artillery and Commandant of the U.S. Army Field Artillery School, Fort Sill, Okla.

This year's Fires Conference (May 5-7) themed 'Deep Future: 2025 & Beyond,' provides Fires professionals the opportunity for intellectual thought and discussion on the shaping of doctrine, training, materiel, and leader development.

Lessons learned gleaned from the Unified Quest 2013 Deep Future War Game will help to focus our discussions.

As a part of these discussions, we plan on outlining several initiatives that will allow the Field Artillery to continue to occupy a position of dominance on the battlefield of today as well as 2025 and beyond. These initiatives include advances in precision Fires, frequency and accuracy standards for target location error, fire support coordination at the corps and division level with the re-introduction of the FA brigade and division artillery, leader development, and modernized institutional training in all career fields.

All of which ties into our vision to create the nation's premier Fires Force; organized, equipped, and trained to employ and deliver joint and combined arms Fires.

The foundation for this vision is the United States Field Artillery 2016-2025 Strategy, see Figure 1.

Within this strategy you will see four lines of effort, which are: organize the force, train and develop the force, employ the force, and finally, sustain the force. Under this construct we have defined our priorities, which are modernize FA Fires, joint Fires, and implementation of the tenants of the Army Learning Model. Additionally, we have set several goals. Among these goals are updating the "Five Requirements for Accurate Fire" or 5RAF, a 13 Series MOS redesign, and a holistic focus on operational-level Fires that includes force design updates and doctrinal updates.

Modernize Field Artillery Fires. In order to remain relevant, we must modernize FA Fires. For us as a branch, this means focusing on precision and accuracy across all domains as well as embracing a

change within our FA culture… i.e., our philosophy, values, behavior, and thought processes. Rest assured this is not change for change sake…but necessary in order to create even greater dominance on the battlefield of 2016 and beyond. To assist with this culture shift we have started with re-designing an age old concept known as the "Five Requirements for Accurate Predicted Fire."

5RAF. Since World War I, our five requirements for accurate and predicted fire have remained the same, but in this modern era of joint operations, global positioning systems, digitized systems, and precision munitions, it became necessary to re-look these requirements.

After a thorough examination by a working group consisting of FA professionals from the United States Field Artillery School, these requirements have now been amended to read the "Five Requirements for Accurate Fire."

To some, this change in title might seem to be insignificant; however, when one considers that every word of the 5RAF, to include the title, means something significant to the precision mind-set demanded of the Field Artilleryman, this change is monumental and will require an overhaul of how we think about Fires within our FA culture.

In current times, 'predicted' in the title is a misnomer. When taking into consideration computer automations, target locating devices, employing precision munitions and near-precision munitions … we are no longer 'predicting' but rather providing accurate Fires.

Providing accurate Fires means applying standards of precision with equal vigor in each of the subcomponents:

1. Accurate target location and size, applying an 80-10-10 targeting

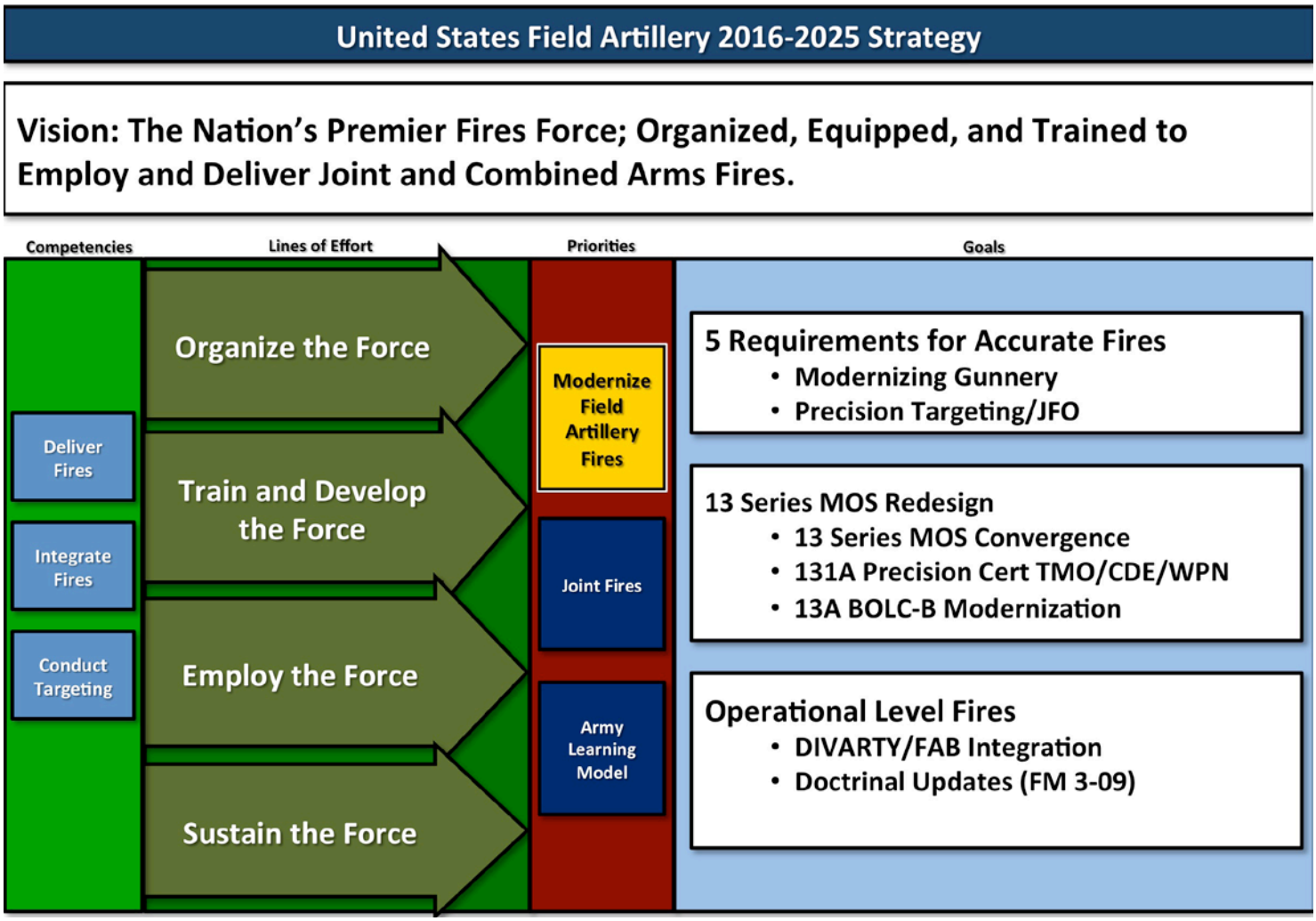

Figure 1. The US Army Field Artillery 2016-2025 Strategy. (Image courtesy of the FA Commandant)

standard tied to joint target location error categories, see Figure 2 on page 10

2. Accurate firing unit location, leveraging self-locating weapon platforms with embedded directional control verified by unit leadership
3. Accurate weapon and ammunition information, applying the effect of shell/fuze combination square weights on every round when determining muzzle velocity variations with modernized automated chronographs
4. Accurate meteorological information, leveraging modern meteorological modeling data and procedures to validate accurate met along the gun-target line
5. Accurate computational procedures, which takes into consideration major advancements in computational procedures on the weapon platform, such as the Advanced Field Artillery Tactical Data System, Centaur (handheld tactical fire direction system) and other hand-held devices, while adhering to strict automated independent checks.

Thus the title was changed to "The Five Requirements for Accurate Fire." 'Predicting' is a term of our past and it is no longer applicable as we go forward with modernizing FA Fires. In order to continue to embrace this culture shift we must also embrace an '80-10-10' standard and training philosophy.

Precision Targeting. 80-10-10, or a 'grid getter standard' is a ratio based on a precision mindset that makes it necessary for forward observers and fire support teams to achieve joint TLE categories while on the battlefield. Specifically, achieving a CAT I (6 m TLE) and CAT II (10 m TLE) 'precision grid' 80 percent of the time; achieve a CAT IV (50 m TLE) 'near precision grid' 10 percent of the time; achieve a CAT V/VI (200 m or greater TLE) as a degraded operation, the final 10 percent of the time. This 80-10-10 ratio defines for us as professional artillerymen the term accurate in the first requirement for accurate Fires. It also defines for us, as a profession of arms, how we train, certify and deliver accurate target locations in support of strategic, operational and tactical Fires.

Modernizing Gunnery. Another component of modernizing FA Fires and a much-needed shift in our culture is centered on modernizing gunnery.

Gunnery instruction has been consistent for the last 50 years; while it produced the best FA Soldiers in the world, it isn't adequate for current requirements for precision Fires. In an era of precision technology and state-of-the-art educational facilities, we are working to modernize current methods and means that we use to teach ballistic theory. AFATDS version 6.8 is at the centerpiece of this modern instruction. AFATDS is our mission command weapon system that allows for quick and accurate technical and tactical computation as well as development and integration of fire support plans into the scheme of maneuver. It is imperative that AFATDS becomes the

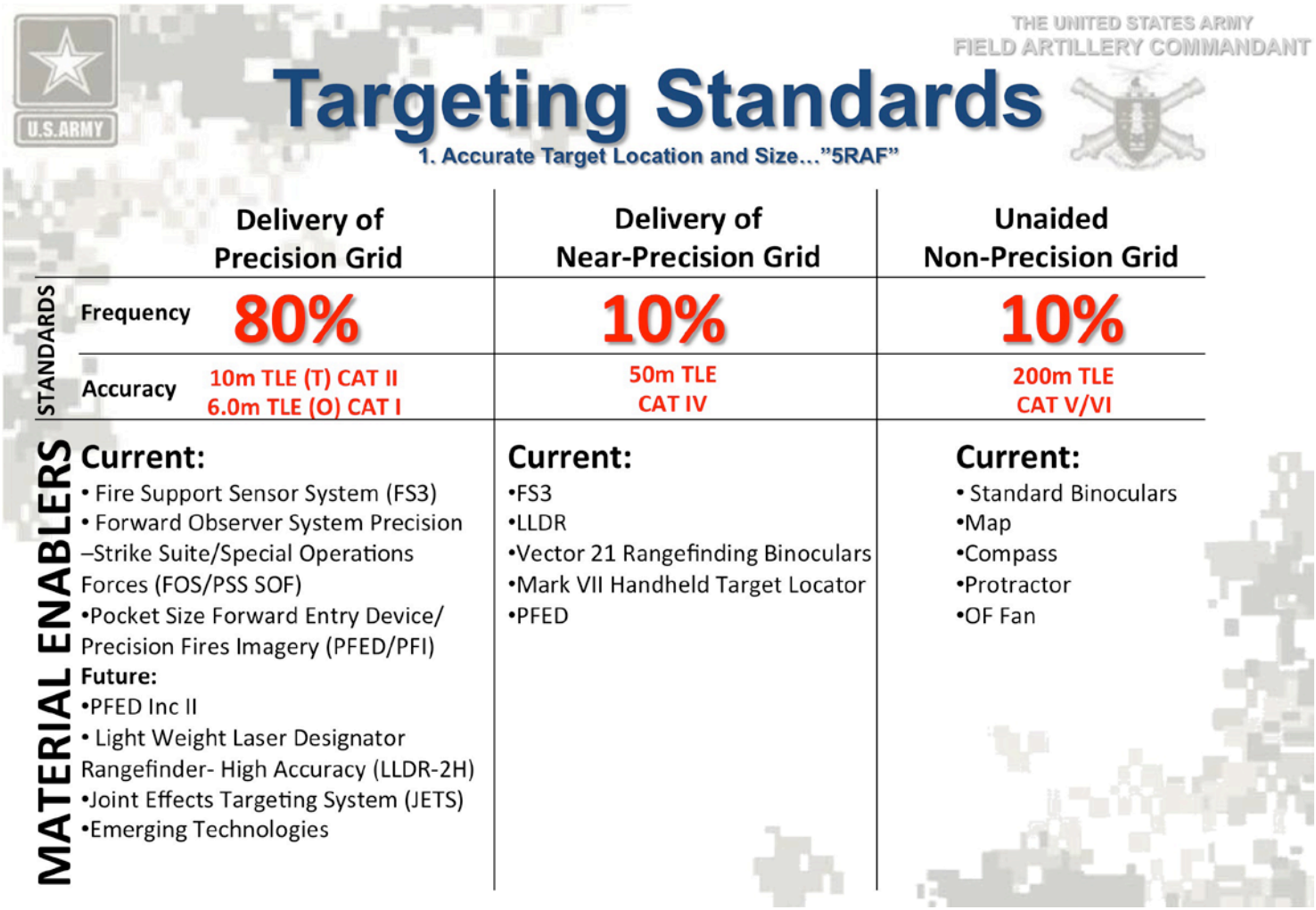

Figure 2. US Army Field Artillery Targeting Standards. (Image courtesy of the FA Commandant)

centerpiece for institutional, organizational and individual training and education. In addition, USAFAS will implement tenants of the ALM leveraging technologies to enhance these institutional training opportunities. These training enhancements include development and utilization of advanced interactive multimedia instruction products with expanded simulation and live-fire opportunities. There is a call to the science and technology community to develop these advanced IMI products as well as enhancements to the precision gunnery simulation products.

All this will be pulled together by providing experiential learning opportunities on the 'process' of gunnery theory and troubleshooting. The intent is to provide scenarios to advance precision observer techniques while understanding the 5RAF and ballistic theory to provide learners with opportunities to hone their troubleshooting skills at any time, and any place.

This scenario based learning will pull together fire support and fire direction instruction utilizing live, virtual and constructive training in line with the continuous adaptive learning model that engages learners in a career-long continuum of learning sustained by adaptive support systems. Additionally, modernized gunnery academics will be added to core Basic Officer Leaders Course instruction beginning in the first quarter Fiscal Year 2015.

Modernizing FA Fires also means focusing on joint Fires. Joint is inherent to everything we do. In order to achieve the desired effects on the battlefield, we must achieve centralized and decentralized, decisive action across wide areas through access to joint and multinational Fires capabilities across all echelons. The bulk of our training, therefore, must focus on the skill sets needed to execute joint Fires capabilities. In order to accomplish this, we are modernizing our institutional training across all career fields; highlights of this initiative include a 13 series MOS convergence, the addition of a precision Fires certification for our warrant officers (131As), and upgrades to our 13A BOLC which includes the addition of joint Fires observers certification for all those who attend.

JFO Certification. JFOs time and time again have proven critical to the fight. JFOs bring unique skill sets that only the FA provides to the maneuver commander. Once certified, JFOs are proficient at surface-to-surface call-for-fire, naval surface call-for-fire, AC-130 call-for-fire, and close combat aviation procedures. JFOs, in conjunction with Air Force joint terminal attack controllers, are trained to assist maneuver commanders with the timely planning, synchronization, and responsive execution of close air support.

Beginning in the third quarter FY14, JFO academics will be core BOLC instruction.

131A Precision Fires Institutional Training. In an environment where collateral damage has operational or strategic implications, Fires delivered with precision accuracy is a necessity. We will continue to ensure our targeting warrant officers, 131As, have opportunities to enhance their unique skill set to support the commander's ability to meet this requirement anytime and anywhere. As precision capabili-

ties have grown, so has the requirement for FA targeting officers with the skill set necessary to employ munitions precisely.

In 2013, target mensuration only and collateral damage estimate certification were incorporated into Warrant Officer Basic Course and Warrant Officer Advanced Course instruction as a requirement for graduation. The need for this requirement allows our 131As to support the momentum of our initiative to modernize FA Fires.

13 Series MOS Convergence. Modernization of FA Fires is only part of the equation; while we modernize internally we must also focus on keeping pace with the modernization goals set by the Army as a whole. For the FA, this has necessitated a 13 Series MOS review.

We must ensure our MOSs are sustainable, the best training is provided, and Soldiers are offered the best assignment/promotion opportunities possible to ensure we produce the most-capable and well-trained FA noncommissioned officers for the branch.

We are currently conducting analysis, with the end state being maintaining four MOSs instead of the current seven. The first step in this process is currently under way with the merger of 13D (Field Artillery Automated Tactical Data Systems Specialist) and 13P (Multiple Launch Rocket Systems Operator [Fire Direction Specialist]). This merger will set the conditions for the next era of Fires that will speak to increased connectivity, net-centric operations, increasing real-time data feeds, precision fires, increased communication ranges, more platforms and sensors, and increased air and ground de-confliction.

Each MOS's critical task list is virtually the same as they share 75 percent of all critical tasks in the NCO ranks. In Advanced Individual Training, the entry level cohort is trained on the same tasks with the exception of the introduction of degraded/manual operations for MOS 13D. The core competency and function of both specialties is to oversee fire direction; automated fire direction via AFATDS computer interfaces.

Today, MOS 13D and 13P are far more homogenous in hardware and software applications. Our platforms are becoming more digitized, thus reducing the need for manual gunnery, short of emergency degraded operations. Our munitions are smarter and more accurate. As a branch our collective inventory of enablers are more integrated and interconnected; these facts have provided a natural roadmap for a merger between these two specialties. This merger is slated to be complete not later than FY18. MOS 13D and MOS 13P after the merger will become MOS 13J, the FA's core fire control MOS capable of fulfilling fire control roles and responsibilities across both cannon and rocket formations.

Additionally, we have determined the need to eliminate the 13T (Field Artillery Surveyor/Meteorological Crewmember) MOS career field. This decision was based on the fact that we currently accomplish meteorological tasks through a modernized materiel solution, and the fact that a modernized materiel solution is forthcoming for survey tasks. Going forward, we are also developing a course of action that will include meteorological being identified as a part of the 13D/P critical tasks. Additionally, until a permanent materiel solution is created for survey, both 13B and 13M will get an additional skill identifier to encompass survey tasks. Possible materiel solutions for survey include software only or equipment mounted in vehicles and helicopters as needed in formations.

Finally, we are reviewing options and courses of action to set the conditions for a merger between our 13B (Cannon Crewmember) and 13M (Multiple Launch Rocket System Crewmember). We are currently in the preliminary stages of this analysis and recommendations should be forthcoming within FY14.

Operational-Level Fires. As we go forward in the future, it will remain a requirement for us to provide operational-level Fires. To quote Training and Doctrine Command Pam 525-3-4, *The United States Army Functional Concept for Fires*, we have a responsibility to establish and maintain a fire support system that can, "enable the defeat of a wide range of threats, provide timely and responsive fires in environmental and operational conditions, provide a range of precision to conventional scalable capabilities to engage ground targets, prevent fratricide and minimize collateral damage, and to provide access to and integrate joint, Army, and multinational Fires capabilities at the lowest appropriate levels." We are aggressively addressing this requirement for operational Fires and have proposed that operational Fires should be conducted as a part of the commander's operational design. This will allow the commander to achieve his desired effects on the enemy in a manner that does not require detailed integration with the scheme of subordinate maneuver elements.

Operational Fires, as opposed to close supporting Fires, are usually conducted at the operational level of war, but may be conducted at any level of war. Operational Fires generally integrate Army FA (surface-to-surface) Fires with joint and multinational capabilities, but could be conducted by any combination of available Fires assets. FA brigades and DIVARTYs focus on the conduct of operational Fires, including the fusion of sensors and intelligence assets to support the targeting process, although they can also conduct close support Fires that require detailed integration with the scheme of subordinate maneuver elements. Close support Fires are usually planned, coordinated, integrated, synchronized and conducted by brigade combat team FA battalions.

Doctrinal Updates (FM 3-09). Our Fires headquarters will have new relevance for the integration of joint and combined Fires and we are currently working to refine doctrine.

In line with TRADOC's Doctrine 2015, we will continue to update our FA doctrine; the latest in this endeavor is the update of our Field Manual 3-09, *Field Artillery Operations and Fire Support*.

The revamped FM consists of four chapters which cover FA operations, fire support, fire support and the operations process, and fire support coordination and other control measures.

As we go forward with implementation of this plan, we must stay progressive and aggressive. We are setting a new standard for the integration and employment of joint, multinational and combined arms Fires, sensor fusion and sensor integration.

Army Learning Model of 2015. As the commandant of the FA School, I have a responsibility to ensure FA training continues to be captured under the intent of the ALM 2015.

The ALM describes the deliberate actions and concepts we must implement at Fort Sill, Okla., to train and mentor our Field Artillerymen to face the challenges of adaptive enemies, decentralized operations, decreased resources, increased mission requirements, and increased technology. We will continue to aggressively pursue all tenants of ALM.

In retrospect, the Army's Unified Quest 2013 Deep Future War Game did illuminate the need for change and as a branch we are examining what these changes will entail for us as a part of the operational force, especially in the aspect of the integration of joint Fires. Success beyond 2025 requires us to develop leaders and embrace accuracy for precision Fires now.

The 2014 Fires Conference is a tremendous opportunity to gather and discuss all these details. It's only through the collaborative process, that we can accurately see ourselves as we prepare to make important decisions that affect how and what FA brings to the battlefield of the future. I hope to see you there.

Conceptual Fires Capabilities in Deep Future Wargame

By Mr. Andres Arreola Jr. and Mr. John Yager

The year is 2030. Terrorists operating out of the failing state of Sasani have smuggled a chemical weapon into the United States and detonated it in a large urban area. In response, the U.S., already engaged in humanitarian operations in the neighboring state of Junapur, employs advanced technologies and regionally aligned forces to attack and secure weapons of mass destruction sites in the region.

This fictional scenario is the basis for the Army chief of staff's annual Unified Quest Future Study Plan. The Deep Future Wargame is the capstone event of a year-long study of the operational environment for the years 2030 to 2040. Over a series of seminars, workshops and planning events, service members from all branches, civilians, industry and academia work together to explore future concepts and capabilities that will influence the Army of the future.

The Fires Center of Excellence, Fort Sill, Okla., contributed Air Defense and Field Artillery concept expertise to this exercise. In concert with government researchers and industry, future systems with plausible capabilities were envisioned, employed in the scenario and evaluated for potential. These systems include multi-role sensors and launchers, an air-droppable counter-rocket, artillery and mortar system, an electromagnetic rail gun system and a mobile high energy laser system. While most systems were light weight and mobile, others were less mobile, emplaced at fixed sites and required protection for survivability. Systems featured advanced automation and mission command capabilities and integrated via a unified Fires network.

The Deep Future Wargame is the capstone event of a year-long study of the operational environment for the years 2030 to 2040.

In the exercise, Fires capabilities were employed in support of the exercise's joint task force commander. Their mission was to defend critical assets against aerial threats such as rocket, artillery, cruise missiles and ballistic missiles and provide deep strike precision Fires. Some of the significant implications for the future Fires Force that emerged are:

Multirole/Multi-Mission Systems are Extremely Valuable. One of the most notable Fires implications from the 2013 Deep Future Wargame is the ability of future enemy forces to overwhelm a limited amount of high technology systems with 'swarms' of lower technology weapons. One way to counter this strategy is to develop Fires Forces that can conduct multiple missions simultaneously with the same equipment and the same Soldiers. This versatility will allow increased numbers of missions from fewer platforms, helping to counter threat numerical superiority.

Investment in the development of multi-capable systems can help mitigate the risk of insufficient air and missile defense and the lack of light weight, long range Field Artillery capabilities. Platforms that can be fitted with mission-specific munition combinations (for example, both counter air and deep strike) will allow Fires Forces to precisely tailor capabilities to the mission without requiring the five different rocket/missile launch systems (and three cannon systems) currently in service. A common launcher will reduce the burden of training crewmembers and maintainers for multiple platforms and will simplify sustainment in stocking and providing parts for each system. Consolidating the capabilities fielded by the six radars currently used by Fires Forces into a smaller number of sensors will yield similar improvements and savings. Finally, a single Fires mission command system, including a high-bandwidth, low latency network, can combine the Air Defense Artillery and Field Artillery into a truly integrated Fires Force.

Striking the Right Balance Between Mobility and Survivability is Critical. In a future operational environment dominated by anti-access and area denial strategies, the ability to deploy quickly and with sufficient combat power will be vital to seizing the initiative. This necessitates lighter platforms that require fewer strategic lift assets for inter- and intra-theater movements. However, these platforms must still be sufficiently survivable and sustainable in order to maintain pace with the supported force. Fires Forces that are highly vulnerable or that lack tactical mobility are of very limited utility, even if they are deployed quickly. Current platforms such as Paladin, Multiple Launch

Platforms can be fitted with mission-specific munition combinations and will allow the Fires Forces to precisely tailor capabilities to the mission

Rocket System, Patriot, and Terminal High Altitude Air Defense Systems are too large and heavy to move by anything other than heavy strategic lift aircraft or sea deployment. Once in theater, these systems suffer from large electronic and visual signatures, huge logistical requirements, and in the case of Patriot/THAAD, extremely limited tactical mobility. These limitations have a significant impact on the overall utility of these systems; though their munitions and sensors remain effective, they cannot always bring their capabilities to where they are most needed.

Development of Fires Leaders and Soldiers will be a Consistent Challenge. Technological improvements will undoubtedly provide greater capability, but will also increase the requirements on those who employ said systems. A major training challenge will be creating common launcher crewmembers that are comfortable conducting close support, deep strike, or counter-air missions simply by selecting the munitions they load. Leadership will be required to plan and execute widely varied Fires missions while simultaneously advising other Army, joint, and coalition commanders on how best to employ Fires capabilities.

'Deep Magazine Systems' Show Potential to Offset Significant Capability Gaps. Future conflicts with numerically superior opponents, restricted regional access, limited systems, and constrained resupply will challenge sustainment of Fires Forces. Systems that feature deep but lightweight magazines can help to offset numerical saturation while minimizing sustainment requirements. Weapons such as lasers and high powered microwave show great promise for air defense, while electro-magnetic rail guns show promise for both the ADA and FA. Both of these technologies may significantly increase both range and rates of fire while reducing the sustainment requirements for munitions.

We are transitioning from an operational environment that offered predictable deployments and low intensity operations to an environment that requires contingency responses against highly capable opponents. This environment requires new thinking, renewed emphasis on core competencies, training and focused investment. Our challenge is to deploy Fires Forces that are operationally and tactically useful; that build momentum from the beginning and achieve positional advantage from the onset. This will require focused science and technology investment in order to develop rapidly deployable, scalable, survivable, mission tailored, and sustainable Fires Forces. Our goal is to exploit technologies to make order of magnitude improvements in our sensors, platforms and mission command resulting in significant increases in expeditionary, delivery and integration capabilities.

Mr. Andres Arreola is the deputy for Air and Missile Defense Concepts in the Concepts Development Division of the Capabilities Development and Integration Division at the Fires Center of Excellence. He previously commanded E Company, 6th Battalion, 52nd Air Defense Artillery, 31st Air Defense Artillery Brigade. He has served as a Patriot battalion battle captain, assistant S-3, Patriot battery executive officer and launcher platoon leader. While enlisted, he also served as an observer/controller at the Joint Readiness Training Center, Fort Polk, La. He has deployed to Operation Desert Storm with the 3rd Armored Cavalry Regiment (Stinger/Vulcan), Operation Joint Guard with the 2nd Armored Calvary Regiment (Avenger) and several deployments to Saudi Arabia (Patriot).

Mr. John Yager is the deputy for Field Artillery Concepts in the Field Artillery Concepts in the Concepts Development Division of the Capabilities Development and Integration Division at the Fires Center of Excellence. After active duty in a variety of Field Artillery positions at the platoon to division-level, including deployment to Operations Desert Shield and Desert Storm, with 3rd Armored Division, Division Artillery, He transitioned to a civilian position in the U.S. Army Field Artillery Center's Directorate of Combat Development where he worked for 20 years in Training and Doctrine Command System Manager-Cannon, Requirements Determination Division and Concepts Development Division. He has published articles in the Field Artillery Bulletin, the Marine Corps Gazette, and various newspapers and magazines.

The first of two Terminal High Altitude Area Defense interceptors is launched during a successful intercept test. The test, conducted by Missile Defense Agency, Ballistic Missile Defense System Operational Test Agency, Joint Functional Component Command for Integrated Missile Defense, and U.S. Pacific Command, in conjunction with U.S. Army Soldiers from the A Battery, 2nd Air Defense Artillery Regiment, U.S. Navy Sailors aboard the guided missile destroyer, USS Decatur, and U.S. Air Force Airmen from the 613th Air and Operations Center resulted in the intercept of one medium-range ballistic missile target by THAAD and one medium-range ballistic missile target by Aegis Ballistic Missile Defense. (Photo courtesy of the MDA)

Electronic Fires

By LTC Shannon D. Judnic and MAJ Michael J. Burke

During a training exercise at the National Training Center, Fort Irwin, Calif., an infantry company forward observer in a platoon defensive position prepares for an opposing forces counterattack. A member of the platoon hears a humming noise and recognizes a small unmanned aerial system flying overhead, 30 seconds later, it disappears. This event happens before the unit can react and with no capability to detect, track, or identify the company FO focuses his efforts with the pending OPFOR regiment inbound. Within hours the platoon loses all communication with higher headquarters. Moments later the position receives incoming artillery and a chemical munitions strike followed by the OPFOR maneuvering through the defensive positions. This results in the OPFOR seizing key terrain and defeating the Blue Force. So what happened? At the after action review, the company FO is informed that the UAS was enemy and helped the OPFOR gain intelligence on BLUEFOR positions, resulting in an accurate artillery strike on the platoon. The UAS was also emitting a high power microwave device that allowed it to knock out the platoon's communication resources, basically rendering the unit combat ineffective.

The chief of staff of the Army priorities for the Army are to rapidly deploy, fight, sustain itself, and win against complex state and non-state threats. The Army has to become leaner, while retaining its capability, prevent overmatch through 2025, and set the conditions for fundamental change by 2030-40. While the United States Army has focused on winning the wars in Afghanistan and Iraq, our adversaries have been developing directed energy and electromagnetic powered weapons and systems that can pose a threat to our Army in the near future. Recognizing these weapons as potential game changing technology, the Fires Center of Excellence, Fort Sill, Okla., chartered the Electric Fires Office to work with the Fires Battle Lab and begin laying the ground work for long-term efforts for offensive and defensive capabilities based on emerging concepts, gaps and the operational environment.

The Army must leverage current emerging technologies. In an environment of decreasing resources, the Army must plan for a shift in strategic focus while preparing to confront threats. The Army must pursue emerging technologies to develop countermeasures to future threat capabilities and maintain its technological advantage over future threats. A well-equipped force with significant overmatch demonstrates a level of dominance over would-be opponents that discourages competition and at the same time, serves as an example to allies and partners

The EFO will provide subject matter expertise and conduct/coordinate efforts across the Army. The near term focus is on Army vulnerabilities and gaining insights into what technology is currently available; conducting experiments with enablers such as DE/electromagnetic energy and developing tactics, techniques and procedures. The long term effort includes both offensive and defensive capabilities based on concept development gaps and the operating environment. One of the first efforts is the Electric Fires White Paper that establishes the initial way ahead. The EFO encourages feedback on the paper. It is a classified paper but is available for those that have access. In June 2013, the vice chief of staff of the Army tasked the Headquarters Department of the Army G3/5/7 with a review of threat-related testing and evaluation programs to identify gaps related to DE and electrodynamic kinetic energy weapons, prioritize testing requirements, and identify funding requirements for such testing and evaluation. The task consists of five phases with various organizations responsible at different times. Phase 1 was to detail the overarching Army strategy for EF and articulate the difference between EF and DE to include high power microwaves, radio frequency weapons, electromagnetic pulse weapons and electro-optical weapons. We are currently in Phase 2 with HQDA G2 as lead.

One of the Army's greatest competitive advantages resides in its ability to learn fast and adapt quickly. The current pace of technological change challenges the Army's ability to maintain this edge over potential adversaries. In the highly competitive global learning environment where technology provides nearly ubiquitous access to information, the Army cannot risk failure through complacency, lack of imagination, or resistance to change. It is important to conduct experimentation and demonstrations. According to Training and Doctrine Command Regulation 71-20, *Concept Development, Capabilities Determination, and Capabilities Integration*, experiments and demonstrations are to be conducted by the Capabilities Development and Integration Directorate organization, specifically the Battle Lab. "… battle labs conduct prototype experiments to put capabilities in the hands of Soldiers earlier and provide experimentation services

to the broader Army (Program Executive Office/Program Manager, Army Research, Development & Engineering Centers, and others)." Along with that the FCoE, serves as the force modernization proponent for both Field Artillery and Air Defense Artillery units and Soldiers. According to Army Regulation 5-22, *The Army Force Modernization and Proponent System*, the FCoE must take all measures to guarantee that our Fires Soldiers have the best equipment, organization and doctrine to win on any battlefield. In order to accomplish this, all options are on the table, especially those that will give us the technological edge in the next 10 to 30 years. The FCOE has initiated the development of an Electric Fires Range at Fort Sill. This range will be used to conduct demonstrations of and experiments with emerging technologies. This range is not a test facility but a range that allows the government, industry, and academia to demonstrate EF capabilities and emerging technologies to combat developers, concept development, requirements developers, and training developers. Currently, non-Program of Record systems must be fired at test facilities such as White Sands Missile Range, N.M. or Dugway Proving Ground, Utah, making it difficult for combat developers to understand the true capabilities of these systems. It is anticipated that this range will be available by the summer of 2015. The range facility must complete an environmental assessment process to ensure these emerging technologies will properly fit within the range limits. We plan on having a DE event on this range to open it up. Look for an industry day notice and the opportunity to participate.

The Fires Battle Lab recently completed its second annual Electric Fires Seminar, Feb. 26-27, 2014. The seminar is a government-only gathering of the services, science and technology organizations, and the Defense Advanced Research Project Agency. The objective of the seminar is to identify, define and discuss emerging EF concepts, capabilities, technological threats and countermeasures likely to be encountered on battlefields in the 2020-2040 timeframe. The purpose is to identify and discuss potential impacts to include doctrine, organization, training, materiel, leadership and education, personnel, facilities and policy of EF capabilities across the Army that will inform Army 2025 analysis on the integration of EF capabilities into the warfighting functional concepts and understand what is being developed in the S&T, industry and academia realm. Expected outcomes:

- Provide a greater understanding of how electronic Fires could be integrated into the future planning, synchronization and the execution of missions
- Provide a venue so the S&T community can cross-talk with the WfF on EF topics
- Creation of EF work group what meets monthly or quarterly
- Identify concerns across the centers of excellence
- Provide an update to the EF (i.e., range, white paper, demonstrations, etc.)
- Facilitate the incorporation of knowledge to all organizations within the supporting community (CoEs, S&T Community, Labs)
- Receive real time intelligence assessment on the emerging threats

The EF organization expects this to be an annual forum and continue to explore emerging technologies and advances.

The FCoE and EFO plan on establishing cooperative efforts between Army organizations such as the U.S. Army Space and Missile Defense Command and interested industry partners. These agreements will establish the roles and responsibilities for the sharing of technologies and resources. These agreements between the Army and industry are Cooperative Research and Development Agreements. The Fires Battle Lab is currently working with SMDC on improvements to

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Soldiers unload from a Utah U.S. Army National Guard UH-60 helicopter during maneuvers at Dugway Proving Grounds, Utah. (Photo by MAJ Justin Hurt, U.S. Army)

The Future Challenge to US Air Superiority

By COL Matt Tedesco, Mr. Chris Lowe and Mr. Tom Arnold

The proliferation of unmanned and autonomous systems technology necessitates the Army to confront this growing threat to the supremacy the United States has enjoyed for the past decade and to pursue counter-unmanned aircraft systems defense efforts. The U.S. superiority in unmanned aircraft technology is beginning to erode and will continue to decline as other nations leverage the developments in the commercial sectors, particularly in the areas of computing and robotics. The United States and its allies will be increasingly threatened by reconnaissance and armed unmanned aircraft systems in the near and distant future.

The technology required to build and deploy UAS is relatively easy and cheap to obtain and can be controlled through pre-planned way points or by human controller from a remote location. The importance of C-UAS technology stems from the expansion of UAS research and fielding activity in recent years. Various sources have suggested that there are up to 700 current and developing UAS programs worldwide. The Federal Aviation Administration estimates that by 2018, 7,500 small commercial drones will be operating at low altitudes inside the U.S. Current FAA rules only allow hobbyists to fly within visual range and at an altitude of less than 400 feet, but the FAA is conducting research to examine the expanding application of UAS. The commercial application of UAS is a worldwide phenomenon, with countries like the United Arab Emirates and the Peoples Republic of China currently pursuing aggressive commercial applications for UAS technology.

The ability for the U.S. forces to maintain over-match capability is quickly dwindling. The monetary cost to use today's military systems to combat this threat set are unattainable in the current fiscally constrained environment. Therefore the U.S. military must think and develop smarter systems that are integrated and interoperable to protect friendly forces and our interests from a strategic environment all the way to the tactical edge of the operating environment. Science and technology efforts are required to explore cost effective ways to counter threat UAS to include networking, directed energy, and cyber exploitation that will enable both lethal and non-lethal Fires to defeat the future UAS threat.

The C-UAS threat is particularly difficult to 'detect, identify and defeat,' and will be employed against all echelons, impacting all levels of warfare. This directly impacts the defense of the homeland, as well as forward deployed forces and our allies. As UAS proliferate, adversaries will mirror current UAS tactics employed by the U.S. and develop new tactics to exploit seams in air and ground defensive forces, put military force and the general populace in arms way, both in the homeland and abroad. Threat UAS do or may employ a variety of sensors and operate at a variety of tactical levels. These levels include micro-sized to large vehicles and operate with varying altitude and speed. When developing and proposing a capability all levels of detection, decision, and defeat must be considered.

Two distinct areas have emerged that should be considered in the development of any potential solutions. These areas are:

1. Brigade and higher
2. Below the brigade (aka the tactical edge)

These two areas are currently separated by available network connectivity and situational awareness differences, as well as available skill sets. This separation may be geographically, conflict, or technologically induced. Due to the sometimes isolated nature of the 'tactical edge,' this level of employment is considered analogous to many potential homeland continental U.S. applications (both in the size of the area of operation and the temporary/mobile/adhoc nature of these areas). Network connectivity allows for detection of potential threat, classification of unknown threats (friendly or unknown or hostile) and coordination (for engagement) with U.S. joint and coalition forces (ground and air). Each of these components should be considered when developing a potential solution.

In the future, medium-sized, tactical unmanned aerial vehicles will be more intelligent and complete tasks as a swarm. A swarm of UAVs will work together to survey the battlefield and provide the combat commander a seamless real time view of the enemy. These UAVs will communicate with each other, to ensure no area goes uncovered, reducing the need for individual operators. Larger, strategic UAVs will incorporate stealth technology, such as the United Kingdom's Taranis stealth drone. These larger stealth UAVs will replace manned systems performing similar missions of surveillance, stand-off/stand-in jamming, and deep strike. Small, hand-launched UAVs will continue to plague ground forces; too small to carry munitions, they will provide their operators with 'around the corner' or 'over the hill'

surveillance coverage to locate U.S. forces. This threat is a key concern for maneuver commanders and will remain as technology and capabilities develop that can threat freedom of maneuver.

The Army must stay focused on the operational environment over the next decade and beyond and develop C-UAS capabilities. The Army designated the Fires Center of Excellence, Fort Sill, Okla., as the Army lead for C-UAS in August 2012, as a part of Air Defense and Theater Missile Defense proponency as outlined in Army Regulation 5-22, *The Army Force Modernization Proponent System*. The FCoE has developed a C-UAS Strategy for the U.S. Army using the five lines of effort:

1. Threat UAS capability, limitations, vulnerability assessments
2. Detection and identification (active, passive, self-reporting)
3. Defeat (kinetic and non-kinetic)
4. Mission command (material and non-material)
5. Integration, experimentation and exploitation

The goal of this strategy is to develop a combined Army approach for integrating systems from space, aerial and terrestrial layers, to successfully implement the detect, identify and defeat methodology against the UAS threat.

As the FCoE leads the Army in the development of C-UAS capability some basic questions need answers: How do Army forces provide and integrate C-UAS capabilities against threat UAS within their area of operations and at ranges that preclude reconnaissance, surveillance, target acquisition, and attack operations on friendly forces?

How does the Army best utilize available capabilities to defeat threat UAS?

How does the Army influence allocation of airspace for friendly UAS operations while enabling the engagement, identification, and defeat of threat UAS targeting ground forces?

What future required capabilities are required to address UAS threats?

How does C-UAS influence the Army's ability to execute other air defense missions?

All domains of doctrine, organization, training, materiel, leadership and education, personnel and facilities should be considered. The materiel and non-materiel solutions should consider threshold capabilities that can be employed and potentially added to later, as well as how the solution fits into the existing organizational structure of U.S. forces.

Items to consider are: What level/echelon employs its use?

What military occupational specialty is trained to use it (or must be trained)?

Who controls its use and how flexible can the control be?

How is leader confidence ensured while speed and accuracy of service maintained?

What is the overall cost/impact (across the DOTMLPF spectrum) to employ and maintain?

Hybrid threats, budget constraints, continued deployment cycles, and modular transformation will shape how the Army will achieve mission success. C-UAS must be a combined approach, integrating systems from the space, aerial and terrestrial layer, to successfully implement the 'detect, identify and defeat' methodology against threat UAS. It will help the Army Prevent conflict through its forward presence and capacity, Shape the environment with our allies and by ensuring access, and if prevention fails, Win by defeating the full range of UAS threats on tomorrow's battlefield.

Colonel Matt Tedesco is the Training and Doctrine Command Capability Manager for the Air Defense Artillery Brigade with primary responsibility as DOTMLPF integration for Counter-Rocket, Artillery and Mortar 'Systems of Systems,' Joint Land Attack Cruise Missile Elevated Netted Sensor, Stinger-based systems, and Sentinel. Tedesco is a graduate of the University of Oklahoma with a masters in Public Administration.

Mr. Chris Lowe is currently the Air Defense Capability Developer, Concepts Develop Division, in the CDID working as the C-UAS subject matter expert and the principle author of the Army's C-UAS Concept of Operations. Lowe has more than 30 years of military experience as a Department of Army civilian, contractor, and an active duty Sailor. Lowe is a graduate of Webster University, Mo., with a Master of Arts in Management and Leadership.

Mr. Tom Arnold is currently an intelligence specialist, Concepts Develop Division, in the CDID, providing threat support to the Air and Missile Defense and Field Artillery programs. Arnold has more than 10 years of military experience as a Department of Army civilian, contractor, and an active duty Soldier. Arnold is a graduate of the College of William & Mary, Va., with a Bachelor of Arts degree in Public Policy and is pursuing a master's degree in International Relations from the University of Oklahoma.

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Integrated Air and Missile Defense mission effectiveness. The Fires Battle Lab provides modeling, simulations, and experimentation capabilities by leveraging existing, developmental, and experimental technologies to include battle command, command, control communications computers, surveillance and reconnaissance, and targeting systems. An initial outcome was the investigation of using DE weapons to counter unmanned aerial systems. The Fires Battle Lab partnered with SMDC through the CRADA, provided the experimentation location, and received all results from the CRADA. History was made with the successful shoot downs of UAS on Fort Sill. The FCOE welcomes the opportunity to work with industry and to continue these investigations.

There is a train of thought among the Army and Fires community that we have time and that the maturity of the technology is further into the future. People argue that the DE community has been promising for years that DE weapons will be ready in five years and that has not come to fruition. It just takes a few minutes on the web to determine that research, development, and testing of EF technologies is happening. Failure to recognize the maturation, proliferation and potential of EF technology effects across the range or military operations will significantly increase the risk to our forces. We need to work together to maintain our position as a world strategic leader and not allow our adversaries dictate the future operational environment. To ensure we have a ready and modern Army, we must work with science and technology and invest in emerging game-changing technologies not only to counter enemy threats, but to ensure our future force retains a decisive materiel edge and tactical overmatch. Emerging developments in the electric Fires domain will provide the brigade combat team of 2025 the capability it needs.

Lieutenant Colonel Shannon D. Judnic is currently assigned as the chief of Electric Fires in the Fires Battle Lab, at Fort Sill. She is a military intelligence officer with 23 years and has been deployed working in the J2 office in the North Atlantic Treaty Organization Headquarters, Pristina, Kosovo; member of a battlefield coordination detachment assigned to the Combined Air Operations Center in Al Udeid, Qatar; operations officer in the Joint Intelligence Operations Center-Afghanistan, NATO Headquarters, Kabul, Afghanistan, and J2 for the Military Information Support Operations Battalion in Kabul, Afghanistan. She holds a Master of Science in Public Administration from Central Michigan University.

Major Michael J. Burke is an electronic warfare officer currently assigned to the Electric Fires Office in the Fires Battle Lab at Fort Sill. He has previously served in a variety of positions as a signal officer, to include the J6 for Joint Special Operations Task Force-Trans Sahara and a signal detachment commander for the 3rd Infantry Division Headquarters while deployed in support of Operation Iraqi Freedom. He worked in industry as an electrical engineer for more than five years, designing the next generation of military technology. He holds a Master of Science in Electrical Engineering from the University of South Florida.

Basics of Army Science and Technology

By Mr. Darrin Carter

The U.S. Army science and technology community includes five primary S&T organizations: the Army Research Institute for the Behavioral and Social Sciences; the Engineer Research and Development Command; the Research Development and Engineering Command; the Medical Research and Materiel Command; and the Space and Missile Defense Command. Each of these organizations performs research and development in core areas necessary for the Army to maintain relevance as an implement of national power and to assure the Army maintains overmatch against any potential adversaries.

The S&T program is shaped collaboratively through close partnerships with warfighting customers, related S&T developers across the Department of Defense, other federal agencies, industry, academia, and international partners. The overall S&T strategy is to identify, mature, and provide technology that will enable transformational capabilities for the future force, while seeking opportunities to mature, provide, and facilitate transfer of these enhanced capabilities. Army scientists and engineers execute R&D programs under the policy oversight and guidance of the deputy assistant secretary of the Army (research and technology).

ARI comes under the G1 and has the unique mission to improve Army readiness and human performance through advances and applications of the behavioral and social sciences in personnel, training, and leader development; individual and team performance; and behavioral and social aspects of network science.

ERDC is the research arm of the Army Corps of Engineers and is one of the most diverse engineering and scientific research organizations in the world. ERDC synergistically addresses R&D in four major areas: battle space environment, military engineering, environmental quality/installations, and civil works/water resources through the capabilities of seven laboratories located at four primary sites.

MRMC headquartered at Fort Detrick, Md., operates six major medical research laboratories and institutes and several smaller specialized research facilities in the United States, Thailand, Kenya, and Germany. They are centers of excellence in specific areas of biomedical research, staffed by highly qualified military and civilian scientists and support personnel.

RDECOM is a subordinate command of the Army Materiel Command established to achieve greater synergy, collaboration, and efficiency across the AMC research, development, and engineering centers and laboratories. RDECOM fosters increased innovation and business process improvement to speed research and technology development for Soldiers. Subordinate organization under RDECOM include the Army Research Laboratory and six research and development centers that perform R&D in a range of areas that include aviation, communications, land-based platforms and individual Soldier equipment.

SMDC Technical Center develops and transitions space, missile defense, and other related technologies for the Army, the Missile Defense Agency, and other defense-related government agencies. Its S&T program provides space-based remote sensing, signal, and information processing technologies, in collaboration with other DoD and government agencies to integrate space force enhancement and space superiority advanced technology into Army battlefield operating systems. It also includes a high-energy-laser-applied technology initiative.

The Army's Training and Doctrine Command represents the warfighter by overseeing the development of Army warfighting requirements. The Army's Capabilities Integration Center, a field operating agency supporting headquarters, TRADOC, specifically manages the Army's architecture of the future to ensure that the warfighting requirements are integrated and understood as a complete enterprise. S&T serves two purposes in this developmental process. First, it provides a vision of the possible. This vision reflects what technology can bring to military operations derived from ideas, developed through concepts, to realized capabilities. Second, it develops the means necessary to implement these ideas, concepts, and capabilities. TRADOC is responsible for validating R&D priorities for key Army S&T needs and assures that S&T programs are consistent with Army developmental efforts from the perspective of Soldiers and leaders who employ warfighting capabilities. Additionally, TRADOC plays a role in the process to ensure that promising capabilities from emerging technologies are transitioned to the Soldier through enabling concept, programs of record. ARCIC, along with the TRADOC centers of excellence, participate in the S&T process by periodically reviewing new technology options for enhanced warfighting capabilities.

An SM-3 Block 1B interceptor is launched from the USS Lake Erie during a Missile Defense Agency test and successfully intercepted a complex short-range ballistic missile target off of the coast of Kauai, Hawaii. (Photo courtesy of the Missile Defense Agency)

ARCIC and the CoEs support the analyses to assess concepts, determine required capabilities and capability gaps, and evaluate Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities initiatives to provide needed solutions. ARCIC conducts the capabilities needs analysis annually to identify the required capabilities for the current and mid-term (2025) forces and then, through analysis of current capabilities versus desired capabilities, determines the capability gaps. These gaps are used by the S&T community to determine appropriate new-start R&D efforts or refine existing efforts relevant to the force from today to the mid-term (approximately 10 years from today).

On a yearly basis, the CoEs working with the S&T community review new-start proposals for their relevance to the warfighter and the proposed program's ability to meet a required capability or solve a capability gap. The refined proposal is then endorsed by the CoE and this information is provided to ARCIC and the S&T community to assist in follow-on processes that should result in an approved S&T program executed in the next fiscal year.

The CoEs work collaboratively with the S&T community to execute the S&T program ensuring that it continues to meet warfighter needs and that requirements document for more mature programs are developed at the appropriate time to transition to a program-of-record. The Low-Cost

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The Future of Fires

By Mr. Daryl Youngman

To remain operationally relevant in the future, the Fires Force must have the ability to integrate and deliver Fires (both indirect fire support and air and missile defense) in support of joint and maneuver forces and protect friendly forces and other critical assets from air and missile attack. Over the last five to 10 years, the Army has been focused on wide area security missions in Iraq and Afghanistan. As we draw down our forces in Afghanistan, it is time to focus on how Fires will transform to support both wide area security and combined arms maneuver in future integrated distributed operations. In addition to focusing on a wider spectrum of operations, constrained resources make it critical to have a strategy that maximizes return on investment.

The Fires Center of Excellence, Fort Sill, Okla., is in the process of developing a strategy to guide currently planned programs and future science and technology efforts. The end state for the strategy is to provide persistent, integrated, all weather, ubiquitous Fires (Air Defense Artillery and Field Artillery) in support of homeland defense and joint, combined, and unified land operations.

As we look at how to achieve the desired end state, there are four major ways, that when applied across the Fires' mission area, will assist us in achieving our vision. They are commonality, expeditionary, network integration, and optimize force structure.

We define the first of these ways, commonality, as optimizing the use, re-use, and adaption of hardware components, software, and interfaces to increase operational efficiency, logistics, and training. Implementation of small-scale commonality, including common man-machine interfaces, common algorithms, or common components, could lead to significant cost savings. As technology matures, commonality could extend to multi-functional or multi-mission mission command systems, radars, launchers, and munitions that increase operational flexibility and efficiency in addition to providing cost savings.

The current Fires Material Roadmap documents the first steps in achieving commonality. Currently, there are nine distinct Air Defense Artillery and Field Artillery radars in the Fires Force, not including multiple variants of the same radar. The plan is to move from nine to five radars in the mid-term. This plan consists of converging the short-range, counterfire radar variants, leaving just the AN/TPQ-50 and replacing the long-range counter-fire radars, the AN/TPQ-36 and AN/TPQ-37, leaving only the AN/TPQ-53. In the area of mission command, the plan is to converge down to two mission command systems in the mid-term. Air and Missile Defense is collapsing seven different mission command systems into the Integrated Battle Command System and the Field Artillery is collapsing three different role-based mission command systems into Army Field Artillery Tactical Data Systems Increment 2. As we move toward the future, the plan is to look for additional commonality, both within each of the Fires branches and across the Fires warfighting function.

The purpose of the next way, expeditionary, is to ensure Fires Forces have the requisite combination of deployability and mobility to support joint, combined, and unified land operations. This characteristic is mission dependant. For example, forces and systems in support of tactical units will likely require cross-country mobility and transportability on C-130 aircraft, while strategic forces, such as ballistic-missile defense systems may only require mobility on improved roads and transportability on C-5/C-17 aircraft.

One unique way we are currently improving the expeditionary aspect of the Air and Missile Defense force is through the IBCS program. Currently, for joint force integration a battalion-level mission-command element is required. When appropriate, IBCS will allow this integration to occur at the battery level, reducing the force package requirement for initial entry operations. Additionally, we continue to make strides in reducing size, weight, and power for existing platforms. An example of this is the new, lightweight, base plate for the M119 howitzer. We plan to leverage Army and Department of Defense investments in power generation and storage. Additionally, several long-term initiatives, such as rail gun or laser weapons, have the potential to significantly reduce the logistics burden on the force.

Network integration is the 'way' that we apply to maximize Fires coverage and capability through data sharing. One of the key capabilities network integration enables is sensor fusion. When multiple counter-fire radars detect a target, sensor fusion can significantly reduce target location error. In the Air Defense mission area, network integration, enables both improvements in combat identification and advanced engagement techniques, such as engage on network.

The two objective Fires mission command systems, IBCS and AFATDS Incre-

ment 2, are the key to enabling integration of the Fires Force into joint and Army networks. By leveraging information available on the network from the complement of Fires, other Army, joint, and national assets, significant improvements to situational awareness, combat identification, and targeting are likely.

The final way of our strategy, optimizing force structure, will allow us to maximize capabilities and flexibility while minimizing required force structure. As we achieve more commonality and achieve better network integration, this could allow us to potentially provide more complete coverage with the same amount of force structure and systems, reduce the number of military occupational specialties, or even reduce crew sizes.

A near-term example of optimizing force structure is the joint air-ground integration concept at the division level. By reorganizing the division operations cell and co-locating the existing Fires, Air Defense and airspace management, and aviation cells with the U.S. Air Force tactical air control party and air support operations center, significant improvements in air-ground integration can occur with no increase of force structure. This effort will benefit from the improvements in commonality, such as common platforms, mentioned above and future technology efforts, such as robotics and automated battle management aids, to reduce force structure requirements.

The FCoE has begun to work with both the materiel development, and science and technology communities to determine the necessary steps and timing (the 'means') to achieve the ways outlined above. To achieve our long-term vision, focused science and technology efforts are necessary to ensure we can make informed decisions for future modernization.

One example of a 'means' that would further the execution of the strategy would be to increase investment in multi-role, multi-functional, and/or multi-mission platforms. Some of today's platforms are already multi-role, simultaneously fulfilling multiple roles within the same mission. An example of this is the Patriot radar, which simultaneously provides Air Defense surveillance and fire control. As technology matures, some of the more modern radars, such as those with active electronically steered array technology, have the potential to be developed into multi-functional radars, performing multiple missions at different times or even possibly multi-mission radars, performing multiple missions simultaneously. This investment could support commonality, network integration, and optimizing force structure, helping to achieving the vision of our strategy.

The Fires Strategy, summarized above, is intended to provide to guide the way forward and allow Fires Forces to integrate and deliver Fires (both indirect fire support and air and missile defense) in support of joint and maneuver forces and protect friendly forces and other critical assets from air and missile attack. It is intended to guide the science and technology and the Fires modernization effort.

Mr. Daryl Youngman is the air and missile technical advisor at the FCoE. He has more than 20 years of Air Defense experience, including more than 15 years in combat development. He received a Bachelor of Science Degree from the U.S. Military Academy, a Master of Science Degree from Colorado State University, and a Master of Business Administration Degree from Northcentral University, Ariz.

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Tactical Extended Range Missile initiative is a prime example of the tremendous benefits derived from this process. The Fires Center of Excellence, Fort Sill, Okla., in cooperation with RDECOM is working to develop a low-cost precision missile with advanced propulsion systems and navigation techniques with lessened dependence on global positioning systems in support of long range Fires. This technology effort will develop key components feeding into the Long Range Precision Fires Acquisition program. This initiative is designed to mature and field technologies to fill the extremely high risk CNA capability gap created by the loss of the Army Tactical Missile System and the joint Fires requirement for an enduring long range precision, and area Fires capability, which facilitates capability, growth, and responsiveness to shifts in threat capabilities and national priorities.

Several opportunities exist each year to build partnerships and align needs to technologies, which include events such as TRADOC Industry Days, S&T Workshops, and CoE sponsored Science and Technology Home-on-Homes. The formal approval process concludes with reviews at the one-star (Warfighter Technical Council), two-star (Army Science and Technology Working Group), and four-star (Army Science and Technology Advisory Group) level to ensure our S&T programs are investing in the right technologies with a clear path to a program of record.

ARCIC, working with the CoEs is currently refining seven lines of effort that articulate needs for the deep future force (2030-2040). These LOEs are:

- Mobile, Protected Platforms
- Improved Lethality
- Logistics Optimization
- Aviation
- Information to Decision
- Human Performance Optimization
- Robotics

The intent of these LoEs is a fundamentally different Army that is a lean, lethal, and expeditionary force that is not overmatched by any adversary, orders of magnitude more deployable than the current force.

The entire enterprise, to include TRADOC and the S&T communities, works to assure the needs of Soldiers are addressed in a coherent process. The Army S&T initiatives are executed by a dedicated workforce of Army scientist and engineers in world-class facilities and in cooperation with industry, universities, and other government organizations. The warfighter needs and cutting edge capabilities are addressed by TRADOC experts in written imperative capability gap statements. The research and development programs are then developed in close cooperation and partnership between the entire enterprise to assure the best possible capabilities for Soldiers now and in the future.

Mr. Darrin L. Carter serves as the science and technology advisor for all requirements and concept work at Fort Sill's FCoE Capability Development and Integration Directorate. Carter serves as the initial point of contact for all small business innovative research and university affiliated research. TRADOC lead science and technology advisor, responsible for work with Research Development Command, AMC, Defense Advanced Research Project Agency and other science and technology organizations DoD-wide, on a daily basis in order to coordinate efforts across the Lethality Technology Focus Team and requirements to meet Soldiers needs in a timely manner. Carter is responsible for the Science and Technology Home-on-Home, a senior-level working group and seminar with the science and technology community. He is an active member of the Joint Ground Robotics Team serving as the TRADOC S&T lead for Fires monitoring effects of both offensive and defensive effects. Carter assisted in the development of the TRADOC PAM 525-66 (identify current forces, as well as the future force gaps), develop and accomplish individual studies of Fires doctrine, concepts and material initiatives to stay abreast of current and future initiatives. Carter is the subject matter expert on high-power microwave and high-energy laser technologies and is Fort Sill's Contact to the Army Science Board. Carter attended George Mason University in Washington D.C., and Georgia Technical University; has 20 years of combined service in the Army Reserve and active Army and eight years of Civilian service as a TRADOC science and technology Advisor at Fort Benning, Ga., and Fort Sill.

Long Range Precision Fires Strategy

By Mr. Charles Hutchinson

This article describes the Fires Center of Excellence's, Fort Sill, Okla., long range precision Fires strategy and approach to filling the extremely high-risk capability gap created by the loss of the Army Tactical Missile System. The primary focus of the strategy is to address the joint Fires requirement for an enduring long-range precision and area Fires capability which facilitates capability growth and responsiveness to shifts in threat capabilities and national priorities.

2019 Cluster Munitions Moratorium. At its core, LRPF provides the warfighter a capability to mitigate the loss in current munitions capabilities due to the Department of Defense policy on cluster munitions and unintended harm to civilians June 19, 2008. That policy effectively eliminates operational employment of more than 50 percent of the current ATACMS inventory. Additionally, because the ATACMS program was terminated in 2007, the current ATACMS inventory is quickly approaching its useful shelf-life. To partially mitigate the impact DoD has directed the Army to apply a service life extension program to a small portion of the ATACMS unitary inventory. While improving the overall quantity of munitions available, the limited SLEP fails to close one of the 28 highest priority Army capability gaps and fails to provide tradespace for future growth, not only in range but with future development in advanced warheads.

Capability Gap. Training and Doctrine Command Capability Needs Analysis 16–20, which was approved Sept. 27, 2013, defined the capability gap LRPF is designed to address as, "The Fires Brigade lacks the ability to engage targets at extended ranges (out to 499 km) under all conditions while conducting unified land operations in order to destroy tactical to strategic targets and provide fire support for decentralized operations over wide areas." The Army Capabilities Integration Center rated this as a Tier-1 gap that the Army must fully solve or mitigate to ensure mission accomplishment and ranked it in the top 28 of 568 gaps across the Army.

Combatant Command Support. Central Command, Pacific Command, United States Forces Korea and Special Operations Command have all substantiated the inability to engage targets beyond 300 km as one of their highest priority capability gaps. Through the integrated priority list process each of the combatant command commanders have expressed an overwhelming need to have a long-range (500 km) all-weather precision strike munitions to attack time sensitive or troops-in-contact, with point and area capabilities. This need is even more urgent now with the pending CM moratorium taking effect in 2019. While the COCOM commanders understand their objective requirements may not be achievable (e.g., 500 km) in the near term, they strongly expressed the operational need to extend their battlespace with the ability to impact/shape operations beyond what is currently available today. The ability to quickly strike at extended ranges with unprecedented accuracy in all weather conditions is of paramount importance in each theatre of operations. Each command has strongly supported the need for an ATACMS replacement program and stressed the importance of maintaining ATACMS-like capabilities (i.e., 300 km range) as the minimum threshold requirement.

Options for Mitigating/Eliminating the Gap. Several options have been discussed to mitigate the gap. The first option is to rely on joint assets. The second is to SLEP a portion of existing ATACMS missiles. The third is to restart the terminated ATACMS production line with current unitary warhead. The fourth option is to restart ATACMS with a new CM compliant warhead. The fifth is a new start missile. The sixth option is to do a combination of restarting ATACMS or SLEP and procuring a new missile at a later date. Option one does not does provide an all-weather 24/7 time sensitive capability. Options two-four do not provide the potential to grow the program to meet the COCOM commander's current or future requirements. Options five and six have the greatest potential to meet objective requirements and meet the operational need of the warfighter.

LRPF Strategy. The FCoE believes a new start is the most cost effective manner to achieve a balance between the current needs of the warfighter and provide the growth potential to meet future needs of the joint force. In coordination with the FCoE Program Executive Office Missiles and Space and Project Manager, Precision Fires Rockets and Missiles has developed a blocking strategy to achieve balance in an affordable and time sensitive manner.

The first block of the program is designed to provide an immediate capability that provides current ATACMS operational requirements document lethality and ranges with a CM compliant warhead and modern technology. This design will not require any modifications to the current launcher or pod

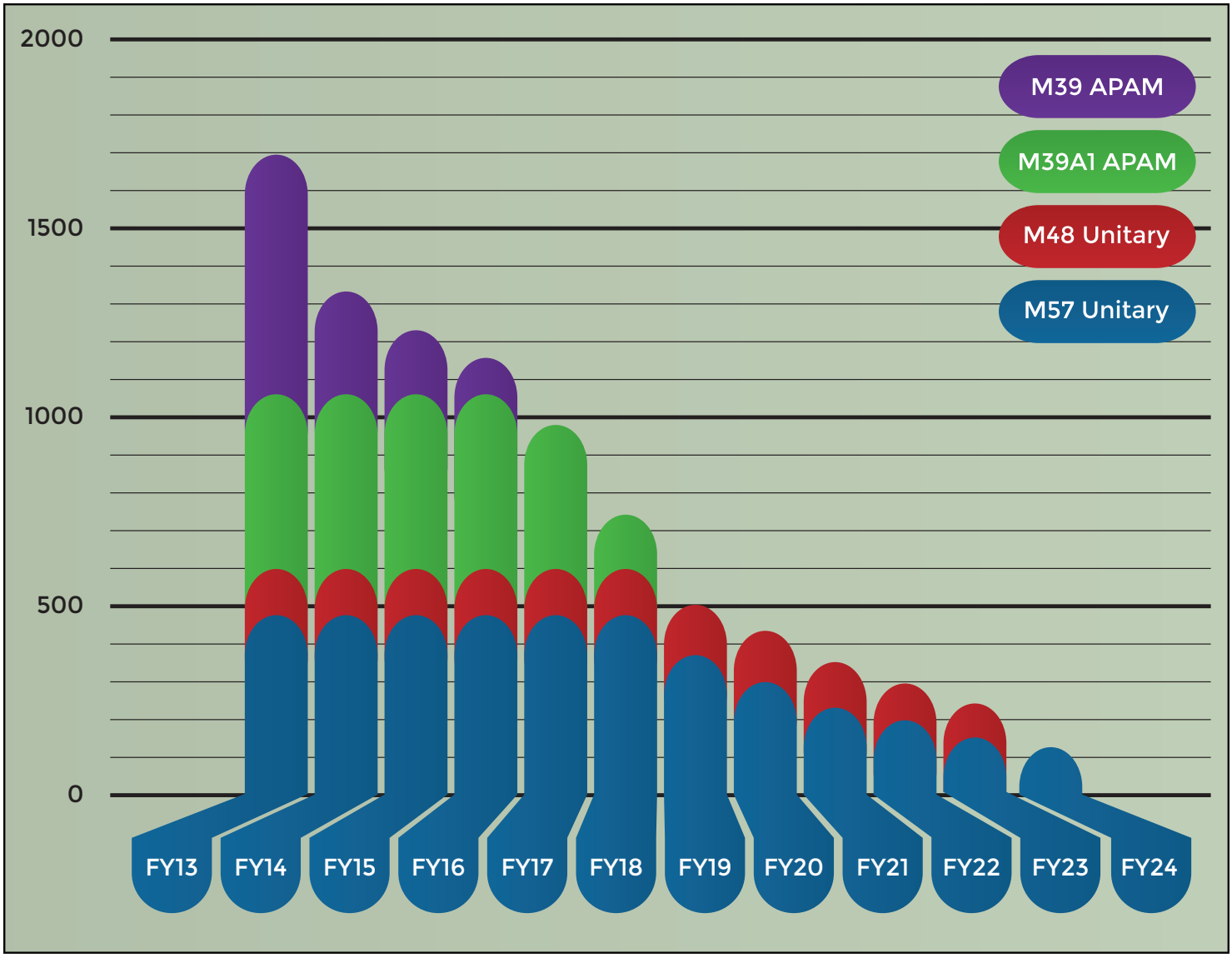

Figure 1. The projected reduction of specific munitions during Fiscal Years 2013-2024. In FY14, the munition production line goes cold. In FY19, the cluster munitions policy goes into effect. (Information provided by Mr. Gary Lemons and Mr. Charles Hutchinson)

and provides the greatest opportunity to field an affordable and achievable solution to meet the warfighter's demand for an ATACMS replacement in a timely manner. Through close coordination with the warfighter materiel developer and industry our intent is to field a solution that closes the time gap between the CM moratorium and ATACMS shelf life expiration. More importantly, as technology matures and funds become available our proposed initial block design supports future expansion.

Follow on blocks will enable the materiel developer to quickly cut into production advanced technologies, such as in flight updates, scalable warheads seekers and increased range. These future technology insertions will ensure the warfighter has the most effective and affordable solution available consistent with funding levels and operational needs of the force.

Initial Capabilities. LRPF key capabilities are base-lined against the current ATACMS requirement. It will provide 24/7, all-weather precision area and time sensitive capability to destroy tactical to strategic targets over wide areas. The adjacent chart depicts desired threshold and objective values for the first block of production.

The LRPF program will provide the joint force with a responsive and adaptive Fires solution. It will enable future Fires Forces with the necessary capabilities to meet the challenges in the emerging operational environment and be a key contributor to the COCOM's mission of destroying adversaries' systems in time, space and purpose to decisively accomplish their campaign objectives.

Figure 2. The desired threshold and objective values for production. (Information courtesy of Mr. Gary Lemons and Mr. Charles Hutchinson)

Capability	Threshold	Objective
Range	70-300 km	60-499 km
Compatibility	Current launchers	Threshold equals Ovjective
Time of Flight Responsiveness	Equivilent to ATACMS	Less than ATACMS
Efficiency	2 rockets per pod	6 rockets per pod

Mr. Charles F. Hutchinson, a retired Field Artillery officer, has served in a variety of Fires capability development roles, both as a defense contractor and Department of the Army Civilian. As a result of his years of capability development experience, Hutchinson is considered to be the senior Joint Capabilities Integration and Development System advisor to the Fires CDID Director.

How Do We Define Massing Fires?

By the Fires Center of Excellence Capability Development and Integration Directorate

Historically, artillerymen have been known for providing a 'wall of steel' with the intent to destroy, neutralize or suppress enemy formations. The impact was always awe inspiring from a shooters standpoint and teeth rattling from the enemy's perspective. Over the past 10 plus years of conflict, in a wide area type scenario, the need for massing battery and above artillery formations has been limited. It bodes the question; "What do we think massing means for future operations?" Bottom line up front – we need to determine what we, as artillerymen, believe massing Fires means for future operations. Will we mass platoons, batteries, battalions, etc? Understanding the concept of operations expectation will help drive some of the Fires Center of Excellence, Fort Sill, Okla., future material, doctrine and training decisions.

As artillerymen, we understand massing from the lowest levels (a pair of howitzers) to some of the largest levels (division artillery). We took pride in understanding those high-payoff targets worthy of some level of massing – a level normally dictated by the effects desired. We understood the need for irregular shaped targets requiring volume Fires in order to effectively mitigate or eliminate the abilities of enemy combatants. Today, however, we have to consider a number of factors when considering what massing in the future really means. Some of the factors include, but are not limited to, the proliferation of precision and near-precision munitions, collateral damage considerations, area of responsibility sizes, rules of engagement, and we need to consider training from the perspective of the ability to coordinate the Fires of multiple units over large areas.

The proliferation of precision and near-precision munitions, such as Guided Multiple Launch Rocket System's, Excalibur and Precision Guided Kit have given rise to the thought that in the future, massing will be virtually non-existent and that the majority of missions will be at point targets or at multiple aim points, for large irregular targets. Based on discussions I've had with many of our leaders rotating though the Pre-Command Course, the majority believe massing above the battery level will be limited and that normal operations will be at the platoon level. That opinion is understandable given the type of fighting they've been involved with over the last 10 plus years. However, when presented with some probing questions about potential combined arms maneuver type scenarios or other situations that require more fire power, the first thought is that fixed or rotary wing forces would support. I don't necessarily agree with the assessment, but we need to come to grips with 'what right looks like' for future operations and ensure we all understand that picture. I would guess that many of our battalion commanders (Field Artillery and maneuver) have never witnessed a battalion time-on-target live, nor have they ever thought they needed a battalion mass mission. Some of that can be attributed to the combat outpost/forward operating base operations and some of it can be attributed to the simple fact that they don't know what they don't know.

There may have been situations they were in which could have leveraged massing, but they either didn't know how to coordinate it, or they didn't know it was even an option. It may also have been that many commanders actively avoided the 'CNN moment,' given the obvious negative publicity collateral damage received. I believe that we, as a military, let this ultimately drive the rules of engagement which had a detrimental impact on many leaders by limiting options and not allowing prudent, risk assessed, measures (Fires) to be implemented in support of operations.

Some other valid reasons why, I believe, we think the way we do about massing is because our new-age leaders really believe that we're going to have this wealth of precision munitions available and that they won't need conventional munitions to meet any commanders intent (destroy, neutralize or suppress). Our leaders don't take into account the procurement cost, or the life cycle cost on munitions that have a finite shelf life (normally 10 years). More importantly, we tend to not consider what we do with those munitions once they reach shelf life and no longer have the required reliability. Options normally include a service life extension program, that's normally costly, de-mil which now adds to the sunk procurement cost, or we accept reduced reliability over time which has operational implications. All of these reasons are why I believe we really won't have a wealth of precision munitions. Instead, I believe we'll have a combination between precision and conventional munitions, which if lucky, will be a 50/50 mix.

Collateral damage implications, which directly ties to some of the restricted rules

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Fighting Fires Faster

By LTC Dan Elliott

Consider for a moment that the key ingredient to winning our nation's future wars and conflicts is a function of the speed and agility of our force to be globally responsive in strategic landpower. Through the discussion of this article, we will attempt to answer the following questions relating to increasing the speed and agility of Fires: How does the Fires community achieve such speed and agility in 2025, to fight with Fires faster, not fully understanding what capabilities and limitations lay ahead in our future? What can we do to enable our warfighting function to accelerate its outputs to gain and maintain a position of relative advantage in 2025 decisive action?

Achieving mutual trust in the employment and coordination of Fires is central to our collective success in air-ground combined arms operations. The speed at which we gain this trust within the combined arms force is critical for gaining that position of relative advantage against our adversaries of the future.

"There is one thing that is common to every individual, relationship, team, family, organization, nation, economy, and civilization throughout the world – one thing, which, if removed will destroy the most powerful government, the most successful business, the most thriving economy, the most influential leadership, the greatest friendship, the strongest character, the deepest love.

On the other hand, if developed and leveraged, that one thing has the potential to create unparalleled success and prosperity in every dimension of life. Yet, it is the least understood, most neglected, and most underestimated possibility of our time. That one thing is trust." An excerpt from Stephen Covey's "The Speed of Trust," 2006

Obviously, Covey's approach relates the effects of trust on the operational environment. Building cohesive teams through mutual trust is a principle of mission command. Mutual trust is shared confidence among commanders, subordinates, and partners. There are three distinct areas of Fires in which we can accelerate our trust among our combined arms, joint, and multinational stakeholders in the future. Those areas include: integrating air-ground operations, employing Fires at the operational level, and coordinating effects.

These quotes not only support the approach of this article, but also demonstrate that this thing we call trust, is crucial to the success of the Fires warfighting function: the related tasks and systems that provide collective and coordinated use of Army indirect Fires, Air Missile Defense, and joint Fires through the targeting process. Army Fires systems deliver Fires in support of offensive and defensive tasks to create specific lethal and nonlethal effects on a target. The Fires warfighting function includes the following tasks: deliver Fires, integrate all forms of Army, joint and multinational Fires, and conduct targeting.

Covey presents an equation that lays out the economics of trust:

↓ Trust = ↓ Speed ↑ Cost

↑ Trust = ↑ Speed ↓ Cost

This insight demonstrates that trust always affects two outcomes – speed and cost. The effects of increasing our trust among our Fires stakeholders is vital to increasing our speed at which we achieve and coordinate effects in support of the commander's objectives, such that we place them in a position of relative advantage.

Integrating Air-ground Operations. MG Kevin W. Mangum, commanding general of the Aviation Center of Excellence, said, "This year, Field Manual 3-04, *Aviation Operations*, will be the first Army doctrinal publication where we have described, defined, or codified the importance of orchestrating air and ground operations in how we fight. Air-ground integration suggests bringing together disparate entities instead of the inextricable link between air and ground in air-ground operations."

FM 3-04 describes air-ground operations as the simultaneous or synchronized employment of ground forces with manned and unmanned, rotary- and fixed-wing aviation, and Fires to seize, retain, and exploit the initiative. Effective air-ground operations are built upon relationships, mutual trust, and a common understanding of the operational environment, current operation, and mission. They require detailed planning, coordination, and synchronized employment of ground, air maneuver and Fires in order to achieve the commander's objectives and ensure freedom of movement and action.

Integrating air-ground operations requires continuous coordination between the air and land commanders. It requires interfacing with the appropriate joint air operations center or combined air operations center to exchange current intelligence and operational data, support requirements, and coordinate Army forces' requirements for airspace coordinating measures, fire support coordination measures and theater airlift.

Integrating air-ground operations is a specific Fires warfighting function task in the Army Unified Task List, and an integral necessity for the delivery of timely Army, joint and multinational Fires. Our ability to execute this function faster in the future relies on the level of trust we have with our combined arms partners in air and maneuver. Of course we intend to move toward one network and integrated mission command systems to enable faster coordination amongst our echelons to speed the coordination and clearance of Fires. But there are also other measures we ought to take to make our craft stronger and more efficient.

One of these measures is to embrace our understanding and role in the joint air-ground integration center. Beginning in FY11, the United States Air Force began habitually aligning its air support operations center capabilities with each active duty Army division. Twelve ASOCs (one per division and two Air National Guard ASOCs) are projected to become operational by FY17. In February 2014, the Army and Air Force collaborated efforts to approve the signature draft for the techniques and procedures for JAGIC in Army Training Publication 3-91.04, *The Joint Air-ground Integration Center*. This is a new publication that integrates mission command, Fires, aviation, and maneuver doctrine at the division and ASOC level, encouraging synergistic techniques both physically and systematically to better achieve more timely effects and coordination in air-ground operations.

The JAGIC co-locates decision-making authorities from the land and air components with the highest levels of situational awareness to support the maneuver commander's concept of operations, joint force air component commander objectives and intent, and requirements of joint force commander's designated authorities, including the airspace control authority and area air defense commander. The JAGIC collaborates to more effectively execute missions and reduce risk at the lowest tactical levels. Aligning ASOCs provides an effective method to command and control close air support, intelligence, surveillance, and reconnaissance, and dynamic and deliberate interdiction operations and to provide an effective means to coordinate suppression of enemy air defenses within division-assigned airspace. Integrating ASOCs and tactical air control parties with division Fires, airspace, air and missile defense, and aviation personnel and functions gives the division a powerful joint team capable of collaborative Fires while maximizing the use of airspace.

Already described in Army Doctrine Reference Publication 3-09, *Fires*, the Fires cell includes the roles and functions of fire support and AMD into one integrated cell. This correlates to a requirement for fire supporters and *Air Defenders* to strive for a cross-branch functional understanding and expertise of the warfighting function as a whole. At the brigade combat team and division-level, Fires officers and noncommissioned officers are the experts on the Fires warfighting function and their mission command systems requirements in support of the air and ground maneuver command and staff. This approach allows for increasing the speed and agility of the Fires cell and the maneuver command post as a whole. Fire supporters should fully understand and be able to communicate air-space clearance requirements and the coordination of permissive measures. They should understand the system integration requirements for Air Defense mission command systems and recognize the common air picture populated by the Air Defense team. *Air Defenders* should fully understand the call-for-fire process and be able to prioritize air-space clearance in support of fire missions. They should understand system integration requirements for fire support mission command systems and recognize the common operational picture for surface-to-surface Fires.

A level of trust is further gained in this approach which provides dividends such as increased value of the Fires staff, accelerated growth in understanding the common operational picture to make better and faster coordination and decisions. This approach enhances innovation and improves collaboration by facilitating a high trust environment in the functional cells and centers. This approach additionally enables our potential for stronger partnering with our combined

Speed happens when people truly trust each other.

Edward Marshall

If you're not fast, you're dead.

Jack Welch

Our distrust is very expensive.

Ralph Waldo Emerson

The world is changing very fast. Big will not beat small anymore. It will be the fast beating the slow.

Rupert Murdoch

arms, joint and multinational stakeholders. Relationships are easier to develop because we have increased our capacity for better understanding and execution. Roles become better understood and our ability increases for learning and taking on more innovative and capable techniques and systems. As a result of increasing our trust, we gain efficiencies and synergy in our support of unified land operations.

Employ Fires at the Operational Level. Already familiar with the concept and term 'joint Fires,' the Army Fires force largely coordinates them at the BCT level and above. However, with the oncoming of the division artillery to complement Forces Command divisions in FY14, an approach to providing operational Fires needs exploration. Bringing the DIVARTY back to the formation enables further building of trust and confidence in the Fires warfighting function in support of maneuver. On Jan. 27, 2014, the Fires Center of Excellence, Fort Sill, Okla., released the DIVARTY White Paper for worldwide staffing. The intent of the paper clarified roles between Field Artillery brigades and DIVARTY headquarters and provided employment and procedures guidance for Fires utilizing the DIVARTY at its full potential. In this approach, the paper introduced the concept for employing Fires at the operational level and its relationship to the DIVARTY.

In the White Paper, Fires at the operational level are Fires coordinated, integrated, synchronized and employed through the Field Artillery brigade or the DIVARTY to provide additional Fires resources to achieve the commander's desired effect. Operational Fires task execution is largely provided by joint and multinational forces. A Field Artillery brigade or DIVARTY asset may also deliver long-range precision Fires in support of operational Fires tasks.

The Field Artillery brigade and the DIVARTY are the primary source of coordinating, integrating and synchronizing operational Fires to achieve the commander's desired effects. These Fires include surface-to-surface Fires, air-to-surface Fires, and electronic attack. Simply put, Fires at the operational level are the means to describe to the division commander their organic Fires combat power in support of the division area of operations.

Crucial to increasing the mutual trust with the division commander and staff is the DIVARTY's ability to enable mission command and enhance global responsiveness at the operational level. In gaining this trust, the DIVARTY must develop a clear scheme of Fires and fire support tasks through mission orders by phase of the operation and for home station training. The DIVARTY must also provide oversight of the development and training of the organic Fires force while integrated with maneuver to ensure competence and agility in providing Fires in support of decisive action. This responsibility includes training the Fires force through the battalion-level to become agile in coordinating and providing timely strike, integrated sensor fusion and counterfire operations – gaps which evolved from the modular construct pursuit.

The role of the DIVARTY is pivotal in building more fluid relationships with joint and multinational partners. It is the conduit in which interoperable techniques and procedures are refined for coordination of operational Fires and effects, reinforcing the division's ability to remain regionally engaged and aligned. In support of the maneuver commander's objectives, the DIVARTY assures the readiness of forward deployed and rotational Fires Forces. This shaping function is best maintained through the DIVARTY's role to train and equip Fire supporters and *Air Defenders* to develop a sound understanding of joint and multinational capabilities, constraints, cultural awareness and procedures at this level. Building these relationships not only increases trust with partnering nations, but also develops trust with inter-agency organizations in Department of State and Department of Defense.

Coordinate Effects. As the fire support coordinator for the division, the DIVARTY commander is the primary advisor to the division commander on all aspects of the Fires warfighting function. On behalf of the division commander, the FSCOORD ensures targets are prioritized, resourced and executed in an expedient manner through the targeting working group and targeting board. Crucial to increasing the speed of target strike execution is developing the trust among the collective participants of the working group, to include the joint and multinational members. This requires proactive communication and distribution of targeting guidance, synchronized coordination of target priorities and resourcing, and a rehearsal process that enables permissive procedures to most efficiently strike dynamic targets.

As subordinate levels of fire support and Air Defense become more capable through modernizing the force, the DIVARTY must streamline and shape its coordination process to best enable the most timely Fires with the desired effects. The approach toward mission command becomes increasingly important. Maintaining an adaptive learning approach toward applying mission command is essential to gain and maintain a position of relative advantage against the enemy. This agility is neither common nor automatic. It is an approach that must be mentored, trained, and cultured regularly from the senior leaders of the DIVARTY on down through the battalions.

Using the distinct steps of dynamic targeting, the FSCOORD advises the commander or his representative to readily coordinate complementary and reinforcing activities to best enable decisive action. A rehearsed dynamic targeting battle drill in current operations that involves collocated and integrated functional liaisons between joint Fires, aviation, and the chief of operations, or battle captain will increase the speed and effectiveness of command decisions, and allow for greater flexibility. In this process, the joint tactical air controller, joint Fires observer, fire support officer and tactical air control party liaisons coordinate air-ground operations integration requirements through liaisons at the division echelon to enhance shared understanding. Organizing effects and air-space coordination in this manner increases command post agility and the ability of the commander to strike faster.

A key enabler to training Fires coordination of effects is the availability of the Call-For-Fire Trainer at numerous installations in the Army. In fact, wherever there is a Fires formation on an Army installation, there is also the CFFT. The CFFT allows for the most realistic sustainment training and certification for joint Fires observers and joint tactical air controllers at a fraction of the cost of performing live air-ground operations Fires training. The DIVARTY takes on a training oversight role to enable Army Learning Model principles to infuse through the use of the CFFT in regular home station training. This training is not only useful for Fires observers, but also for the tactical and operational command post training for coordination of effects. As the CFFT continues modernization and augmentation to train multiple stations simultaneously for precision Fires, DIVARTY's maintain a critical role to influence the maneuver formation to advocate for continued CFFT resourcing through unit readiness reports and program objectives memorandum life cycle inputs.

The dividend of increased trust placed with our combined arms, joint and

See FIRES FASTER, Page 28

Forward Observers in 2035

By MSG Rutilio Guzman

The mission of a forward observer has always been technical and tactical knowledge with the means to provide and employ rapid and accurate Fires. Despite the inception and utilization of precision capabilities, the FO in the future, like in years past, must remain relevant and essential to the Field Artillery's mission of accurate Fires.

In years past, fire supporters have served in many dynamic roles across the combat arms community; however, technological advancements in precision capabilities, unmanned aerial vehicles, and Non-Line of Sight - Land System threaten the everyday mission of the FO. Continued advancements in guided munitions and advanced instruction in call-for-fire to military occupational specialties, such as 19D and 11B, threaten the future requirement of specialized FOs within the maneuver platoon. Additionally, Air Force joint terminal attack controllers assigned within the brigade eliminates the need for a fire supporter inadequately trained in close air support.

Aided by programs such as Precision Fires Warrior System, precision Fires in conjunction with target mensuration, tomorrow's 13F will need to be better prepared to rapidly locate targets with greater accuracy than in years past. Programs such as the Joint Fires Observer Course continue to broaden the gamut for highly trained Fire supporters and increase the demand for experienced and lethal FOs across the Army. Greater demand exists in attendance, completion, and certification as an Air Force trained Army JTAC with the ability to conduct unassisted Type I and Type II controls and drops all the way to brigade and/or division level.

Many changes are ahead for the fire support community and we must continue to adjust and be flexible to remain relevant. Fire support sergeants must get back to the basics and improve their level of instruction to their FOs. Get to know their capabilities, prepare them daily, provide them the necessary courses to become confident and competent, and lastly challenge them through meaningful evaluations. Take ownership of your team and prepare them not only to be the best, but to give their best at all times.

In years to come, it's not difficult to envision a 13F monitoring and orchestrating CFF through the eye of a UAV. In 2035, I envision a 13F who can take a picture of what he sees, digitally send it to higher, and approve a UAS strike within a matter of minutes/seconds. Furthermore, a 13F in 2035 will also have the capability to plan non-lethal targets, conduct detailed targeting meetings with a battalion/brigade combat team staff, and have the intelligence to provide multiple courses of action.

Soldiers have served on the battlefield for thousands of years; the next 20 will not change that. FO's, like any other Soldier, will remain relevant in spite of advances in technology.

Master Sergeant Rutilio Guzman is the Joint and Combined Integration Directorate noncommissioned officer in charge. Guzman served as fire support team chief for A Battery, 3rd Battalion, 327th Infantry, Iraq, 2003, and fire support advisor to the Iraq border police in 2010.

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multinational stakeholders is an increased value of the Fires warfighting function. Accelerated growth and enhanced innovation become self evident within the command post and Fires cell. Improved collaboration and stronger partnering with our air-ground maneuver counterparts in the Army, joint and multinational communities are products of increased trust in Fires competence and expertise. Better execution of Fires coordination and delivery of effects produce a heightened loyalty among our stakeholders.

Integrating air-ground operations, employing Fires at the operational level, and coordinating effects through DIVARTY is fundamental to the Fires warfighting function gaining trust from the division on down through the battalion. This increased trust not only directly increases our operational force's agility and speed for strategic landpower in the future, but also decreases the costs of speculation and doubt in our ability to train and execute our craft in support of air-ground maneuver. This approach of increasing our trust allows our force to learn, adapt, and improve as new technologies and enemies emerge in the future.

Lieutenant Colonel Dan Elliott consulted with Doctrine Division Chief LTC Terry Braley and Mr. Kyle Smith, Chief of Education and Training Programs, Directorate of Training and Doctrine, for input and concurrence on the release of this article. Elliott is currently Deputy Director, DOTD at the Fires Center of Excellence and recently served as a doctrine writer with inputs to Combined Arms, Joint and Multinational Fires related doctrine publications to include ADP 3-09, ADRP 3-09, FM 3-09, FM 3-95, FM 3-96, FM 3-04, FM 3-52, ATP 3-91.04, JP 3-09, and ATP 3-09.34.

Army and Air Force Airspace Control in 2025

By Lt. Col. Greg DeFore, US Air Force

Over the past five years of the Army Capabilities Integration Center's Battle Lab experiments, one experimental focus was common to all these experiments. They all attempted to use 'machine-to-machine interface' to gain a better handle on airspace control. Joint Publication 3-52, *Joint Airspace Control*, defines airspace control as, "A process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace." The experimental objectives essentially focused on automation improvements in an attempt to reduce the time between the call-for-fire and the resulting weapon's effects on the target. This quest for an automation solution to airspace control issues lead to a common understanding developed from these experiments. Technology changes at a very rapid rate (as long as there is money to pay for the change), and seemingly no amount of technology can make up for personnel who were not adequately organized and trained.

Based on the reality of our current budgetary constraints, to attempt to answer the question found in the title of this article by focusing on automation would simply result in a 'science fiction' article. To be honest with ourselves, no one can project what 'toys' we will be able to dream up, then pay for, between now and 2025; so this article will not attempt to do so. Instead, this article will attempt to identify the human capital expenditure required to allow our two branches of service to arrive in 2025 with a Theater Air Control Systems/Army Air-ground System interface that will guarantee successful airspace control for the joint force commander.

In order to develop a common understanding of the topic, we need to start in the now. By answering four questions, we can develop our baseline understanding.

1. What does 'right' look like regarding an airspace control system?
2. What factors enable a 'right' system to exist?
3. How close to 'right' are we, the U.S. Air Force and U.S. Army, in 2014?
4. What changes to the way we organize and train our personnel will enable the TACS/AAGS to function more effectively, thus creating 'right' for the USAF and U.S. Army?

First question. What does right look like regarding an airspace control system? If you query 'airspace professionals' from all the services, whether many want to admit it or not, the U.S. Marine Corp's, Marine Air Command and Control System would be the system most deserving of the 'right' label. Those same airspace professionals can also agree, 'there are many similarities between the MACCS and the TACS/AAGS.' Although the systems are very similar in a macro view, these same professionals can agree, "the MACCS works better than TACS/AAGS."

Second question. What factors enable a 'right' system to exist? I have heard many Marines reason that the MACCS works so well because they all work for the Marine air-ground task force commander. Although Marines working for Marines can't be completely discounted, the TACS/AAGS has a 'common commander' too, it is the JFC. So, there must be other factors involved. When taking a macro viewpoint when comparing the MACCS and the TACS/AAGS, the macro perspective yields these two marked differences between the USMC and USAF/U.S. Army systems; the MACCS is composed of airspace control specific MOSs and all members of the MACCS define/understand airspace control in the same way . The fact that the USMC invests in airspace control with specific military occupational specialties and it is the primary job of those Marines for their entire careers, leads to 'system-wide, universal understanding,' which allows the MACCS to operate more efficiently than the TACS/AAGS. Additionally, the USMC aviation utilizes a system of testing which incorporates USMC and joint doctrine into their advancement exams. If/when attempting to promote to the next level, an individual Marine cannot pass the required doctrinal test, the Marine will not be promoted. Specific airspace MOSs and institutionalized doctrinal training are the two key differences within the MACCS which enable the ability to perform at higher levels of professionalism than many of their USAF and Army counterparts. The focus of this article from this point to the end will suggest how the USAF and Army could/should duplicate this proven successful model of providing organized, trained and equipped airspace control personnel within the TACS/AAGS to enable similar success.

Third question. How close to 'right' are we, the USAF and Army, in 2014? To answer this question, it is necessary to first compare MACCS and TACS/AAGS organizations, and then look deeper into the organizations at the individuals who enable the unit's function. A unit-to-unit, entity-to-entity comparison of the MACCS and TACS/

AAGS yields the following organizational similarities:

- Marine air-ground task force commander is 'like' the joint force commander
- Ground combat element commander is 'like' the joint force land component commander
- The air combat element commander is 'like' the joint force air component commander
- Tactical air command center is 'like' the joint air operations center
- Direct air support center is 'like' the air support operations center
- Fire support coordination center is 'like' the Fires cell

Note: The TACS/AAGS entities above are delegated responsibilities/authorities from the airspace control authority but not from the area Air Defense commander. This article will only discuss shortcomings in the TACS/AAGS that relate to ACA authorities at the division-level and will not address the complicating issues of non-existent AADC authorities within the division headquarters.

For the purposes of this article, the focus will be on the division level, assuming the Army division is operating as the 'senior tactical echelon', thus the level at which the ASOC function will be performed.

On the surface, the TACS/AAGS contains all the 'right' parts…the commanders perform similar roles with similar training to accomplish those roles, but an examination of the personnel which make up the entities at the division level, yields a different story. On the USMC side nearly every person in the DASC and FSCC are MOS trained to perform that entity's mission and the previously discussed promotion testing, including Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) sponsored doctrinal testing, ensures all personnel are in tune with the most current USMC/joint doctrine for airspace control.

For both the USAF and Army, doctrine is something only tested while attending professional military education. Thus, for example, if the last PME an Airman or Soldier attended was five years in the past, and the Airman or Soldier actually retained the doctrinal airspace control knowledge presented during the PME, the result is still out of date 'knowledge' being used during on-the-job-training and execution of their mission.

USAF Organize. Specifically regarding the Air Force specialty code (Air Force speak for MOS) of personnel within the air support operations squadron, the unit providing the ASOC and TACP functions, the vast majority of the personnel in these jobs are not AFSC specific to these entities. The officer manning of an ASOS is made up of personnel whose AFSCs are not career long 'air-ground integration' focused AFSCs.

U.S. Air Force 1st Lt. Nathan Maxton, 15th Air Support Operations Squadron, air liaison officer, communicates with a pilot during a week of training at the Dare County Bomb Range in Stumpy Point, N.C., Aug. 26, 2013. Maxton and other JTACs called in a variety of commands to multiple F-15E Strike Eagles to ensure all targets were destroyed. (Photo by Airman 1st Class Brittain Crolley, U.S. Air Force)

Staff Sgt. Steven Stein (right) works with members of his joint terminal attack controller team to plot targets during a joint training exercise Feb. 6, 2014, at the Bollen Live-Fire Range Complex on Fort Indiantown Gap, Pa. The JTACs worked with C-17A Globemaster IIIs and A-10C Thunderbolt IIs in the mountainous, snowy terrain of central Pennsylvania. Stein is a JTAC from the 11th Air Support Operations Squadron, 3rd Air Support Group, which supports the U.S. Army's 3rd Armored Calvary Regiment at Fort Hood, Texas. (Photo by Greg L. Davis, U.S. Air Force)

On the enlisted side of the ASOS, this is fortunately not the same story, there are AFSCs which enable the enlisted personnel to flow from one air-ground specific unit/job to the next.

Air Force Train. One common thread throughout these disparate AFSCs that allows the USAF's 'pick-up game' in the ASOS to work is the fact that the entire USAF is trained using a common set of Tenants of Airpower. This enables one common view of how airspace control of aircraft is best accomplished. In this fashion, when another command and control entity within the TACS contacts an aircraft, and gives it information, direction, or a change of mission; the aircraft's pilot simply follows the guidance, without requiring the pilot's commander to issue new orders. The Army does not hold this point of view, which will be discussed shortly.

Army Organize. Specifically relating to Army personnel in the TACS/AAGS diagram, the FC is manned by MOS trained Field Artillery personnel, so issues with MOS mismatch are not occurring within the FC. However, from an airspace control perspective a more serious MOS mismatch is occurring, specifically regarding the 15Q MOS, the air traffic control operator career field.

Army Train. 15Q personnel are trained to facilitate the air operations in/around aviation assembly areas. However, when a division is given a volume of airspace to control in accordance with the JFC's airspace control plan, the Army turns to the 15Qs to control the Army's assets within that volume of airspace. This large volume of airspace is beyond the current level of organization and training of the 15Q community. The ASOC is responsible for the JFACC assets within the same volume, as part of the joint air-ground integration center, within the division current operations integration cell. There is actually a larger issue compounding the added workload of the 15Qs, the doctrinal mission command focus, which the combat aviation brigade uses to maneuver its assets clashes with the joint force's understanding/definition/use of airspace control.

To illustrate this conflict, assume the JAGIC (within which the airspace element within the division will work) were to be able to contact a flight of Army AH-64s maneuvering in division assigned airspace (thus eliminating any equipping issue as a possible causal agent to this scenario), and desired for the flight to 'hold short' of a river while an artillery mission was in progress across the river. The AH-64s would not be organized and trained to respond to the division guidance coming from the JAGIC, as they are organized and trained to only respond to combat aviation brigade commander's guidance. To non-Army air assets, this example seems too impossible to be true…but it is. Army doctrine, in an effort to not step on commander's authorities to command, doesn't empower Army airspace control personnel/entities to direct assets outside of their assembly areas.

Given the same scenario, but changing the variables to be USMC assets (AH-1s instead of AH-64s and DASC instead of the ASOC within the JAGIC). The USMC AH-1s would not hesitate to respond to the guidance of the DASC, and would never expect their aviation unit commander to be involved in airspace control guidance required to keep aircraft alive, while they perform their assigned mission.

Fourth question. What changes to the way we organize and train our personnel will enable the TACS/AAGS to function more

effectively, thus creating 'right' for the USAF and Army?

Regarding USAF and Army personnel and their opportunity to gain/maintain required doctrinal knowledge in the course of their careers, the PME-to-PME doctrinal void may be the most simplistic of the problems to address. By simply 'cloning' the USMC model, the solution for the USAF could be addressed using doctrinal questions developed within Air Education and Training Command, that address airspace control issues. The same model could be followed for the Army, utilizing questions developed within Training and Doctrine Command. Perhaps even more beneficial to facilitating a common air-ground integration perspective, have AETC and TRADOC collaborate to create a common master data base of questions. Thus, an individual unit could pull from the 'master data base of questions' to conduct individual unit training of their airspace MOS and AFSC specific individuals.

More complicated than this doctrinal issue, is the lack of airspace control specific AFSCs and MOSs to enable seasoned professionals with the nodes of the TACS/AAGS. One positive step in the 'right' direction is currently being taking by the USAF. The addition of the 13L, or career air liaison officer, AFSC to the USAF's personnel rosters results in an officer whose entire career will be serving as the USAFs linkage to the Army for air-ground integration. This change should institutionalize the professionalism of the USAF air liaison officer within the AAGS. By the projected 2025 timeline, the seeds (lieutenants) of this specialty planted in 2011-2014, will have grown into trees (majors and lieutenant colonels). Thus enabling career long expertise to reside within the ASOC function provided by the ASOS, effectively placing the ASOC and DASC on equal levels regarding organized and trained personnel.

For the Army, the issues are even more formidable. Not only existing in the MOS arena for large volume airspace controllers, but also in the doctrinal arena regarding the clash between mission command and airspace command and control. As a first step, the Army could expand the organization and training of 15Qs to adapt to a larger volume of airspace under their control. This step would still leave the doctrinal side needing to better define the cooperative relationship between mission command delivery of commander's intent, and the joint definition of airspace control, which seeks to maximize the effective use of the airspace for all users. However, without this critical, common doctrinal understanding of 'airspace control,' no amount of training will yield the 'right' model for the Army and Air Force.

Between today and 2025, airspace control will be challenged by known issues such as more extensive use of our own unmanned aircraft, enemy aircraft systems, proliferation of neutral unmanned aerial systems, and expansion of long range, high altitude, artillery systems. These are only the known, currently recognized challenges facing our TACS/AAGS of today. Between now and 2025, it is likely there will be more challenges to USAF/Army airspace control. Without a more significant investment in our human capital specific to airspace control, we may not be prepared for 'airspace control in 2025.' Fundamentally, we must properly organize, train and (as resources allow) equip ourselves to accomplish airspace control tasks, in order to be able to successfully accomplish our mission.

Lieutenant Colonel Greg "Skidder" DeFore is a former Army Cavalry/Attack helicopter pilot, turned Air Force Special Operations helicopter pilot. He served as USCENTAF's Chief of Killbox Interdiction and Close Air Support (KI-CAS) for OEF and OIF. "Skidder" is currently the Operating Location-Sill Director of the LeMay Center's Joint Integration Directorate.

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of engagement, are also contributing to the question of massing in the future. During the last 10 plus years of conflict, collateral damage has played a significant part of our fire mission processing procedures and has limited the potential use of massing, as well as having increased the time it takes to prosecute a target. I don't think there is any doubt that we will always consider collateral damage, but I also believe that even with collateral damage considerations and rules of engagement restrictions, both the WAS and CAM environments will require volume Fires on irregular shaped targets, as well as on larger enemy formations. One look at the various combatant commands and their respective AORs will convince most that massing Fires is still relevant for future operations.

On the subject of AORs, we see a significant increase in the area that a brigade combat team must cover, which would lend itself to the thought that we wouldn't necessarily be able to mass. However, I would submit that it would still allow massing, but may limit the average size of elements that would be massed. For example, consider a BCT AOR that is 50 km by 150 km in a linear type engagement. One would assume that sections would normally be in paired operations and spaced to support a wide BCT frontage. Massing would still be possible, but limited. Given the range of weapon systems, it would be unlikely that a pair or platoon, on the extreme left side of the BCT sector, would be able to mass with one on the extreme right side. Mission, enemy, terrain and weather, and troops would drive the number of units; however, I'm convinced that the ability to mass is still relevant. I would add that I'm also convinced that the ability to mass any formation above one battery (two batteries or more), provides the understanding that translates to massing at any level, even massing a DIVARTY.

On a non-linear battlefield, one could imagine position areas throughout the depth and breadth of the AOR. In this case, as with the linear fight, there would still be the ability to mass with the level of massing being dictated by the range of the weapon systems. You could very easily make the case that in a 50 by 150 km AOR, with FOB and COP-like positions throughout, the ability to mass would be more limited. In my opinion, platoon and battery massing would be the norm, and very seldom would we see any massing above battery, as evidenced by our lessons learned during the last 10 plus years of conflict.

It can safely be said that massing above the platoon-level has been very limited throughout the history of our current conflict. It is my opinion that the art and science of knowing how to coordinate and integrate massing missions, as well as understanding the lethality and psychological effects of massing is lost on our current leaders. If so, we need to ask ourselves if massing is an option we have in our playbook to support our maneuver commanders. If the answer is yes, then we need to further define what level of massing we need to be trained on to produce the desired effects.

Every scenario is different and everybody will have an opinion on each scenario, but suffice it to say, we need to think this out and understand what we believe massing will be for future operations in the near and mid-term (now – FY30). Once we decide what massing means, we can then make better decisions about munitions mixes (procurement strategy), future howitzer requirements and training requirements, both at training institutions, as well as in the operational force.

The Future Joint Fires Observer 2025 and Beyond

By LTC Michael A. Todd

Since inception, the joint Fires observer has been a critical component for the maneuver commander and provides the maneuver force access to joint Fires at the lowest tactical level. In accordance with the Joint Close Air Support JFO Memorandum of Agreement, July 2013, "The JFO is a certified/qualified service member trained to request, control, and adjust surface-to-surface Fires, provide timely and accurate targeting information in support of CAS to a joint terminal attack controller, forward air controller-airborne, or directly to aircraft when authorized by the controlling terminal attack controller, and perform autonomous terminal guidance operations. The JFO is an extension of the tactical air control party, and in conjunction with TACs, assist maneuver commanders with the timely planning, synchronization, and responsive execution of all joint Fires and effects. JFOs provide a capability to exploit those opportunities that exist in the operational environment where a trained observer can efficiently support air-to-surface Fires, surface-to-surface Fires, and facilitate targeting." This extremely important combat enabler has proven critical to mission success throughout the history of the JFO program, most evident in combat operations in Iraq and Afghanistan and will likely continue enabling success for maneuver forces to 2025 and beyond.

The Future Environment. The JFO will continue being the critical link at the tactical level between the maneuver force and the Air Force TACP in the future. The JFO focuses on performing duties as a 13F, forward observer, by requesting and controlling indirect Fires, provides targeting information to JTACs and FAC(A)s while performing Type 2 and 3 CAS missions, coordinates rotary wing close combat attack missions, and provides TGO for JTACs and pilots. In many instances in Afghanistan and Iraq, the JFO was the only link between ground forces and fixed wing aviation, conducting CAS missions as a non-JTAC, saving countless lives on the battlefield. In the near and distant future, JFOs must not only continue being technically proficient in these areas, but also realize and adjust to working with joint and coalition forces on a more regular basis and prepare for emerging friendly and enemy capabilities, such as unmanned aerial systems that are quickly gaining momentum. As TRADOC Pam 525-3-4, *The United States Army Functional Concept for Fires 2016-2028* suggests, "Future operations will closely integrate joint, Army, and coalition air-to-ground, and ground-to-air capabilities. The continued fielding of joint, Army, and multinational unmanned aerial systems will further add complexity to the airspace."

As JFOs continue to provide access to joint Fires at the lowest tactical level, they must become adept at friendly, as well as enemy UAS capabilities, limitations, and employment, and realize that working with joint and partner nation forces will not be a 'concept' but a reality in the future. The JFO's core missions of requesting and controlling indirect Fires, providing targeting information to a JTAC, and conducting autonomous TGO will become exponentially more difficult as he must also account for several other factors - the ever-increasing friendly, enemy, and civilian UAS presence that causes cluttered airspace, joint and partner nation considerations, cyber and electronic warfare impacts on communication and target location equipment, and collateral damage/rules of engagement concerns. In preparation for the future and in an effort to improve the JFO 'brand.' There are many steps the Army needs to take to transition a good product to a great product.

Making a Good Product Great. Since its inception in 2005, the JFO has been a huge success in that it offers a high degree of specialized joint Fires training to fire supporters at the company level and below. JFOs have taken their skills and applied them in countless real-world situations, both saving lives and helping accomplish the maneuver commander's mission. In light of the overall success of the program, there are numerous steps the Army must initiate to transition the JFO for the challenges of the future.

Improve Initial Training. "Revolutionalized training which replicates operational environment complexities and integrates a realistic home-station training environment that is consistent with the joint operating environment. Professional military education in each cohort (noncommissioned officer, warrant officer, and officer, active, reserve and National Guard) delivers the foundational learning required to meet the education requirements of an adaptive Army." This is the end state of Major Objective 4.0 (Design Training and Education (Learning) for the Future), from Line of Effort #2 (Design the Force), TRADOC Strategic Plan 2020, and describes the route initial JFO certification at the schoolhouse should take.

In order to maximize resources and training effectiveness for initial JFO certifi-

Joint Fires observer instructors, SFC Richardson and SSG Sanchez, observe the target area at Falcon Bombing Range on Fort Sill, Okla., during a scheduled JFO course, range training day in February 2014. (Photo courtesy of LTC Michael A. Todd)

cation, it should be incorporated into PME for officers and enlisted Soldiers, and the course should be extended to ensure all joint mission tasks and additional Army requirements are adequately learned and proficiency displayed. Officer PME is an easier challenge to answer than enlisted PME. Where is the right place for JFO in the 13F continuum of education? Although Advance Individual Training is too early, and Advance Leader Course is too late, somewhere in the middle, prior to Warrior Leader Course (intended for E4s and junior E5s), may be the right answer. The course will need to be lengthened in order to train not only the Joint Mission Tasks in the JFO MOA, but also (a) precision targeting devices, such as the Lightweight Laser Designator Rangefinder-Hand-Held, Joint Effects Targeting System and the Precision Fires Warrior; (b) friendly, enemy, and civilian UAS systems and their capabilities and limitations; (c) airspace, cyberspace domain and electromagnetic spectrum considerations; and (d) CDE, rules of engagement, and media techniques. It is also imperative to keep Air Force JTACs and air liaison officers and other joint/coalition partners thoroughly involved with the instruction at the JFO course. In order to promote the joint and partner nation 'mindset,' it is crucially important to keep those different types of uniforms involved in the training.

Improve JFO Sustainment. The Army's biggest challenge with the JFO program since inception has been currency sustainment, management, and tracking. The Digital Training Management System has been the Army's system for JFO sustainment tracking, but most units do not use it for various reasons. A user-friendly centralized sustainment, management and tracking system should be developed, whether it's an improved version of DTMS, or another centralized database similar to the Air Force's JTAC TACTICS system. Along with a centralized tracking database, units' reporting of their JFO qualification status should also be required, allowing leadership to maintain visibility of their subordinate units' status, and a forcing function for units to keep their JFOs current.

Set the JFO up for Success. Properly equip and protect JFOs in authorized Modified Table of Organization and Equipment positions allowing them to maintain currencies, train with their respective air support operations squadron and JTACs, and practice their joint Fires trade. The JFO position should not be looked at as an 'additional skill' but as that individual's primary duty and the commander's link to the TACP and joint Fires. The JFO also must be protected from taskings and other additional duties, in order to allow him the time to maintain his currencies and to train with his partner JTACs and TACP. This is a significant problem today throughout the Army that we must change. Also, the JFO should be equipped properly with at least the JFO MOA's minimum recommended equipment list.

By 2025, conducting voice 9-line CAS requests and call-for-fire missions will not be the way to do business. Instead, the standard will be digitally aided close air support and digital fire missions via JETS and PFW. The Army should transition our current method of equipping JFOs to more of an Air Force model in which JFOs will be issued their 'kit' consisting of the latest (and lightest) multiband communication equipment, DACAS and CAT1-level target location equipment, self and target marking equipment, and so on.

The Army needs a paradigm shift in its approach to JFOs - initial training, sustainment, and equipping - all must be improved to transition a good product currently to a future, great product, ready and able to adapt and conquer the challenges of 2025.

As the U.S. Army Functional Concept for Fires 2016-2028 states, "To prevail in the future operating environment and succeed in a wide range of contingencies, future Army forces will operate with greater decentralization in full-spectrum operations. Greater decentralization means future operations conducted by increasingly lower tactical echelons with the authority and resources to accomplish assigned missions. Future Army forces must also be prepared to conduct decentralized full-spectrum operations simultaneously across wide areas."

JFOs have proven critical for success in decentralized operations in Iraq and Afghanistan over the last 12 years, and with some increased emphasis on adapting and improving initial training, equipping, and sustainment, will continue to provide critical access to joint Fires into the year 2025.

Lieutenant Colonel Michael A. Todd is the chief of the U.S. Army's Joint Fires Observer program in the Joint and Combined Integration Directorate at the Fires Center of Excellence, Fort Sill, Okla. He was previously assigned to 3rd Infantry Division, Fort Stewart, Ga., and served as the 3rd Combat Aviation Brigade fire support officer; 4-3 Brigade Special Troops Battalion executive officer; and 1st Battalion, 76th Field Artillery Regiment executive officer, deploying to Al Anbar province, Iraq in 2010 in support of Operation Iraqi Freedom/Operation New Dawn. He also previously deployed to Iraq in 2007 in support of Operation Iraqi Freedom as a battalion military transition team chief.

Airpower's Contribution to Deep Fires in 2025

By Lt. Col. W. Jason "Junk" Wilson, US Air Force

Since inception, airpower has focused on the deep fight. The U.S. Air Force has traditionally called this mission 'air interdiction' or AI. Airmen have long taken pride in our various attempts to have strategic impact on the outcome of conflict prior to the enemy getting within range of our land forces brethren. This pride has led some airpower advocates to propose that if everyone else would just stay out of the way, airpower could win wars by itself. Nowhere was that more successful than the Gulf War. Airpower skeptics correctly point out that many impediments challenge airpower's ability to realize this vision. Impediments to airpower include adverse weather, sophisticated Integrated Air Defense Systems, and even our own understanding of how the enemy will react to strategic air strikes. All three of those limited airpower's effectiveness in Operation Allied Force. Airpower has traditionally dealt with these impediments, though ever evolving technology, like the joint direct attack munitions, stealth, and unmanned air systems, intelligence surveillance, and reconnaissance. By 2025, a new reality will require more than just a technological solution to win the deep fight.

Early airpower advocates in the U.S. Army were dissatisfied with the cost of linear warfare. World War I demonstrated that defensive formations could stalemate enemy land forces, and airpower was seen as a way to circumvent the advantage of the defensive fortifications. Airpower advocates asserted that the fielded forces could be entirely circumvented, and the enemies' centers of gravity could be targeted directly in order to expedite the end of the conflict. That prevailing philosophy grew and evolved through World War II and the Cold War with the development of intercontinental ballistic missiles and nuclear weapons until the strategic standoff known as 'Mutually Assured Destruction Doctrine' finally showed the world the limits of that strategy. While MADD successfully prevented another world war, it did nothing to reduce the intensity of regional conflict or insurgent warfare.

The Soviet war in Afghanistan, and the U.S. war in Vietnam, were effective demonstrations of airpower's limitations in irregular warfare. In both cases, the land forces' limited ability to synchronize efforts with the airpower assets allowed their enemy to survive and maneuver to the point they could have strategic effects on the technically superior land forces. Airpower couldn't do it alone, and land power couldn't do it alone. Thus, both campaigns were strategic failures in spite of vastly superior technology.

In the Gulf War, the combination of ideal weather conditions and ideal enemy force structure gave airpower advocates the opportunity to demonstrate exactly what early airpower profits had envisioned. With all other friendly troops safely out of the battle space, allied airpower had cart blanch for 100 days. That time was not wasted. Unquestionably the most one-sided campaign in modern history, the world took notice that U.S. led airpower had changed the very nature of warfare. Never again will an adversary give allied airpower months to build up, weeks to practice, ideal weather conditions, and thousands of easily identifiable targets from which to choose.

Operations Allied Force and Iraqi Freedom effectively expressed the limitations that adverse weather, sophisticated IADS, irregular tactics, and a limited understanding of the enemy can have on AI. The U.S. Air Force responded to these challenges in its traditional way by investing in ever more sophisticated technologies. JDAM now enables precision strikes in all weather conditions. Super-cruse and super-maneuverability is now coupled with stealth to counter sophisticated IADS. Exponential growth in UAS ISR has helped allied forces counter irregular tactics and the challenges of phase IV stability operations. While these technical solutions will continue to give airpower an asymmetric advantage in the near future, by 2025 our adversary will certainly have learned to counter each of, as well as any new versions that may evolve between now and then. The battlefield of them, 2025 will require evolutions in the paradigm of warfare, more than evolutions in the technology of warfare.

While OIF was certainly not a linear battle space, it may prove to be the last time land forces used mechanized transport to drive across a modern battlefield with anything resembling a forward edge of the battle area or

The deep future of Fires will see an end to the distinction between deep Fires and any other kind.

a forward line of owned troops. By contrast, Operation Enduring Freedom demonstrated the potency of fully integrated widely dispersed land forces and air power assets.

By 2025, even major regional conflict may be conducted by disbursed teams of well equipped highly trained land forces fully integrated with airpower assets so that each can bolster the inherent limitation of the other. Where the land forces will lack firepower, mobility, and perspective, airpower assets will provide scalable weapons effects, theater wide tactical mobility, and continuous ISR from multiple perspectives. Where airpower will lack the ability to knock on a door and build a relationship with a village elder, land forces will be able to conduct such engagements knowing no one is sneaking out the back door and a massive arsenal of firepower is at their fingertips. The battlefield of 2025 will be more integrated and synchronized than ever before, and our tactics will have to change to capitalize on the strengths of both, or we will risk repeating the type of mistakes demonstrated in Vietnam and Kosovo.

The lines between air forces and land forces will blur considerably by 2025. Fire support officers will have to become as adept at air planning as air liaison officers. Attack aircraft pilots will have to understand the commander's scheme of maneuver, as well as they understand how to react to a surface-to-air missile launch. All of this will be enabled by an increasingly sophisticated array of communication capabilities, both for the machines and the humans on the battlefield. Fighter, attack, and ISR aircraft will be in the same network with Soldiers, sharing data, full-motion-video, and real time threat information. Fighter pilots, attack pilots, and maneuver commanders will be in continuous voice and video contact using Skype-like technology in environments that will blend the virtual and the real worlds.

A common vision of the battle space will enable a common understanding of the battle space in a way that will be taken for granted by the graduates of the United States Military Academy and United States Air Force Academy in 2025. The land forces will be capable of visualizing not only what is within a few miles of their position, but everything within the regional theater. Air power practitioners will have situational awareness, of not just the targets in the air tasking order, but everything the ground forces see as they walk down the street. In this era of overwhelming volumes of information, gone will be the cumbersome nine-line or call-for-fire radio transmission, and in its place will be an integrated visual targeting system that capitalizes on the speed of machine-to-machine data sharing so targets can be identified and prioritized by both land and air weapons systems in real time. The speed and lethality of current AI tactics, techniques and procedures, will need to be blended with the tactics of close air support to enable detailed integration in close proximity of friendly forces throughout the entire breadth and depth of the battle space. The deep future of Fires will see an end to the distinction between deep Fires and any other kind.

Now is the time to identify and implement the education and training required to utilize this capability. The technology is already in development. Will our Soldiers and Airmen be capable of such complex operations? Certainly not, unless we start educating them now. Will our doctrine and tactics evolve quickly enough to keep up with the changes in network architecture and the capabilities that come with such changes? Will ground commanders admonish young Soldiers by saying, "That's not the way we did it when I was a captain," or will they encourage young Soldiers to experiment and accept the risk of failure associated with experimentation? How will the doctrine, organization, training, materiel, leadership and education, personnel and facilities paradigm react to such an exponential rate of change?

U.S. Air Force Master Sgt. Chuck L. Barth, a tactical air control party specialist with the 182nd Air Support Operations Group, speaks with a C-130 Hercules at Grayling Gunnery Range, on a deployment of a training bundle during Exercise Northern Strike 2013 in Grayling, Mich., Aug. 6, 2013. Exercise Northern Strike 2013, is a joint multinational combined arms training exercise conducted in northern Michigan. (Photo by Master Sgt. Scott Thompson, U.S. Air Force)

Lieutenant Colonel W. Jason Wilson is a command pilot with 18 years of experience in the F-15C, F-117A, T-38, and T-6. He graduated from the USAF Academy in 1996, the USAF Weapons School in 2004, Command and General Staff school in 2010, and earned his Masters of Business Administration from the University of Colorado in 2011. He has deployed to Saudi Arabia, Qatar, Bahrain, Kunsan, Osan, and Pakistan in support of contingency operations, and currently commands the Air Force Detachment at the Fires Center of Excellence, Fort Sill, Okla.

Joint Air-ground Integration Challenges in 2025

By LTC Anthony V. Gonzales

> **As a result from lessons learned during combat operations in Afghanistan and Iraq (2001-2005), the imperative to build command and control structures has highlighted both doctrinal and technical air/ground integration issues. The key concept will be to integrate rather than just deconflict Joint assets.**
>
> -Air Support Operations Center Enabling Concept, June 2006

During the 2009 Army Air Force Warfighter Talks, the chief of staff of the Army and chief of staff of the Air Force agreed upon the definition of the Joint Air-ground Integration Center as, "a modular and scalable center designed to fully integrate and coordinate Fires and air operations over and within the division commander's area of operations. The JAGIC collocates decision making authorities from the land and air components with the highest levels of situational awareness to support the maneuver commander's concept of operations, joint forces air component commander objectives and intent, and requirements of joint forces commander designated authorities. This center collaborates to more effectively execute the mission and reduce risk at the lowest tactical levels." Draft JAGIC ATP 3-91.1, AFTTP 3-2.86

In FY11, the United States Air Force started the habitual alignment of its air support operations center with each active duty Army division. Twelve ASOCs (one per division and two Air National Guard ASOCs) are projected to become operational by FY17. Aligning ASOCs provides an effective method to coordinate and control close air support, intelligence, surveillance and reconnaissance, and dynamic and deliberate interdiction operations, and to provide an effective means to coordinate suppression of enemy air defenses within division assigned airspace. Integrating ASOCs and tactical air control parties with division Fires, airspace, air and missile defense, and aviation personnel and functions, gives the division a powerful joint team capable of collaborative Fires while maximizing the use of airspace.

The Army-Air Force Liaison Memorandum of Agreement, signed in March 2011, describes how the USAF provides "a modular ASOC in direct support to the Army's senior tactical echelon, as the focal point for supporting air operations. Directly subordinate to the air operations center, the ASOC is responsible for the direction and control of air operations directly supporting ground combat operations."

During execution, the capabilities within the JAGIC facilitate responsive joint Fires, as well as near-real-time airspace control for airspace users supporting division operations. The JAGIC gains its greatest efficiency through co-locating specific air component and land component personnel and systems, allowing rapid decisions and responsive Fires while simultaneously reducing the level of risk.

Once the alignment and ASOC integration is complete, the division commander will have a powerful tool and capability to synchronize, integrate and coordinate joint Fires and air operations. As we move forward to 2025, several challenges will become apparent for JAGIC and joint air-ground integration. First, as the U.S. Army integrates the USAF ASOC into their command posts and divisional headquarters, each service has a different suite of systems, communication packages and support requirements. This is one of the reasons we have designed a specific seating chart for the JAGIC, to allow the Army and Air Force operators to sit next to each other and collaborate, de-conflict and synchronize efforts. While not ideal, it greatly improves coordination and synchronization; however, our systems must be able to operate seamlessly and jointly. Theater Battle Management Core System, Tactical Airspace Integration System, Air and Missile Defense Workstation, and Advanced Field Artillery Tactical Data System are some of the systems used in JAGIC and sharing a common operating picture on one screen is challenging and virtually impossible. A shared Army/Air Force 'systems of systems' will be needed to deconflict, synchronize and integrate all joint Fires and air operations in a dynamic environment.

Secondly, we must work closely with our coalition partners and have them fully

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Field Artillery Beyond 2025: A Look Ahead Using Business

By LTC Mark O. Bilafer

> **"Artillerymen have a love for their guns which is perhaps stronger than the feeling of any Soldier for his weapon or any part of his equipment.**
>
> -BG Samuel Lyman Atwood Marshall

In a recent "Sixty Minutes" interview with the founder and president of Amazon, Jeff Bezos talked about profit margin, product innovation, and acquisition strategies. While these are not unique concepts in the business world, what set Bezos' comments apart was his emphasis on one core belief—Amazon must always focus on the need of its customers. The intellectual and organizational ability not to fall in love with the product, but rather the customer and his evolving needs, is the mindset the Field Artillery needs to adopt to maintain its relevance in 2025 and beyond.

Against the backdrop of this quote, is it any wonder the FA continues focusing its acquisition and training efforts in putting the finest cannon and rocket artillery pieces in the hands of the finest fighting force in the world? Is there any reason to relook our strategy for Fires in 2025 and beyond? We must, if we want to stay relevant! The FA must adopt the way business thinks in closing the existing gap in training Army personnel in operational targeting and establishing targeting as its cornerstone.

To analyze the current gap in targeting requires taking a page out of the Amazon playbook and viewing combatant commanders as our customers. Paragraph one of the 2014 Army Campaign Plan mandates, "we provide a full range of capabilities to combatant commanders in a Joint, Interagency, Intergovernmental, and Multinational (JIIM) environment." Combatant commanders look to artillery officers, warrant officers, and non-commissioned officers to lead the way in targeting—a process that starts the capability discussion. Combatant commanders have a clear vision of what they want to achieve, but not always the best way to achieve their goal. So they look to artillery officers to figure out what entities they must focus on and what national/joint options can be synchronized and integrated to provide the needed effect. To do so, targeting personnel must understand how to access, integrate, and coordinate national and joint-level intelligence and asset resources—a capability the FA does not train. This forces our personnel to ask our sister services to accomplish this task for them.

The lack of training in targeting puts our operational Fires cells in the back seat and leads many in the joint community to make targeting synonymous with the 72-hour air tasking order process, not the Army and joint targeting cycle. During two recent multinational training events conducted by Eighth Army and U.S. Army Central, this gap was clearly evident as both Fires cells looked to their Air Force counterparts for target development assistance. Our personnel are not trained on the modernized and integrated database, joint standards for electronic target development, and accessing national/joint resources. As the historical pictures below indicate, combatant commanders now require fully developed target packets that have precise target location, target function, and limit collateral damage. If targets do not meet joint standards, they cannot be introduced at the joint target coordination board. Thus, in the short term, filling this gap will require artillery officers to attend joint-level targeting meetings, ensure joint targeting guidelines are trained, and educate our personnel on accessing national and joint-level capabilities.

In the long term, establishing targeting as the cornerstone of the FA is essential to maintaining its relevancy. Advances in cyber and electronic warfare and unmanned capabilities, and the joint nature of all future acquisition efforts will shape our branch. Using the Amazon example, Amazon started with their own delivery systems, but is now delivery system agnostic and even ships goods through its peer competitors. Why? Amazon listens to its customers and provides them with what they are asking for. Imagine if Amazon told a customer that it could not provide a product because it did not own it, or did not know how to get it. Would the company still be in business in 2025? Now suppose the joint and combined world in

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> **"If you dislike change, you're going to dislike irrelevance even more.**
>
> -GEN Eric Shinseki, Dec. 10, 2001

Interoperability of Joint and Combined Operations

By Lt. Col. SJ Canning, British Army

Joint and combined operations require the capabilities of all deployed levels-of-power to be integrated and focused on delivering the required political end state. There is no practical limit to the number and type of organizations that can participate in, or affect such operations: in the 21st century, 'joint and combined,' is by no means synonymous with 'military.'

We live and operate in a joint, interagency, intergovernmental, and multinational environment. There are often many frictions which can actually deliver against an organization's stated aims of being effective, as well as national or institutional interests to overcome. This is evident in the frequency of the debates about what 'joint' means, or whether 'combined' is really the way ahead.

Nevertheless, the JIIM environment has evolved into something tangible in the first 25 years of the 21st century. Nations and institutions have identified this environment as the character of the space within which we will operate. The world shows no signs of becoming a simpler and happier place; thus it seems reasonable to assume that joint and combined operations will continue to describe the military contributions to political activity in the JIIM environment.

In order to take decisive military action in pursuit of a stated political goal, a nation must seek legitimacy and political authority for its conduct. It will usually seek this from the international community, but recent history has reminded us that legitimacy also stems from a nation's own political institutions. Legitimacy can come from acting under existing legally binding treaty provisions, from a United Nations Security Council resolution, or when the UN is driven by irreconcilable national or bloc interests, through a sufficiently large coalition of the willing. The route differs, but the destination is the same: a multinational military force. Whatever the mix of nationalities, it is certain there will be a requirement for a joint effort among land, sea and air forces in order to maximize their effectiveness. There will remain areas, such as anti-piracy operations or enforcing a no-fly zone, which are less able to be turned into a joint operation; however, where decisive military action is required, it will almost invariably be conducted in the land environment and will require the closest integration of maritime and air capabilities into land operations.

Operations will continue to be conducted 'amongst the people,' in complex urban terrain, in a 'three block war' context and under the unremitting scrutiny of the media in the information age. It will no longer be enough for multinational forces simply to deconflict activity, to exchange liaison officers with national tactical communications, to use 'swivel chair' technology for mission command systems, and to follow diverging national chains of command. To do so would result in unresponsive, inflexible operations, which risk civilian casualties, collateral damage, tactical failure and ultimately the erosion of the political and national will required to maintain the coalition and conduct the operation. There are frictions within national forces when conducting joint operations which are only going to be exacerbated when doing so in a multinational context.

The very nature of the environment and the make-up of the forces, which will be called upon to operate in it, will demand the very best from leaders and Soldiers alike. In such a challenging environment, 'good enough' will be a thing of the past and will no longer be acceptable. This will be so as much within the Fires community as across the deployed force. What then are the implications of this for the Fires community and will they change and develop over the next 20 years or more? To answer this we must determine what we must do in order to be truly joint and combined; then regardless of that aspiration, we must also determine what we can do; and finally we must decide how 'joint and combined' we want to be. It is not enough to change formation badges and adopt common tactics, techniques and procedures: being 'joint and combined' demands genuine interoperability, real effort and some hard decisions.

There are aspects of interoperability which we cannot get wrong or the venture will flounder at the outset. These will include political and legal issues, but fundamentally rest on comparable capabilities, connectivity of systems, levels of training and assurance, and a common language for staff and command functions. The degree to which we must be interoperable will depend on the complexity of the operation and the specific partner nation concerned. The simpler the operation and the less compatible the partner, the less interoperability there would need to be; in contrast, the more complex the operation, the more interoperability there must be and this will be best achieved with the most compatible partners.

Most, if not all, operations in the 2025 timeframe will be operations of choice, i.e.,

they will not be wars of national survival, and we can of course usually choose our partners and allies. Therefore, we can choose how interoperable we must be depending on the circumstances. It is important to note however, that the highest levels of interoperability will only be achieved as a result of planned, focused long term effort and cannot be achieved overnight.

How interoperable must we be? We must be legally interoperable or some force elements will be unable to play a full part in operations. Such legal interoperability will encompass rules of engagement, recognition of international conventions, such as the Geneva Convention and agreement on the clear delineation of the applicability of national laws. For some countries, these legal considerations are added to by constitutional constraints on deployment and employment, making their armed forces unable to conduct certain operations. While limited legal compatibility may be acceptable and dealt with by assigning roles and tasks suitable to the constraints, we immediately assign a lower priority to those partners by determining the level of interoperability required is low. In so doing, we are also saying that when it comes to complex, high tempo, decisive action, we will not choose to do it with those partner nations. Clearly there will be instances where a political requirement is met by some actors simply being on the ground; therefore, any 'integration' needs only to be cosmetic. Equally, less demanding operations could be conducted with lesser levels of interoperability. By implication however, to conduct the most complex mission sets, we must choose those nations with whom we can be legally interoperable and focus our efforts on working with them.

While many militaries share doctrine, training and qualification standards and field equipment, which meet defined standards, there are more potential partners who do not. We must, therefore, consider the comparative capabilities of those forces with whom we would operate in a coalition or alliance. A good start point is asking if the levels of training and equipment capabilities are sufficient to avoid fratricide. A lack of shared situational awareness, a poor ability to track blue forces, high target location errors, low levels of judgmental training for commanders in the kill chain and unnecessarily permissive ROE are but a few of the issues that would significantly increase the fratricidal risk of operating with another nation. To operate as we would wish, we must choose peer or near-peer partners where mutual trust and confidence exist.

For the last decade, even the very best armies have wrestled with the efficient implementation of the tactical targeting process across service and national boundaries. The challenge has been to make it responsive enough to the needs of the soldier on the ground and robust enough in its safeguards to give it real utility on the congested modern battlefield. For this to be so, there must be targeting professionals who consider collateral damage, who have the ability to mensurate target coordinates, who select the most appropriate weapon for each target and who have clearly defined target engagement authorities and hierarchies.

Equally, there must be a genuine precision Fires capability in order to exploit this targeting capability and to fight a war amongst the people. Armies which do not own this top-level capability will again be relegated to second tier activity in the most demanding operational scenarios.

There are clear and agreed international standards for close air support and the methodology used in this area must be applied to others. This methodology applies to joint tactical air controllers and joint Fires observers where memorandum of agreement signatory nations train people to a recognized and accepted standard, which then allows them to operate with U.S. fixed-wing and rotary-wing aircraft. There is no equivalent for forward observers and fire supporters or, just as importantly, for the standards applied in the fire direction center and on the firing platform. Who, then, is permitted to call for fire from whom, assuming national ROE allow it as well? The acid test would be to ask who you would trust to fire a danger close mission for you, if you have no idea of whether or not the fire unit applies the five requirements for accurate fire or an agreed equivalent. Training standards must be sufficiently high to deliver certification and qualification to standards that are equivalent to and endorsed by U.S. forces.

For the conduct of decisive operations, we must be able to integrate with other nations' units and formations in such a way that we retain our edge in combat and do not lose fighting power, or increase the risk to our own Soldiers. The integrated force elements must be exactly that; there must be sufficient commonality that there is absolutely minimal duplication of effort or parallel procedures both in TTPs and in force structures. If we are to take integration seriously in the most demanding scenarios, there are a number of areas where we cannot compromise on the standards and levels of capability of the partner nation. The number of nations with whom we really integrate, rather than de-conflict, is going to be a select few.

How interoperable can we be? Having determined areas where we must be fully interoperable, we must turn to immediate practicalities of what can actually be done. We can train people, if the resources are available, to an agreed and verifiable standard. Command and information systems can talk to each other if we can make and buy the interfaces. We can replace computers and ballistic algorithms with more accurate versions. We can sell our coalition partners target acquisition equipment with low target location error and we can sell them precision Fires systems. This, however, is already an admission that in a significant number of 'red card' areas we are simply not immediately interoperable with most other armies. True interoperability may be limited by the physical constraints of national equipments, the ability to speak a common language or by fiscal considerations: we simply may not be able to do what we say we 'must' do.

National procurement strategies and materiel solutions are often multinational for affordability, but there are usually national political issues and differing operational and tactical requirements involved as well. The result is a plethora of equipments, which while often solutions to the same problem, can be very different beasts. Immediately, there are constraints on sharing across mission command systems, both physically and in terms of security. There will be workarounds for the simplest of physical differences, such as the number of pins in plugs and sockets or differing voltage requirements, but national policy, bandwidths and data formats may be more challenging. If constraints cannot be overcome and there are 'swivel chair' solutions which result in a lack of responsiveness or of shared situational awareness, then operational efficiency will directly suffer as a result.

Focusing on surface-to-surface Fires as an example, the materiel solutions of differing nations produce immediate friction to be overcome. Confusion is possible through differences in the most fundamental terminology, which sees cannons laid on azimuth or deflection with different data required to point at the same target. This, too, presupposes that the equipment is designed on the assumption that there are 6,400 mils in a circle, which is not universally the case. There is considerable ammunition compati-

bility across NATO and nations, but not all same calibre ammunition can be fired from every same calibre cannon. This results in a significant increase in the logistical footprint of a deployed force. A simple measure of interoperability is the ability of an observer, from one nation, to call for fire from a weapon system of an ally. This starts with certification and qualification of the observer and continues with the language spoken and the vocabulary used to call for fire, with combat net radio/data compatibility or connectivity and ends with ROE and the authority to engage. If all of these are compatible, then the mission is achieved, but as more prove incompatible, the mission becomes increasingly complicated until it cannot be achieved.

Interoperability efforts must be focused to succeed. This is true not only in the number of nations we can simultaneously achieve genuine interoperability with, but in what mission scenarios we can achieve it. It will simply not be possible, or indeed necessarily desirable, for a single nation to attempt to configure and train its forces to be interoperable with innumerable other nations in high tempo combat operations, when each presents different issues and challenges.

Equally, some partners will be more suited to some types of operation than others, making the interoperability requirements different. We cannot attempt to be all things to all men and so what we can do, will also be limited by factors other than those presented by the need to find physical or materiel solutions.

How interoperable do we want to be? It is a truism that the levels of information sharing between nations depends on which nations you consider. For a wide variety of reasons we choose to share more with some and less with others. This includes not just information and intelligence per se, as with Four/Five Eyes in the current fight, but with technology. A number of countries deploy a Patriot missile capability, but the standard of the weapons system varies depending on the endorsed disclosure level between nations. Simply put, there are nations with whom we could be fully interoperable, but with whom we choose not to be. The hard question which has to be asked up front, and clearly as national policy, not simply in an arbitrary manner, is which specific nations do we want interoperability programs with and who, therefore, are we by implication excluding? If every materiel program requires an interoperability element at increased cost, will the potential partners be prepared to pay, or for that matter, will we? Should it reach the point where making ourselves interoperable with a partner nation means trading a national capability to afford it, it is unlikely that we will want to be fully interoperable in the final analysis.

On a more practical level, while we may

Soldiers assigned to the United Nations Command Security Battalion-Joint Security Area, 210th Fires Brigade, 2nd Infantry Division, move through a cloud of white smoke for extra security while assaulting an objective during the team live-fire exercise at Story Live-Fire Complex near Warrior Base, Jan. 23, 2014. The purpose of the training is to certify fire teams capable of employing in the military armistice commissioned headquarters area at the Korean Demilitarized Zone. (Photo by SSG Carlos R. Davis, U.S. Army)

share political, social or cultural spheres of interest with a potential partner, the hurdles to overcome may simply be too great. This does not preclude alliance, cooperation, capacity building or even fighting together, but if interoperability cannot be achieved, it does mean that the partner's role in a complex operation must be significantly reduced. There may not be the political will and available finance to strive for interoperability where the effort is not worth the return. In order to deliver real interoperability we must choose partners for specific mission types and focus on specific, not all encompassing, interoperability goals.

Essential to ensuring confidence in partners will be enforcing common or equivalent standards for certification, qualification and sustainment/currency pertinent to all elements of, for example, 5RAF. From this base, the employment of key processes, such as tactical targeting and air-ground integration must also share basic principles and methodologies. Executing operations using such training and TTPs will require compatible equipments from mission command systems to precision Fires weapons. So fundamental to the effective integration of Fires into high tempo combat operations are these issues: that failure to meet their requirements will result in deconflcition not integration, a loss of flexibility and responsiveness, an increased risk of fratricide, loss of shared situational awareness, and a reduction in our ability to apply decisive force in a war amongst the people. In the joint and combined arena beyond 2025, we will require real interoperability in order to integrate Fires in a coherent and effective manner.

The Army Plan 2014, clearly states in its opening paragraph, that the Army will operate in a JIIM environment. Joint and combined capabilities provide the fundamental military contribution to that JIIM environment. Battlefields within the last century have become increasingly complex, increasingly multinational and increasingly lethal, making ever greater demands on those charged with the integration of effects, including Fires, across the battle space. Where 100 years ago, global actors were able and prepared to act in isolation within their self-defined spheres of interest, this is simply no longer the case in the 21st century. The lives of nations continue to become increasingly intertwined through all aspects of globalization, be it trade, culture, migratory and changing populations, finance, social media or law. The notion that these linkages will begin to unravel in as short a time as 20 years, thus erasing the need for joint and combined operations, is a challenging one at best. Joint and combined operations will continue to be the military contribution to political activity in the JIIM environment. Within such operations, interoperability will be a key to success.

Lt. Col. Canning is the British Exchange Officer at the Fires Center of Excellence and is currently the chief of operations in the Joint and Combined Integration Directorate. His operational experience includes forward observer in the Gulf War, deputy chief of operations with the U.N. in Bosnia, military assistant to the divisional chief of staff in Multi National Division (South East) Iraq, and chief plans officer for the U.N. in the Congo. He has considerable multinational experience including being the executive officer for the Force Artillery of the Allied Command Europe Mobile Force (Land).In his last appointment he was responsible for the Royal Artillery's tactical doctrine, individual and collective training policy, FA and Air Defense Artillery safety policy and the 'Lessons Learned' process.

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integrated into our operations. The International Security Assistance Force headquarters is a good example of this with a U.S. commander, UK deputy and French or Turkish chief of staff working together to accomplish a mission. Exercises, such as Bold Quest and Talisman Sabre, provide opportunities to share lessons and conduct joint training, but much work remains. How do we fully integrate their systems, capabilities and Fires without violating foreign disclosure and operational security? U.S. exchange officers and foreign liaison officers must be part of our training and operations. Third, all levels of joint air and ground integration must be fully exercised and developed. The JFACC must interact with an Army force headquarters, while the JAGIC synchronizes and integrates joint Fires and air operations concurrently. Captured lessons learned and refinements of tactics, techniques and procedures will enhance teamwork and training.

While our future conflicts and adversary in 2025 remains unknown, it is clear the ability to fully integrate and coordinate joint Fires and air operations will be critical. The JAGIC must evolve with fully integrated systems, multi-service and echelon training, while supported by coalition and U.S. personnel. This will enable joint air and ground integration to become more lethal, timely and effective in a complex and dynamic future environment.

Lieutenant Colonel Anthony Gonzales is currently the chief of the Joint Integration Division, Joint and Combined Integration Directorate, Fires Center of Excellence. Prior to his current assignment he was the executive officer to the commanding general, Combined Joint Interagency Task Force 435, in support of the Afghanistan ISAF. Previously, Gonzales has also served as the Field Artillery Proponency Office chief and commander of 1st Battalion, 14th Field Artillery.

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2025 is delivery system agnostic. What role would the FA play in this environment? Targeting is the answer to that question. Future advances in technology will provide a wide range of capabilities, but still require who or what must be targeted in order to meet the commander's objectives. The need to understand current and emerging national and joint capabilities, integrate them into our planning efforts, and synchronize them across the battle space will never go away. If targeting becomes our cornerstone, we will maintain our current standing as major players in the planning and execution of joint and combined operations because we will target, integrate, and synchronize the full range of options available.

We are behind our sister services in targeting at the operational level. This gap will only continue to increase if we do not address it and take a hard look at the role of the FA in the future. Without embracing targeting as its primary reason for being, FA may have a reduced role in 2025 and beyond. Instead of thinking in terms of Amazon, it will have to consider the fate of Eastman Kodak. In the mid-20th century, Kodak was on the cutting edge of cameras and photography. By the 1990s it began to struggle because it didn't transition quickly enough to digital photography and now, Kodak does not even make cameras. Pay attention, *Redlegs*! We need to close the current gap in operational targeting and establish targeting as our cornerstone so the Field Artillery does not have 'a Kodak Moment.'

Lieutenant Colonel Mark Bilafer graduated from Norwich University, Vt., and was commissioned in the FA branch on July 1, 1992. He has served in many positions, including fire support officer, fire direction officer, executive officer, battalion fire support officer, battery and battalion commander, and as the collateral damage course manager at the Joint Targeting School at Dam Neck Naval Annex, Virginia Beach, Va. Among other locations, Bilafer has served in Germany, Bosnia, Alaska, Kuwait and Korea. He is currently assigned to the Joint Integration Directorate at the Fires Center of Excellence, Fort Sill, Okla.

Integration 2025 Food for Thought

By Lt. Col. Karsten Schoenau, German Air Force

Starting combined integration in a very early stage of a new technology development will build and improve a common understanding of the challenges to tackle. The mutual support amongst participating nations will increase exploitation of future capabilities and synergetic effects. Such coalition effort will help provide a better quality of our defense, while saving time, money and troops. Start the action now!

When have you recently been pushed to think about the unpredictable future behind the horizon of 20 years ahead? Was it by planning your marriage, the career of your kids, your plans for retirement or buying the new home for your family? What neighborhood, stores and service providers are close by? How big should it be and what features are mandatory to make it your home?

Somehow this is connected all together? Yes! You are quite right. If we are going to make plans about our future, we must consider various facts that will first influence our decision and then subsequently, will create consequences we have to live with afterwards. Developing ideas and plans, and transforming thoughts into reality will need a holistic approach. It will ensure that in the end, not only you, but your family is happy with the chosen home too.

Developing the future of Fires will be 'slightly' different but in some way parallel. A complex variety of requirements and interests needs to be analyzed. Appropriate weapon and information systems, e.g., Integrated Battle Command System/Emergency Operations Center or Army Battle Command System, meeting the future demands have to be developed and implemented. So first, we need a system -- then we start the integration? Sorry, that's too late!

Integration is the arrangement of military forces and their actions to create a force that operates by engaging as a whole.

The high value of our forces at present reflects the great capabilities of each single weapon system and the technical compatibility amongst each other. Weapon and communication systems with state of the art characteristics, i.e., high fire power, mobility, connectivity and interoperability are highly appreciated in the Fires community. They will lead us to a family of systems where 'agility and flexibility' will count and tasks can be shared equally – somehow.

Really? Is this the answer? Will we await the big black box which will solve all challenges?

Following the Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities matrix, it appears quite bright that any system consists of much more than a cold piece of metal with a fancy, colorful screen... remember the battle of programming your first garage opener without using the manual.

The quick, smooth and successful integration of a system will depend on the ability to embed the technical capabilities provided into an environment ready to exploit the full range and beyond. This is what it takes, a system and not just a toolbox.

Therefore, integration should be the critical step ahead in order to ensure appropriate measures necessary to create proper waypoints on the road of implementation.

The Joint Capabilities Integration Development System, or JCIDS, is the formal United States Department of Defense procedure which defines acquisition requirements and evaluation criteria for future defense programs. It is intended to reflect the needs of all four services and to ensure the joint integration process. But is this enough for the future?

Reading various occupational publications, everybody points out the increasing need of powerful multinational coalitions and combined integration as a prerequisite. Stop!

It is on us to end only emphasizing the importance of combined integration. Start the action now and build a reliable, lean but comprehensive DOTMLPF structure around the developing future of multinational technologies. Use an open architecture, as our home might have to serve a growing family. Keep the kids in mind as they will take over the house in the future and use it for additional purposes you cannot even imagine.

Doctrine. Do you still use your old phonebook or yellow pages? What makes us think that it is up to date to work through a manual which looks like a combined edition of both. Others (e.g., European Union) already use structure, process and product oriented information technology based trainers for their individuals. Accelerating the familiarization process and increasing the quality of any training provided will support our efforts. Doctrine unquestionably provides guidance but should also give opportunities to ensure that we freely can think and walk forward on new unexplored paths.

Organization. New systems consisting of sensors, interceptors and command elements will deliver new ways of fighting the battle. Behind the 'integrated' scenes (or screens) there still will be Soldiers to lead i.e. to command, to supply, to protect and solve all their needs as human beings. These 'simple' functions are critical and must reach (coalition) troops over longer distances. They are scattered in various directions more than ever before. Additionally there will be less capacity to solve these functions since 'boots on ground' is an issue. I am convinced that combined integration could create a reliable, multinational 'pool of supplies' collocated with a 'battle management advisor' serving troops in a certain area. Will the future coalition Soldier be lead via an 'integrated battle service center?'

Training. Having these kinds of functions in mind, it will be an enormous effort to build and implement a force like this. The specific, individual and later the unified training for the men and women who will take the challenge at all levels must be considered. Creating a common understanding of the battle without leading into an overload will require the use of quite smart simulations. Simulations may help to save money and time, but FTXs probably will remain mandatory. Regarding the complexity of troops, levels and functions involved through combined integration – can we responsibly extend the current time of preparations for the battlefield?

Instead we maybe start standardized portion of this preparation in an integrated effort as soon as possible - e.g. at the boot camp.

Materiel. Even if this article appeals not to focus on 'machines' only, do not take me wrong, the trend to provide solutions via new technology is still en vogue. The continuous development and improvement of additional systems to solve command, leadership, and information objectives, to serve the requirements of leaders and subordinates as well, is on demand and will boost the progress of integration. But is there really still a need for my own technical solution solving any specific threat? Sharing burden in terms of particular capabilities will probably not impede the overall ability to defend. Implementing strong, reliable partnerships and integrating their capabilities, rather than inventing new (own) weapon systems shall be deemed to be key.

To fill gaps meanwhile, we should consider solutions which can be generated by sister services. Searching through their capabilities, I bet you will be surprised what they can do for you.

Leadership and Education. Partner nations already appreciate the high professional leadership training and leader's education measures the Fires Center of Excellence at Fort Sill, Okla., currently provides. Their representatives frequently take part in meetings and ceremonies. Is there more benefit for the U.S. Army? Sure there is.

Let us start now exploiting that mostly unused source of Fires expertise and out-of-the-box-thinking. Combined integration will create and improve appropriate processes and forums. Developing knowledge amongst the coalition will increase the quality of leadership and education in return and boost the integration process. Be sure more nations will be eager to participate in such a course of action.

Personnel. People are changing and we should stop complaining the computer and game tablet addicted young Soldiers and start to use their (integration) potential. As we already do with simulators etc., so go ahead. We are living Facebook worldwide and trusting faceless voices in our automobile navigation systems. So it might be easier for future (integrated) Soldiers to obey to the well known and always calm communicator in their hand than to the frequently changing and most of the time overreacting real leader at the phone or radio. Is that what we want? Can 'being connected' substitute the feeling of personal maintained leadership? Combined integration should start to find answers now.

Facilities. Taking in consideration a changing perception of teaching, as well as individual and collective learning, the FCoE will might turn into an 'Integrated Fires University,' which provides the necessary knowledge to U.S. and multinational students equally, but also worldwide via internet. Distance learning will potentially play new roles and it develops quick and continuously. Integrated partnership universities established in Asia and by the European Union may be enabled to serve coalition forces there and participate in an integrated instructor exchange program. Setting common training standards worldwide, but sharing the burden.

The process of combined integration is a difficult and complex business but obviously not depending only on the development of new technologies. Most of the ideas are not new but taking action rather than creating more fancy papers is rare. Considering the facts and thoughts following the DOTMLPF matrix, combined integration seems already to be alive. But we have to move toward the many potential construction sites around us. There are already real processes of future development where coalition partners are being involved. Other ideas seem more beyond 2025.

All in common - they should be addressed very soon because 2025 is just about 10 years away. Development of a new technology is only a question of time and money. Creating a combined, integrated force on the basis of strong, reliable and trustful partnerships means more time and much more patience amongst associates.

Modern technology then may connect us to partners in seconds. Combined integration takes years or even decades but will merge us to real brothers in arms. The time, money and troops we invest now will multiple our effort in return of future results.

What about your family plans for the future? Even the biggest and nicest house will not serve as home for your family without the needed features inside and complementing infrastructure outside – school, shopping mall, restaurants, fitness and grocery. Equal to the joint and combined integration process all these facts have to be considered. Future proved proposals shall be integrated in our final solution. Are your plans ready to get reviewed by your wife? Or you might better 'adjust' some details?

Our 'home' for 2025 and beyond will not be built in a far unpredictable future. Therefore this article should be considered as an appeal and our 'call of duty!' Go forward! DOTMLPF is the matrix. It will take us to fill it with action instead with words. The Joint and Combined Integration Directorate is the authorized agency within the U.S. Army Fires Center of Excellence to supply with ideas, counseling, initiatives and contacts to the joint and combined world. Do not hesitate! INTEGRATION 2025 STARTS HERE AND NOW!

Lieutenant Colonel Karsten F. Schoenau joined the Luftwaffe in 1991 as a draftee and was commissioned as a 2nd lieutenant in the Air Defense Artillery branch in July 1995. He has served in many positions, including tactical control officer, reconnaissance officer, executive officer, support battery commander and combat battery commander. Later his assignments included instructor leadership training at the German Luftwaffe Officer School, strategic force generation planner and chief analyst 'knowledge development' for the European Union. Among other locations, Schoenau has served in Afghanistan, United States and United Kingdom. He is currently assigned to the Joint Integration Directorate at the Fires Center of Excellence, Fort Sill, Okla.

A Future for Army Artillery Fires from the Sea

By Mr. Ronald K. Alexander

Studies have been conducted and articles written that list what the U.S. Army can contribute to the anti-access/area denial fight of the air-sea battle. Most missions discussed deal with maintaining the U.S. forces' access to the global commons. LTC Aaron Bazin outlines in his article, "The Army's Role in Countering Anti-Access and Area Denial: Support to Air-Sea Battle," in the Air Land Sea Bulletin, January 2014, how the Army needs to integrate with the joint force more effectively. Another area he mentions is the need to develop new capabilities.

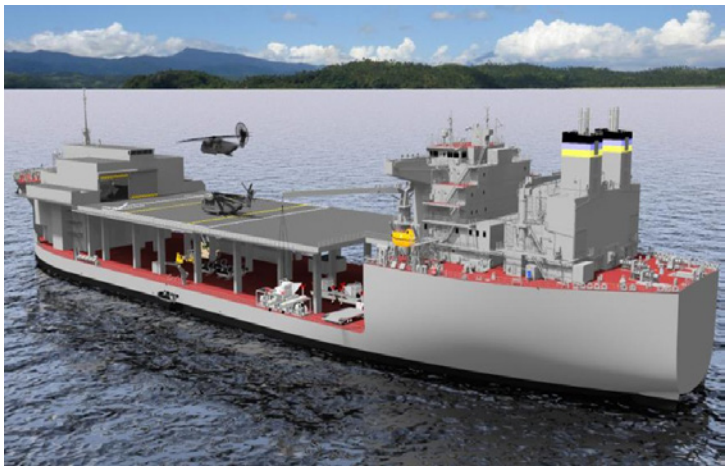
One area that has not been emphasized is to utilize Army Fires to increase the fire power and fire support to overcome an adversaries' A2/AD. Developing Fires from the sea is a mission the Army could uniquely provide. The U.S. Marines remain the country's amphibious force, but added fire power to shape the battlefield before putting forces ashore and then providing fire support once forces are on land, whether Marines over the shore or Army jumping in, can assist the Navy with their limited number of barrels onboard their ships.

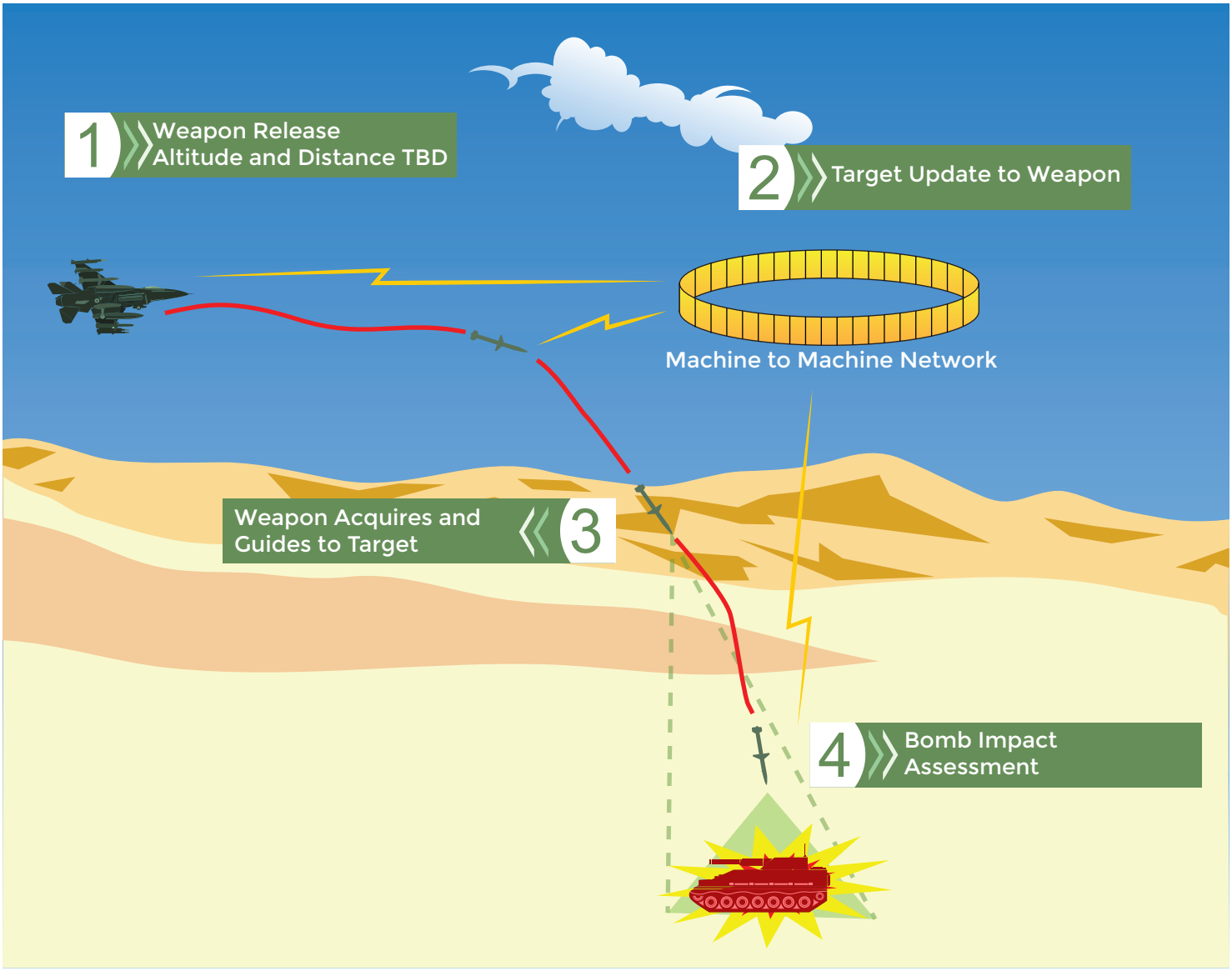
The U.S. Navy recently christened the United States Navy Ship John Glenn. The John Glenn is a mobile landing platform that will provide flexible capability for large scale logistics movements, such as the transfer of vehicles and equipment from sea to shore. Other uses of the large deck area, possibly with modifications, could be to support other missions such as new longer range Army rocket/missile launchers. The MLP will also have another version of the ship called an Afloat Forward Staging Base. This would carry helicopters and provide other options for support of land forces. Improved High Mobility Artillery Rocket System-type systems adapted to shipboard use could greatly enhance surface-to-surface firepower.

Utilizing these platforms as firing bases not only requires improvement in the weapon systems, but also other parts in the firing chain, from target location to fire mission transmission. All will need to be transformed. Today's new lightweight laser designator rangefinders improve the target location accuracy. As technology improves and accuracy of targeting devices improve, which will decrease the target location error, unmanned aerial system payloads can be improved to provide accurate target locations to joint Fires coordinators. Joint Fires observers would not be in the field for the initial battles, but may be at a console with the UAS feed during this stage, or they might even be airborne in a command and control

The Military Sealift Command mobile landing ship USNS John Glenn (MLP 2) underway off the California coast. John Glenn successfully completed Builder's Sea Trials on Jan. 13. The ship is expected to be delivered to the Navy in March following Acceptance Trails. (Photo courtesy of the U.S. Navy)

Artist's concept of the Afloat Forward Staging Base. (Photo courtesy of the U.SMC)





Network-enabled precision guided munitions. (Information provided by Mr. Ronald K. Alexander)

aircraft looking at a live video feed with direct communications to the UAS controller and the firing units. The fire chain could be further enhanced by the development of longer range, longer time of flight weapons that not only keep the firing units outside of shore based anti-ship fires, but allow for updating target location information to the weapon after launch.

Network-enabled weapons are under development by both the Air Force and the Navy. NEW allows coordinate-seeking weapons to receive target location information from a third party after weapons launch, updating an impact point for a moving target or retargeting for a high value target for example. This capability is currently being developed and demonstrated during Bold Quest exercises. Equipping a JFO or FO with the capability to communicate with the weapon, as well as to communicate with the proper authorities who could give the JFO authorization/direction to retarget a weapon would greatly enhance the efficiency of Fires in the A2/AD fight.

It would benefit the Army to participate in the development of NEW capabilities, looking ahead to develop NEW rockets and missiles and NEW ground kits for JFOs. The net centric operations, such as Army's Nett Warrior, puts Soldiers in a network of communications on the battlefield already. The next step is to outfit Soldiers with NEW capabilities (along with the planned Army's Land Warrior) that will put the Soldiers in the network with other services' weapons and tactical air controllers, and provide an added dimension to the prosecution of targets. The future generation of coordinate seeking weapons with longer ranges and the capability to receive target location updates provide more lethality through better accuracy and will make for more efficient Fires execution.

Mr. Ronald Alexander is a Department of the Army Civilian and currently works in the Joint and Combined Integration Directorate at Fort Sill, Okla., in the Joint Integration Division. He is a retired naval officer and pilot with more than 26 years of service. Following retirement he worked as a military analyst and joint integrator at the former Joint Forces Command in Norfolk, Va.

Initiatives to Maintain Decisive Capabilities in 2025

By COL John T. Smith

The secretary of the Army, the chairman of the joint chiefs, our Army chief of staff, the commander of the Training and Doctrine Command, and the secretary of the Army for acquisition, logistics and technology have all used recent speaking engagements to highlight the need for changes to help us equip ourselves for the Army of 2025 – just 11 short years away. GEN Robert W. Cone, believes that a reduced operations tempo gives us an opportunity to involve more of our Army in the experimentation and exercise business, and thereby better equip ourselves. This paper will review opportunities that we should exploit in the current environment and suggest future initiatives. The intent is to encourage dialogue amongst our smartest leaders and use the insights gained to focus science and technology as we look beyond the perceivable and into the unknown. Time spent now deciding where to focus and what systems and doctrine to develop could give us significant advantages in the coming conflicts.

In order to help us think about how much change we should expect in 2025, let's review a few key events that took place in the last 10-20 years. We can use these events to make some assessments about the future environment and to help us predict how much change to expect between now and 2025.

Faster processing speeds and data transfer rates over the past 20 years created exponential growth in the world's technological capacity to store, communicate, and compute results. These developments have significantly impacted the way that the U.S. military fights and were very evident in the short decade between Operation Desert Storm in 1991 and Operation Iraqi Freedom. Industry experts expect these technological factors to continue to increase exponentially in the future. Faster processor speeds and data transfer rates enable better command and control by improving our ability to track friendly and enemy units in a near real time environment. These same developments that enabled better command and control and situational awareness are factors that many credited with the U.S. success in OIF.

In the future, we can expect continued progress that enables both friendly and enemy capabilities that result in not only our improvements, but also significantly more capable future enemies. For example, better processors and transfer rates enable better and cheaper sensors, improved command and control, greater precision, and more responsiveness, for both the U.S. military and its threats. So, although smaller formations, less platforms, and more integrated command and control will enable a smaller and more lethal U.S. military force, we have to also recognize that these same advantages will make our enemies better and more capable.

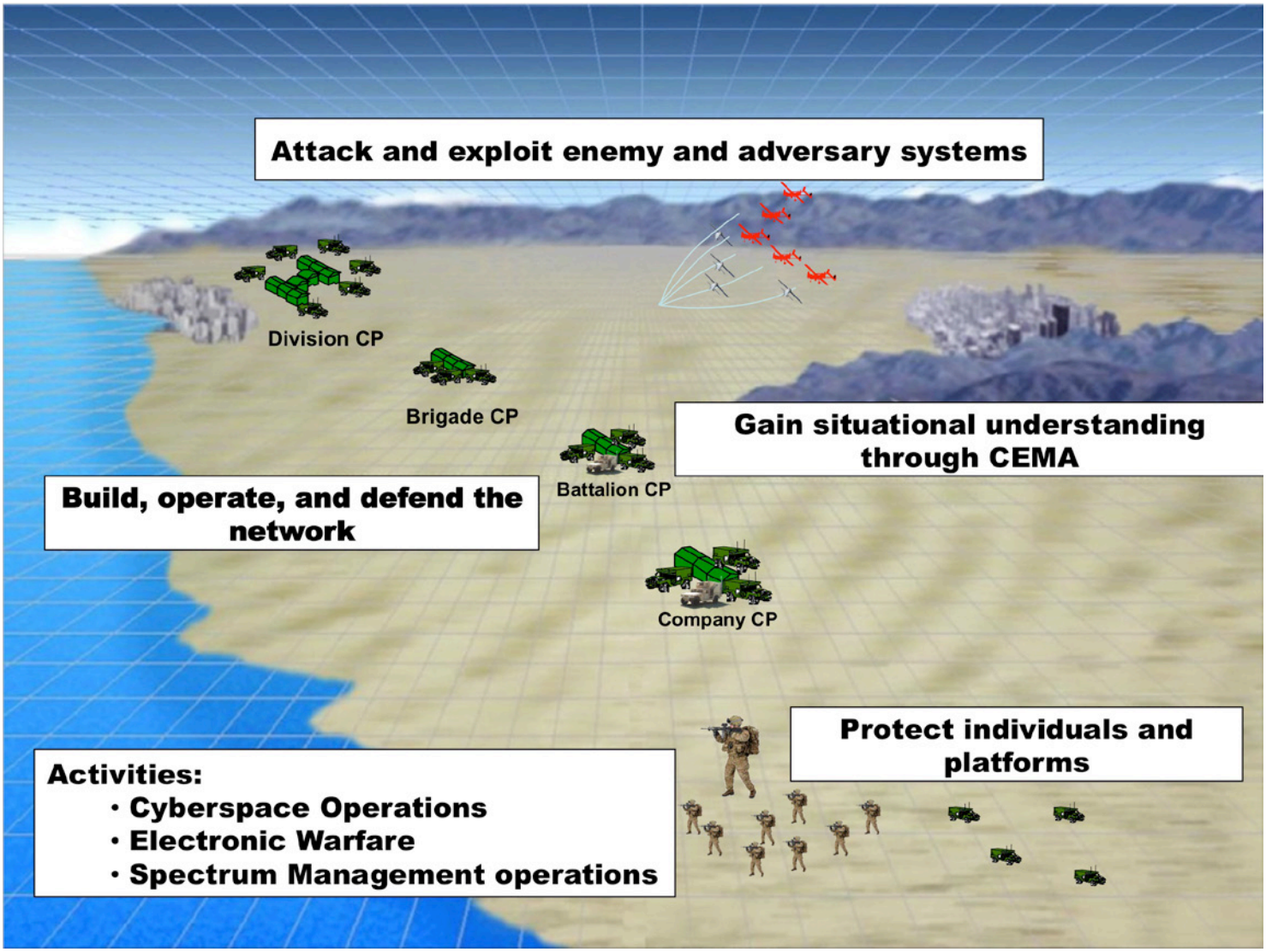
So, what should we be talking about now to manage our expectations appropriately? Our leaders today have been encouraged to embrace change. Nearly all leaders have heard and understand GEN Eric K. Shinseki's warning, "If you dislike change, you're going to dislike irrelevance even more," as he envisioned Army requirements in future potential environments. Our current Chairman of the Joint Chiefs, GEN Martin E. Dempsey, acknowledges that change is happening more quickly now, and consequently he encouraged leaders to "… be quicker on our feet" and to "…be more willing to make changes that provide what the nation needs in its military dimension and power."

A key point here is that, given the amount of access to future science and technology today by both friendly and enemy forces, we must change, but we have to manage change better to get the most out of our future systems. We will gain the advantage if we concentrate our efforts in joint and combined integration.

In a Jan. 23, 2014, Institute of Land Warfare talk, The Chief of Staff of the Army, GEN Raymond T. Odierno, recognized the importance of continued investment in science and technology. He acknowledged the need to be very choosy about where we invest, presumably in those systems that enable the most efficiency in our joint and combined future operational environment.

During the 2014 Winter Association of the United States Army Symposium, the Assistant Secretary of the Army for Acquisition, Logistics and Technology, Dr. Heidi Shyu, shared, "To prepare the Army for tomorrow, the seeds must be planted today." Managing change must stand up to informed debate encouraged by forums like those found in the AUSA Institute of Land Warfare or like those found in our very own U.S. Army Fires Conference. These types of forums are the 'seeds' that Shyu references. These forums must result in support for programs and systems that allow us to manage change better than our adversaries can.

A look at the likely future operational environment might help us feel more comfortable betting on the gains in technology.



At its heart, CEMA are designed to posture the Army to address the increasing importance of cyberspace and the electromagenetic spectrum and their role in unified land operations. CEMA are implemented via the integration and synchronization of cyberspace operations, electronic warfare and spectrum management operations. (Illustration courtesy of COL John T. Smith)

Predicting the future operational environment is not easy, but a few thoughts can get us planning and help us think deeper about what type of force we might need in the future.

Given the forecasted technological advances in an increasingly-connected world, a complex, uncertain, rapidly changing situation involving a wide range of threats should be expected. Lesser advanced enemies will continue to avoid decisive engagements by seeking the best chance of success using dispersion, concealment, and terrain. The decreasing cost of technology continues to encourage asymmetric approaches. Lesser resourced extremists will continue to gain more access to improvised explosive devices and weapons of mass destruction. Weaker groups and individuals will continue to threaten otherwise stronger forces, emboldened by successes apparent in the global news networks. Given the rapidly growing proliferation of unmanned aerial systems, the U.S. military will have to work harder to integrate ground and air responses to these threats. Issues such as extremist ideologies will continue to fuel conflict. Urbanization and environmental changes will cause shortages in water, food, and fuel that encourage conflict. Increasing global access to information will fuel informed classes of haves and have-nots.

So, if we recognize these possible threats we may face in future operational environments, on what should we focus these next 10 years? I believe that there are three prudent things to work:

1. Synchronizing and integrating cyberspace operations, electronic warfare, and electromagnetic spectrum operations

2. Synchronizing and integrating the third dimension to manage a growing proliferation of friendly capabilities while simultaneously protecting against the threat of unmanned aerial systems

3. Increasing responsive access to joint Fires in environments where our enemies seek dispersion and concealment

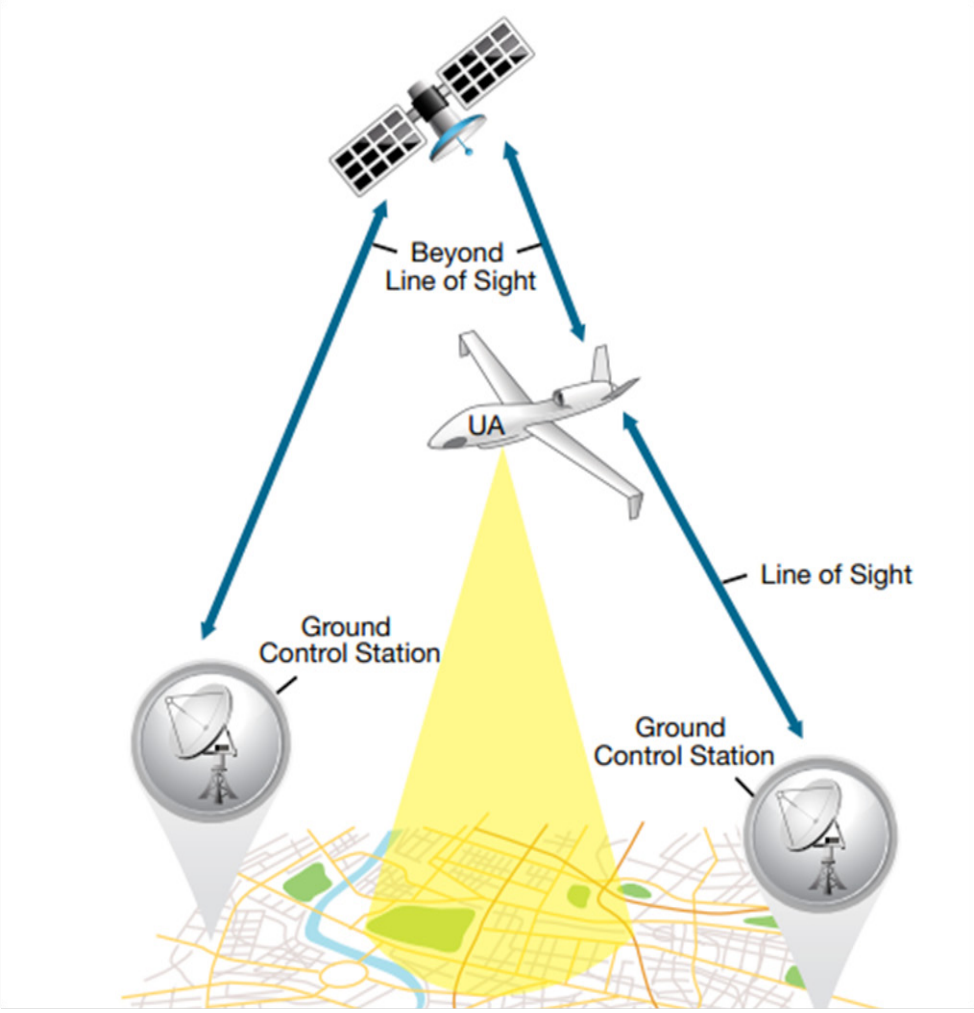
Cyber Electromagnetic Activities. A voracious electronic warfare market in the commercial, military and private sector makes our current and future focus on EW a prudent venture. In fact, rapidly expanding our capabilities in cyberspace operations and electromagnetic spectrum operations will help ensure that the Army can operate effectively in both cyberspace and the electromagnetic spectrum. Failure to maintain these robust cyber electromagnetic activities can

be a game changer in the future operational environment.

An Amsterdam Based Market Research Program recently shared that "The global electronic warfare market - currently estimated at more than $12 billion, will grow by more than four percent each year and reach nearly $15.6 billion by 2020. This phenomenal rate highlights important trends that military developers should note. In an environment where information sharing is increasingly dependent on digital systems, sensors, and communications, military operations will not be effective without continued aggressive development of the electromagnetic spectrum. It should be no surprise that the most significant market growths referenced above are in the Middle East, the Asia-Pacific region, and Latin America – areas that are rapidly developing their own capabilities to protect their forces while attacking threats.

Retired Army LTG Robert Elder Jr., who developed the U.S. Air Force Cyberspace Mission, –cites another reason that CEMA is a capability that the U.S. military should continue to exploit. CEMA is very cost effective during times of shrinking budgets. Dempsey emphasized recently, "We'll have to be able to throttle up force and just as quickly throttle it back. We'll have to embrace change, not just accept it or riskier elements." CEMA can do that. Additionally, investing in CEMA is a proactive step that can address significant risk in the future operating environment.

Air - The Third Dimension. A second imperative for operating effectively in the coming 10 years is to become increasingly comfortable integrating and synchronizing the third dimension with ground and cyber operations. The size and scope of a rapidly growing friendly and enemy UAS capability is forcing a response. On the friendly front, industry analysts show that there are more than 7,000 UASs in the Department of Defense which are flying more than a million hours annually. Given the rapid growth, the U.S. military is working to codify how to integrate new capabilities into the third dimension. On the enemy front, equal attention is focused on exploiting rapid advances in low-cost science and technology to enable the spread of UASs that could soon threaten the U.S. military with an array of technological peers. These same analysts see no change in this rapid growth throughout the next decade. The potential threat of enemy UASs is very significant and consequently has industry and military circles buzzing about possible strategies to counter them.



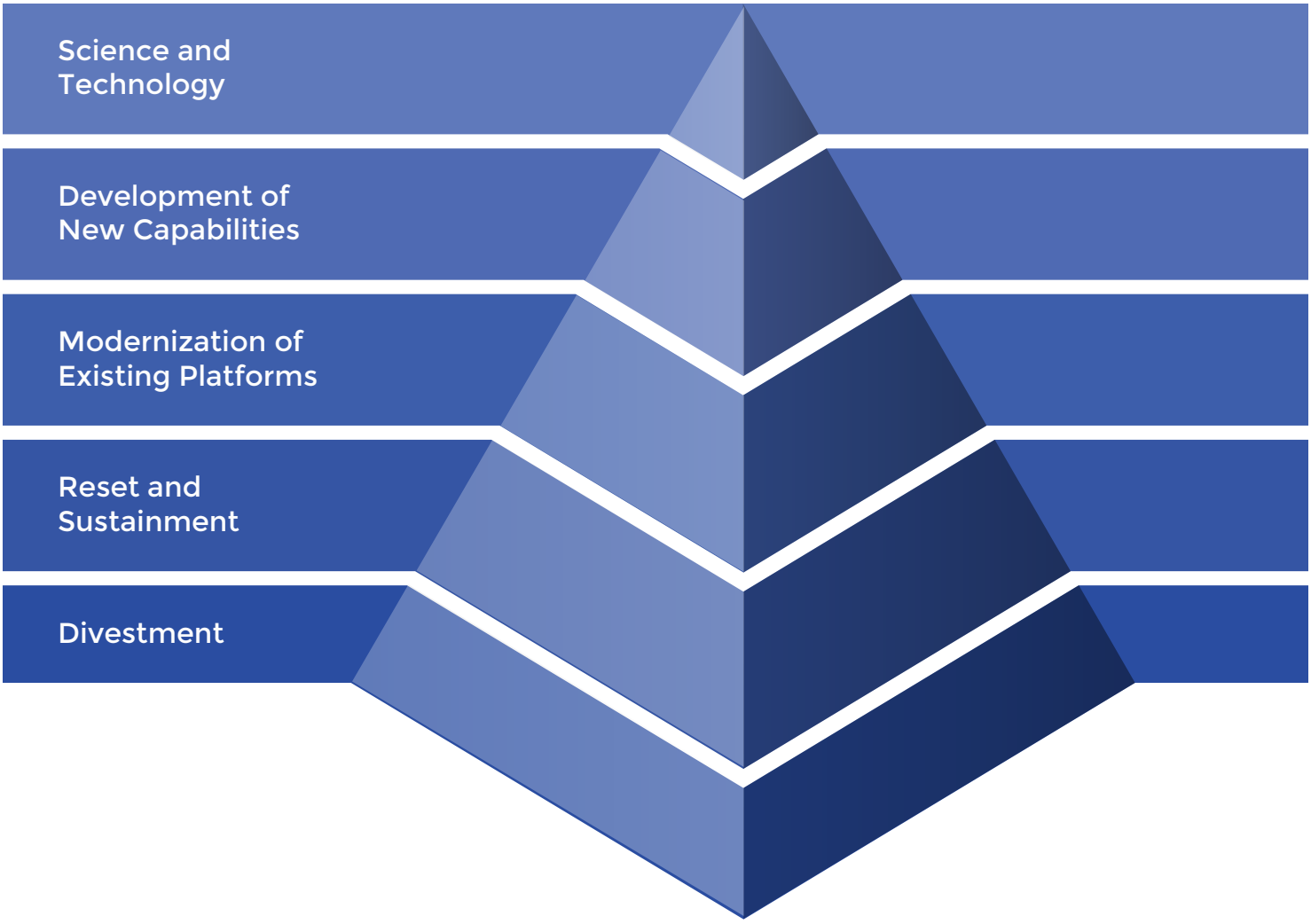
Effectively operating in the third dimension will help us benefit from shared situational awareness to land forces. (Illustration courtesy of COL John T. Smith)

It is estimated that UAS spending will almost double over the next decade, from $6.6 billion to $11.4 billion on an annual basis, and the segment is expected to generate $89 billion in the next 10 years. The scope and size of this market analysis helps us to see the importance of developing doctrine, organizations, and training programs to better utilize this rapidly growing friendly capability while countering enemy UAS capabilities.

Entrepreneurs like Jeff Besoz at Amazon Prime are already beginning to demonstrate the business opportunities for this rapid growth. Recently Besoz appeared on "60 Minutes" highlighting his futuristic business plans for Amazon Prime as he announced that Amazon is currently testing drones for same-day package delivery. The intrigue and potential for such plans suggests a very significant commercial application of air-ground integration in the near future. If we broaden our thinking of this potential commercial use of the third dimension, we quickly understand that our previous military approach to deconflicting air and ground in time and space is no longer developed enough.

Thinking broader and deeper about the importance of this commercial potential helps us realize now the potential military applications of drones in the future. Accepting that Drones are becoming hot commodities for armed forces around the world and that Some 600 companies from more than 50 countries are dabbling with drone tech for both spying and killing legitimizes our future focus on better operations in the third dimension. Our current JAGIC doctrine seeks to facilitate the integration of friendly air capabilities in an effort to help U.S. forces deal with this emerging threat. Given the ever-increasing chatter about UASs and threat capabilities, maybe we should benefit by shifting some of the JAGIC capabilities to leveraging air, ground, and CEMA capabilities to prevent enemy UASs from exploiting the third dimension.

Access to Joint Fires. A final key to



The Modernization strategy developed by the Honorable Dr. Heidi Shyu, assistant secretary of the Army for acquisition, logistics and technology. (Information provided by COL John T. Smith)

future success in the coming 10 years will be maintaining responsive access to joint Fires. Given continued emphasis on seeking efficiencies across the U.S. military, services are becoming more interdependent. Increasingly, joint operations are toted as the way we should fight both now and in the future. Joint Publication 1, *Joint Doctrine for the Armed Forces of the United States*, says, "The nature of the challenges to the U.S. and its interest's demand that the Armed Forces operate as a closely integrated joint team with interagency and multinational partners across the range of military operations."

In a discussion of joint force development, the final chapter of JP 1 uses Dempsey's words to highlight the need for a joint force that is "responsive, decisive, versatile, interdependent and affordable." In the opening pages of the current Joint Forces Quarterly, Dempsey suggests that the "uncertain security and fiscal environments" will force us to seek more access to joint forces in the future. He emphasizes that this is the only way to provide the range of options necessary in future environments.

Given these imperatives, leaders today should consider 'access to joint Fires' as a key piece of operational design when crafting future concepts for operations. Leaders should ensure access to joint Fires through training programs like the Joint Fires Observer course, by employing organizations like JAGIC, and by developing capabilities found in the air support operations center and the corps air liaison element.

Shyu envisions a pyramid to help us manage change that is required in the near future. The five layers build on each other and are necessary for us to benefit from our current interest in implementing key changes for the future.

Shyu encourages us to exploit our current thinking - CEMA, the third dimension, and joint access - in the development of these next generation breakthrough technologies to define the Army of the future. Accepting Shyu's vision would suggest that these three initiatives – things that have real future value – should be pursued to exploit next generation breakthrough technologies and define decisive Army capabilities of 2025. Given the advances in science and technology that are increasingly available in cyberspace weapons, unmanned systems, and global advances in the areas of long-range precision weapons, we – the U.S. Military - must act now or risk putting our nation's defenses at peril.

Colonel John T. Smith is the Director of Joint and Combined Integration at the U.S. Army Fires Center of Excellence. Smith has 30 years of service - planning, leading, and training as well as extensive operational experience. He is a graduate of the 1998 School of Advanced Military Studies and a graduate of the 2011 Advanced Strategic Arts Program.

The Joint Targeting Coordination Board

By COL Dennis Pastore and MAJ Jeff Fair

The Joint Targeting Coordination Board is arguably the most important event in the battle rhythm of a joint force command. The JFC requires support from a robust joint Fires element to ensure the joint force commander's objectives are met. A successful JFE acts as the focal point for joint targeting, enabling operations, and intelligence to integrate information and synchronize Fires. The JFE plays an integral role in coordination between component commands and between the commands and the JFC. The JFE accomplishes these tasks through the JTCB and other cross-functional working groups.

Joint Publication 1–02, *Department of Defense Dictionary of Military and Associated Terms*, defines the JTCB as "A group formed by the joint force commander to accomplish broad targeting oversight functions that may include but are not limited to coordinating targeting information, providing targeting guidance, synchronization, and priorities, and refining the joint integrated prioritized target list JP 3–60, *Joint Targeting Process,* also further refines the definition to include "The JTCB normally facilitates and coordinates joint force targeting activities with the components' schemes of maneuver to ensure that the JFC's priorities are met." Both definitions name the joint force commander as the source of the board's charter and informing him as the board's purpose. The joint force commander will tailor the JTCB to meet his needs and the needs of the command. A JTCB will differ from organization to organization and will change through different phases of an operation.

In order to prepare for a board chaired by a senior officer on the staff, the JFE will host a joint targeting working group, also called a targeting effects working group. The JTWG is an action officer-level meeting that attempts to prepare planning and coordination for the JTCB chairman's review and approval. JP 3–60 provides a comprehensive definition, "The joint targeting working group supports the JTCB by conducting initial collection, consolidation, and prioritization of targets and synchronization of target planning and coordination on behalf of the JFC…and meets as required to consolidate and prioritize the draft JIPTL and discuss targeting integration and synchronization issues raised by the JFC, staff, planning teams, and the JFC's major subordinate commands." Representatives from across the staff and components will attend the JTWG and can include representatives from J–2, J–3, J–4, J–5, staff judge advocate, civil military operations, information operations, U.S. Strategic Command and the chaplain's office. Many of the products presented to the JTCB chair are discussed and finalized in draft form at the JTWG.

The JTWG provides information to the attendees to assist in coordination and synchronization. Information can include an enemy situation forecast, weather outlook, intelligence, surveillance, reconnaissance schedule, assessment, JFC plan, component plans, and commander's guidance and intent. The period under review at the JTWG will usually be a 24-hour period tied to the air tasking order cycle administered by the joint force air component command. The guidance shown at the JTWG is the approved guidance for the ATO under planning at the meeting and draft guidance for a future ATO (generally 96 to 120 hours in the future), which is presented to the JTCB chairman for approval.

One of the JTWG's goals is to address and resolve issues at the staff level. If possible, the action officers will reach consensus and present a proposal to the JTCB chairman when the board reconvenes. For example, all action officers agree on recommended time sensitive target guidance and prepare a final draft for approval by the chair during the next board. Alternatively, if two components disagree or if the JFC staff and a component cannot come to agreement at the JTWG, the chairman is asked for a decision when presented each of the alternative courses of action at the subsequent JTCB.

The definition from JP 3–60 states that the JTWG "…meets as required to consolidate and prioritize the draft JIPTL…" in preparation for approval at the JTCB. This can be done two ways. First, the draft JIPTL can be prepared by the JFE or the JFACC prior to the JTWG for discussion. This takes a great deal of coordination and preparation prior to the JTWG. A second approach is to submit JIPTL nominations following the JTWG. This allows action officers to gather information from other organizations and then discuss what they plan to nominate to the JIPTL. Duplicate nominations can generally be identified using this technique, while also reinforcing the coordination between components as they transition from briefing operational plans to target nominations at the JTWG. Component target nominations are then finalized and sent either the JFE or JFACC for the draft JIPTL build.

One of the main purposes of the JTCB

SGT Matthew Varrato, section chief on a Paladin M109A6 self propelled howitzer, B Battery, 3rd Battalion, 16th Field Artillery, 2nd Armored Brigade Combat Team, 4th Infantry Division, rests in between fire missions during a live-fire at the Udairi Range Complex, Camp Buehring, Kuwait, March 19, 2014. (Photo by SGT Marcus Fichtl, U.S. Army)

as outlined in joint doctrine is to approve the JIPTL. In order for the JFC's designated chairman to do this, he must be informed to make decisions and confident that the staff and components have properly coordinated to deliver a synchronized plan. Designing a JTCB briefing that can do this is a challenge. First, the chairman requires the most current information to base his decisions; a good intelligence picture is key to understanding the operational environment. Just as important is a quick review of the JFC's guidance for the ATO under discussion, which the chairman has seen and may have approved for the commander.

Assessments are another key component of a JTCB briefing that will create conditions for future JFC success. It is critical that the chairman view the assessment of the most recent ATO and JIPTL cycle possible, which can place strain on the multi-echelon assessment team. Although many consider battle damage assessment the only component to the assessment process, there are several other factors that can influence the conclusion. The flow of displaced civilians, intentions of enemy commanders, and types of enemy attacks can be considered when finalizing an assessment. The bottom line is that anything that helps determine that the JFC's desired effects are being met, is a component of the JFC assessment.

Many joint staffs have several operational plans on the shelf, ready to be used if a crisis develops. These plans will contain desired effects linked to operational objectives that can be measured and assessed. Many plans even contain the recommended metrics used in future assessments and guide the staff to what criteria is important in each phase of the operation. This part of the plan can also assist staff that is charged with developing daily commander's guidance by providing effects that should be included during particular timeframes.

Each joint force staff will create a battle rhythm that maximizes their ability to keep the commander informed and able to make timely decisions. Some joint force commanders may want to personally approve any guidance that is published on his behalf, but the joint force commander's busy schedule may prevent this, especially for daily guidance. Many joint force commanders will send daily guidance through the JTCB, where it can guide the components and staff and add to the desired level of synchronization at the meeting. Following guidance approval, the desired effects for a given ATO are assessed following execution and then presented to the chairman at the JTCB, completing the feedback loop for the JFC.

When building the battle rhythm for a JFC, one must consider the placement of the JTCB first, over almost every other event. Although one may be tempted to view the commander's daily update or similar event as the lynchpin to any functional battle rhythm, the JTCB plays an important role in linking component command planning and execution to the joint force headquarters as well as serving the needs of the joint force staff. The most important inter-echelon linkage the JTCB can facilitate is that between the JFACC and the JFC. The synchronization of the JFACC's air tasking order cycle and the JFC battle rhythm is critical to any successful targeting effort.

It is common practice for commands to mold their battle rhythm to that of their higher headquarters, ensuring that any requirements are met and that the lower unit headquarters can provide requested information while also accomplishing battle staff

tasks. The JFACC, however, can only adjust their battle rhythm to a point. The ATO cycle, while flexible to meet emerging needs, is much less flexible when it comes to adjusting the timing of events that feed the 24-hour sequence. The ATO cycle has demonstrated its effectiveness through decades of use and drives not only the JFACC, but also many parts of other components, which rely on it for delivery of joint Fires.

The JTWG is the point at which the ATO initially engages the JFC's battle rhythm in preparation for the JTCB. At these two battle rhythm events, the detailed lethal targeting data from the JFACC is merged with non-lethal targeting and support efforts to develop fully integrated and mutually supportive missions to achieve the joint force commander's desired effects. The ATO cycle culminates at the JFC in a third and final master air attack plan brief, usually presented by the JFACC to the joint force commander for approval.

The JTCB can be viewed as an anchor battle rhythm event for the commander, similar to his daily operations and intelligence update. However, the JIPTL approval is a critical event for not only the JFC, but also for each component. The JFACC is usually given the task to execute the ATO, even planning for timing and execution of other service joint Fires such as U.S. Navy Tomahawk Land Attack Missile and U.S. Army Tactical Missile System. Other components require confirmation that their requested targets are on the approved JIPTL and will be flown in the ATO, so they can finalize maneuver plans and begin execution. Components will generally work with the JFACC using liaisons at the air operations center to ensure their requirements are being presented in the draft JIPTL and then executed in the ATO. Initial target nominations can go to the JFE or to the AOC, but the detailed JIPTL planning will occur at the JFACC.

As target nominations come from components to the JFC, the nominations have generally been reviewed by the JFACC through the target effects team-action officer meeting. The nominations are reviewed at the component level by the nominating component, usually through a targeting board process. The TET–AO then conducts a review of all the nominations and, if any duplication remains from the JTWG discussions, a final decision is made to determine what component will nominate the target. The TET–AO produces the draft JIPTL that is then sent to the JFE for coordination and synchronization with the desired non-lethal effects prior to being presented at the JTCB.

The non-lethal effort brings additional player into the targeting process and to the

Landing support specialists with Combat Logistics Regiment 2, 2nd Marine Logistics Group, II Marine Expeditionary Force, connect cables to a CH-53E Super Stallion from Marine Heavy Helicopter Squadron 461, Marine Aircraft Group 29, Marine Corps Air Station New River, during a Helicopter Support Team exercise at Davis Airfield aboard Camp Lejeune, N.C., March 19, 2014. 1st Battalion, 10th Marine Regiment brought two M777 howitzers for 2nd MLG LS specialists to train with. (Photo by Cpl. Devin Nichols, USMC)

An M142 High Mobility Artillery Rocket System assigned to the 41st Fires Brigade, Fort Hood, Texas, fires a rocket during a live-fire at the Udairi Range Complex, Camp Buehring, Kuwait, March 13, 2014. The Headquarters and Headquarters Battery, 3rd Battalion, 16th Field Artillery Regiment, 2nd Armored Brigade Combat Team, 4th Infantry Division provided radar coverage as Company C, 2nd Battalion, 8th Infantry Regiment, 2nd ABCT provided forward observers to the live-fire. (Photo by SGT Marcus Fichtl, U.S. Army)

JTWG and JTCB. If the JFC holds a non-lethal effects working group or an information operations working group, many of the non-lethal planning can take place prior to the JTWG. The challenge for the JFE and those that will brief the chairman of the JTCB is to demonstrate that the lethal and non-lethal plans are complimentary and reinforce each other. The TET–AO will provide some non-lethal inputs, captured from all the component liaisons. The inputs can include pamphlet, jamming, and broadcast operations as well as support to other non-lethal missions.

The JFE then gathers the other non-lethal inputs from civil-military operations, military information support operations, public affairs, strategic communications, and more. One good way to visually depict this for the JTCB chairman is to use the desired effects for the ATO and show that both lethal and non-lethal means are being used to achieve those desired effects, while not degrading any other effort. The challenge is to depict the ATO visually for the chairman so he can gain understating rapidly and know that the staff is using all available means to achieve the commander's desire effects.

The complexity of managing the JFC staff in the targeting effort is dwarfed by the much wider mission of orchestrating the theater targeting enterprise. Every component brings a set of targeting requirements and operational capabilities that must be coordinated to achieve the JFC's desired effects. The JFE ensures each component has a voice at the JFC level and that assets are being allocated in accordance with the commander's guidance and intent. If a JFC chooses not to establish a JFE, the burden of lethal and non-lethal joint Fires synchronization falls to another section or component. This huge workload will obviously detract from the primary mission of the organization and degrade their ability to accomplish tasks more central to their mission.

The JFE brings an ability to work targeting issues both vertically, with components and higher headquarters, and horizontally across the staff. A JTCB cannot meet even the most basic mission of approving the JIPTL without a great deal of time and effort coordinating and synchronizing the joint Fires plan. The organization in a position to best do this is a robust JFE with operations, plans, and intelligence functions built into the organization. Planners accomplish and enable most of what the JTCB aims to achieve. A solid JFE plans team can accomplish the deliberate targeting described above and aid the interactions with planners, assessment teams, and others that are so critical to success. The operations section within the JFE monitors the execution of the ATO, but also guides dynamic and time-sensitive targeting requests through the system to ensure their execution. A robust intelligence section within the JFE will liaise with the J–2 and ensure that the JTCB chairman is receiving the latest intelligence, ISR, and weather information. An intelligence team is also critical in working with the planners in early phases of operations to refine targets and conduct in-depth target systems analysis. The JFE is an essential component of any joint staff that desires to maximize the JTCB and the benefits a good JTCB can have for a JFC.

A well-run JTCB can be the difference between mission success and failure to realize the commander's desired effects. In order to have an effective JTCB, a JFC must ensure that all components and staff sections are involved and in close coordination. The one sure way to accomplish this is to invest in a robust JFE and resource it to orchestrate the joint force targeting enterprise. The JTCB is the key battle-rhythm event for the JFC and for meeting the commander's intent on time and on target.

Colonel Dennis Pastore is the current Fires Test Director at Fort Sill, Okla. and recently served as the United States Forces Korea chief of Fires and deputy Combined Forces Command chief of Fires assigned to the Combined Joint Fires Element in Yongsan, Korea. He holds a Bachelor of Science in Sports Medicine and a Master of Science in Administrative Management.

Major Jeff Fair is the chief of Ground Analysis at the USFK J2 and recently served as the senior targeting officer, Combined Joint Fires Element, J3, USFK. He holds a Bachelor of Arts in International Affairs from the George Washington University, a Masters of Business Administration from Hawaii Pacific University, a Masters of Public Administration from the University of Washington, and a Master of Science in Strategic Intelligence from the National Intelligence University.

Advances of Precision Fires and Launchers

By MAJ David Dykema, CW3 Matt MacKenzie, CPT Justin Teague

Ever since cannons and rockets first entered into the battlefield, Fires has been a major contributor to victory in all conflicts. The Precision Fires Rocket and Missile Systems Project Office develops, produces, fields, and sustains the precision Fires family of launchers and munitions to fulfill the long range artillery requirements of the U.S. warfighter and it's allies. The Multiple Launch Rocket System today continues to arm commanders and their units with the advantage to fit and win on the battlefield. The science and technology community working with the PFRMS PO is developing the technologies of tomorrow to maintain that decisive edge to fit, win, and come home safe.

This article focuses on the various platforms of the MLRS family of systems. We will review system upgrades that are currently integrated into our launchers and munitions and future capabilities that will be available to the next generation of Soldiers. As with all acquisitions, these technologies are developed to fulfill requirements provided by the warfighter to answer the call of this nation and support a commander's scheme of maneuver.

Current System Upgrades. The original M270 MLRS, first delivered in 1983, is an armored, self-propelled, multiple rocket launcher. The M270A1 was the result of an upgrade program for the U.S. Army in 2005. The launcher appears identical to M270, but incorporates an improved fire control system and an improved launcher mechanical system. These upgrades allow for significantly faster launch procedures and the firing of new types of munitions, including global positioning system guided rockets. Supporting the Army's transition to lighter, faster and more rapidly deployable vehicles, the M142 High Mobility Artillery Rocket System was developed. HIMARS is a light multiple rocket launcher mounted on a standard Army medium tactical vehicle truck frame. The current launchers will require modest improvements explained to extend the life of the fleet until a next generation vehicle is developed.

Fire Control System-Update. As with all systems with electronic components, the platforms of MFOS all face obsolescence issues that must be addressed to maintain system readiness. For the M270A1, a modification effort that updates the fire control system electronics is the path forward. The PFRMS PO, coordinating with the Training and Doctrine Command, Capabilities Manager and the Tank Automotive and Armaments Command will provide the M270A1 crew continued capability to execute Fires missions. The updated fire control system will preserve current Fires capability by eliminating existing obsolescence issues without negatively affecting system performance. It will comply with existing Army Technical Architecture requirements and have a beneficial effect on operation and support costs.

Operator Interface. In order to ensure that the Army's Field Artillery launchers remain relevant, they must adapt to changing environments and the emerging battlefield of the future. While system software continues to reinvent the way in which the FA Soldier conducts fire missions, advances in ancillary equipment ensure that launchers are more than just weapons systems. Current efforts will see operators with enhanced capabilities while operating in a tactical environment. Driver's Vision Enhancement, a thermal viewing system providing the ability to conduct sustained operations, will be standard on all launchers. This capability will assure that weather or low light conditions will no longer inhibit an operator's ability to move their system across the battle space.

Launchers of the future will see their communication systems enhanced in multiple ways. Blue Force Tracker will be an on-board asset, giving commanders and forces the ability to share encrypted tactical location information using a satellite terminal and global positioning system. This addition will allow users better command-and-control, allowing them to send and receive orders, map routes, provide locations of objectives throughout the formation. Long range communication systems will receive an upgrade as well. The integration of the AN/PRC-150 radio on the current fleet of launchers will provide a high-frequency data path from the Advanced Field Artillery Tactical Data System.

Improved Armor Cab. The HIMARS IAC, designed in 2005 and subsequently cut into HIMARS production in 2009, provides the crew with improved protection from ballistic threats, mines, and improvised explosive devices. The IAC provides the automotive operation controls, fire control system interface, communications systems, and seating for three crewmembers. The IAC, as part of a rocket and missile delivery platform, protects the crew from toxic gases, rocket tube-cover impact, and launch-area debris penetration during firing activities and ballistic attacks. The cab also provides two levels of ballistic protection with a base and

Marines with Romeo Battery, 5th Battalion, 11th Marine Regiment, Regimental Combat Team 7, fire rockets from a M142 High Mobility Artillery Rocket System on Camp Leatherneck, Helmand province, Afghanistan, June 1, 2013. Marines with 5/11 are deployed to Afghanistan in support of Operation Enduring Freedom. (Photo by Sgt. Anthony L. Ortiz, USMC)

base plus appliqué armor cab configuration. The cab window areas and the cab floor provide increased crew protection at all times, with and without the additional appliqué armor. In addition to extra protection, the IAC will result in identical configuration for both the HIMARS and the M270A1 allowing for unified crew drills.

Munitions. Guided Multiple Launch Rocket System and Army Tactical Missile System currently provides 24/7, immediate response, all-weather precision attack of both area and point targets with minimum collateral damage. The GMLRS Unitary is a highly accurate rocket that has earned the nickname of 'The 70 km Sniper Rifle.' The alternative warhead will replace the current GMLRS cluster munitions variant to provide devastating effects on area and imprecisely located targets without the danger of unexploded ordnance on the battlefield, in compliance with the "Department of Defense Policy of Cluster Munitions and Unintended Harm to Civilians." ATACMS also has two variants: The Unitary High Explosive variant provides very accurate deep Fires capability; and a cluster munitions variant is undergoing a Service Life Extension Program that will increase the service life of the munitions while converting it to an airburst unitary munitions in compliance with the cluster munitions policy.

Future System Upgrades. In order to continue to provide Soldiers the best capability to precisely engage targets at longer ranges, PFRMS works closely with the science and technology community, through Aviation and Missile Research Development and Engineering Center, to develop state

of the art capabilities to enhance emerging technologies in their state of the art labs. Although the current MFOS platforms are undergoing significant modifications to enhance their capabilities, they are near the limit of performance for the current design. To increase the capabilities, replace obsolete systems, and fulfill the user's needs, the PO will provide Soldiers with new missiles, pods, and launchers that minimize total life cycle costs.

Munitions. As we look at battlefield and engagement changes that surfaced since the initial development of the programs, it becomes clear that even with system upgrades, there needs to be a program developed with a phased approach to counter current and emerging threats, both short and long range. Presently, there is an analysis of alternatives being conducted to examine future gaps in this area and one option being examined is Long Range Precision Fires. The first increment of LRPF will service targets at ranges from 70 to 300 km. The preferred LRPF solution would allow for a two missile per pod packaging design (twice the capability of ATACMS), and with a lower cost than ATACMS.

The long-term strategy for LRPF is incremental development that folds in maturing technology to meet current and emerging key performance parameters. Examples include:

- Execution ranges beyond 300 km.
- Expansion of the current target set(s) by incorporation of new warhead technologies.
- Increased system accuracy and navigational robustness to GPS jamming.
- Ability to engage moving targets or in-flight updates to transmit an updated target location.

The capability to extend the operational range of LRPF will be predominately based on maturing motor technology coupled with lightweight airframe and composite technology. Propulsion advancements in the area of dual pulse motors need to be examined. In addition, the Insensitive Munitions motor program will be leveraged as a means of providing the warfighter with a safer munition that also incorporates an ignition safety device system.

Much advancement has been made in warhead technology to include increased IM compliancy, selectable effects, and large area effects. Fuze and proximity sensor technology research will allow LRPF to incorporate a state of the art warhead capable of addressing emerging threats. Kinetic energy warheads, as well as electromagnetic effect warheads should be looked at allowing commanders the ability to deny the enemy of local infrastructure. Seismic, audio and millimeter wave sensor technologies are also being investigated.

GPS jamming is an ever evolving threat and one of the biggest that the Army will encounter in the coming decade. Improvements in jamming detection and countering, as well as GPS and inertial navigation system guidance robustness are needed. The complete MLRS family of munitions has some of most accurate long-range Fires available to the warfighter, but there is always room for tightening this accuracy. Updated inertial measurement unit technology, optimized guidance algorithms, and addressing obsolescence issues will be critical in maintaining the MFOM level of accuracy. Advancements in terminal guidance, specifically related to seeker technology, and in-flight target updates, will add a performance capability to engage moving or fleeting targets.

Many of these new capabilities are at a

Marine Reservists watch as an operator maneuvers an expended pod onto a trailer after the day's fire missions were complete at training area 18 on Fort Sill, Okla. (Photo by Caitlin Kenney, U.S. Army)

A reduced-range practice round heads for the impact zone during a fire mission at Camp Guernsey, Wyo. Approximately 330 Soldiers of the 1st Battalion, 121st Field Artillery, Wisconsin U.S. Army National Guard, conducted annual training at Camp Guernsey. The different venue allowed the HIMARS units to fire from multiple points, as opposed to the single firing point at Fort McCoy. Lack of familiarity with the training site also tested navigation skills as batteries moved from one location to another several times during the field exercise. (Photo by ISG Vaughn R. Larson, Wisconsin U.S. Army National Guard)

low technology readiness level and manufacturing readiness level and require significant science and technology effort to meet warfighter requirements. The block improvement technique should be used since there is no need to delay providing the warfighter with a 21st century munitions equipped with state of the art components as we work with the labs in improving other technology areas.

Rocket Pod Improvements. The Army is also looking to upgrade the current rocket pod to protect the munitions from threats to include bullet fragment impacts and fire and thermal threats. This improvement will help the MFOS meet IM requirements. The MFOM continues to use legacy pod technology initially developed for the early MLRS munitions; this pod does not currently provide the protection required to meet IM requirements. Additionally, the Army is looking for pod improvements in the interface controls, logistics, rocket load-out, and flexibility to future munitions considerations. Reconfigurable and reloadable aspects are to be investigated as a means to reduce the return of partially fired pods.

The pod will address the issue of debris (tube covers, cables, sabots) ejected during rocket egress, a major concern for other service users. A major requirement is that any new pod design must retain the ability to interface with the current launchers since they are planned to be employed for 15 more years. This pod improvement will allow more capability to be added to the launcher.

New Ground Launcher. To accommodate the increased capabilities for the munitions and user control and interfaces, new vehicle development will initiate with Milestone 'A' in 2020. The green technologies currently in development by industry will lessen this vehicle's environmental impact.

- Emerging hybrid technology will reduce the need for sustainment in the operational environment.
- Solar power can harness needed power with applications of panels into the outer skin of the vehicle.
- Nano-technology batteries will help power the suite of electronics with increased functionality giving greater situational awareness.

All of these technologies will be housed on a ruggedized vehicle that is light enough to be transported using the, still to be developed, Joint Tactical Lift helicopter.

Robotics technology will also play a role in performing hunter-follower tactics, techniques and procedures using a man in the loop launcher suite with robotic launchers featuring automated reload. Primary targets can be more rapidly engaged and fleeting targets can be reengaged. The launcher will have vertical launch providing 360-degree Fires. Integrated fire control will be employed utilizing worldwide communications.

There are new ways we can more effectively provide Fires effects. The intelligence community will watch the emerging and future threats to ensure the best capability is developed. The user community will annotate the requirements to meet necessary operational effects. The research and development community will attempt to develop emerging technologies to fulfill gaps. Moreover, the product developers will package those technologies to provide the warfighter with the tools to meet their requirements. This article looked at several potential technological improvements to increase the capabilities of our Fires community. While many upgrades are already in implementation, the Precision Fires Project Office continues to look forward and develop future systems with emerging technologies to provide Soldiers with the best capability they deserve.

Major David Dykema is an assistant product manager for the ATACMS Program in the Precision Fires Program Office. He holds a B.A. Degree from New Mexico State University. He is Level II certified in Test and Evaluation.

Chief Warrant Officer 3 Matt MacKenzie currently serves as the assistant product manager for FA Launcher Sustainment. MacKenzie is a logistics warrant officer who spent the majority of his 17-year career in various brigade combat teams, with multiple deployments to Afghanistan and Iraq. Prior to arriving at Precision Fires, he completed a one year Training with Industry Program at Lockheed Martin's Missile and Fire Control, Camden Operations where he became intimately familiar with FA platforms and munitions. MacKenzie holds a Masters in Management from American Military University.

Captain Justin Teague was commissioned as an ordnance/logistics officer from the Reserve Officer Training Corps through the 'Green to Gold' program from the University of Central Arkansas in December 2004. He holds a Masters degree in Transportation and Logistics Management from American Military University. In October 2013, Teague was assigned to Program Executive Office, Missiles and Space at Redstone Arsenal, Ala., in the Precision Fires Rocket and Missile Systems Project Office. He is currently serving as the M270A1/M142 HIMARS Fire Control System-Upgrade assistant product manager.

Acronyms

5RAF – Five Requirements for Accurate Fires
A2/D2 - Anti-Access/Area Denial
AADC - area air defense commander
AAGS - Army Air-ground System
ACA - airspace control authority
ADA - Air Defense Artillery
ADRP - Army Doctrine Reference Publication
AETC - Air Education and Training Command
AFATDS - Advanced Field Artillery Tactical Data System
AFSC - Air Force specialty code
AFSP - Afloat Forward Staging Base
AI – air integration
AIAMD – Army Integrated Air and Missile Defense
AIT - Advance Individual Training
ALC - Advance Leader Course
ALM - Army Learning Model
AMC - Army Materiel Command
AMD - Air and Missile Defense
AMDWS - Air and Missile Defense Workstation
AMRDEC - Aviation and Missile Research Development and Engineering Center
AOC - air operations center
AOR – area of responsibility
ARCENT – Army Central
ARCIK - Army Capabilities Integration Center's
ARI - Army Research Institute
ASOC - air support operations center
ASOS - air support operations squadron
ATACMS - Army Tactical Missile System
ATO - air tasking order
AUSA - Association of the United States Army Symposium
BCT - brigade combat team
BDA - battle damage assessment
BFT - Blue Force Tracker
BLUEFOR – Blue Forces
BOLC - Basic Officer Leader Course
CAM – combined arms maneuver
CAS - close air support
CDID - Capabilities Development and Integration Directorate
CEMA - Cyber Electromagnetic Activities
CM – cluster munitions
CNA - capabilities needs analysis
COCOM - Combatant Command
CoE - centers of excellence
COP – combat outpost
CRADA - Cooperative Research and Development Agreements
C-UAS - Counter-Unmanned Aircraft Systems
C-UAS - Counter-Unmanned Aircraft Systems
DACAS - digitally aided close air support
DASC - direct air support center
DE - directed energy
DCO - Defense Connect Online
DIVARTY – Division Artillery
DOD - Department of Defense
DOTMLPF - doctrine, organization, training, materiel, leadership and education, personnel and facilities
DTMS - Digital Training Management System
DVE - Driver's Vision Enhancement
EFO - Electric Fires Office
ERDC - Engineer Research and Development Command
EW - electronic warfare
FA - Field Artillery
FAA - Federal Aviation Administration
FAC-A - forward air controller-airborne
FC - Fires cell
FCoE - Fires Center of Excellence
FCS-U - Fire Control System-Update
FM - Field Manual
FO - forward observer
FOB - forward operating base
FSCC - Fire support coordination center
FSCOORD - fire support coordinator
FY – Fiscal Year
GMLRS - Guided Multiple Launch Rocket System
HIMARS - High Mobility Artillery Rocket System
HQDA - Headquarters Department of the Army
IAC - Improved Armor Cab
IADS - Integrated Air Defense Systems
IBCS - Integrated Battle Command System
IFCS - improved fire control system
IFPC - indirect fire protection capability
ILMS - improved launcher mechanical system
IM - Insensitive Munitions
IMI - interactive multimedia instruction
ISAF = The International Security Assistance Force
ISR - intelligence surveillance and reconnaissance
JACI - Joint and Combined Integration
Jacids - Joint Capabilities Integration Development System
JAGIC - Joint Air-ground Integration Center
JAOC - joint air operations center
JDAM - joint direct attack munition
JETS - Joint Effects Targeting System
JFACC - joint force air component command
JFC - joint force command
JFC - joint force commander
JFE - joint Fires element
JFLCC - joint force land component commander
JFO - joint Fires observers
JIIM - joint, interagency, intergovernmental, and multinational
JIPTL - joint integrated prioritized target
JP – Joint Publication
JTAC - joint terminal attack controller
JTCB - Joint Targeting Coordination Board
JTWG - joint targeting working group
LC-TERM – Low-Cost Tactical Extended Range Missile
LLDR-2H - Lightweight Laser Designator Rangefinder-Hand-Held
LOE - lines of effort
LRPF - Long Range Precision Fires
MAAP - master air attack plan
MACCS - Marine Air Command and Control System
MADD - Mutually Assured Destruction Doctrine
MAGTF - Marine air-ground task force
MFOM - MLRS family of munitions
MFOS - MLRS family of systems
MLP - Mobile Landing Platform
MLRS - Multiple Launch Rocket System
MOA - Memorandum of Agreement
MOS - military occupational specialty
MRMC - Medical Research and Materiel Command
MTOE - Modified Table of Organization and Equipment positions
MTV - medium tactical vehicle
NATO - North Atlantic Treaty Organization
NCO - noncommissioned officers
NEW - Net-Enabled Weapons
NLOS-LS - Non-Line of Site Land System
OIF - Operation Iraqi Freedom
OPFOR – opposing forces
PF - precisions Fires
PFRMS - Precision Fires Rocket and Missile Systems
PFW - Precision Fires Warrior
PFWS - Precision Fires Warrior System
PME - professional military education
PO - Project Office
R&D – research & development
RAM - rocket, artillery and mortars
RDECOM - Research Development and Engineering Command
ROE – rules of engagement
S&T – science and technology
SLEP - Service Life Extension Program
SMDC - Space and Missile Defense Command
TAC - terminal attack controller
TACC - tactical air command center
TACOM - Tank Automotive and Armaments Command
TACP - tactical air control party
TACS - Theater Air Control Systems
TADSS - training aids, devices, simulators and simulations
TAIS - Tactical Airspace Integration System
TBMCS - Theater Battle Management Core System
TCM - TRADOC Capabilities Manager
TET-AO - target effects team-action officer meeting
TEWG - targeting effects working group
TGO - terminal guidance operations
THAAD - terminal high-altitude area defense
TLE – target location error
TRADOC - Training and Doctrine Command
TST - time sensitive target
TTPs – techniques, tactics and procedures
UAS - unmanned aerial system
UAV - unmanned aerial vehicles
UN - United Nations
USAF - United States Air Force
USAFAS – United States Army Field Artillery School
USMC – United States Marine Corps
WAS – wide area security
WMD - weapons of mass destruction

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Soldiers from 5th Battalion, 3rd Field Artillery load M142 High Mobility Artillery Rocket Systems onto a C-17 Globemaster III aircraft. The systems were prepared for the HIMARS Rapid Infiltration exercise involving Airmen from the 728th Airlift Squadron and Soldiers from 17th Fires Brigade, 7th Infantry Division. The HI-RAIN exercise consisted of using a C-17 to transport the HIMARS units and their crews from McChord Field to Hunter Liggett, Calif., which acted as a theater environment. Once there, crews fired on a stationary target using the HIMARS and then were immediately extracted by C-17 from the launch site. (Photo by SSG Mark Miranda, U.S. Army)

PIN 103905-000