

21st Century Combined Arms

Integration of lethal and non-lethal actions
and effects across multiple domains

by Col Brian P. Duplessis

The proliferation of information related capabilities (IRCs) has exacerbated the challenge of effectively integrating—in time, space, and purpose—IRCs with lethal, traditional fires as envisioned in current and emerging doctrine. The *Marine Corps Operating Concept (MOC)* captures our Service ambitions for lethal/non-lethal (L/NL) integration and directs:

We will confront adversaries who seek to disrupt, degrade, or destroy our information capabilities and systems. We will counter them with an information warfare approach integrated with C2, ISR, and precision fires from the MEF to the small-unit level.¹

The Corps is searching for answers on how to integrate these capabilities as the 2017 Earl “Pete” Ellis essay contest asked entrants:

>Col Duplessis is the Director of Operations and Training, Expeditionary Warfare Group, Atlantic.

How can the Marine Corps better integrate traditional means of fire support with lethal and non-lethal fires, especially emergent capabilities such as cyber and electronic warfare?²

Furthermore, the most recent MAGTF Fires Operational Advisory Group saw L/NL integration considerations account for two of six out-brief items.³ This article analyzes considerations for MAGTF-level L/NL actions and effects integration within the naval Services and joint force answering the Commandant’s task to, “Integrate a

21st century combined arms approach into education, training, exercises, and organizations.”⁴

Considerations

As a point of departure, we must remember where MAGTFs belong in the joint and naval force in order to properly envision how we will integrate L/NL actions and to what effect(s). Once we have identified those requirements, we have to consider how we can best organize our staffs; highly qualified personnel improperly organized will achieve nothing at best and often prove counterproductive. MAGTFs, to include MEFs, are tactical formations with an operational focus fighting as part of the larger joint and naval force aligning operations, objectives, and actions within the naval battle(s) of the joint force commander’s (JFC) campaign. Consequently, JFC guidance and objectives drive MAGTF targeting objectives and supporting effects;⁵ all actions must adhere to JFC constraints and restraints. Naval integration is required as MAGTF commanders fight seamless naval battles in conjunction with the joint/combined force maritime component commander. Fully integrated action across all warfighting functions, to include fires and operations in the information environment, is imperative.

Staff organization. To achieve effective L/NL integration, the staff must be properly organized. Multiple considerations drive organization to include weight of effort between L/NL actions, battle rhythm, and available personnel and resources. Regardless of the model selected, the organization must move at



Fully integrated action across all warfighting functions is imperative. (Photo by SSgt Daniel Wetzel.)

- 2015: I MEF had a FECC with three elements (Lethal Fires, IO, Air).
 - Participated in DB15.
 - Used EFSTs, IRC specific Objectives.
 - Lacked utility and integration.
- 2016: I MEF had a FECC, G-39 IO Section, and Air Section.
 - Participated in MEFEX-16.
 - Used EFSTs, IO Support Tasks, IRC specific Objectives.
 - Lacked integration and synchronization.
- 2017: I MEF has a FECC (IO and Fires) and an Air Section.
 - Participated in OCA-17, Pacific Sentry 17.2, and MEFEX.
 - Used Targeting Objectives and Effects.
 - Fostered increased staff integration and effects synchronization.

Figure 1. (Image provided by author.)

the speed of war and fulfill the commander's vision. Potential staff models include separate L/NL sections with a common senior decision-maker responsible for L/NL integration, separate L/NL sections with the fires and effects coordinator (FEC) as sole integrator, or a fully integrated entity with the FEC as sole integrator. Regardless of the model selected, the designated integrator should reside at the MAGTF CE, the lowest common commander for multiple fires and effects providers. The recently published *Functional Concept for MAGTF Fires* advocates this approach.⁶

The first model has little chance for success as potential integrators have many other weighty responsibilities significantly limiting their ability to give L/NL integration the attention and effort required. The end result trends toward separate L/NL lines of effort which never meet; when they do meet it is by accident vice design. The second model moves closer to true integration but still has the potential for separate, uncoordinated efforts. Conversely, JFCs have selected variations of the last model almost universally. For example, U.S. Strategic Command (USSTRATCOM) stood up a Joint Fires Element (JFE) empowering the JFE chief with authority to integrate cyber, space, and global strike operations. Similarly, U.S. Pacific and European Commands rebuilt their previously divested targeting capability by selecting a JFE construct with the chief designated as L/NL integrator. In both cases, the existing information op-

erations cell was deemed inappropriate for L/NL integration during potentially high-end operations against near-peer competitors. This trend continues at the joint task force (JTF) level where, after some experimentation, CJTF-OIR (Commander Joint Task Force—Operation INHERENT RESOLVE) ultimately settled on a combined JFE with L/NL fires divisions under the JFE chief as single integrator. At the Service level, I MEF experimented with each of the previously described models over the past two years (see Figure 1) with varying degrees of success before settling on a fully integrated fires and effects coordination center (FECC) under cog-

nizance of the FEC as the sole L/NL integrator. The results achieved during a joint exercise, JTF certification, and MEF exercise validate this decision.

Based on these examples, the ideal FECC—more appropriately an effects coordination center—is a fully integrated entity reflecting a mindset, not merely an organization chart. For example, a label of current effects vice current fires personifies the approach. Furthermore, the addition of an information warfare (IW) watch officer (WO) on the combat operations center floor is wise. As the MEF information groups gain maturity, a MIG liaison officer—separate and distinct from the information-warfare watch officer—warranted and will pay dividends. In pursuit of naval integration, Navy lethal fires and IW reps are also required. While the addition of these personnel will prove challenging in terms of resources and space, particularly when aboard ship, gains far outweigh costs as we must maintain understanding of operations in the information environment to the same degree, sometimes to a greater degree, as we do in other domains. Going one step farther, we need an aggressive, short-term personnel exchange program (PEP) initiative to rapidly build expertise we lack, but our sister Services have in spades. A

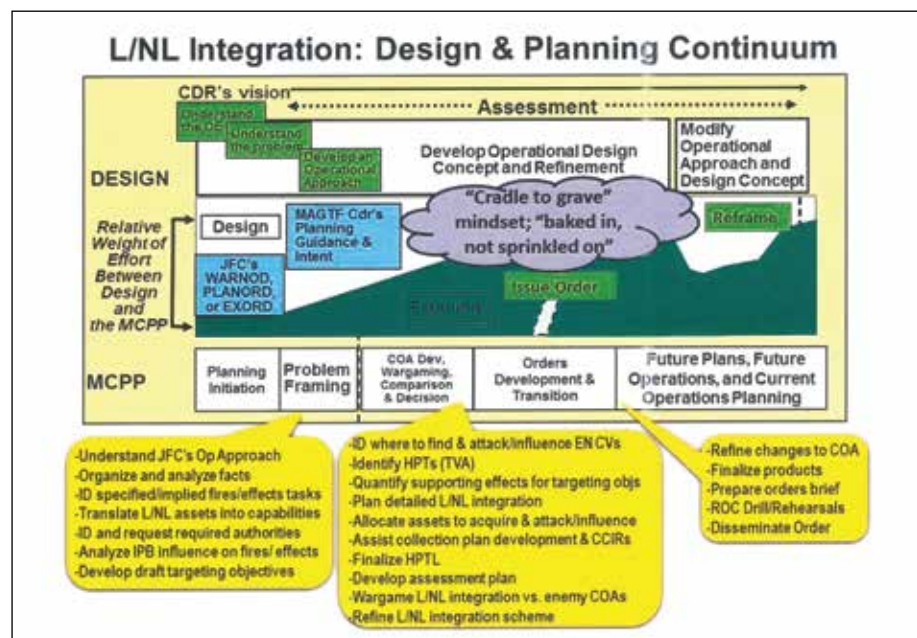


Figure 2.⁸ (Image provided by author.)

rapid infusion of joint experts would significantly enhance our nascent efforts while Marines sent to PEP billets would return with experience we could not replicate as quickly. To limit impacts, we should consider one or two year PEP billets where our selectees rapidly gain experience and insights but return in a timely fashion putting their newly gained expertise immediately into action. Potential PEP billets include Air Force (cyber, space), Army (electronic warfare, special technical operations, military deception (MILDEC), and Navy (all IRCs in a naval setting).

Design and Planning

We must think integration from the start, begin early in design and planning, and not think of integration as a “bolt on” or afterthought during execution.⁷ Figure 2 graphically depicts the design and planning continuum in terms of L/NL integration. Specifically, commanders must identify desired outcomes or effects up front; a starting point is the commander’s battlespace area evaluation (CBAE), specifically the center of gravity (COG) analysis with critical vulnerabilities (CV) driving the “decide” step of the targeting cycle. We then integrate L/NL actions and effects, within the scope of current and planned authorities, to protect our CVs while attacking and/or influencing adversary CVs. Effective integration takes a holistic approach seeking to use all available IRCs vice a few preferred tools or ignoring IRCs altogether in favor of lethal-only solutions. Consequently, we must include diverse IRC experts in all OPTs and fires/targeting venues. Other considerations under the design and planning umbrella include event horizon management, authorities, targeting objectives/essential fire support tasks, “effects fratricide,” and the incorporation of joint, coalition and other government partners.

Event Horizon Management. Deliberate lethal fires are chiefly planned for the future operations horizon and executed in the current operations horizon. IRCs, conversely, often require significant lead times for effective preparation, approval of required authorities, execution, and for effects to manifest and undergo as-

essment while creating desynchronization with lethal planning. For example, while we might influence behavior in a reasonably short period, efforts to change cognitive perception are rarely feasible within 24 to 48 hours whereas a scheme of lethal fires is routine. All of this begs for a single planning approach where pre-planned and approved actions and effects—L/ NL alike—are executed, vice reactive requests for effects that may prove unsupportable given time constraints.

A potential mitigation technique is the conducting of a targeting deep dive periodically at the end of the daily target coordination board. Based on the type and tempo of the operation, combined with the commander’s decision-making style and information requirements, this could be executed every three days, once a week, or less frequently. CJTF-OIR previously used this technique to good effect often updating the commander on largely NL actions to set conditions for major operations more than a year in advance; the results of recent operations validate this technique. Another possible approach is the use of a plans management board (PMB) chaired by the deputy CG or chief of staff or other senior decision maker. The PMB coordinates and deconflicts multiple, simultaneous, and competing planning efforts across all three event horizons.

While not a targeting exclusive event, a PMB can potentially foster L/NL integration across multiple horizons.

Authorities. Authorities confer legitimacy to the missions, methods, and end states that commanders pursue.⁹ While commanders are generally unconstrained to employ lethal, conventional weapons within their area of operations—in consonance with the Law of Armed Conflict and rules of engagement—the same does not hold true for most IRCs compelling commanders to request authorities. These requests should be specific; a blanket request to employ IRCs for an operation’s duration is not likely to succeed. For example, a request for MILDEC authorities for the duration of Phase III has far less chance of success than a request for MILDEC authorities during Phase 3B to deceive XX formation until Objective Y is secured. Requisite authorities must be identified and requested as early as possible because many require high-level and/or multi-lateral approval. Given the importance of authorities, a staff judge advocate representative is critical to effective L/ NL integration and must be part of the process from design and planning through execution. This representative needs to understand the JFC’s process to request supplemental authorities while developing and maintaining a graphical

Targeting Objectives & Effects Analysis

1. Limit 999th Mixed Artillery Brigade’s (MAB) ability to mass fires IVO MEF Objective 1 enabling GCE’s (Main Effort) seizure of MEF Obj A
 - Effect 1.1: HQ 999th MAB unable to communicate w/ firing units (EW, SIGINT, OAS, HIMARS) CV: 1, 2, 4, 5
 - Effect 1.2: Firing units unable to displace/make survivability moves (EW, SIGINT, MISO, OAS, HIMARS) CV: 1, 4, 5, 6
 - Effect 1.3: Firing units unable to receive replenishment (EW, SIGINT, MISO, OAS, HIMARS) CV: 1 - 6

Critical Vulnerabilities (CVs): 999th Mixed Artillery Brigade
 CV 1: Lack of IADS CV 4: Reliance on Centralized C2
 CV 2: C2 Nodes CV 5: Lack of Communications Security
 CV 3: Sustainment CV 6: Limited Mobility Corridors for displacement

Essential Fire Support Task (EFST)

Task: Limit 999th MAB’s ability to mass fires IVO MEF Obj A
 Purpose: Enable the GCE’s (Main Effort) seizure of MEF Obj 1
 Method:

- Priority of Fire: 1) GCE; 2) ACE; 3) FAHQ
- Allocation: 1) Disrupt HQ 999th MAB’s ability to C2 firing units: EW degrades C2, SIGINT locates C2 nodes, MISO erodes morale, OAS & HIMARS lethally strike C2 nodes; 2) Deny firing units’ ability to displace/make survivability moves: EW degrades C2, SIGINT intercepts movement orders, MISO erodes morale, OAS & HIMARS lethally strike displacing units; 3) Firing units unable to receive replenishment: EW degrades C2, SIGINT intercepts replenishment orders, MISO erodes morale, OAS & HIMARS lethally strike replenishment actions.
- Restrictions: BCL 1 in effect; cluster munition approval w/ O6 COs; tactical MISO authority to O6 COs

Effect: 999th MAB unable to mass fires above battery level

Figure 3. (Image provided by author.)

matrix depicting authorities by phase/event. While we plan for and anticipate required authorities, we will not foresee every scenario. Thus, when confronted with unexpected events, resident authorities will drive our dynamic targeting and integration efforts. Finally, our adversaries are largely unconstrained and do not require authorities to act in the same manner we do. We must understand this state of affairs and not allow the adversary to exploit this to his advantage.

Targeting objectives and supporting effects vs. essential fire support tasks. L/NL integration needs to be commander-focused conveying information in the commander's preferred manner to support informed decision making and understanding of the operational environment. Two commonly observed methods are the use of targeting objectives or traditional essential fire support tasks (EFST).

The use of targeting objectives at the MAGTF level is a recent trend. The author's draft of a revised *MCWP 3-31, MAGTF Fires*, defines targeting objectives as, "Goals describing aspects of adversary capabilities or parts of the battlefield system the MAGTF Commander wants to affect."¹⁰ Targeting objectives provide a single, commander-centric lens focusing targeting efforts

across the enterprise; one set of objectives generating one set of supporting effects linked to enemy CVs. Well-developed targeting objectives and supporting effects promote an integrated approach vice assigning separate lethal and information operation (IO) tasks. Targeting objectives can also serve as a framework for ACE apportionment and allocation.

While EFSTs are doctrinal, recognized, and widely used, they should be re-branded "essential effects tasks" as "fire support" conjures a lethal focus and does not inherently promote L/NL integration. The chief challenge to effective L/NL integration via EFSTs is properly wording the method portion. All too often, this key narrative limits L/NL integration to a poorly-defined statement such as, "employ IO." A more useful and effective statement will separate IRCs either individually or by groupings of similar functions/effects. These would need to provide a detailed, yet concise, narrative of employment providing desired effect(s), and the manner of aiding/complementing lethal effects. Despite this challenge, EFSTs remain doctrinal and may prove "user friendly" to a rapidly assembled staff not familiar with targeting objectives and without time to learn. Figure 3 provides a simplistic

comparison between EFSTs and targeting objectives.

Regardless of selected method, graphical depiction of effects integration on a single product is a recommended practice and follows USTRATCOM's integrated tasking order used to integrate global strike, cyber, and space operations. Another method to further L/NL integration is organizing IRCs into inform, influence, and electromagnetic spectrum operations/space/other contingency operations groupings vice a nebulous, overarching label IO or listing fourteen disparate IRCs. This practice creates a concise framework that more precisely considers application of groups of IRCs in conjunction with lethal actions in pursuit of targeting objectives. Again, commander preference will drive the form adopted. Figure 4 provides an example of a simple effects synchronization graphic depicting the EFST/Targeting Objective from Figure 3.

"Effects Fratricide." Almost without exception, every IRC employment is a "cross boundary" event. While we know with reasonable certainty the effects of all manner of lethal ordnance and select non-lethal ordnance (smoke, illumination etc.), we cannot say the same for IRCs as no scientific studies predict the effect of MILDEC operations with the same degree of accuracy associated with a lethal munition. Likewise, we often fail to properly predict and/or assess the moral effect(s) of lethal fires on adversaries and friendlies alike. We have proven procedures to route aircraft flight paths to avoid indirect fire trajectories enabling simultaneous engagement; deconfliction by time, space, or a combination of both is second nature. This cannot be said for IRCs as few, if any of us, innately visualize the hazards of simultaneously employing multiple IRCs in conjunction with lethal fires against the same target sets. Without some manner of deconfliction and synchronization, IRCs have the potential of working at cross purposes and, far from creating a combined arms effect or creating conditions for effective use of L/NL actions as the primary defeat mechanism, we stymie our own efforts.

Coalition, Joint, and other Mission Partners. We fight in a joint, combined,

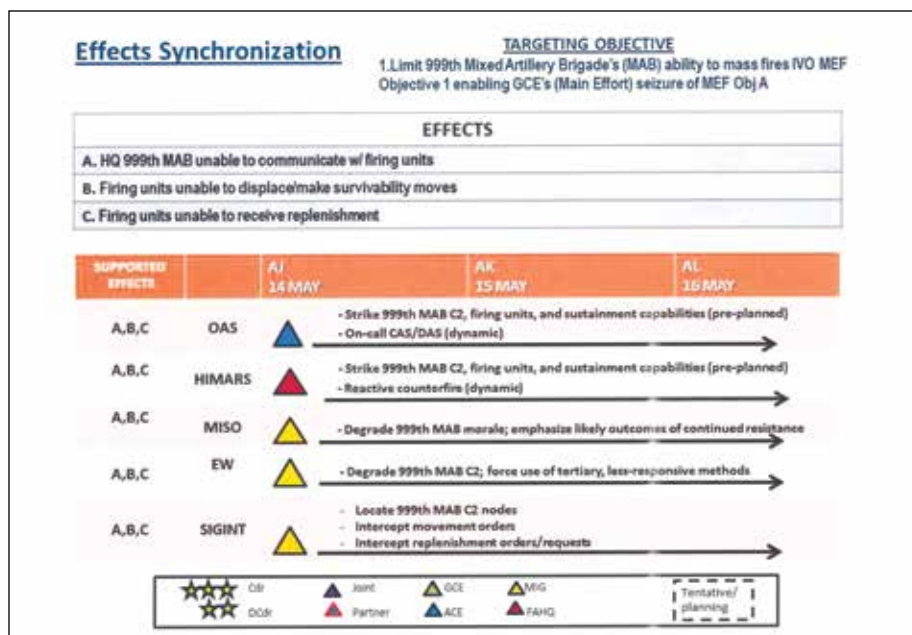


Figure 4. (Image provided by author.)

and whole of government environment to include L/NL integration efforts introducing challenges in information sharing, foreign disclosure, and authorities. Coalition partners will bring non-lethal capabilities but may not be able to disclose sources, methods, or tools. Likewise, we are limited in what we can share with partners, even our closest allies. In response, we must become comfortable with only knowing what effect(s) can be provided while stifling our innate curiosity for complete information and understanding. This reality also creates requirements for separate secure spaces. Coalition partners will also operate with different authorities and national caveats. Often this can prove limiting; but, however, we may have coalition partners with authorities to execute actions we would like to, but cannot. We must never use coalition partner authorities and actions to circumvent established norms and laws.

Similarly, we fight with joint and non-DOD partners who operate under different authorities, answer to separate chains of command, and possess different organizational cultures and mindsets. To achieve unified action, we must understand capabilities and limitations, information exchange requirements and methods, and the preferred lexicon. At times we may have to adjust—within reason—for the greater good. Successful

“If we fail to adapt ... at the speed of relevance, then our military ... will lose the very technical and tactical advantages we’ve enjoyed since World War II.”

—Secretary of Defense James N. Mattis¹²

The table is a calendar-style grid with columns for dates from 18-Oct-12 to 28-Oct-12. Rows represent different units and personnel. Annotations include:

- Top right:** "We use the red/yellow (green) to show 7 min. approximate status. RSC for out of state and leading events, yellow for being re-scheduled, and CDE for good to go."
- Center:** "The event names are color coded into the color patterns to help group the events for the reader."
- Bottom right:** "We use the color code event CDE staff code."

Figure 6. (Image provided by author.)

unified efforts are predicated on close cooperation aided by a spirit of compromise informed by shared purpose.

Execution

While the preponderance of L/NL integration takes root in design and planning, much can still go astray during execution. Potential execution

friction points include targeting cycle, battle rhythm and boards, bureaus, centers, cells, working groups (B2C2WGs), and assessment.

Targeting cycle, battle rhythm, and B2C2WGs. Proper L/NL integration is predicated on a single targeting cycle not separate L/NL cycles. Therefore, we may have to modify existing targeting methodologies to better incorporate combined effects. In order to achieve this ideal, the targeting process must be fully integrated beginning with a venue to pass the commander's guidance—combined with the latest assessments—and culminating with a targeting board or other decision-making venue. In between these initiating and culminating events, a series of mutually supporting iterative working groups serve as connecting tissue. Each event needs clearly defined inputs and outputs avoiding the “bridge to nowhere” syndrome. These connecting files should use as little time as necessary giving the excess back to subordinates for staff work and critical thinking. Figure 5 depicts an example integrated B2C2WGs structure such as previously described.

An overambitious battle rhythm degrades quality staff work and is

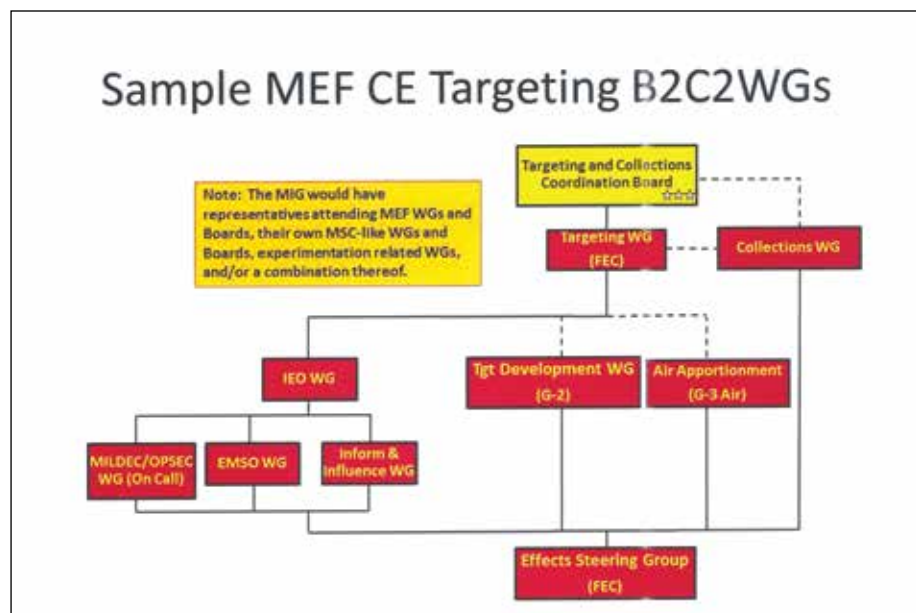


Figure 5. (Image provided by author.)

unsustainable for long-term combat operations. Therefore, we must distill the battle rhythm down to only those truly critical events and, when possible, combine similar events to create efficiencies. For example, a combined targeting/collections board links complementary requirements and limits the number of events senior leaders must attend. Given the need for L/NL representatives to attend a wide array of working groups, we must closely manage personnel bandwidth as it is easy to lose sight of demands on key personnel, particularly high-demand, low-density experts such as the staff judge advocate. A proven management tool is a staff utilization matrix graphically depicting the staff's ability to support multiple, simultaneous, and competing events. A similar tool can manage high demand resources such as spaces and video teleconferences. Figure 6 is an example of a notional JTF staff utilization matrix.

Assessment. Assessment enriches understanding and helps commanders manage limited resources, against seemingly unlimited tasks and objectives, while identifying when transition criteria are met. The results of fires and effects feed the overall command effort and are often among the most critical pieces of information required to produce an informed assessment. In order to best capture this critical information,

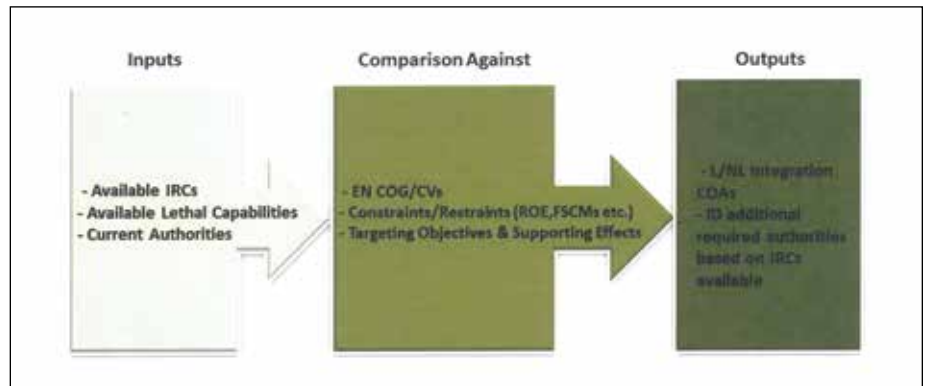


Figure 7. (Image provided by author.)

capabilities and techniques to do so, but they must be recognized early and properly allocated. For example, signals intelligence intercepts, validated by imagery, can assess the effectiveness of a deception plan; conversely, if we focus on the wrong indicators, we will derive a flawed assessment with negative cascading effects across the force. In order to properly identify the correct factors for NL/cognitive assessments, we must rely on cross-functional experts to include regional/foreign area officers and SNCOs as well as experts outside the MAGTF using a federated approach.

Training, Exercises, and Operations

Our current exercise continuum, focused almost exclusively on phase III current operations, does not foster true “cradle to grave” L/NL integra-

lethal assets, and a failure to penalize commanders who do not achieve L/NL integration.

A senior flag officer's quote captures the chief shortcoming of our current exercise continuum, “It is very difficult to master the lethal/non-lethal integration process during a one-week training exercise and nearly impossible to replicate long-term non-lethal effects and measure/assess the impact of those effects to inform the commander.”¹¹ While extending exercises is not viable, we can better structure exercises to capture the L/NL integration process validating and/or refining our methodologies. For example, prior to exercise commencement, phase zero through phase two NL actions could be executed, adjudicated, and assessed. The results, informed by assessment, will set conditions for opening the main exercise forcing commanders to make decisions and adjust plans based on outcomes from the onset rather than the average time it usually takes to meet a commander's critical information requirements and stress their decision cycle.

Even if the previous suggestion became reality, commanders may still ignore L/NL integration if they possess seemingly unlimited lethal resources. All too often, particularly when designated main effort, we have more aircraft than airspace and seemingly unlimited preferred surface-to-surface munitions. If we had fewer resources, we could force commanders and planners to think L/NL from the start. To reach this ideal, we should bring back the mindset of the legacy combined arms exercise (CAX) program.

Our current joint, naval, and Service exercises do not support, much less encourage lethal/non-lethal integration.

collection plans allocate and focus collection assets against those enemy units and capabilities that the commander needs to strike and/or influence in order to achieve success. While this time-tested methodology has proved useful in assessing the results of lethal actions against tangible targets, it must be adjusted to better capture the results and effects of NL actions against intangible aspects such as enemy morale and cognitive perception. We have access to

tion. Additionally, training in our formal learning centers need to include L/NL training at the lowest levels. We also need to enhance support to L/NL decision making to move at the speed of potential adversaries.

Continuum of Joint, Naval, and Service Exercises. Our current joint, naval, and Service exercises do not support, much less encourage, L/NL integration. Barriers to success include short duration exercises, an overabundance of

The CAX program emphasized combined arms at all levels actively penalizing commanders for not achieving combined arms, even when single arms were seemingly capable of achieving objectives. While pedantic to many, this approach enforced good habits of thought and action; a similar mindset needs to be instilled in terms of L/NL integration. While many naysayers will declare this constitutes “group think” and “ties” commanders’ hands, it will change the way we approach attainment of desired effects across the force in the same manner combined arms became second nature due to the CAX program’s influence. It usually took only one devastating antitank guided missile ambush to convince battalion commanders an unsupported, uncoordinated tank company assault on an infantry position was not a good idea.

Expeditionary Warfare Training Group Atlantic (EWTGLANT) initiative. EWTGLANT, alone among the Corps’ formal learning centers, possesses resident subject matter experts with significant Service and joint experience in landbased surface, aerial, and naval surface fires, targeting, and diverse IRCs such as operational security, signals intelligence, MILDEC, military information support operations, and electronic warfare/cyber. EWTGLANT is uniquely postured to address the complex challenge of developing tactics, techniques, and procedures for L/NL integration. Accordingly, EWTGLANT is producing a L/NL integration handbook, informed by feedback from the community of interest (combat Development & Integration, EWTGPAC, Training Command, Fort Sill, MEFs, and MAGTF Staff Training Program, among others). EWTGLANT is also considering formal focused L/NL integration instruction ranging from resident courses to mobile training teams. Instruction could be unit or individual; for example, a mobile training team might train a MEB/MEF FECC as a single entity. Conversely, a resident course could bring together disparate personnel from across the Service and joint communities for training. In the

short term, given the MOC’s requirement for integration, “from the MEF to the small-unit level,” EWTGLANT is already incorporating IRCs and L/ NL integration into our FSCC and supporting arms coordination center resident courses and our FSCC mobile training team cultivating this mindset in tomorrow’s senior leaders and decision makers.

Non-Lethal Joint Munitions Effectiveness Manual (JMEM). The JMEM series of ongoing studies informs our application of lethal munitions against targets or sets of targets; our primary fires planning system, Advanced Field Artillery Tactical Data System, draws extensively from JMEM. As touched on previously, the certainty of predicting NL results is limited; there is no NL JMEM and the viability of a similar study matching the accuracy inherent in JMEM is not promising. What we can do, however, is produce a decision support tool that takes L/NL capabilities and resident authorities as inputs, compares same to enemy CVs and desired effects, producing feasible L/NL integration courses of action for consideration as depicted in Figure 7.

Again, this would be a decision support aid and would still require analysis, critical thinking, and informed decision making. However, such a tool could

increase our ability to rapidly achieve L/ NL integration particularly in dynamic situations such as the potential use of electronic warfare, combined with lethal fires. Given the largely unconstrained freedom of action our potential adversaries enjoy, such a tool could also tighten our planning and decision cycles regaining some lost competitive advantage.

Conclusion

While we have discussed a multitude of considerations, L/NL integration is ultimately the skillful application of lethal actions, IRCs, and authorities, properly coordinated in time, space, and purpose, to attack/influence the enemy center of gravity while defending our own. This is a continuous process, deeply ingrained in the commander’s decision cycle and informed by continuous assessment; one we must master to remain relevant on the 2025 battlefield. Figure 8 graphically depicts this symbiotic relationship.

Secretary Mattis’ quote encapsulates the preceding paragraphs and should spur us to action lest we continue to fall behind potential adversaries. As the Service that revolutionized combined arms—particularly the close integration of aerial, naval, and land-based surface fires—we have the legacy and mindset

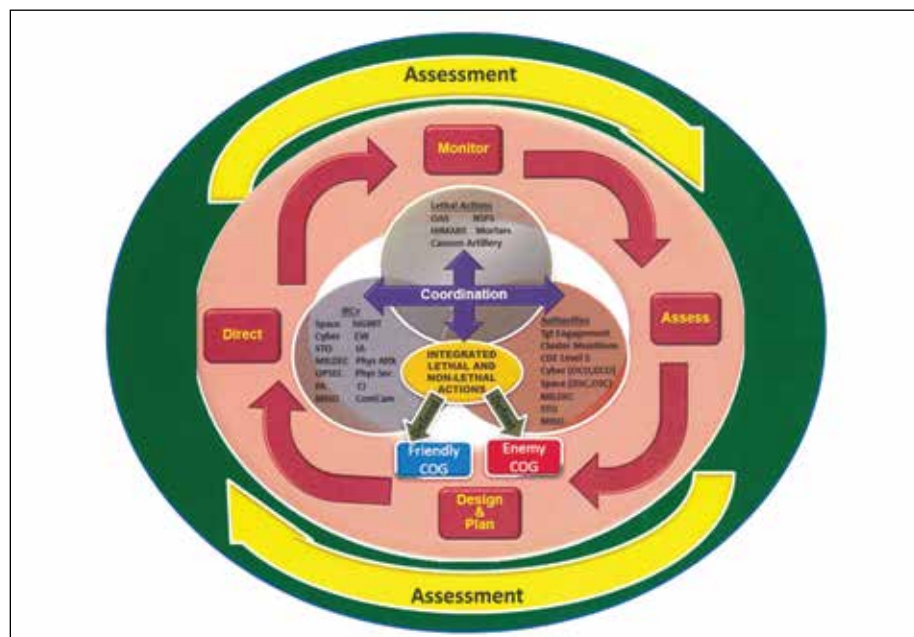


Figure 8. (Image provided by author.)

to set the gold standard in this emerging approach to warfighting. Furthermore, the forward to the *Functional Concept for MAGTF Fires* states a purpose that:

Further develops the challenges and tasks described in the MOC, specific to the fires warfighting function, and is intended to generate professional debate and discussion about these challenges.

With the SecDef's call to action and DC/CD&I's guidance to generate professional debate, let this work contribute to the "opening gambit."

Notes

1. Headquarters Marine Corps, *Marine Corps Operating Concept (MOC)*, (Washington, DC: 2017).
2. 2017 Ellis Essay Contest Announcement, *Marine Corps Gazette*, (Quantico, 2017).

3. Headquarters Marine Corps, *MAGTF Fires OAG 18-1 Wrap-Up Message*, (Washington, DC: 8 February 2018).

4. *MOC*.

5. The joint definition of an effect is: "The physical or behavioral state of a system that results from an action, a set of actions, or another effect. The result, outcome, or consequence of an action. A change to a condition, behavior, or degree of freedom." (See, Joint Staff, *Joint Publication 3-0, Joint Operations*, (Washington, DC: January 2017)).

6. MCCDC, *Functional Concept for MAGTF Fires* (Quantico, VA: September 2017).

7. Joint Staff, "Insights and Best Practices Focus Paper: Integration of Lethal and Non-Lethal Actions," Third Edition, Deployable Training Division, (Suffolk, VA: May 2016).

8. This graphic is based on a slide produced and used by the Deployable Training Division, Joint Staff J-7 for Senior Leader Education.

9. Joint Staff, "Insights and Best Practices Focus Paper: Authorities," Second Edition, Deployable Training Division, (Suffolk, VA: October 2016).

10. Headquarters Marine Corps, *MCWP 3-31 MAGTF Fires*, author's draft, (Washington, DC: draft November 2017).

11. "Insights and Best Practices Focus Paper: Integration of Lethal and Non-Lethal Actions," (May 2016).

12. Available at <https://www.defense.gov>.





This holiday season give back to the Marines who have given so much for us.

Make a tax-deductible donation to MCAF and your gift will be matched dollar for dollar until we reach \$25,000.

www.mcafdn.org



Happy Holidays
**THE MARINE CORPS
 ASSOCIATION FOUNDATION**

Off the X

Artillery survivability in a persistent threat environment

by Majs Paul Keeley, Eric Harley, & Joshua Mills

In “Lessons Learned’ from the Russo-Ukrainian War,” Phillip Karber describes a brief, violent ground rocket attack in which “two Ukrainian mechanized battalions were virtually wiped out with the combined effects of top-attack munitions and thermobaric warheads.”¹ He recounts similar attacks cued by small- to-medium-level unmanned aerial systems (UAS), counter-battery radars (CBR), and electromagnetic direction finding.² Karber’s account brings to life in vivid detail the reality of a near-peer conflict. Russia, of course, is not the only threat—China among others is also observing and developing systematic approaches to defeat our decades-long military dominance.³

The Marine Corps cannon artillery community is neither trained nor equipped to operate in a threat environment characterized by persistent, sensor-netted target acquisition systems. The *Marine Corps Functional Concept for Marine Air Ground Task Force (MAGTF) Fires* acknowledges that our primary weapons system (the M777A2 155mm towed howitzer) was not designed with a near-peer adversary in mind.⁴ Years of counterinsurgency operations with minimal counter-fire threat have created a generation of artillerymen unfamiliar with the tactics needed to survive in a high-threat environment.

While technological solutions are being developed, as a community we cannot give in to the tempting thought that the improved fires system of tomorrow will solve the problems of today. A typical battery command tour is nine to twelve months, whereas the development, acquisitions, and fielding process is measured on a scale of years. Training for the next big fight must be done with the equipment on hand.

>The authors are Field Artillery Officers who recently completed fleet tours as Firing Battery Commanders. Maj Keeley is a student at the Naval Postgraduate School in the Information Warfare Systems Engineering curriculum. Maj Harley works at Manpower Management Records and Performance Branch. Maj Mills is a Fire Support Instructor and Operations Head, Ground Combat Department, Marine Aviation Weapons and Tactics Squadron One.

The imperative is clear: *The Marine Corps cannon artillery community must adapt its approach to training in order to survive and win in a contested environment.* This article develops three recommendations for training based on a discussion of the “battle of signatures,”⁵ and a review of historical and contemporary mitigation techniques. We conclude by providing a number of practical observations as well as considering future development of the recommended techniques.

Threat Systems in the “Battle of Signatures”

An artillery unit may be located

by an enemy through three primary signatures: radar, visual footprint, and direction finding based on electromagnetic (EM) or auditory emissions. The radar signature is inescapable and, with currently fielded technology, impossible to mask or decoy. While this receives the primary attention in training, it is not the only way that a battery can be discovered.

The visual footprint of a battery is distinctive and difficult to conceal. Vulnerability to imaging spans multiple domains, including air (using manned and unmanned systems) and space. Edge detection and pattern recognition software can be used to speed up the



BM-21 Grad 122mm multiple launch rocket systems firing in Eastern Ukraine. These systems are maintained at the Russian brigade level. (Image from YouTube.)

imagery analysis process, which yields cues for realtime sensors such as UAS or reconnaissance forces.

Electromagnetic signatures can be used to produce either firing solutions or cues for visual sensors. A firing unit must communicate, and regardless of how disciplined the communications techniques used, an EM signature is inevitable. The auditory signature of a firing battery is, like its radar signature, inescapable and may be similarly used for location.

Signatures, once captured, will feed into a command and control system where attack decisions are made. To give one example, the Russian Army pushes assets and authorities down to the brigade level. A maneuver brigade commander has an electronic warfare company, a fire control battery (equipped with CBR), and group I and II UAS to capture signatures. Strike assets include 34 2S19 self-propelled 152mm howitzers and 18 BM-21 122mm multiple launch rocket systems.⁶ Unclassified ranges for both of these systems are on parity with that of the M777A2.⁷ To attack larger or deeper targets, more capable systems are available but require further coordination with higher levels of command. Associated timelines are still very responsive. Observed fire strikes from the Ukrainian conflict indicate that massed fires covering a one square-kilometer area are well within the capability of Russian artillery.⁸ Looking toward China, Jeffrey Engstrom provides a conceptual discussion of how multi-domain surveillance assets, command and control systems, and weapons platforms are highly networked as a firepower strike system within the People's Liberation Army's concept of system destruction warfare.⁹

Mitigation in Theory

To survive and dominate in such an environment, we need to create an asymmetric advantage using our existing, less than ideal systems. We must think like the insurgent described by Rupert Smith one who, "Learned to drop below the threshold of the utility of our weapon systems ... not to present a target that favors the weapons we



Frequent, rapid displacements are key to survivability in a persistent threat environment.
(Photo by LCpl Nghia Tran.)

... (the M777A2 155mm towed howitzer) was not designed with a near-peer adversary in mind.

possess and the way we use them."¹⁰ Applying this mindset against an enemy's threat system in the early phases of a contested fight, the challenge is to move within the effective cycle of an adversary's engagement window while simultaneously presenting a multiple-domain signature that is too dispersed for efficient engagement.



BM-27 Uragan 220mm multiple launch rocket systems firing during a Russian military exercise. Timelines associated with coordinating fires using such longer range systems are still very responsive. (Image from RT.)

This is not a new concept—as Jonathan Bailey writes in *Field Artillery and Firepower*, dispersion and movement techniques to break up a firing unit's signature were developed and practiced on both sides of the Cold War. By the 1980s, U.S. Army practices included moving as frequently as ten times a day.¹¹ Current threat analyses support the conclusion that mobility is again critical for survival against a high volume of sensor-networked, long-range artillery.¹² Camouflage when in position is also vital to delay discovery by overhead sensors.

Time-tested techniques for EM signature masking are well-known and include low power settings, reduced communications time, and antenna remoting.¹³ Modern techniques use lower-powered mesh networks to pass digital traffic as opposed to heavy reliance on high-powered, point-to-point voice networks.

Mitigation as Practiced

While survivability movement techniques are referenced in detail throughout a number of current artillery publications, in practice these are typically planned for as contingencies that are rarely executed in training.¹⁴ Rather, “shaping fires” are nearly universally



Techniques of thermal breakup, vehicle camouflage, and integration of micro-terrain as practiced by light armored reconnaissance units should be adopted to reduce visual and infrared signatures while improving speed and flexibility. (Photo by LCpl Holly Pernell.)

successful in removing enemy counter-battery threats from the scenario, and after a few minutes of preparatory fires, the battery remains a static training aid for hours if not days of operation. Worse, headquarters units—with all of the attendant visual and EM signatures—typically remain in place for days at a time.



Decisions need to be made about where and when the maneuver commander will accept the risk of taking an artillery unit out of action in exchange for the decisive effects of fires. (Photo by LCpl Ryan Kierkegaard.)

On a positive note, Tactical Training and Exercise Control Group has begun to include planned survivability movements into the initial fire support control exercises at the beginning of integrated training exercises. The final exercise also incorporates hostile counter-fire considerations. Unfortunately, these measures do not go far enough to address the reality of operating in a persistent threat environment where the enemy's sensing capabilities are far more than a single CBR, his long-range strike capabilities are mobile and numerous, and the assumption that intelligence will have located all of the threats is unfounded.

Regarding visual and EM mitigation techniques, the typical camouflage practice of leaving the gun outside the nets is not effective at avoiding aerial observation from the enemy's perspective. Nor is the typical practice of headquarters units booting numerous Base-X tents together and running up a tactical elevated antenna mast system (TEAMS) in the middle of an open field. From our experience across all three Active Component artillery regiments, the use of remoting has declined over the past ten years. Remoting gear (to include the necessary wires, cables, and junction boxes) is no longer replenished or maintained, if on hand at all. Few of

the other EM mitigation methods are consistently employed.

Recommendations

We make three recommendations. First, batteries need to return to practicing internal survivability movement techniques as detailed in *The Field Artillery Cannon Battery*. These include frequent movements of widely dispersed guns or sections (ideally, at distances of 800 to 1,000m) within a large position area for artillery, all while maintaining battery-firing capability. *The key to this technique is that the guns are frequently moving. "Off the X," meaning that the radar signature leads back to a vacated location, while the battery maintains firing capability throughout.* This should be

flage, and integration of micro-terrain as practiced by light armored reconnaissance units should be adopted to reduce visual and infrared signatures while improving speed and flexibility. A layered application of EM masking techniques need to be practiced to mitigate the EM signature. As an important first step, the lost art of remoting should be revived at the battery level on up. The use of mesh networks employing wideband waveforms should be adopted on a wide scale to further disperse the communications signature.

Finally, conversations need to be had at all levels between artillery units and supported infantry echelons. The unrealistic expectations of fire support developed over the past ten years need

practiced to identify and work through the friction points.

While preferred, practice does not necessarily require live fire. The authors recognize that live fire implementation of survivability movement techniques is currently only feasible using minimum safe line procedures and safe fire areas¹⁵ at venues such as Twentynine Palms or the National Training Center. Pendleton, Hawaii, and Lejeune pose increasingly significant difficulties.¹⁶ However, with proper communications and range safety officer plans, a battery can conduct live fire in centralized mode from multiple gun positions simultaneously. This is a realistic employment technique in a wooded, mountainous, or otherwise restricted environment.

Maneuver and fires planners should work closely to provide the necessary space for survivability movements. Depending on the training venue, larger pre-coordinated movement boxes encompassing multiple firing points may be feasible. Even at the more restrictive training locations, assigning a battery multiple gun positions and pre-coordinated routes between them will reinforce the mindset of dispersion and frequent movement.

Artillery battalion intelligence officers should be heavily involved in exercise development to drive realistic scenarios based on current threat templates. At appropriate classification levels, these exercises should be used to educate all members of the battalion on threat capabilities. Additionally, the intelligence officer should be coordinating observation from the enemy's perspective using all assets available within the MEF. One method is to request overflights and aerial imaging in both the visual and infrared spectrum from supported close air support platforms during the course of routine firing exercises. Similarly, we recommend coordinating EM collections for signature development through the MEF Information Group—specifically through the signals search team.

Future Developments

Further development of these movement techniques—if applied in a non-

The unrealistic expectations of fire support developed over the past ten years need to be tempered with the realities of the above signature mitigation techniques.

practiced along with frequent planned moves of the entire battery, for example after periods of heavy firing.

At a battalion level, the principle of "two up, one back" (referring to active firing, not physical location) allows massing the battalion (minus) on high-payoff targets while keeping an unmasked battery in reserve for reactive fire if needed. Regimental plans that place entire battalions in single position areas a few kilometers square, rather than assigning a battalion to the zone of a supported maneuver element, needlessly concentrate lucrative targets. While not vulnerable to CBR, long-range direction finding and overhead observation platforms mean that even headquarters and support units should move more frequently than typically seen during training.

Our second recommendation is that artillery units at all levels need to rethink their visual and EM footprints. Having a row of 4 to 6 visible guns, 50 meters apart, and in close proximity to large clusters of camouflage nets and antennas is unacceptable. Techniques of thermal breakup, vehicle camou-

to be tempered with the realities of the above signature mitigation techniques. Fire support teams should not plan to receive 45 minutes of continuous suppression from a single unit—no battery can expect to survive such a mission. Decisions need to be made about where and when the maneuver commander will accept the risk of taking an artillery unit out of action in exchange for the decisive effects that are produced by concentrated, high volume fires at discrete points of time.

Practical Considerations

Two of the authors have practiced or observed these techniques during live fire training, both internally and in support of maneuver. The tactical and technical problems are not trivial. Successful implementation requires the full use of the digital capabilities of the M777A2 howitzer, as well as advanced levels of troubleshooting. A fresh approach to local security and crew-served weapons employment is also needed. Each battalion is different and will solve these problems in unique ways—the point here is that these techniques must be

linear fashion at the battalion level and below in movement zones rather than restrictive position areas—begins to approach what John Arquilla and David Ronfeldt term “swarming.” The basic principle is “the ability to repeatedly strike the adversary—with fire or force—from all directions, then to disperse from the attack, redispense, and repeat the cycle as battle conditions require.”¹⁷ Successful swarming will require large numbers of small, dispersed, highly connected units, integrated sensors, and command systems to provide “top-sight,” and a highly flexible level of task organization and mutual support of units.¹⁸ The *Marine Corps Operating Concept* similarly refers to an ability to aggregate, disperse, and re-aggregate at a tactical level.¹⁹

Large-scale adoption of true swarming is beyond the scope of this article. However, tactical application of some of its elements within the artillery battalion is instructive. In this hybrid application, top-sight is provided by networked CBR, UAS, and target acquisition networks from across the MAGTF or joint force. Given a large, not necessarily contiguous area to maneuver within, the signature of a battalion moving at random by small elements presents a challenging targeting problem for any fires planner. Further development will be needed to solve problems of logistical resupply (hours-long “rapid” resupply points are clearly a no-go) as well as fires clearance procedures.²⁰

In the near term, what is important is to develop practices at the battery and battalion level that will support distributed and highly mobile operations. This can be done (albeit in a limited fashion) using current tactical constructs and existing range and safety restrictions. Moreover, we must begin developing these skills when we have the luxury of trial and error rather than learning these lessons the hard way—underneath the steel rain of an enemy artillery volley.

Notes

1. Dr. Phillip A. Karber, “Lessons Learned’ from the Russo-Ukrainian War,” conference paper presented on 8 July 2015 at U.S. Army Capabilities Integration Center’s Historical Lessons Learned Workshop, Ft. Eustis, VA, revised 29 September 2015, available at https://www.researchgate.net/publication/316122469_Karber_RUS-UKR_War_Lessons_Learned.

2. Ibid.

3. Jeffrey Engstrom, *Systems Confrontation and System Destruction Warfare: How the Chinese People’s Liberation Army Seeks to Wage Modern Warfare*, (Santa Monica, CA: RAND, 2018).

4. Deputy Commandant, Combat Development & Integration, *Marine Corps Functional Concept for Marine Air Ground Task Force (MAGTF) Fires*, (Washington, DC: 2017).

5. Headquarters Marine Corps, *Marine Corps Operating Concept*, (Washington, DC: 2016). The *Marine Corps Concept for Signature Management* classifies signatures as physical, technical, and administrative. We consider only the physical and technical signatures within this article.

6. Dr. Lester W. Grau and Charles K. Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, (Fort Leavenworth, KS: Foreign Military Studies Office, 2017).

7. Asymmetric Warfare Group, *Russian New Generation Warfare Handbook Version 2*, (Fort Meade, MD: 2017).

8. *Russia New Generation Warfare Handbook*.

9. *Systems Confrontation and System Destruction Warfare*.

10. Gen Rupert Smith, *The Utility of Force*, (New York, NY: Vintage Books, 2008).

11. MajGen Jonathan B.A. Bailey, *Field Artillery and Firepower*, (Annapolis, MD: Naval Institute Press, 2004).

12. *Russia New Generation Warfare Handbook*.

13. DTIC Threat Handbook, Battlefield Survival and Radioelectronic Combat, (Fort Belvoir, VA: DISA, 1983). Additional techniques still applicable today include mobile antennas, directional antennas, decoy antennas, and antenna masking.

14. Survivability movement techniques at the battery level are detailed in the July 2015 publication of MCWP 3-1.6.23, *The Field Artillery Cannon Battery*. Survivability moves as a battalion planning consideration are also mentioned throughout the May 2002 publication of MCWP 3-16.1, *Artillery Operations*.

15. Artillery safety as currently practiced hampers the live fire training of these procedures. However, a full discussion of the safety implications of the M777A2 howitzer firing with a fully digital loop in the ready mode, with dry-fire verification procedures complete, and safe fire area geometries verified, is well outside the scope of this article.

16. Having collectively fired at all of these locations we also know that these can be practiced non-live fire at positions such as Lejeune’s Gun Position 13, or any number of large landing zones at Fort Bragg, to give just a few examples.

17. Dr. John Arquilla and Dr. David Ronfeldt, *Swarming and the Future of Conflict*, (Santa Monica, CA: RAND, 200).

18. Ibid.

19. *Marine Corps Operating Concept*.

20. One possibility is to use gun-target cones drawn from an artillery maneuver box rather than gun-target lines from an aggregated battery position, akin using final attack cones versus headings when coordinating close air support.

>Editor’s Note: The views expressed in this article are those of the authors and do not reflect the official policy or position of their respective organizations, the United States Marine Corps, Department of the Navy, Department of Defense, or the U.S. Government.



NSFS in a Contested Environment

Long-range naval surface fire support (NSFS) is a force multiple in any operation giving its users considerable advantages ... but the benefit comes with risk

by LtCol Jon M. O’Gorman

During October 2016, Iranian supported Houthi rebels conducted multiple missile attacks on the U.S.S. *Mason* and other vessels operating in international waters in the Red Sea and the Bab el Mandeb Strait, one of the world’s most heavily trafficked waterways.¹ This act is representative of the evolving threat that was only previously inherent to nation states. This is a fact on which we, the U.S., have based our force structure and tactics. It is time to not only recognize non-state threats in the contested environment but also how they couple with operational design and strategy of the force. Long-range naval fires, manifested in developing and legacy weapons systems, provide its users continued access within contested waters at a time when those waters are multiplying.

Throughout 2016, there have been multiple cases of Iranian naval craft intercepting U.S. naval vessels, or in one case, the detaining of Navy Sailors by Iran operating from fast attack craft from small islands in the Persian Gulf. With these threats, the United States is looking at a global freedom of navigation challenge not seen since World Wars I and II. Our naval concepts discuss counters for these actions. The Chief of Naval Operations (CNO) in “A Design for Maintaining Maritime Superiority,” orders the Navy to prepare for decisive combat operations:

>LtCol O’Gorman is assigned to the Amphibious Warfare Branch, Expeditionary Warfare Division, Pentagon.



Long-range naval fires provide its users continued access within contested waters. (Photo by SCPO Matthew Bodenner, USN.)

U.S. combat at sea must address blue water scenarios far from land and power projection ashore in a highly “informationalized” and contested environment.²

USMC Title 10 responsibilities are also quite clear:

The Marine Corps shall be organized, trained, and equipped ... in the seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign.³

While these naval concepts are very relevant in the current world situation, the risk today is from shore defense missiles that can range 80nm and greater,

which aids definition of the term *contested environment*. Naval campaigns have experienced contested environments before: the classic example is the Allied attempt to force the Dardanelles Strait in World War I, known to history as the Gallipoli campaign. An Allied naval force of French and British capital ships (18 battleships with associated cruisers and destroyers) attempted to force a passage through mined waters covered by Ottoman coastal artillery. It was believed this effort could knock the Ottoman Empire out of the war. However, the Allied fleet was unable to suppress the shore batteries in order to allow the minesweepers to clear a passage—resulting in the loss or dam-

age of five capital ships to mines and shore fire.⁴ This is a prime example of a contested naval environment, and not dissimilar from the modern day threat of cruise missiles (versus coastal artillery) and mines. The increase range of cruise missiles will require creative solutions and naval forces must have counter measures.

This range gap was further exacerbated by the decommissioning of the battleships in 1992, and it caused the Marine Corps to rely on aviation to offset this loss in firepower. However, in a naval campaign or amphibious operation, aviation comes with limitations; as with missiles, aircraft are expensive and lack capacity in any sustained action.

Past naval history and current war gaming recommend overlapping fires capability (and capacity) for these types of operations. This means aviation, land attack missiles, and naval surface guns must all function in concert to support an amphibious operation. Investment decisions in high priced weapons programs, such as the F-35 and missile systems, have delayed investment in range improvements to gun systems and their associated rounds. This gap of surface fires in supporting operations on a contested island/shore requires solutions and resourcing.

Current naval thinking seems to support improvements: "In Surface Force Strategy: A Return to Sea Control," VADM Thomas Rhoden notes:

The concept of distributed lethality enables the goal of sea control ... It is achieved by increasing the offensive and defensive capability of individual warships.⁵

Distributed lethality opens the aperture for creative solutions to include Naval Surface Fires.

Currently, the Navy-Marine Corps Team is researching temporary solutions to the NSFS range gap while increasing distributed lethality. One option is the backfit of the MK41 Vertical Launch System (VLS) and Tactical Tomahawk Weapons Control System (TTWCS) on LPD-17 (amphibious) San Antonio class ships. This will increase the strike range of the amphibious forces to greater than 1,000nm—thus achieving more stand-

off range from the cruise missile threat. The basic infrastructure for a sixteen-cell launcher was built into the early ships of the class, but the requirement was eventually removed and replaced with more affordable point defense systems (RAM). A 1,000nm range could neutralize those threat missile sites, thus setting conditions for joint forced entry operations. However, back fits to ships require time and extensive maintenance periods; they are also not cheap. The Navy is studying costs associated with this question and affordability, given the current budget constraints.

Another short-term, low-cost option that could bring distributed lethality to an LHD/LPD/LSD will be firing the M142 HIMARS from the flight deck. While this option brings its own tradeoffs (deck heat shielding, weapons stowage, reloading, and loss of a flight deck spot for aviation operations), it requires less engineering, modification, and procurement compared to

ly be in need of resupply and the need for volume fires will fall to naval guns. The current range of our Mk-45, 5-inch caliber gun is 13nm.

The Marine Corps has codified the need for a naval gun range of 97nm, in a letter "Naval Surface Fire Support Requirements for Expeditionary Maneuver Warfare," signed by LtGen Edward Hanlon in 2002. The rationale for range is derived from ships' guns supporting a heliborne assault force inland (helo range plus the range of enemy rockets from the landing zone).⁶

The Office of Naval Research (ONR) has been researching this problem and has a few initiatives underway that might meet the naval need for sustained long-range and volume fires. The hyper-velocity projectile (HVP) is a next-generation, guided projectile designed for the five-inch guns on all our fleet of cruisers (CGs) and destroyers (DDGs). The five-inch guns have inherent value as the only all-weather,

Currently, the Navy-Marine Corps Team is researching temporary solutions to the NSFS range gap while increasing distributed lethality.

VLS. The HIMARS system firing the Guided Multiple Launch Rocket System (GMLRS) can achieve a range of 48nm. One HIMARS launcher carries a pod of six GMLRS rockets. The HIMARS system can also carry a pod with one Army Tactical Missile System, which can achieve a range of 160nm. These ranges with organic Marine Corps systems firing from Navy amphibious vessels is a low-cost fix to add firepower (and distributed lethality) to our naval forces, however, this only partially closes the gap in range for naval fires; while a good advancement in capability, there will still be a capacity issue.

If high-end weapons and platforms are costly when used for lower-end conflicts, an operation against a near-peer competitor greatly exacerbates cost and capacity problems. In a major amphibious operation on a contested coastline, expensive precision weapons will quick-

sustained (with magazine depth) fire support asset in the initial stages of an amphibious operation. HVP is currently under testing and could achieve ranges of 41nm.⁷ Therefore, multiple ships with HVP munitions fired from five-inch guns supporting a landing force will be a major capacity upgrade in the depth of targets they could range and volume effect they could produce.

Another future weapon showing promise under development by ONR is the electromagnetic railgun. The railgun is a long-range weapon that fires projectiles using electricity instead of chemical propellants. This leap-ahead technology uses magnetic fields created by high electrical currents to accelerate a sliding metal conductor, or armature, between two rails to launch projectiles up to 4,500mph. It is expected to be powerful enough to do more damage than a Tomahawk missile at a fraction of

the projectile cost. On 31 January 2008, the Navy tested a magnetic railgun; it fired a shell at 2,520 m/s using 10.64 megajoules of energy. ONR projects 100+ nautical mile initial capability while shooting at 10 shots per minute.⁸ The railgun is the only gun technology that meets the Marine Corps' stated need for a 97nm precision range and volume capability. This is a future capability and will need to be placed on a ship that could generate the power required for the gun, but if put in service with the fleet, it could be a true game changing technology, both in range and sustained rate of fire.

The counter-argument to these concepts is that advancements in anti-ship cruise missile technology makes close-in supporting fires too costly. Consider the example of the Falklands in 1982, when the Argentines seized British held territory and garrisoned it with forces equipped with surface and air anti-ship missiles. British forces had no long-range fires available to support the amphibious landing; thus, the Royal Naval cruisers and destroyers had to move dangerously close toward the shore, putting themselves in range of Argentine missiles. In the initial stages of the operation, the British warship HMS *Sheffield*, a Type 42 destroyer, was struck by a single air-launched Exocet missile, she later sank as a result of the damage that she sustained. On 13 June 1982, as British forces fought to recapture Falklands capital of Port Stanley, they were supported by naval gun fire from the destroyer HMS *Glamorgan*, when the ship was struck by an MM38 missile from an improvised trailer-based launcher from land, resulting in 13 killed and extensive damage. All told, the British naval forces suffered seven sunk or damaged ships in support of the operation.⁹ These results have led some to consider amphibious operations ancient history, an archaic way of fighting negated by the current proliferation of anti-ship cruise missile systems around the globe. Yet, in several engagements, naval guns hastened the surrender of the Argentines, helping to psychologically break their will to resist.¹⁰

If we were to cede this form of maneuver and warfare to the enemy, not

only do we lose the ability to project power, but it changes the threat calculus in the enemy's favor (less threats they must defend against). Consider the concept of a "fleet in being." In naval warfare, a fleet in being is a naval force

... true range capacity and capability will only arise from investment in HVP and railgun.

that extends influence (credible threat) without ever leaving port, but because it exists, the enemy is forced to continually deploy forces to guard against it.¹¹ Investments spent on amphibious warfare, mean adversaries must spend even more to defend their coastline against it. For enemies with large coastlines, this presents a problem; the more those forces spread out, the more likely it will be to create a gap in that defense to exploit.

As naval fires are the enabling function to amphibious operations, the naval Services must continue to develop naval gun, munitions, and platform systems for possible procurement. As the Commandant of the Marine Corps has noted in the *Marine Corps Operating Concept*:

We must develop capabilities and training that reflect the mutually reinforcing relationship between sea control and power projection.¹²

The combination of these systems, if procured, may finally fix the volume/range capability gaps that were created when the battleships were decommissioned. Adding HIMARS and VLS to our amphibious fleet is in line with CNO/CMC and distributed lethality guidance/concepts and will partially help. But the true range capacity and capability will only arise from investment in HVP and railgun. These game-changing technologies will prepare us for decisive combat at and from the sea and will be the means to allow us to maintain true maritime superiority.

Notes

1. *The New York Times*, (Online: 13 October 2016), available at <https://www.nytimes.com>. Matthew Rosenberg and Mark Mazzetti, V.S. Ship off Yemen Fires Missiles at Houthi Rebel sites.
2. Office of Chief of Naval Operations, *A Design For Maintaining Maritime Superiority*, Version 1.0, (Washington, DC: January 2016).
3. Information available at 10 U.S. Code § 5063, see <https://www.law.cornell.edu>.
4. Philip Haythornthwaite, *Gallipoli 1915: Frontal Assault on Turkey*, (Oxford: Osprey Publishing, 1991).
5. Thomas Rowden, "In Surface Force Strategy: Return to Sea Control," Commander Naval Surface Forces, available at <http://navylive.dodlive.mil>.
6. Edward Hanlon, "Naval Surface Fire Support Requirements for Expeditionary Maneuver Warfare," (Quantico, VA: Deputy Commandant for Warfighting Requirements letter, 19 March 2002).
7. Office of Naval Research, "Hypervelocity Projectile," available at <https://www.onr.navy.mil>.
8. Office of Naval Research, "Electromagnetic Railgun," available at <https://www.onr.navy.mil>.
9. J.B.A Bailey, *Field Artillery and Firepower*, (Annapolis, MD: Naval Institute Press, 2004).
10. Robert Scales, *Firepower in Limited War*, (Novato, CA: Presidio Press, 1995).
11. J.B. Hatterdorf, "The Idea of a 'Fleet in Being' in Historical Perspective," (Newport, RI: *Naval War College Review*, Winter 2014).
12. Headquarters Marine Corps, *Marine Corps Operating Concept: How An Expeditionary Force Fights in the 21st Century*, (Washington, DC: September 2016).

