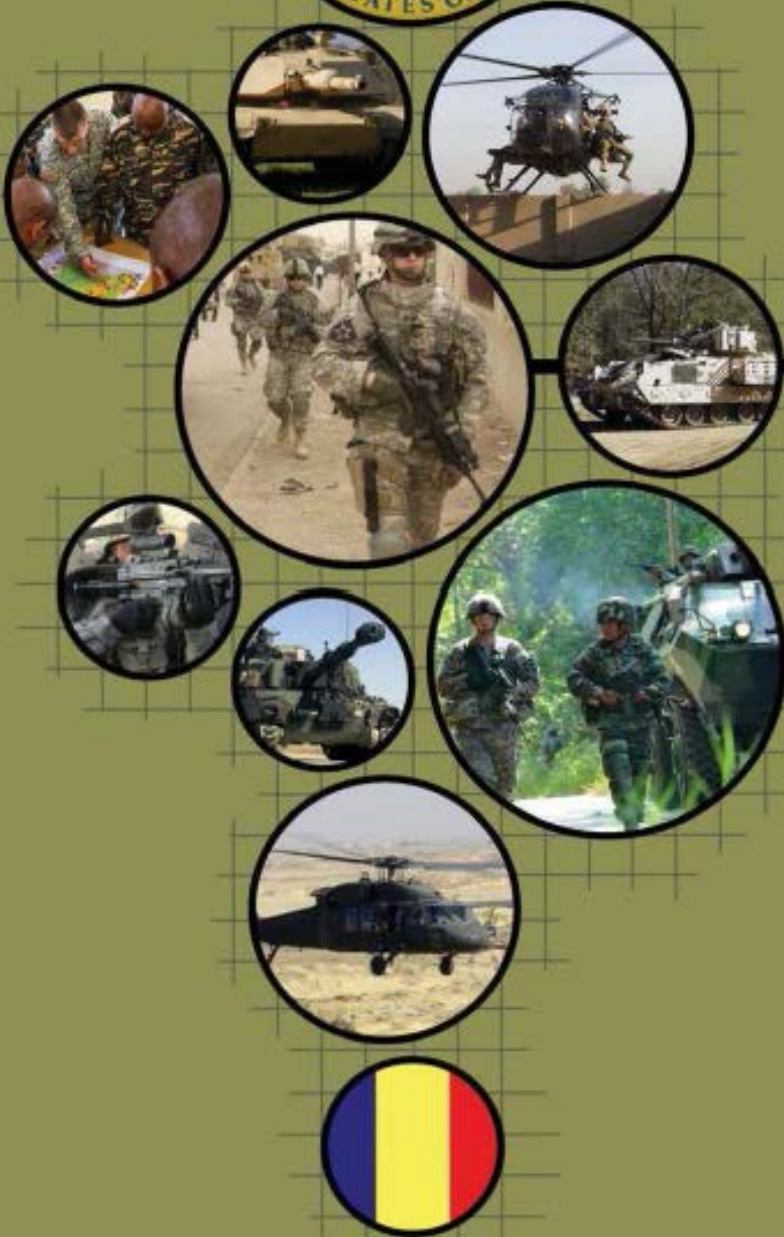TRADOC Pamphlet 525-3-4

# The U.S. Army Functional Concept for

# Fires

## 2020-2040

FEBRUARY 2017

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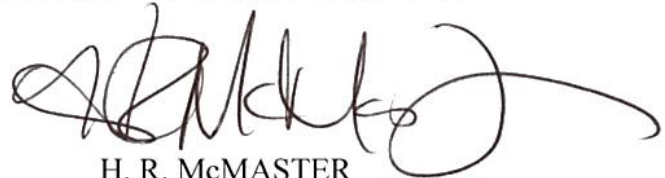
## Foreword

*From the Director*
*United States (U.S.) Army Capabilities Integration Center*

The U.S. Army is the Nation's principal land force organized, trained, and equipped for prompt and sustained combat on land. Today's adversaries have studied how the U.S. Joint Force prefers to operate and adapted to develop capabilities that contest U.S. operations on land, at sea, in the air, in space and cyberspace, as well as the electromagnetic spectrum, information environment, and human perception. Defeating future enemies that possess advanced capabilities calls for land forces operating as part of integrated joint teams that conduct simultaneous and sequential operations across multiple domains. In multi-domain battle, future Army forces will fight and win across all contested spaces to create temporary windows of superiority across multiple domains that enable Joint Force freedom of action to seize, retain, and exploit the initiative.

TRADOC Pam 525-2-1, *The U.S. Army Functional Concept for Fires* (AFC-F)*,* expands on the ideas presented in TRADOC Pam 525-3-1, *The U.S. Army Operating Concept: Win in a Complex World* (AOC*)*. The AFC-F describes the complementary relationship between fires and maneuver as the foundation of multi-domain battle. The principal role of fires is to enable freedom of maneuver, while maneuver forces compel the enemy to concentrate when they place something of value at risk. Land-based fires, capable of power projection across all domains, achieve overmatch for Army forces in close combat and ensure Joint Force freedom of maneuver.

The AFC-F addresses four fires-specific tenets and introduces four emerging fires concepts, which support future missions to coordinate, integrate, and deliver fires. These ideas provide cross-domain fires, (integrating and synchronizing employment of mutual supporting lethal and nonlethal fires across all domains), the electromagnetic spectrum, the information environment, and human perception, to create multiple dilemmas for the adversary, achieve overmatch, and enable friendly freedom of maneuver.

The AFC-F serves as a foundation for developing future fires capabilities and helps Army leaders *think* clearly about future armed conflict, *learn* about the future through the Army's campaign of learning, *analyze* future capability gaps and identify opportunities, and *implement* interim solutions to improve current and future force combat effectiveness.

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Director, Army Capabilities
    Integration Center

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## Preface

*From the Commanding General*
*United States (U.S.) Army Fires Center of Excellence*

The future Army will face multiple, complex and integrated threats that span the possibilities of armed conflict. To deter conflict and prevail in combat, future Army forces must maintain overmatch against all threats across all domains. However, the Army must achieve overmatch in an environment of fiscal austerity and uncertainty. System requirements and doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy (DOTMLPF-P) solutions must meet increased needs with reduced resources. The Army will need thoughtful, innovative, and unorthodox solutions to build for the future.

TP 525-3-4, *The U.S. Army Functional Concept for Fires* (AFC-F) describes Army fires built to support future, joint, Army, and multinational operations, focusing on how fires support combined arms maneuver. The AFC-F presents strategic guidance from key leaders as a future fires vision, and then derives required capabilities from this vision. These required capabilities form the foundation for future capability development DOTMLPF-P changes.

The AFC-F describes future fires capabilities through four key fires tenets: fires must be precise, responsive, effective, and multifunctional. Fires must be *precise*, operating with accuracy, producing desired effects only on desired targets, building confidence in fires units' capabilities. Fires must be responsive, deploying rapidly and achieving appropriate effects on the target. Fires must be effective, providing appropriate capacity, range, and lethality in a wide spectrum of operations. Finally, fires must be multifunctional, task organized to respond easily to a wide variety of circumstances and conditions. Leaders and Soldiers conduct both fire support and air and missile defense tasks.

This concept also introduces four key emerging fires concepts: leverage joint, interorganizational, and multinational capability; multifunctional fires convergence; enhanced sensor-to-shooter linkages; and cross-domain fires expansion. These four ideas support the mission to coordinate, integrate, and deliver fires through targeting and presents ideas to support TP 525-3-1, *The U.S. Army Operating Concept: Win in a Complex World's* (AOC's) core competencies.

Leveraging joint, interorganizational, and multinational capability. Increased threat capabilities coupled with reductions in resources across all services has highlighted the need for improved Army integration with joint, interorganizational, and multinational partners. Fires organizations and leaders play a key role in this integration. Improved integration multiplies system capabilities, reduces redundancy and overlap, enhances relationships with key partners, and maximizes multiple dilemmas and synergistic effects against opponents. Fires forces understand partner capabilities and integration challenges to facilitate targeting to enable freedom of maneuver across all domains.

Multifunctional fires convergence. Multifunctional fires convergence is the evolutionary combination of organizations, systems, skills, training, and education common to both air defense

artillery and field artillery. Several aspects of the future operating environment drive the move towards convergence of surface-to-surface and surface-to-air forces: multi-mission sensors and shooters are becoming technologically feasible; expeditionary requirements place a premium on reducing manpower and equipment necessary to conduct a mission; reduced training and maintenance resources demand streamlining institutional operations wherever practicable.

Enhanced sensor-to-shooter linkages. Sensor-to-shooter linkages must be a state of being, rather than a temporary or ad-hoc arrangement. To deliver fires against concealed, hardened, low observable, or mobile targets effectively, sensor capabilities available to fires units must expand to include joint, interorganizational, and multinational sensors. Networks supporting the sensor-to-shooter link must be protected, reliable, and fast. Sensor management must integrate through targeting, synchronizing sensor and collection plans with commander objectives at all echelons. Further, space capabilities must aid the decide-detect-deliver-asses targeting methodology at every echelon. This complete sensor-to-shooter system must sense, engage, and destroy rockets, artillery, mortars, theater ballistic missiles, cruise missiles, unmanned aircraft systems, fixed and rotary wing threats as well as ground targets through a common command and control system that utilize interoperable organic sensors and links to joint, interorganizational, and multinational sensor networks tied to multifunctional weapons systems and munitions for surface-to-air, surface-to-surface, and shore-to-ship engagements in any terrain.

Cross-domain fires expansion. Fires units must deliver timely effects against targets across all domains. Currently, fires focuses largely on the land and air domains. The future operating environment demands fires that operate across maritime, space, and cyberspace domains, and the electromagnetic spectrum effectively. Fires systems must deliver fires, targeting efforts must support target identification, discrimination, de-confliction, airspace control, and fires control through all domains.

This vision's end state is a suite of fires capabilities that ensure commanders enjoy freedom of maneuver across all domains. Fires employ through all domains by common sensors and shooters, enabled by a single Army information network. Effects, both from fires systems and from joint, interorganizational, and multinational partners, are created seamlessly through targeting and integrated air and missile defense planning. Fires forces are deployable rapidly, mission-tailorable, and capable of operating across the range of military operations.

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Major General, U.S. Army
Commanding General, Fires Center of
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Department of the Army                              TRADOC Pamphlet 525-3-4*
Headquarters, United States Army
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Fort Eustis, VA 23651-1047

25 January 2017

## U.S. ARMY FUNCTIONAL CONCEPT FOR FIRES 2020-2040

FOR THE COMMANDER:

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**History.** This pamphlet is a major revision of United States Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-4 dated 13 October 2010. Due to the extensive revisions, not all changes are highlighted in the summary of change.

**Summary.** TRADOC Pamphlet 525-3-4 describes broad capabilities the Army will require in 2020-2040 to enable the employment of fire capabilities. This concept will lead force development and modernization efforts by establishing a common framework within which to develop the specific capabilities required to enable fires fully during future joint combined arms operations in uncertain, highly-competitive, and dynamic operational environments.

**Applicability.** This concept applies to all Department of the Army (DA) activities that develop doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy (DOTMLPF-P). This concept guides future force development and informs subsequent supporting concepts and the Joint Capabilities Integration and Development System process. It also supports Army capabilities development processes described in TRADOC Regulation 71-20 and functions as a conceptual basis for developing subordinate concepts related to the future force within DOTMLPF-P.

**Proponent and supplementation authority.** The proponent of this pamphlet is the TRADOC Headquarters, Director, Army Capabilities Integration Center (ARCIC). The proponent has the

authority to approve exceptions or waivers to this pamphlet that are consistent with controlling law and regulations. Do not supplement this pamphlet without prior approval from Director, TRADOC ARCIC (ATFC-ED), 950 Jefferson Avenue, Fort Eustis, VA 23604-5763.

**Suggested improvements.** Users can submit comments and suggested improvements via The Army Suggestion Program online at https://armysuggestions.army.mil (Army Knowledge Online account required) or via DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Director, TRADOC ARCIC (ATFC-ED), 950 Jefferson Avenue, Fort Eustis, VA 23604-5763. Suggested improvements may also be submitted using DA Form 1045 (Army Ideas for Excellence Program Proposal).

**Availability**. This TRADOC Pamphlet is available on the TRADOC homepage at http://www.tradoc.army.mil/tpubs/ .

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**Summary of Change**

TRADOC Pamphlet 525-3-4
U.S. Army Functional Concept for Fires, 2018-2030

This revision dated 25 January 2017-:

o Covers 2020-2040 (title page).

o Expands on the ideas in United States Army Training and Doctrine Command Pamphlets 525-3-0 and 525-3-1, and focuses on Army fires capabilities required to support joint combined arms operation (chap 3).

o Provides a revised central idea (paras 3-1 and 3-2).

o Introduces fires tenets (para 3-3).

o Introduces emerging fires concepts (para 3-6).

o Updates fires required capabilities (app B).

o Provides fires warfighting functions unique dependencies on other Army warfighting functions, joint, interorganizational, and multinational partners (para B-2).

o Provides a science and technology appendix (appendix C).

o Provides a risk and mitigation appendix (appendix D).

## Contents

**Figure List**

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# Chapter 1
# Introduction

## 1-1. Purpose
United States (U.S.) Army Training and Doctrine Command (TRADOC) Pamphlet (TP) 525-3-4, *The U.S. Army Functional Concept for Fires* (AFC-F), describes how future fires leaders, Soldiers, organizations, and platforms work as part of joint, interorganizational, and multinational efforts, to support joint combined arms operations, national military strategies, and the national interest. The AFC-F provides the conceptual framework that guides development of Army fires capabilities. The AFC-F expands on and supports the ideas expressed in TP 525-3-0, *The U.S. Army Capstone Concept* (ACC), and TP 525-3-1, *The U.S. Army Operating Concept: Win in a Complex World* (AOC). The AFC-F introduces fires-specific core competencies and tenets to assist future Army forces conducting expeditionary maneuver and joint combined arms operations.

## 1-2. References
Appendix A lists required and related references.

## 1-3. Explanations of abbreviations and terms
The glossary explains abbreviations and special terms used in the pamphlet.

## 1-4. Linkage to the Army Capstone Concept (ACC)
The ACC retains operational adaptability as its central idea. The ACC establishes the foundation for subordinate concepts that describe how the future Army must fight and identifies the required capabilities essential to ensuring combat effectiveness against future threats. The AFC-F builds on the ideas expressed in the ACC and describes the fires forces contribution to these ideas.

## 1-5. Linkage to the Army Operating Concept (AOC)
The AOC introduces joint combined arms operations as part of its central idea.[1] The AFC-F describes how expeditionary fires leaders, Soldiers, and units support the tenets and core competencies described in the AOC, enabling joint combined arms operations and power projection from land across all domains.

# Chapter 2
# Operational Context

## 2-1. Introduction

   a. Army capability requirements must consider multiple, complex, and integrated threats across the range of military operations (ROMO). Future fires capabilities must continue to deter adversaries, and when necessary, enable freedom of maneuver via the destruction, neutralization, or suppression of adversary capabilities. Fires units must be expeditionary and prepared for global threats. Potential threats range from conventional and unconventional forces, to irregular militias and paramilitaries, to terrorist groups and criminal organizations. Training, education, capabilities,

concept, and doctrine development must reflect this reality to integrate and deliver fires to support joint combined arms operations.

b.  The future operational environment includes adaptable enemies able to employ innovative combinations of conventional and irregular forces.  Threats are investing in technologies to obtain a differential advantage and undermine U.S. ability to achieve overmatch.[2]  Threat systems include precision-guided rockets, artillery, mortars, aircraft, satellites, electronic warfare (EW), and ballistic and cruise missiles that challenge traditional U.S. dominance in the air and maritime domains.  Threats may emanate from nation states or non-state actors such as transnational terrorists, insurgents, and criminal organizations.  Adaptability is vital to overcoming threats.

## 2-2.  Future operational environment

a.  The future operational environment is characterized by increasing complexity, ambiguity, and international economic interdependence.  Future fires units will operate in an environment shaped by fiscal austerity.  Austere economic conditions at home and abroad limit resources available to the U.S. military and its multinational partners.

b.  The global geopolitical situation continues to grow more complex and ambiguous.  In most scenarios, many state and non-state actors, including noncombatant civilians are present, complicating everything from diplomacy to target identification.  State and non-state actors will pursue both traditional and asymmetric avenues of approach to threaten the U.S. and its multinational partners.

c.  Increased urbanization worldwide requires the Army to operate in complex urban terrain. This trend will influence changes across doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy (DOTMLPF-P).  Fires support to operations in urban terrain is challenging due to the close proximity of targets and noncombatants, difficulties in target identification and mensuration, and restrictive rules of engagement.

d.  For the last half-century U.S. forces have had near-complete freedom of action in the air, maritime, and space domains.  However, in recent years, technologically-advanced competitors have developed conventional and asymmetric capabilities able to contest U.S. superiority.  This trend will continue into the future; by 2020-2030, well-funded competitors may achieve parity with the U.S. in key capability areas.  Thus, assumptions regarding freedom of action through the air, maritime, and space domains may no longer be valid.

e.  Further, the cyber domains relative importance has increased exponentially.  Extreme dependence on global information networks by both the global economy and the U.S. military combines with their vulnerability to make them a low-cost, high-payoff target for state and non-state actors.

## 2-3.  Threat

a.  Intelligent, adaptive threats will utilize aerial platforms such as unmanned aircraft systems (UAS) and cruise missiles to exploit sectored defense systems.[3]  UAS will proliferate rapidly as

their cost to capability ratio decreases. Proliferation of UAS with long ranges and advanced sensors, enabled further by advanced EW and conventional munitions, will challenge the fires units' ability to target rapidly and engage large numbers of enemy aerial threats. UAS proliferation extends to friendly forces as well, which leads to congested airspace and associated issues, friendly protection, and target identification. Fixed and rotary wing manned aircraft, and ballistic and cruise missile platforms will continue to proliferate worldwide while increasing their overall technical capabilities. Advanced countermeasures, low observability, and standoff engagement capabilities challenge existing and future fires sensors and munitions.

b. Peer and near-peer competitors will seek to overmatch fires capabilities with advanced technologies, such as hypersonic munitions, massed indirect fires, and highly responsive counterfire. Enhanced threat capabilities enable friendly fire support elements engagement at standoff ranges, precluding or pre-empting friendly fire support operations. Threats will employ advanced EW technologies in both offensive and defensive roles and will attempt to deny or disrupt satellite-based position, navigation, and timing (PNT) services.

c. Future fires units face opponents who develop strategies by learning from past conflicts. The most prominent anticipated strategy is anti-access and area denial an approach that seeks to deny the U.S. and its multinational partners the use of wide geographic areas and regional force-generation assets.[4] Using ballistic missiles, cruise missiles, littoral watercraft, and UAS in complex, structured attacks are key components of this strategy. Another key component is the denial/disruption using counterfire and proactive fires.[5] Other potential emerging strategies include cyber-attacks on U.S. military and global information networks, and denial of global positioning satellites (GPS) and other space-based capabilities. Globalization has accelerated weapons of mass destruction (WMD) proliferation. This, coupled with increased capability in delivery platforms, magnifies the gravity of the WMD threat.

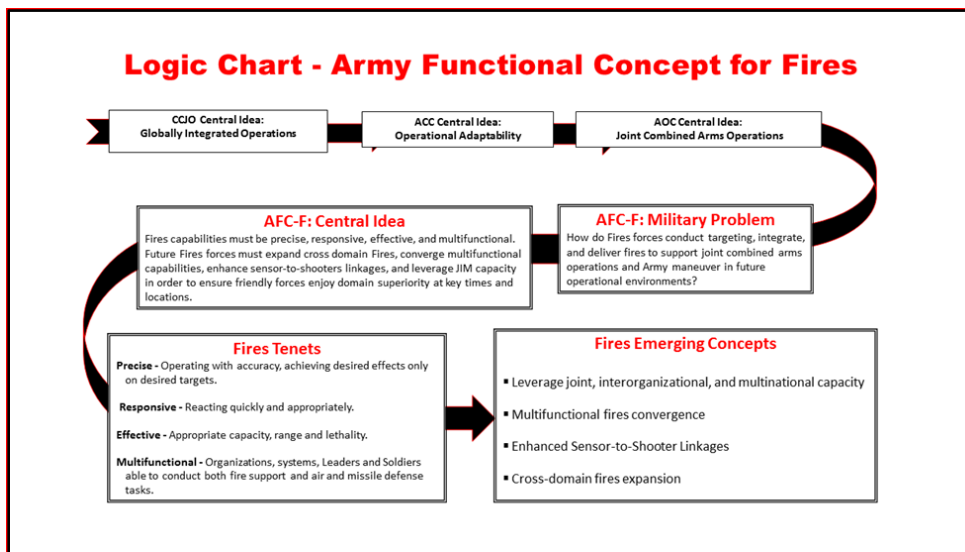## Chapter 3
## Military Problem and Solutions



**Figure 3-1. The U.S. Army Functional Concept for Fires (AFC-F) logic chart**

**3-1. Military problem**
How do fires forces conduct targeting, integrate, and deliver fires to support joint combined arms operations and Army maneuver in future operational environments?

**3-2. Central idea**
To support joint combined arms operations in future operating environments, fires capabilities must be precise, responsive, effective, and multifunctional. Future fires forces must expand cross-domain fires, converge multifunctional capabilities, enhance sensor-to-shooters linkages, and leverage joint, interorganizational, and multinational capacity to ensure domain superiority at key times and locations.

**3-3. Fires tenets**

    a. Tenets guide combat power development and application. Commanders use tenets to determine how to align efforts in time, space, and purpose to achieve campaign objectives. Capability developers use tenets to guide concepts, requirements, and acquisition decisions. The future Army considers initiative, simultaneity, depth, adaptability, endurance, lethality, mobility, and innovation when visualizing, describing, directing, leading, and assessing operations.[6]

    b. The AFC-F describes future fires capabilities through four fires-specific tenets: fires must be precise, responsive, effective, and multifunctional. Fires tenets outline the future fires force's contribution to the AOC's central idea. Together with the AOC tenets, these fires-specific tenets provide commanders, capability developers, and industry partners with the intellectual baseline to develop and employ future fires capabilities. These tenets guide future capability development and support the six fires principles outlined in Army Doctrine Publication (ADP) 3-09, *Fires*.

    (1) Precise.[7] Being precise is operating with accuracy, achieving desired effects only on desired targets. The Army must deliver fires with precision. Precision fires means applying accuracy standards to planning and targeting, target location, platform capabilities, munitions, computational procedures, judgment, and execution. The quest for precision includes delivering area and massed fires accurately, whether from organic or non-organic shooters. Area and massed fires, when required, are delivered on precisely located targets to enable maximum effect with minimal ammunition. Surface-to-air fires classify, discriminate, and identify aerial targets correctly, then engage designated threats with the appropriate number and type of interceptors. Greater precision protects friendly forces, noncombatants, infrastructure, and facilitates friendly narratives as part of perception management. Precision gives commanders greater flexibility in applying fires in all situations. Precision conserves ammunition and reduces the sustainment footprint. Fires leaders, Soldiers, and units must consider precision paramount to all activities.

    (2) Responsive. Being responsive is reacting quickly and appropriately. Fires forces place a premium on their ability to react rapidly to battlefield stimuli. Fires missions, particularly ballistic missile defense and counterfire, are time-sensitive by their nature, and require rapid responses for success. Responsiveness is critical during other phases of conflict. Fires units must be both strategically and tactically mobile, ready to deploy and move quickly across long distances to meet the mission requirements. When called upon, fires forces must create desired effects on the target, to include hardened, concealed, low observable, or in motion targets, with the first engagement.

(3) Effective. Effective is the appropriate capacity, range, and lethality. Future fires forces must be equipped, trained, and manned to provide the appropriate capacity to enable friendly maneuver and to defeat any threat. Future fires forces have adequate range, precision, and mass to offset threat capabilities and defeat threat forces throughout the depth of the battlefield in all domains. Fires capabilities are scalable and lethal, providing the appropriate effect on any target in a timely manner. Lethality includes multifunctional munitions that detect and engage threat systems while providing real-time surveillance and damage assessments.

(4) Multifunctional. Organizations, leaders, and Soldiers must conduct both fire support and air and missile defense (AMD) tasks. Future fires forces must support operations across the ROMO and wider geographic areas with fewer assets in relation to a potential adversary's. Multifunctional capabilities provide the commander with sufficient scale and endurance to support joint combined arms operations with limited assets. Future fires leaders tailor systems and organizations precisely, sending the right mix of mission command, sensors, shooters, and munitions for the mission and the operational environment. Army information networks support expeditionary, dispersed, and semi-independent operations. Future fires leaders and Soldiers conduct fire support and AMD tasks in a variety of conditions and missions to support joint combined arms operations.

**3-4. Future fires operations**

a. Fires units provide commanders with capabilities to create desired effects and defend friendly forces. Commanders employ available fires capabilities as a system, integrated with other elements through targeting and integrated AMD (IAMD) planning. This involves integrating, synchronizing, and coordinating, joint, Army, interorganizational, and multinational fires. Fires units support joint and combined operations to seize, retain, and exploit the initiative. Fires units' first priority is Army maneuver support.

b. Fires units support joint combined arms operations by delivering fires through multiple domains in time and space. Fires units achieve surprise through movement across strategic distances and arrival at unexpected locations. Fires units have the range, mobility, protection, and lethality necessary to strike from unexpected locations while defending against enemy fires and reconnaissance. In anti-access and area denial environments, dispersion, deception, and hardening allow future fires units to evade enemy attacks, deceive the enemy, and achieve surprise. Fires units exploit space-based intelligence and deliver fires at extended ranges through the exosphere and into space.

c. A comprehensive sensor network and rapid, reliable sensor-to-shooter combinations enable fires capabilities. Informed by the sensor network, target data is available to fires networks; appropriate shooters pair quickly, either automatically or by a decision-maker, and fires are delivered through any or all domains. Fires shooters are not constrained by traditional stove piped or proprietary constructs; shooters are agnostic to the sensor providing data, and can create desired effects rapidly regardless of the origin of the targeting data.

d.  Fires units assist in integrating cyber electromagnetic activities (CEMA) with air-ground operations through targeting.  Future Army units will create effects using electronic attack (EA) and cyber operations.  Fires planners must be sufficiently versed in EA and CEMA capabilities to synchronize and assist commanders on matching EA and CEMA effects with targets.[8]

## 3-5.  Fires support to Army core competencies

a. Core competencies are the Army's strengths, strategic advantages, and essential contributions to the joint force.  The AOC discusses the core competencies in detail; the AFC-F discusses fires contributions to these competencies.

b.  Shape the security environment.  Fires units provide capabilities that support deterrence directly through physical destruction and offsetting threat capabilities.  Forward-positioned fires units enable deterrence through denial by raising the prospective cost of an operation by an aggressive opponent to unacceptable levels.[9]  In addition, fires leaders and Soldiers develop habitual relationships and conduct training with partner forces which increase cultural awareness and multinational interoperability.

c.  Setting the theater.  Setting the theater includes actions to establish and maintain the conditions necessary to retain joint force freedom of action.  Fires forces contribute to setting the theater by defending force generation assets from air and missile attack, integrating, and delivering early phase deep strike fires through targeting and standoff fire support.  These deep actions at the strategic level set conditions for future successful combined arms maneuver.

d.  Project national power.  The Army projects national power by maintaining a viable, visible, and expeditionary land combat capability.  Fires forces support this competency with a highly capable, expeditionary land force that deters threat aggression and enables commanders to achieve and maintain overmatch.  This land force includes both the active and reserve components; the reserve component provides or augments critical capabilities missing in the active Army.

e.  Combined arms maneuver in the land, air, maritime, space, and cyberspace domains.  Fires units provide lethal and nonlethal effects against targets in all domains, enabling freedom of maneuver to support joint combined arms operations.  Fires sets the condition for successful combined arms maneuver by suppressing threat capabilities, disrupting threat operations, destroying or attriting threat formations, and protecting friendly critical assets.  Competent leadership, seamless integration, and enhanced situational awareness gives commanders at all echelons confidence in fires, allowing them to delegate clearance and engagement authorities to the lowest practical echelon.

f. Wide area security.  Fires units support wide-area security operations by providing long-range artillery and AMD to consolidate gains, retain the initiative, defend critical assets, and ensure freedom of maneuver.  Integrating partners' capabilities through targeting employs fused sensor data from partners, which enables friendly units operating dispersed to see and fight over wide areas.  Fires units support wide area security with mission-tailorable fires organizations, multi-mission sensors, launchers, and munitions delivering scalable effects.

g.  CEMA operations integrate EW and cyber effects through targeting.  CEMA operations combine three key elements: an individual or team of experts; a system; and appropriate protocols, authorities, agreements, and policies.  Fires planners must be versed in CEMA operations to synchronize and assist commanders and CEMA personnel on matching the appropriate cyber and/or EW effect with the intended target.  CEMA operations require coordinating with other elements, assessing their capabilities, and then integrating those capabilities into the commander's effects options menu.  CEMA effects must be employed with precision and control in the same way as more traditional fires; this requires the adaptation of traditional fire control measures or the development of new measures to suit emerging CEMA capabilities.

h.  Special operations.  Fires and special operations forces (SOF) integration enhance SOF's ability to execute strategic reconnaissance, direct action operations, and special warfare campaigns.  Precise target location, integrating air-to-surface and surface-to-surface fires, and enhanced interoperability results in increased synergy between SOF and the fires elements.  Fires planners leverage SOF sensors providing intelligence support for targeting and location for high payoff and time sensitive targets.

**3-6.  Fires support to movement and maneuver**

a.  TP 525-3-6, *The U.S. Army Functional Concept for Movement and Maneuver* (AFC-MM) introduces concepts that envision how the Army maneuvers in the future.  The AFC-MM focuses on how tactical echelons (the brigade combat team (BCT) and below) operate in a highly contested, rapidly changing environment.  The AFC-MM proposes four components of the solution: cross domain maneuver, semi-independent operations, realized mission command, and continuous reconnaissance and security operations.  The AFC-F supports each of these components.

b.  Cross-domain maneuver.  The expansion of cross-domain fires supports cross-domain maneuver inherently.  Expanded capability through all domains is critical to successful maneuver on the future battlefield; fires must prepare to support cross-domain maneuver through cross-domain capabilities.  Cross-domain fires, synchronized with the scheme of maneuver, enable friendly freedom of action and create windows of domain superiority at key times and locations.

c.  Semi-independent operations.  This component envisions formations, particularly BCTs, operating for up to seven days in near-autonomous fashion, which is a challenging idea to support.  Fires are most effective when synchronized in time and space to create massed effects.  Semi-independence complicates the process of massing and synchronizing capabilities not resident to the BCT.  To support semi-independent operations, flexible and multifunctional fires capabilities are required, along with a robust sensor-to-shooter network, enhanced sustainment, and protection capabilities.

d.  Realized mission command.  The AFC-MM relies on the mission command philosophy to reach the full potential of units at every echelon because networks may be degraded or denied.  To support mission command under degraded conditions in the future operational environment, fires capabilities must be both comprehensive and agile.  Sensor networks must be wide-ranging and robust; sensor-to-shooter linkages must be ever-present and resilient; fires leaders must be comfortable executing missions to support a variety of different units, missions, and degraded

environments. Degraded does not automatically defer to traditional manual means, but rather describes a future fires force that maintains redundancy and resiliency as a part of the culture.

e. Continuous reconnaissance and security operations. The AFC-MM calls upon higher echelons to coordinate security in the geographic areas unassigned to BCTs, to include areas containing bypassed enemy forces. Fires formations must support this effort by integrating joint, interorganizational, and multinational capabilities, attached or task-organized security personnel, and rear area forces to provide AMD and fire support as required.

## 3-7. Emerging fires concepts

a. The AFC-F introduces four fires-specific and emerging concepts: leverage joint, interorganizational, and multinational capabilities; multifunctional fires convergence; enhanced sensor-to-shooter linkages; and cross-domain fires expansion.[10] These concepts support the fires mission to coordinate, integrate, and deliver fires through targeting and IAMD planning to support joint combined arms operations and Army maneuver in future operational environments.

b. Leverage joint, interorganizational, and multinational capabilities. To meet future demands, fires forces must work closely with joint, interorganizational, and multinational partners. This process is challenging, requiring tactical and technical expertise, skillful human interaction, and persistent engagement worldwide. Future fires capabilities should be interoperable by design to facilitate seamless joint, interorganizational, and multinational partner integration. In some cases, partner integration may require modifications of foreign disclosure rules, seminars, experimentation, and exercises. The following ideas support this emerging concept.

(1) The Army must participate fully in joint targeting, providing leaders, Soldiers, and targeting products to integrate fires. Targeting is the process of selecting and prioritizing targets and matching the appropriate response to them considering operational requirements and capabilities.[11] Targeting integrates available means to create required effects while mitigating risk and maximizing use of available resources. When properly executed, targeting is a critical enabler supporting simultaneity of effort, synchronizing different elements of combat power to overwhelm opponents. Targeting enables commanders to achieve depth of effort, coordinating operations to retain the initiative and keep opponents off-balance. The Army must participate fully in joint targeting, providing trained and certified leaders, Soldiers, and targeting products to integrate fires. The Army must continue to evolve institutional and unit training to encompass required joint and Army training and certifications. Improved targeting builds partner capacity and provides commanders with fires capabilities to create effects to support joint combined arms operations.

(2) Army air defense forces must integrate Army ground-based air defense capabilities into the theater area air defense plan effectively. This includes establishing comprehensive, integrated joint and multinational sensor management plans, establishing defended assets according to theater commander objectives, integrating multinational ground based air defenses into the area air defense plan, and employing joint integrated fire control to maximize available air defense systems effectiveness.

(3) Fires leaders, Soldiers, and units must train regularly as multinational joint combined arms teams to develop standardized procedures and habitual relationships. These relationships must enable effective planning, integration, coordination, and fires delivery. Effective use of the relationships developed by regionally aligned forces is instrumental in enhancing coordination and integration with potential partners. Advances in training coupled with enhanced multinational relationships improve target identification, deconfliction, and airspace management procedures, standardizes doctrine, and ensure effective fires integration in all domains.

(4) Land forces are dependent on joint and multinational air power, particularly close air support (CAS) and air interdiction, to enable freedom of action and achieve desired effects. Air-ground integration between Army fires units, Army aviation, and joint and multinational aviation assets is critical for successful future joint combined arms operations. Joint combined arms teams will train, operate, and develop tactics, techniques and procedures to integrate joint, multinational, and Army aviation seamlessly. Airspace control measures, joint data networks, and tactics, techniques and procedures must accurately track friendly and neutral forces speed up clearance of fires, and reduce fratricide. Joint airspace control measures, joint integrated fire control, and joint combat identification processes help optimize aircraft utilization, advanced interceptors, and long range precision weapons.

c. Multifunctional fires convergence. This is the evolutionary combination of organizations, systems, skills, training, and education common to both air defense artillery and field artillery. To achieve multifunctional fires convergence, the Army must meet the following requirements.

(1) Fires leaders and Soldiers will form cohesive teams of trusted professionals who thrive in a complex world. Generating and operational forces will develop bold, agile, and adaptive formations guided by human dimension's three lines of effort: agile and adaptive leaders, realistic training, and institutional agility. Fires leaders and Soldiers must be knowledgeable about Army and partner capabilities and highly proficient on fires systems. Leaders must focus on building mental agility coupled with strong theoretical foundations, creating the ability to execute key tasks properly and learn new tasks quickly. The generating force must provide leaders and Soldiers with a sound technical and doctrinal foundation, while not overly constraining creative thought or adaptability.

(2) Task organized fires.[12] Future fires organizations assemble mission-tailored organizations capable of integrating and delivering fires with scalable effects rapidly. Fires planners combine capability components including sensors, shooters, munitions, information systems, mission command, and personnel, into fires organizations designed to accomplish a specific mission set. This approach allows commanders to develop supporting fires formations to meet mission requirements, maximizing capability to support a given mission while minimizing equipment and manning requirements. Task-organizing allocates available assets to commanders and establishes command and support relationships.

(3) Cross-domain fires organizations. To support emerging concepts, such as the semi-independent BCT, fires organizations at echelons above brigade must integrate and deliver fires through all five domains and at all levels of war. This requires an appropriate mix of lethal shooters (surface-to-surface, surface-to-air, shore-to-ship), nonlethal capabilities (electronic warfare,

offensive and defensive cyber, directed energy), and fires integration (joint and multinational fires) that reside within a single command. These commands combine organic and task organized capabilities based on mission requirements.

(4) Multi-mission sensors, launchers, and munitions.[13] Fires forces gain versatility and capability through multi-mission weapon systems. Multi-mission capabilities provide greater flexibility in deployment and operations while reducing acquisition requirements, training and manning requirements, and sustainment footprints. Munitions capable of engaging targets through multiple domains enhance the capability of platforms and underscore flexibility, and multi-mission platforms facilitate task organization. The Army must weigh multi-mission systems development carefully against issues such, as cost and scarcity; centralizing capabilities on one system has many advantages, but may create greater vulnerability and scarcity. Future fires formations are built around components, not systems. As a result, fires' military occupational specialties (MOSs) must evolve from the current system-based model to a functional model. Future fires MOSs are based around functions, such as sensors, shooters, mission command, or information systems. In addition, advances in technology enable convergence of fires competencies. Fires institutional forces combine fires training programs and facilities, reducing training resource requirements and streamlining programs of instruction. This supports future common fires MOSs development, reducing required institutional education and training resources and enabling the future multifunctional fires organizations.

(5) Fires integration at the combatant command level. The combatant commander may designate a command element to integrate capabilities at the theater level. This command element integrates joint, interorganizational, and multinational fires capabilities and serves as the fire support element for the combatant commander. The command element's mission is to plan, coordinate, and execute fires to support the theater commander's objectives. This support may include advising the theater commander on fires capabilities and limitations, conducting targeting and IAMD planning at the theater level, providing targeting guidance to lower echelons, and assisting the theater commander in developing critical target and asset lists.

d. Enhanced sensor-to-shooter linkages. Fires systems rely on reliable, rapid, and agile linkages between sensors and shooters that provide data on targets in all domains. To deliver fires against concealed, hardened, low observable, or mobile targets successfully, sensor capabilities available to fires units must expand, to include joint, interorganizational, and multinational sensors. Networks supporting the sensor-shooter linkages must be protected, reliable, and fast. Sensor management must integrate through targeting, synchronizing sensor management and collection plans with commander objectives at all echelons.

(1) Joint, interorganizational, and multinational network integration enhance detection, combat identification, classification, discrimination, location, and battle damage assessments.[14] New sensor technologies offer enhanced electronic and signals identification, utilizing targets' electronic or radio frequency signatures as a means of positive identification. These new sensor capabilities must synchronize through operational plans to inform targeting and improve situational awareness. Providing precision target location capabilities to the lowest practical echelon ensures supported forces employ fires quickly and effectively. Engagement assessments pass automatically to decision-makers, facilitating rapid and accurate re-engagement decisions.

(2)  Network enabled fires.  The future Army information network enables fires units to engage the enemy with speed and accuracy, beyond the range of fires' organic weapons and sensors, and destroy targets at the time and place of the commander's choosing.  Network enabled fires leverage all available assets to locate, track, classify, discriminate, identify, and engage targets rapidly with lethal and nonlethal effects through all domains.[15]  Networks support the, "any sensor, best shooter," construct, and enhance interoperability with joint, interorganizational, and multinational partners.[16]  All fires sensors and delivery platforms integrate into the network.  All elements of the network support the task organizational approach and plug-and-fight mindset.[17] The network and fires information systems with battle management aids provide opportunities to push authorities to the lowest practical echelon and assists commanders with employing both organic and non-organic fires capabilities.  The network enables automated effects assessment and updates to the common operating picture (COP) to improve situation understanding.[18]  Future network capabilities mitigate network disruptions through protected, redundant capabilities, agile network management, and a robust, layered network transport.

(3)  The COP is an important element of networked warfare.  Fires information systems will fuse sensor data from joint, interorganizational, and multinational partners into the COP.[19] Integrating sensors and their associated languages and connectivity architecture into a single integrated picture is a challenge.   The COP gives joint, Army, interorganizational, and multinational forces a tailored, real-time or near real-time view of friendly forces, known enemy forces, and other relevant aspects of the environment, enabling situational awareness and supporting timely, accurate decision-making, and capabilities synchronization and integration.

e.  Cross-domain fires expansion.  Cross-domain fires is the employment of lethal and nonlethal fires across all domains to support multi-domain battle operations.  Multi-domain battle requires projection power through all domains, joint, interorganizational, and multinational capabilities integration, and cross-domain fire and maneuver synchronization.  To support multi-domain battle, future fires units must integrate and deliver fires through all five domains and the electromagnetic spectrum, creating windows of temporary domain superiority and preserving freedom of maneuver for the joint force.  This requires the enhancement of current capabilities and the development of new capabilities, as well as enhanced integration and improved targeting at all echelons.

(1)  Fires in the land domain are capable of extended ranges, increased precision, and greater responsiveness.  The extended rocket and tube artillery range allows land-based fires to support operations across wider areas with fewer systems.  Long range precision strike capabilities shape the theater, provide operational and strategic deterrence, and provide an additional strike option to operational and strategic commanders.  Precision fires against strategic and operational targets shape the battlefield and enable combined arms maneuver.  Extended range fires systems counter WMDs prior to employment, reducing exposure and attack risk.  Long-range, precision fires provide greater flexibility to maneuver forces, ensuring freedom of maneuver and support to wide area security.  Counterfire at all echelons and through all domains undermines or defeats enemy fires capabilities, enabling freedom of maneuver, and friendly forces and critical assets protection. Networked-enabled fires enable passing target location digitally from sensor to shooter, reducing response times and errors, and improving area, near precision, and precision effects.

(2) Fires in the air domain demonstrate extended ranges and increased integration with joint, interorganizational, and multinational partners. Fused sensor information improves decision-making, situational understanding, and aerial target engagements. Joint integrated fire control enables advanced engagement techniques, increases engagement ranges, and increases decision space.[20] Air-ground integration cells ensure air-ground integration at all echelons. This integration enables timely fires at the tactical level that are not restricted by broad overarching authorities. This capability will be achieved through organizational changes using fires cells, air defense airspace management, brigade aviation elements, and other Army elements, such as CEMA and information operations cells as required to meet mission requirements.

(3) Fires in the maritime domain can support the land scheme of fires with traditional naval gun fire, as well as protecting global shipping lanes and friendly maritime assets to maintain freedom of maneuver. Shore-to-ship fires protect coastal and littoral assets, including sea bases, from surface and subsurface attack and augment naval control of littoral areas. Fires augment on-board naval magazines, providing naval commanders with flexibility in choosing munition load-outs and allowing ships to remain on station longer without having to re-arm. Fires support amphibious operations from embarkation to debarkation, ensuring freedom of maneuver for amphibious forces. Shore based fires protect the homeland from attacks by maritime threats and restricts enemy freedom of movement.

(4) Fires in the space domain enhance fires integration and delivery through space force enhancement, satellite communications, PNT, intelligence, surveillance, reconnaissance, missile warning, and environmental monitoring. Space-based enhanced targeting leverages a variety of sensors to provide precision targeting capability. Fires capabilities provide lethal and nonlethal responses to offensive and defensive space control to deny adversaries overhead access and to protect U.S. and partner space-based sensors.

(5) Fires in the cyberspace domain integrate and synchronize into the operations concept planning process at echelon and adjust based on the targeting guidance. Fires planners at all echelons coordinate and assess cyber capabilities to provide effects options in the form of cyberspace attacks. Cyber and fires planners advise commanders on matching cyber capabilities to desired effects and targets. Fires delivers munitions with scalable (lethal to nonlethal) effects designed to attack threat networks, inhibit communications, or disrupt local electronic infrastructure.

**Chapter 4**
**Conclusion**

a. The AFC-F introduces four fires tenets and four emerging fires concepts. The Fires tenets are a starting point for developing capabilities to mitigate the AFC-F's military problem and challenges. The AFC-F introduces four key emerging fires concepts: improved integration of joint, interorganizational, and multinational capabilities; multifunctional fires convergence; enhanced sensor-to-shooter linkages, and the expansion of cross domain fires. The AFC-F sets the stage for future capability developments across DOTMLPF-P to overcome the Army Warfighting Challenges required to coordinate, integrate, and deliver fires through targeting and IAMD

planning as presented in the AOC.  The AFC-F provides the conceptual framework to coordinate and integrate weapon systems, sensors, mission command, and capable organizations in support of joint combined arms operations.

b.  The 2020-2040 fires forces end state envisions flexible, expeditionary, and sustainable formations.  These formations are mission-tailored organizations, whose agile leaders and Soldiers integrate and employ multi-role and multi-mission weapon system capabilities using a common mission command network and procedures.

c.  The AFC-F and the conceptual work it supports are ongoing projects.  Their revisions are constant, incorporating changes in the operational environment and strategic guidance.  Future fires forces support joint combined arms operations, enable freedom of maneuver, defend critical assets, and defend the homeland.

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**Appendix A**
**References**

**Section I**
**Required References**
For all sections: Army regulations, Department of the Army (DA) pamphlets, Army field manuals, Army doctrine publications (ADPs), Army doctrinal reference publications (ADRPs) and DA forms are available at Army Publishing Directorate Home Page http://www.usapa.army.mil. TRADOC publications and forms are available at TRADOC Publications at http://www.tradoc.army.mil. Joint publications (JPs) are available at the Joint Electronic Library at http://www.dtic.mil/doctrine.

Capstone Concept for Joint Operations: Joint Force 2020

TP 525-3-0
The U.S. Army Capstone Concept

TP 525-3-1
The U.S. Army Operating Concept: Win in a Complex World

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**Appendix B**
**Required Capabilities**

**B-1.  Fires required capabilities (RCs)**

   a.  Fires RCs are generated from the ideas and proposed solutions found in this pamphlet.  These capabilities are closely interrelated and, potential DOTMLPF-P solutions may simultaneously fulfill more than one RC.  RCs are based on the broad ideas from the ACC and AOC, proponent analytical work, lessons learned from the last decade of conflict, and this concept.  Each RC is followed by a citation that can be used to find amplifying data within this concept.

   b.  The following capabilities are required to develop, prepare, and equip Army leaders, Soldiers, Army Civilians, and organizations at all echelons to apply the fundamental principles of fires to help prevent conflict, shape the strategic environment, and win the Nation's wars.

      (1)  Future fires forces require mobility, survivability, and protection commensurate with the supported force at every echelon to operate across the ROMO (3-4.b.).

(2)  Future fires forces require the capability to conduct targeting in concert with Army and joint, interorganizational, and multinational partners at every echelon across the ROMO to integrate, coordinate, and synchronize capabilities to support commander's objectives (3-7.b.(1)).

(3)  Future fires forces require the capability to compensate for the effects of the physical and operational environment on fires systems, munitions, and effects across the range of military operations to employ fires in austere, contested, dense urban, or degraded environments (3-7.e).

(4)  Future fires forces require the capability to detect targets in all domains, utilizing both non-organic and persistent 360 degree organic sensors, with sufficient range, accuracy, and speed across the range of military operations to employ cross-domain fires (3-7.d.(1), 3-7.e).

(5)  Future fires forces require the capability to classify, discriminate, and identify targets in all domains at every echelon across the ROMO to inform engagement decisions, apply rules of engagement, prevent fratricide, and minimize collateral damage (3-7.d.(1)).

(6)  Future fires forces require the ability to gain engagement authorization rapidly for targets in all domains across the ROMO to employ cross-domain fires (3-7.d.(1), 3-7.e.).

(7)  Future fires forces require persistent sensor-to-shooter linkages at every echelon across the range of military operations to deliver responsive fires (3-7.e.).

(8)  Future fires forces require the capability to deliver 360 degree fires against moving, displaced, and stationary targets in all domains across the ROMO with sufficient range, speed, capacity, lethality, and accuracy to achieve desired effects on all target types (3-7.e.).

(9)  Future fires forces require the capability to assess engagement effectiveness against targets in all domains across the ROMO to facilitate re-engagement decisions, preserve ammunition, and inform commanders on target status (3-7.d.(1), 3-7.e.).

(10)  Future fires forces require rapid, accurate mission command capabilities that allow fires forces to plan, prepare, execute, assess, and integrate collaboratively with joint, Army, interorganizational, and multinational capabilities across the ROMO at all echelons to employ cross-domain fires (3-7.b.(2), 3-7.d.(3)).

## B-2.  Fires dependencies

a.  The future operational environment requires a combined arms team that is composed of combined arms elements, joint service partners, interorganizational agencies, and multinational partners.  Fires units and systems have unique dependencies upon other joint, Army, interorganizational, and multinational organizations and weapons systems.

b.  Army elements.  Unique Army warfighting function dependencies are discussed below.

(1) Movement and maneuver.  Maneuver and fires are inseparable and complementary.  The principle role of fires on the battlefield is to enable freedom of maneuver; the first priority of all

fires units must be to support maneuver. Fires and maneuver forces must work together to plan and execute fire support tasks effectively, creating lethal and nonlethal effects to defend the force from aerial attack and surveillance. Maneuver forces must provide security for fires units when necessary, and must assist fires elements in moving to positions of advantage.

(2) Mission command.

(a) Technical and tactical fire control, targeting, and fire direction depend on mission command information systems to clear airspace for fires and to transport information to support detection, tracking, and targeting. Fires units depend on space assets for early warning, PNT data, targeting data, and network operations.

(b) Cyberspace. Fires weapons systems have unique service quality and service speed requirements for Army information networks. The speed at which incoming missiles, rockets, and artillery travel requires fire control information that is accurate and real-time to target and destroy these targets. Fires weapons systems use networks and information systems that are reliable over vast distances, have intuitive interfaces, and are interoperable with all applicable systems at each echelon. Mission command systems provide a single Army information network, including a tailorable COP, critical for integrating, coordinating, and delivering fires. Fires systems must integrate and exchange mission critical data seamlessly with other Army systems at all echelons.

(c) EW platforms require fielded sensors adequate to support their employment. A high priority requirement to employ friendly EA platforms necessitates developing capabilities to operate in the electromagnetic spectrum. Threat EA capabilities drive the requirement to protect Army forces and systems.

(3) Intelligence. Intelligence and fires leaders, Soldiers, and units must maintain a close relationship. Commanders must have a reliable picture of the disposition of the adversary or enemy to influence targeting. The commander obtains this intelligence picture through intelligence preparation of the battlefield, execution of the intelligence collection plan, and reach-back support from national resources. The intelligence leaders, Soldiers, and organizations support fires organizations by ensuring the information collection plan supports the finalized targeting plan. Providing intelligence support to targeting includes support to target development, support to target detection, and support to combat assessment. Target development includes vetting, validation, and imagery analysis, all critical to determining accurate target location success, weaponeering, and collateral damage estimations. Intelligence and fires systems must be interoperable and exchange targetable data seamlessly and instantaneously (sensor-to-shooter). Where possible, The Army must share relevant intelligence data rapidly with joint, interorganizational, and multinational partners to enable their own fires systems fully.

(4) Maneuver support. Fires and maneuver support have a symbiotic relationship that enhances and supports each other's organic capabilities across five separate branches for support to joint, Army, and friendly forces. This relationship and holistic dependencies develop through sharing information from planning, target identification and analysis of WMD (targets and effects), geospatial data, mobility, counter-mobility, fires (lethal and nonlethal), and protection which includes hardening and concealing key fires equipment and positions from surveillance and attack.

(5) Sustainment. Fires dependencies on sustainment are similar to all other warfighting functions, and include transportation, supply, health, personnel, legal, and chaplain. However, fires forces depend heavily on sustainment resources to supply large amounts of class V in a high intensity scenario. Fires class V is unique: it is large in both weight and volume, highly specialized, expensive and often fragile, all of which places additional requirements on sustainment assets. In addition, low-density fires munitions may have to be moved significant distances from depots or other theaters to support fires operations.

(6) Special operations. Special operations fires dependencies center on cooperation with special forces elements. Special forces provide critical surveillance inputs to targeting, particularly strategic reconnaissance, which enable engagement and assessment of deep strike and other high priority missions.

c. Joint elements. Fires units are interdependent with joint and combined forces. The Joint Force requires responsive, Army fire support and AMD capabilities. All echelons develop target materials and aid in target development and asset employment in both deliberate and dynamic situations. Examples include sensors, intelligence collection assets, air assets for CAS and air interdiction, and intratheater airlift. Underpinning employment of complementary and interdependent capabilities effectively is the rapid networked information exchange to identify targets and clear fires. This information exchange helps make informed engagement decisions. Fires are dependent upon timely strategic indications and warnings to enable global missile defense decisions and for fires deployment from the U.S. to the theater.

d. Interorganizational elements. Fires units have unique dependencies in homeland defense. Air defense artillery weapons systems require special rules of engagement and information from interorganizational agencies to operate and engage in the homeland. Strategic missile defense is dependent upon integrated joint, interorganizational, and multinational sensors to provide better detection, tracking, engagement, and hit assessment. Missions like National Capital Region defense require information and integration with federal and civilian agencies.

e. Multinational elements. Fires units have dependencies on multinational partners for the employment of their national weapon systems and munitions, for weapons systems location and defense plans and designs, for communications, mission command and for coordinating and providing operations areas to locate and employ fires units. Fires units will synchronize and leverage multinational sensors to locate targets. Conversely, many potential multinational partners do not possess adequate fires capabilities and fires units must prepare to extend support to them to prevent conflict and shape the operational environment. Liberal policies regarding data sharing to ensure interoperability between U.S. and multinational partner units enable these efforts.

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**Appendix C**
**Science and Technology**

**C-1. Introduction**

Future fires leaders, Soldiers, and organizations will continue to provide persistent, integrated, all weather, ubiquitous fires to support joint combined arms operations. This support manifests itself in the integration of technology, with innovative leaders, skilled Soldiers, and well-trained teams. Science and technology efforts will develop and integrate advanced technologies to enhance precision, lethality, magazine depth, and range where required and reduce logistical requirements to sustain high tempo operations. Fires Soldiers, leaders, and systems must be precise, flexible, tailorable, and responsive to maintain overmatch.

**C-2. Technology focus areas and first principles**

a. Technology focus areas and first principles accelerate new technologies into the force to maintain the Army's ability to overmatch enemies. The Army requires expeditionary technology-driven capabilities that allow rapid deployment of scalable, power projection forces on short notice to austere locations across the ROMO often in persistent anti-access and area denial environments.

b. Below are key technological focus areas and first principles, from a fires perspective, to guide development of future fires capabilities.

(1) Mobile protected precision firepower. Emerging technology provides increased protection, survivability, deployability, scalable precision firepower, and the ability to locate, identify, and achieve desired effects accurately.

(2) Lethality and effects. Emerging technology will provide overmatch, the ability to create both lethal and nonlethal effects, achieve precision and discrimination capability, provide increased range, precision guidance, and significant increases in range, effectiveness, rate of fire, and magazine depth.

(3) Logistics optimization. Technology enhances fuel economy, the ability to generate, store, and distribute power efficiently to enable enhancements to weapons, platforms and Soldier-borne systems, and increase affordability of operations and munitions expenditures. Platform commonality streamlines maintenance, logistics, and training.

(4) Army aviation. Advances in Army aviation increase mobility and impact next generation weapon system design (such as, transportability, weight, and others).

(5) Information to decision. Technology will assist future leaders with advanced decision aids and analytical tools and increase interoperability during joint combined arms operations.

(6) Human performance optimization. Enhanced training, (blended, live virtual and constructive learning environments), improves Soldier performance.

(7) Medical sciences. Continued investment in medical sciences improves Soldier resiliency, physical and mental healing, and quality of life.

(8) Autonomous systems. Robotics and autonomous systems increase unit capabilities, situational awareness, mobility, and speed.

**C-3.  Potential technology candidates for Force 2025**

a.  Counter unmanned aircraft systems (C-UAS).  The Army engages with industry to evaluate future technology initiatives for C-UAS solutions.  C-UAS is a high priority identified through the capability needs analysis process.  Technology candidates include laser, lethal cannon and missile solutions, high power microwave weapons; and other directed energy solutions.

b.  Long range precision fires.  The Army needs to attack enemy high value targets protected by air defense systems to include electronic guidance jamming and manipulation systems, directed energy systems and nonlethal countermeasures.

c.  Fires sensors.  Fires sensors conduct targeting, air surveillance and counterfire roles to provide flexibility to the commander.  Fires sensors require electronic protection to ensure fires systems integration and delivery as adversaries develop EA capabilities.  Potential technology candidates include next generation fires systems and upgrades to current systems.

d.  New generation artillery munitions.  Fires forces service both stationary and moving targets rapidly creating lethal and nonlethal effects as the situation demands.  This requires munitions capable of dynamic targeting and re-targeting while in flight, munitions with intelligent on-board sensor suites, and munitions that loiter for extended periods.  Future munitions must support both precision and mass, able to scale effects from highly localized to across wide areas with a minimum of reconfiguration.  Future munitions must also be affordable and available widely to offset threat advantages in both mass and availability.

**C-4.  Fires science and technology needs for 2025-2040**

a.  Based on *Force 2025 Maneuvers*, fires leadership developed the framework for future fires sensors, shooters, information systems, and mission command.  The end state provides persistent, integrated, all-weather, ubiquitous fires to support homeland defense and joint combined arms operations.  Key enablers include commonality, expeditionary, network integrated, and optimized force structure.  Commonality is using, re-using, and adapting hardware and software components, and interfaces to increase operational efficiency, logistics, and training.  Expeditionary is combining deployability and mobility to support joint combined arms operations, with some forces forward deployed.  Network integration is maximizing fires coverage through data sharing.  Finally, to optimize force structure, fires maximize fires capabilities and flexibility while minimizing required force structure.

b.  Next generation sensors: radars, elevated sensors and beyond line-of-sight and beyond-the-horizon sensors.[21]  Fires organizations will move to five radars in the mid-term and fires strategy envisions further consolidation of air defense artillery and field artillery radars to increase operational flexibility, efficiency, and expeditionary capabilities.  This includes operating on the ground or elevated and conducting operations in the land, air, maritime, space, and cyberspace domains.  The Army envisions future sensors fusing data from all joint, national, multinational, and commercial sensors from space to subterranean.  The Army's goal is real time integration and targeting data optimization with category 1 coordinates for a range of field artillery applications

and fire control quality data for AMD applications.[22]  Potential technology approaches include persistent high altitude sensors, radar technologies, satellite targeting and surveillance technologies; sensor fusion technologies; airborne radars and sensors; advanced combat identification.

c.  Soldier and platform based precision sensors.  Precision target location and mensuration are critical elements of employing precisions fires systems, as fires systems are only as precise as the targeting data.  Future fires Soldiers use a range of sensors: mounted, dismounted, tethered unmanned systems, autonomous unmanned systems, manned-unmanned teams, and over the horizon, to detect, locate and service targets.  The Army's vision is to achieve real time integration and targeting data optimization for a range of fires applications.  Potential technology approaches include precision azimuth technologies; precision vertical angle measurement; advanced optics; and PNT; and non-GPS technologies.

d.  Next generation shooters.  Mid-term investment strategy leans towards consolidating platforms to support joint combined arms operations.  In the far-term, the Army foresees developments in multifunctional platforms and common missiles and rockets across fire support and AMD applications.  The Army will leverage and support emerging advanced technologies such as directed energy, electro-dynamic energy weapons, and hypervelocity projectiles to achieve scalable effects.  The Army will leverage robotics to support manned and unmanned platforms which reduce force structure and improve expeditionary capability.  Potential technology approaches include hypersonic weapons, long-range maneuverable munitions with increased precision, hyper-velocity projectiles, electric fires initiatives, and extended range artillery technologies.

e.  Next generation mission command.  The Army envisions one information system that enables forces to plan, prepare, and execute fires in real time in all domains.  The future Army information network must provide decentralized network structure, automated battle management aids, fused sensor data, targeting assistance, and fire control service quality.  In the mid-term, fires organizations consolidate mission command within fire support and AMD.  In the far-term, fires organizations expect coverage and capability through data sharing and network integration to leverage information available on the network from the full complement of fires assets, to provide significant improvements for situational awareness, combat identification, and targeting in all conditions.  Ultimately, the goal in the far-term is to achieve a single fires mission command system. Potential technology approaches include but are not limited to sensor fusion technologies, automated decision aides, airspace management tools, architecture integration, and ensured networked communications.

## C-5.  Conclusion
Using this concept as a guide to fires end state, fires envision a ubiquitous fires force capable of operations across the ROMO.  This force will have access to coordinate data (fused, near-perfect knowledge), operating multi-mission platforms, with common munitions and multi-mission sensors achieving timely and precision fires.

**Appendix D**
**Risk and Mitigation**

**D-1. Introduction**
Risks to joint and fires formations as the Army implements ideas in this concept and develops the future force under *Force 2025 and Beyond* reside in four areas: resources and readiness, extended areas of responsibility, inability to integrate with joint, interorganizational, multinational combined arms teams, and policy. The Army must work with the Joint Force and civilian leaders to assess these risks continuously and act to mitigate them.

**D-2. Areas of risk**

a. Insufficiency and inadequate capability.

(1) Fires organizations may not have ready systems and munitions in sufficient scale. Underpinning this area of risk is the fires munitions cost-equation. Adversaries have proliferated inexpensive systems in a broad attempt to overwhelm high-tech U.S. and allied forces numerically. Developing low cost-per-shot fires capabilities is critical to countering future enemy capabilities. Without sufficient resourcing of fires formations, the U.S. homeland, friendly forces, and multinational partners, relying on forward deployed fires forces abroad, are at risk of attack and overmatch. Fires mitigation strategies include science and technology investments in extended range and low cost interceptors. In addition, future fires systems may lack sufficient lethality and scope of massed and area effects, resulting in fires forces being outmatched by threat fires capabilities.

(2) Cuts in personnel and equipment and the deployment rate for fires units stress unit readiness. To mitigate risks, the Army must maintain high levels of readiness while investing in future force modernization efforts for fires. The Army must retain sufficient institutional fires organization to expand the force. Improved interoperability by design with joint, interorganizational, and multinational partners provides additional methods to mitigate this risk by improving synergy across all domains and realizing the full potential of joint combined arms maneuver. Fires organizations must preserve fighting capacity in ready combined arms formations and improve the readiness of its reserve components.

(3) The reduction of air support, and in particular, CAS and air interdiction, puts land forces at greater risk. Reduction to fires capabilities over the last two decades were made on the premise that Air Force CAS and air interdiction would provide those fires needed to support combat in the land domain. Fires capabilities are insufficient to meet current demand and cannot absorb more cuts. Army combat aviation also faces force reductions that limit their ability to support demand resulting from the reduction in fires and CAS platforms.

b. Delivery of fires to support larger operational areas.

(1) Adversaries continue to develop capabilities that standoff at greater ranges. Advancements in guidance system technologies and component miniaturization allow adversaries

to attack from multiple avenues and domains.  The Army will mitigate these threats by increasing precision at extended ranges.  Fires weapons coverage at extended ranges requires quality of service improvements in networks and information systems.

(2)  Fires assets have critical quality and timeliness of data requirements due to the speed at which friendly forces and fires targets move, particularly surface-to-air and exoatmospheric targets.  The Army's network must support these requirements to deliver integrated, coordinated, timely, and effective fires.  This capability provides increased early warning, improved support to troops in contact, and deep strike capabilities.

c. Coordination and integration.  Enemy organizations may attack systems critical for joint and Army combined arms operations.  The most damaging attacks disrupt the force's ability to form and concentrate combined arms capabilities.  To mitigate this risk, the Army develops resilient and hardened systems that degrade gracefully under attack rather than fail catastrophically.  Joint, Army, interorganizational, and multinational forces develop redundant means for communication and coordination, then conduct realistic joint training under degraded positioning, navigational, and timing conditions.  Army forces anticipate countermeasures and pursue a mix of technological and non-technological solutions to build sufficient redundancy and adequate reliability of systems and nodes.  Information sharing restrictions put coordination and integration at risk.

d. Policy.  Fires emerging concepts face two major obstacles regarding U.S. government policy: data sharing with multinational partners and treaty based weapons range restrictions.  Limitations on data sharing can undermine building partner capacity and foreign military sales.  Treaties that limit ranges of certain weapons system run contrary to emerging operational environment trends, creating significant capability gaps.  Adversaries are developing anti-access area denial strategies, rendering U.S. capabilities obsolete due to policy.  Army leaders, DOD, and other government agencies need to pursue policy changes that reflect changes in the operational environment.

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**Glossary**

**Section I**
**Abbreviations**

| | |
|---|---|
| ACC | Army Capstone Concept |
| ADP | Army doctrine publication |
| ADRP | Army doctrine reference publication |
| AFC-F | The U.S. Army Functional Concept for Fires |
| AFC-MM | The U.S. Army Functional Concept for Movement and Maneuver |
| AMD | air and missile defense |
| AOC | Army Operating Concept |
| BCT | brigade combat team |
| CAS | close air support |
| CEMA | cyber electromagnetic activities |
| COP | common operating picture |
| C-UAS | counter unmanned aerial systems |

| DA | Department of the Army |
|---|---|
| DOD | Department of Defense |
| DOTMLPF-P | doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy |
| EA | electronic attack |
| EW | electronic warfare |
| IAMD | integrated air and missile defense |
| JP | joint publication |
| MOS | military occupational specialties |
| PNT | position, navigation, timing |
| ROMO | range of military operations |
| SOF | special operations forces |
| TP | TRADOC Pamphlet |
| TRADOC | Training and Doctrine Command |
| UAS | unmanned aircraft system |
| U.S. | United States |
| WMD | weapons of mass destruction |

**Section II**
**Terms**

**accuracy**
The degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard.

**Army special operations**
Operations requiring unique modes of employment, tactical techniques, equipment and training often conducted in hostile, denied, or politically sensitive environments and characterized by one or more of the following: time sensitive, clandestine, low visibility, conducted with and/or through indigenous forces, requiring regional expertise, and/or a high degree of risk.

**cyber electromagnetic activities**
Activities leveraged to seize, retain, and exploit an advantage over adversaries and enemies in both cyberspace and the electromagnetic spectrum, while simultaneously denying and degrading adversary and enemy use of the same and protecting the mission command system (ADRP 3-0).

**cyberspace operations**
Actions at all echelons that generate and exert combat power through cyberspace to enable freedom of maneuver and action (AOC).

**electronic attack**
Using electromagnetic energy, directed energy, or anti-radiation weapons to attack personnel, facilities, or equipment to degrade, neutralize, or destroy enemy combat capability (JP 1-02).

**fires**
The use of weapon systems to create specific lethal or nonlethal effects on a target (JP 1-02).

**fires weapon(s) system**
A combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment required for self-sufficiency to deliver fires and perform fires missions.

**interorganizational**
Elements of U.S. government agencies; state, territorial, local, and tribal agencies; foreign government agencies, intergovernmental, nongovernmental, and commercial organizations (does not include forces) (AOC).

**joint combined arms operations**
The synchronized, simultaneous, or sequential application of two or more arms or elements of one service, along with joint, interorganizational, and multinational capabilities combined with leadership and education across services to ensure unity of effort and create multiple dilemmas for the enemy to seize, retain, and exploit the initiative (AOC).

**multinational**
Two or more forces or agencies of two or more nations or coalition partners.

**precision**
Exactness and accuracy of expression or detail.

**space operations**
Employment of space system capabilities enhance command and control, facilitate force maneuver, reduce commander uncertainty, and improve fire support, air defense, intelligence collection, and combat service support operations (Field Manual 100-18).

**special warfare**
Combination of lethal and nonlethal actions taken by a specially trained and educated force that has a deep understanding of cultures and foreign language, proficiency in small-unit tactics, and the ability to build and fight alongside indigenous combat formations in all environment.

**standoff**
A weapon launched at a distance sufficient to allow attacking personnel to evade defensive fire from the target area.

**surgical strike**
Activities executed in a precise manner that employ special operations forces in hostile, denied, or politically sensitive environments to seize, destroy, capture, exploit, recover or damage designated targets, or influence threats.

**target**
An entity or object considered for possible engagement or other action.

**targeting**
Selecting an object of attention or attack.

**weaponeering**
The process of determining the quantity of a specific type of lethal or nonlethal weapons required to achieve a specific level of damage to a given target, considering target vulnerability, weapons characteristics and effects, and delivery parameters (JP 3-60).

**Section III**
**Special terms**

**nonlethal**
Neutralizing or incapacitating a target without causing injury, death, or gross physical destruction (Director Army Capabilities Integration Center memorandum dated 1 June 2010).

**Endnotes**

[1] See AOC for details and full central idea.

[2] Overmatch is the application of capabilities or use of tactics in a way that renders and adversary unable to respond effectively.

[3] Current sensors and shooters cannot service 360 degrees, but rather only a specific range of direction less than 360 degrees.

[4] Anti-access refers to capabilities designed to preclude a competitor from building up force structure in a given geographic area. Area denial refers to denying one's opponent use of a geographic area for military purposes.

[5] Proactive fires are those that pre-empt enemy actions.

[6] AOC, pg. 20.

[7] This document's use of the word "precise" refers to the colloquial meaning, not the scientific meaning (consistency of results). This is consistent with the US military's wider use of "precision", especially with regard to munitions, as being synonymous with "accuracy".

[8] Electronic attack is a division of electronic warfare involving the use of electromagnetic energy, directed energy, or anti-radiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires. JP 1-02

[9] (Mitchell, 2015)

[10] Interorganizational applies when talking generically about potential partners during joint operations, however, for purposes of fire coordination this is generally more limited to interagency partners than the full scope of interorganizational entities.

[11] (Field Manual 3-60: The Targeting Process, 2012)

[12] Mission tailorable capabilities are leaders, Soldiers with the required equipment that can organize to meet changing conditions in the operating environment.

[13] Multi-mission capabilities are the ability for systems to perform various missions simultaneously or individually with minimal down time, for example, a radar that detects and tracks indirect fires while simultaneously conducting air surveillance.

[14] See endnote #6.

[15] Nonlethal effects are the result of incapacitating targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage to property in the target area or environment. Nonlethal effects typically neutralize or incapacitate a target or modify adversarial behavior without causing permanent injury, death, or gross physical destruction. (ARDP 3-09)

[16] Best sensor to shooter construct is the ability for shooters to use the most relevant and accurate data to engage objects. This increases accuracy and adds flexibility being able to use non organic capabilities to shoot at longer ranges and over and around objects when organic sensors not available.

[17] Plug and fight capabilities are those solutions that can remove the boundaries associated with connecting disparate capabilities into a system of systems. Plug and fight capabilities simply plug into a system network and contribute and use the information and data available. Ultimately it prevents stove piping of systems. (Army Integrated Air and Missile Defense Concept of Operations).

[18] This concept envisions a true COP as a comprehensive, tailorable, real-time view of the battlefield available to leaders at all echelons.

[19] See endnote 6.

[20] Advanced engagement techniques. Advanced engagement concepts embrace three extended range engagement processes: launch-on-remote, engage-on-remote, and forward pass. These concepts make use of sensor data to perform engagements, without the constraint of where the sensor data is coming from. Advanced engagement concepts eliminate the need for organic sensor data for engagements (AIAMD concept of operations).

[21] Over the horizon and beyond line of sight illustrate that fires must target at ranges beyond the horizon and beyond where organic sensors can detect objects. Over the horizon address issues associated with the curvature of the earth and distance. Beyond line of sight address issues with objects such as buildings, foliage, and smoke that would hinder detection capabilities.

[22] Category 1 is the joint standard to determine if a munition is precision munitions. The associated value is the standard that Army fires will use to meet requirements. The specific value is not stated and may change in future revisions.