



March 15, 2017

Testimony before the Subcommittee on Airland of the Senate Armed Services Committee

Future of All Arms Warfare in the 21st Century

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Adapting the Force to Emerging Challenges

Chairman Cotton, Ranking Member King, and distinguished Senators, thank you for inviting me to testify today.

We are at a time of both risk and opportunity for the U.S. armed forces. Budget cuts instituted under the 2011 Budget Control Act have harmed military readiness and delayed urgently-needed modernization. The United States has fallen behind in adapting to challenges from other nations. Russia and China have developed a suite of capabilities, broadly labeled “anti-access / area denial” (A2/AD), that threaten traditional forms of U.S. power projection. In order to remain relevant as a global power, the United States must adapt to these challenges. At the same time, the United States must also find more cost-effective means of conducting day-to-day operations, such as countering terrorism and providing a stabilizing presence in key regions around the globe.

To accomplish these and other high-priority missions, such as defending the homeland from ballistic missile attacks from rogue nations, the U.S. military must continue to evolve and adapt. Congress, working with the Trump Administration, has an opportunity to reverse the harmful budgetary cuts under the Budget Control Act (BCA). In addition to a sustained increase in defense spending above BCA levels, the Department of Defense (DoD) needs a predictable and stable budget in order to plan future activities.

With additional resources, DoD should prioritize (1) restoring readiness by funding maintenance and training and (2) modernizing the force to adapt to emerging challenges. U.S. forces cannot be considered “ready” if they are prepared for the wrong threats. U.S. forces must be trained, equipped, and postured to meet the challenges posed by China, Russia, Iran, North Korea, and violent extremism. Greater capacity alone cannot meet these challenges. The force must evolve its capabilities and operational concepts.

DoD should pursue a disciplined modernization strategy that focuses investments on high-payoff capabilities that can deliver the most value in countering A2/AD challenges. This approach should

Bold.

Innovative.

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leverage existing programs wherever possible in order to maximize the efficient use of scarce resources. DoD should also capitalize on emerging technologies such as robotics and automation to increase operational effectiveness and decrease costs.¹ Finally, DoD should improve its ability to conduct day-to-day activities, such as countering terrorism, in a cost-effective manner by investing in a “high-low mix” of forces: a small number of highly capable assets for countering sophisticated adversaries and larger numbers of lower cost assets for routine operations.

The remainder of this testimony will outline key initiatives DoD should pursue to adapt the Air Force and Army to these challenges.

Air Force – Strategic Environment and Key Investment Priorities

Adversary investments in advanced integrated air defense systems, ballistic and cruise missiles to target U.S. bases, and mobile and relocatable assets require the U.S. Air Force to adapt. U.S. aircraft must be able to project power over long distances, penetrate and survive in contested areas, deliver high volume fires, and persist in order to track mobile and relocatable targets. These forces need robust, secure communications links to operate as a distributed network.²

DoD has taken steps towards developing a global surveillance and strike capability that meets these ends, but more could be done to ensure DoD attention and investments are focused on the most high-priority areas. Key focus areas for the Air Force include:

- **Long-range penetrating strike:** The B-21 bomber, currently in development, will provide DoD with the ability to deliver high-volume fires in contested environments over long distances. Even medium-scale conflicts, like the opening phases of the 2003 Iraq War, require tens of thousands of weapons on targets.³ Congress should work with the Administration to ensure that once the bomber enters production, procurement proceeds at the maximum rate in order to field this capability in sufficiently quantities for future conflicts. In the interim, the Air Force should leverage work underway on the B-21 to upgrade existing B-2 bombers, with a focus on increasing operational availability, survivability, lethality, and connectivity.
- **Persistent surveillance and strike:** In addition to delivering high volume fires, U.S. aircraft must have the ability to persist within contested areas in order to find, fix, and finish enemy mobile and relocatable targets. Stealthy uninhabited (unmanned) combat aircraft are the only way to do this from long range. Refuelable uninhabited aircraft could achieve ultra-long endurance, far exceeding the limits of human pilots.⁴ While the Air Force has invested in a large fleet of non-stealthy uninhabited aircraft for counter-terrorism missions and a smaller number of stealthy uninhabited aircraft for reconnaissance,⁵ it has yet to acquire a stealthy uninhabited combat air system (UCAS) for operations in contested environments. This is the most significant capability gap the Air Force faces today. Fortunately, the Air Force has a ready-made option to affordably develop this capability. The Air Force has stated that it is preserving the option of developing an “optionally manned” version of the B-21 in the future.⁶ Congress should ensure the Air Force exercises that option and develops an optionally manned version that could be used for uninhabited, long endurance persistent surveillance and strike missions.

- **Robust, secure networks:** U.S. forces will be most effective when they are connected via secure, robust networks for communications and position, navigation, and timing (PNT). DoD should capitalize on the rapidly maturing commercial space market to lower satellite launch costs. DoD should also invest in an aerial layer network to increase redundancy, provide a resilient backup against satellite disruption, and diminish the advantages to adversaries of attacking U.S. satellites. This aerial layer could affordably be developed by placing communications and PNT relay nodes on stealthy UCAS so that they provide their own self-healing network in contested areas and on existing non-stealthy uninhabited aircraft for communications relay outside of contested areas.
- **Next-generation fires and effects:** The Air Force must continue to upgrade and increase its quantities of munitions to ensure they are sufficiently lethal, survivable, and acquired in sufficiently high capacity to operate against future threats. This includes procuring larger quantities of munitions such as the Joint Air-to-Surface Standoff Missile–Extended Range (JASSM-ER) and Long-Range Anti-Ship Missile (LRASM) and developing a new longer range air-to-air missile. The Air Force has led the way on developing small air-launched swarming air vehicles, which could be used for jamming, decoys, reconnaissance, battle damage assessment, and strike, and the Air Force should move swiftly to operationalize this technology.⁷
- **Directed energy weapons:** High-energy lasers have the potential to provide a breakthrough capability that radically “changes the game” in aerial warfare because of their deep magazines. Provided they have sufficient power and cooling, high-energy lasers could continue engaging targets indefinitely, intercepting incoming missiles and providing offensive effects.⁸ Coupled with long-endurance uninhabited aircraft, high-energy lasers could potentially provide persistent, cost-effective defenses against cruise and ballistic missile attacks. The Air Force should continue to mature this important technology.
- **Lower-cost delivery systems:** The Air Force will need a way to affordably deliver large quantities of munitions. In addition to procuring long-range stealthy penetrating platforms, the Air Force should maximize the use of existing aircraft (e.g., B-1, B-52, F-15, F-16, and MQ-9) as delivery vehicles for standoff weapons, decoys, and swarming air vehicles. Operating in concert with stealthy aircraft, this high-low mix of platforms could help augment the magazine depth of U.S. forces. The Air Force should upgrade these platforms with the necessary communications, survivability improvements, and other capabilities to optimize their value against sophisticated adversaries.

Even as the Air Force pursues these capabilities to respond to adversary A2/AD challenges, it must also look for more cost-effective ways to counter less capable adversaries, such as the Islamic State. The Air Force should invest in a fleet of low-cost, light attack aircraft to conduct counter-terrorism, close air support, and other missions in permissive air environments. The Air Force should also optimize its MQ-9 Reaper fleet by investing in extended range, multi-aircraft control, and automated information processing, exploitation, and dissemination in order to improve operational cost-effectiveness.

Army – Strategic Environment and Key Investment Priorities

The Army must similarly adapt, investing in new capabilities and concepts of operation to respond to emerging challenges. The Army must be prepared to face a diverse array of potential threats, from sophisticated states such as Russia to non-state actors such as the Islamic State and potentially “hybrid” actors in between. Russia should be the “pacing threat” for Army modernization – the threat archetype that represents the most sophisticated potential adversary in terms of capabilities, technology, and organization. This does not mean that all other threats are “lesser included” cases. Indeed, the U.S. experience in Iraq and Afghanistan demonstrated that ground forces optimized to fight a conventional war against a state actor may be woefully unprepared for counterinsurgency or irregular warfare. The Army must be prepared to fight across the full spectrum of potential adversaries, which may require special-purpose capabilities, doctrine, training, and organizations to counter certain threats. Both states and non-state actors alike are innovating in ways that challenge the U.S. Army and could potentially dramatically change ground warfare in the coming years.

The Army must shift from a force primarily trained for counterinsurgency warfare towards one prepared to deter and defeat aggression against a major state competitor. Key initiatives include:

- Increasing the number of active duty armored brigade combat teams (BCTs);
- Upgrading ground vehicles with active protection systems (APS) to intercept precision-guided anti-armor weapons;
- Investing in long-range precision fires, electronic warfare, and protected communications;
- Upgrading Paladin 155mm howitzers with hyper velocity projectiles (HVPs) and targeting capabilities for ballistic and cruise missile defense;⁹ and
- Experimenting with new operational concepts leveraging air and ground robotic teammates.

At the same time that the Army is upgrading its forces to keep pace with adversaries, it must prepare for potentially dramatic changes in the character of ground combat.

- **Threat from enemy air attack:** For decades, the Army has been able to rely upon U.S. air superiority to eliminate the threat from enemy aircraft such that U.S. ground forces have not faced threats from the air. That era is ending. In a Russia conflict, U.S. ground forces would have to fight within range of Russian air defenses and aircraft before those threats are eliminated. That means that U.S. ground forces would be operating within the A2/AD “bubble.” The Army must adapt its capabilities and concepts of operation to cope with a contested airspace. The Army must increase its investment in air defenses and reduce the signature of U.S. ground forces through camouflage, concealment, and deception. U.S. ground forces also face the threats of air attack from non-state actors equipped with low-cost commercially available drones. While these low-cost drones are not a threat to U.S. fighter aircraft, they are a threat to ground forces and U.S. fighters are improperly matched to counter this threat. The Army will need to invest in countermeasures to detect, target, and destroy swarms of small commercial drones.

- **Air-ground robotic systems:** Other nations are investing in military-specific ground and air robotic vehicles and using them in novel ways. Russia has been developing a fleet of ground robotic vehicles, including some that are armed, and has employed uninhabited aircraft as forward observers for artillery in the Ukraine. Robotic systems can be used to increase standoff from threats, field larger numbers of forces on the battlefield, persist beyond the limits of human endurance, and enable new concepts of operation such as attritable swarming formations. The result could be new doctrine and ways of fighting on par with the invention of the *blitzkrieg*. While the Army has been at the forefront of integrating uninhabited aircraft into its force, partnering uninhabited Gray Eagle aircraft with inhabited Apache helicopters, the Army significantly lags other nations in ground robotics. The Army will be woefully unprepared for future conflicts if it misses out on the opportunity provided by robotic systems. The Army should increase its investment in ground robotics, including armed systems, and experiment with robotic teammates in mixed manned-unmanned formations.
- **Precision-guided infantry weapons:** One of the most innovative transformations in warfare over the past several decades was the invention of precision-guided weapons. Warfare at the level of infantry combat has remained, however, largely a realm of unguided weapons. With the exception of night vision, infantry tactics have changed little since World War II. The continued miniaturization of electronics means that precision-guided weapons are filtering down to the level of the individual soldier, however. A range of new weapons, from smart munitions to intelligent rifles to small drones, are placing precision-guided weapons into the hands of the individual soldier.¹⁰ A future in which individual soldiers can target each other with precision at long ranges would change infantry combat in ways not seen since the invention of the machine gun. While some of these systems have been developed by the Army, others come from the commercial sector and will be widely available. The Army should experiment with new ways of fighting with and defending against these technologies in order to prepare for changes to come.

Even as the Army prepares for these potential changes in warfare, the Army must also conduct a wide range of day-to-day peacetime activities, including advising and assisting partner forces. The Army's current model for resourcing these missions is to pull individual soldiers from Brigade Combat Team (BCT's), an approach that is inefficient and undermines readiness. In order to help restore readiness, the Army should invest in Advise and Assist Brigades (AABs) that would provide a pool of qualified advisors to resource these missions without disrupting BCT readiness.

Finally, the Army should take advantage of emerging technologies that have the potential to directly improve the capabilities of individual soldiers. These include:

- Increasing soldier protection against blast-induced brain injury through improved helmet design;
- Investing in human enhancement technologies, such as transcranial direct current stimulation (tDCS)¹¹ and pharmaceutical enhancements to improve alertness and cognitive performance, such as modafinil;¹² and
- Maturing exoskeleton and exosuit technologies to improve soldier mobility and protection.

Increasing Strategic Agility

These investments can help evolve and adapt the force to confront a range of emerging challenges. Ultimately, however, DoD must become more agile so that it is better suited as an institution to rapidly adapt to adversary innovation. So long as DoD procures major weapon systems in timelines measured in decades, it will continually be shooting behind a moving target. Institutional innovations like the Army's Rapid Capabilities Office will be essential to improving DoD's strategic agility. Congressional support for this and other efforts is critical to sustaining America's military edge in the years to come.

Notes

¹ For more on the cost-saving advantages of robotic systems, see Paul Scharre and Daniel Burg, "The \$100 Billion Question: The Cost Case for Naval Uninhabited Combat Aircraft," Center for a New American Security, Washington, DC, August 2015, <https://www.cnas.org/publications/reports/the-100-billion-question>.

² See also David Ochmanek, "Restoring the Power Projection Capabilities of the U.S. Armed Forces," Testimony before the Senate Armed Services Committee, February 16, 2017, http://www.armed-services.senate.gov/imo/media/doc/Ochmanek_02-16-17.pdf.

³ Micah Zenko, "Comparing the Islamic State Air War With History," July 6, 2015.

⁴ Paul Scharre, "The Value of Endurance," Center for a New American Security, November 12, 2015, <https://www.cnas.org/publications/blog/infographic-the-value-of-endurance>.

⁵ U.S. Air Force, "RQ-170 Sentinel," December 10, 2009, <http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104547/rq-170-sentinel.aspx>.

⁶ Dave Majumdar, "USAF leader confirms manned decision for new bomber," FlightGlobal.com, April 23, 2013, <https://www.flightglobal.com/news/articles/usaf-leader-confirms-manned-decision-for-new-bomber-385037/>.

⁷ For more on swarming concepts, see Paul Scharre, "Robotics on the Battlefield Part II: The Coming Swarm," Center for a New American Security, October, 2014, <https://www.cnas.org/publications/reports/robotics-on-the-battlefield-part-ii-the-coming-swarm>.

⁸ Jason Ellis, "Directed Energy Weapons: Promise and Prospects," Center for a New American Security, April 2015, <https://www.cnas.org/publications/reports/directed-energy-weapons-promise-and-prospects>.

⁹ Sam LaGrone, "Pentagon: New Rounds for Old Guns Could Change Missile Defense for Navy, Army," USNI News, July 18, 2016.

¹⁰ For more on these changes to ground warfare, see Paul Scharre, "Uncertain Ground: Emerging Challenges in Land Warfare," Center for a New American Security, December 2015, <https://www.cnas.org/publications/reports/uncertain-ground-emerging-challenges-in-land-warfare>.

¹¹ Jeremy Nelson, R. Andy McKinley, Edward Golob, Joel Warm, and Raja Parasuraman, "Enhancing vigilance in operators with prefrontal cortex transcranial direct stimulation (tDCS)" *NeuroImage* 85 no. 3 (January 2014), 909-917. Justin Nelson, Richard McKinley, Chandler Phillips, Lindsey McIntire, Chuck Goodyear, Aerial Kreiner, and Lanie Monforton, "The Effects of Transcranial Direct Current Stimulation (tDCS) on Multitasking Throughput Capacity," *Frontiers in Human Neuroscience*, (2016).

¹² Arthur Estrada et al., "A comparison of the efficacy of modafinil and dextroamphetamine as alertness promoting agents in aviators performing extended operations," *United States Army Aeromedical Research Laboratory*, Report No. 2011-05, December 2010, 4. Amanda Kelley et al., "Cognition-enhancing drugs and their appropriateness for aviation and ground troops: a meta-analysis," *United States Army Aeromedical Research Laboratory*, Report No. 2011-06, December 2010, 4. Amanda Kelley, Catherine Webb, Jeremy Athy, Sanita Ley, and Steven Gaydos, "Cognition enhancement by modafinil: a meta-analysis." *Aviation, Space, and Environmental Medicine*, 83 no. 7 (July 2012), 685-690.