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TESTIMONY

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Chairman McCain, Senator Reed, thank you for inviting me to testify today on this important and timely subject. It is one we will have to address for the American military to continue credibly protecting our people, territory, allies, and interests. Without a comprehensive effort to sustain, and in some cases regain, our technological advantage, the U.S. military will have less ability to deter aggression and be compelled to fight more often to demonstrate American resolve. And when they do fight, U.S. forces will be at a disadvantage against our enemies.

After almost three decades of military dominance following the fall of the Soviet Union, the United States is facing an era of increased competition. New technologies are leveling the playing field for rivals such as Russia, China, and the Islamic State seeking to overturn existing borders and security relationships. They are leveraging their proximity to U.S. allies and new military capabilities to pursue their objectives while increasing the risk for arriving U.S. forces. This may significantly raise the bar for American intervention while aggressors quietly accrete territory and influence at the expense of America's friends and allies.

This situation is clearly untenable. The U.S. Department of Defense (DoD) must do more than its current effort to develop plans that will produce new weapon systems in 10–15 years. It must take advantage of emerging technologies from DoD research labs as well as defense and commercial industry to rapidly field new capabilities in key missions such as undersea, strike, air, and electronic warfare that will impose costs on America's rivals and improve the capability of U.S. forces.

The "Third Offset Strategy"

During the Cold War, U.S. forces mitigated their geographic separation from American allies and numerical disadvantages against the Soviets by deploying

nuclear weapons in the 1950s and long-range precision strike and missile defense in the 1970s and 1980s. These high-tech capabilities likely helped deter Soviet aggression by asserting U.S. and NATO forces could attack Warsaw Pact troops, military and political leaders, or civilian populations in response. When the Cold War ended, they continued to give America a military advantage over less capable, internally-focused competitors such as Iraq, North Korea, Russia, and—for a time—China.

This is changing as America's rivals build up their militaries and turn outward in an effort to gain territory and influence or distract their populations from internal grievances. They are increasingly empowered in this effort by the flattening of the research and development landscape. During the Cold War, American government and private institutions created the majority of patents as well as unpatented military advancements. Today most new patents originate outside the United States and scientific journals regularly feature articles by Chinese and Russian researchers in areas such as underwater acoustics, electronics engineering, materials science, and computer processing.

Today the U.S. military again finds itself in a long-term competition and at a disadvantage geographically and numerically; this time against a more diverse set of adversaries than during the Cold War. In Europe, East Asia, and the Middle East U.S. forces are opposing efforts by state and non-state rivals to erode the sovereignty or stability of American allies and partners, aided by high-end technology that enables long-range surveillance and strike capabilities designed to thwart U.S. power projection. DoD plans to address this multifaceted challenge in part through a "Third Offset Strategy" that will leverage technological leaps in areas of current U.S. military advantage to impose costs on competitors and demonstrate the ability to hinder or defeat their aggression.

DoD intends its Third Offset Strategy to build on U.S. superiority in areas such as undersea warfare, long-range precision strike, air warfare, and battle networks and is implementing long range plans to guide its research. But unlike the previous Offset Strategies that focused on a small set of operational concepts and shifted significant funding to their supporting technologies, DoD's current plans appear to cover a wide range of technologies without operational concepts or significant resource reallocation. This lack of focus will significantly reduce the advantage the U.S. military can establish and delay relevant capabilities.

Exploiting emerging technological shifts

DoD needs a coherent and disciplined technology strategy instead of "watering all the flowers" with its current approach. The two most significant challenges this strategy should address are threats to America's ability to project power and paramilitary or insurgent threats to the sovereignty of its allies in Europe and Asia. And it needs to address these challenges by establishing *enduring* advantages for U.S. forces, rather than just gaining the upper hand temporarily.

America created enduring advantages in previous competitions by anticipating and preparing for the next phase in important warfare areas. For example, early in the Cold War, the U.S. Navy realized nuclear submarines would introduce a new phase of undersea warfare dominated by passive sonar and submarine quieting. It expanded investment in these capabilities and dominated the undersea against the Soviets for decades. Similarly, the U.S. Air Force saw how stealth and passive sensing would dramatically change air warfare and aggressively developed these capabilities. They did not reach the force until the Cold War's end, but stealth technologies have given U.S. forces the unique ability to strike targets conventionally anywhere on the globe for the last 25 years.

America's adversaries are now quickly catching up in these and other missions. DoD needs to identify the next phases in warfare areas where DoD has an advantage today that it must protect to be able to credibly deter and defeat aggression in the future. These include:

Undersea Warfare: The U.S. military's ability to project power against high-end adversaries hinges on the ability of its undersea forces to circumvent enemy air and surface defenses. As quiet submarines become the norm and passive sonars reach their range and size limits, active sonar and non-acoustic submarine detection will come to dominate undersea warfare. This could also increase the risk to U.S. submarines near adversary shores and compel them to shift from being tactical platforms, like fighter aircraft, to being host and coordination platforms, like aircraft carriers. To maintain its undersea dominance in light of these two shifts, DoD should focus on concepts and technologies for:

- Low frequency active sonar: They have longer ranges than today's shipboard sonars, but with lower resolution. Improved processing power will continue improving the accuracy of these systems.
- Active sonar countermeasures: As with radar above the water, jammers and decoys will become essential to spoof, confuse, and defeat enemy active sonars.
- Unmanned undersea vehicles (UUV): Particularly small ones that are hard to detect and can be bought and deployed in large numbers and large ones that can act as "trucks" to deploy seabed payloads and UUVs in coastal waters.
- Seabed payloads: Long-endurance sensors, communication relays, and power supplies for UUVs will be a key component of future undersea networks that enable submarines and other forces to support and control UUVs while finding and engaging enemy undersea forces.

Strike Warfare: U.S. forces must be able to threaten targets an enemy values or may use to coerce U.S. allies. Passive and active measures including underground facilities and surface-to-air missiles are changing today's precision strike advantage into a strike vs. missile defense competition. DoD should pursue the following concepts and technologies to sustain its strike capability:

- Overwhelming defenses: Smaller, cheaper networked weapons are emerging that can be launched in large numbers. They will be able to find and classify targets in flight and collaborate to ensure intended targets are destroyed—even if some strike weapons are lost to enemy defenses on the way.
- Disrupting defenses: High-powered microwave (HPM) transmitters are becoming small enough to go on missiles and bombs, while becoming powerful and selectable enough to damage or disrupt enemy sensors, weapons, and control systems at standoff range.
- Reaching hardened and buried targets: New burrowing and electromagnetic pulse weapons offer the ability to reach locations enemies attempt to place out of reach without having to resort to unsustainably large salvos.

Air Warfare: U.S. forces have been able to establish air superiority at will since the end of the Cold War. But improving low-probability of detection (LPD) sensors and sophisticated long-range missiles are reducing the value of aircraft speed and maneuverability and favoring larger aircraft able to carry larger sensors and weapons payloads. To sustain its current air superiority, DoD should prioritize concepts and technologies for:

- Longer-range LPD classification sensors: Historically, air engagements are won by the first pilot to classify a contact as enemy and shoot. Emerging long and medium wave passive infrared sensors and laser detection and ranging systems will enable U.S. fighters and air defenses to detect and classify enemy aircraft farther away without themselves being classified.
- Smaller, less expensive missiles: New energetic materials are making motors and warheads smaller, while new materials and processors are shrinking guidance systems. The resulting weapons can be bought and carried in larger numbers.
- Directed energy: Solid state laser and HPM weapons are reaching maturity. They offer greater capacity for air defense than traditional interceptor systems such as Patriot and can be small enough to be carried on larger aircraft as an offensive or defensive system.

Electromagnetic (EM) Spectrum Operations: The continued sophistication of radar and radar detectors will drive EM operations toward stealth and passive or LPD sensors and communications. DoD should advance the following concepts and technologies to achieve an enduring advantage in its battle networks:

- Multi-spectral stealth: New aircraft and ships incorporate features to reduce their radar signature. Stealth must now reduce the detectability of platforms to IR, UV, or acoustic detection as well.
- Networked, agile multi-function EM operations: Active Electronically Scanned Arrays (AESA) in the RF spectrum and focal plane arrays in the IR spectrum are becoming cheaper and smaller and can simultaneously

transmit and receive over a wide range of frequencies. They can be incorporated on almost every platform and vehicle to conduct sensing, communication, and counter-sensing operations, enabling new multi-platform passive and LPD sensing and communication concepts.

- "Intelligent" EM operations: DoD must go beyond automating radio, jammer, or radar operations and instead get inside the enemy's decision loop. Emerging technologies can sense the EM environment, identify both known and unfamiliar threats, and manage EM operations to conduct friendly operations while denying those of the enemy. Intelligent EM systems being developed today will enable U.S. forces to get inside the enemy's decision loop and dominate the EM spectrum.

The importance of operational concepts

New technologies will not establish an enduring advantage for U.S. forces unless they are employed in operational concepts that achieve friendly objectives while denying those of the enemy. For example, stealth without a concept for how it could be used to conduct precision strike or air interdiction would not be a game-changing technology. Similarly, passive sonar without concepts for using it to track and threaten enemy submarines would not yield an operational benefit.

One effective approach for identifying promising combinations of concept and technology is wargaming, which Deputy Secretary Work has reinvigorated in the DoD. These games, however, have not yet translated into new operational concepts that guide technology investments, acquisition requirements, or resource allocation. Unless the insights from them are analyzed further and acted upon, DoD will continue to pursue new versions of today's capabilities. This approach may yield, at best, temporary advantages.

Reforming how we field technology

Acquisition reform must be an element of any attempt to innovate within DoD. Specifically, reform is needed to address unnecessarily high costs for new weapons systems that threaten to crowd out other new capabilities and protracted development timelines that prevent new technologies from getting to warfighters in time for them to be relevant.

Acquisition reform initiatives being pursued by DoD and Congress focus on improving accountability, but the most significant hindrance to developing affordable systems on time and budget is the requirements process. By defining requirements for new acquisition programs in isolation from technical or fiscal considerations, DoD makes it more likely new systems will use immature technologies while costing more and taking longer than expected. Further, rather than defining requirements and then allowing the acquisition system to develop a range of solutions to different elements of those requirements, DoD currently writes a set of requirements tailored to each new system, essentially eliminating the competition of ideas that might otherwise ensue.

Some improvements are being implemented today to bring acquisition and technology concerns into requirements development, but these are personality and system dependent. Instead, DoD should expand the development of new systems to meet already-existing requirements through prototyping and demonstration programs. This approach is already being used by organizations such as the OSD Strategic Capabilities Office (SCO) and Air Force Rapid Capabilities Office (RCO). It enables new systems to emerge from combinations of new operational concepts and technologies grounded in what is achievable and feasible in the near-term, rather than a "wish list" of what a new weapons system would ideally do in 20 years (when it would otherwise be fielded). In this approach requirements are used to evaluate the proposed system, rather than driving its development from the start.

These efforts should be expanded in DoD and used as the basis for reforming the requirements process, particularly for smaller systems. Platforms such as ships and aircraft have long lifetimes and are designed to carry and support warfighters; a more deliberate requirements process would be appropriate for them. Payloads such as missiles and sensors generally have shorter lifetimes and faster technology refresh cycles. Their requirements may be defined less explicitly in advance and could be developed or evaluated in conjunction with prototype and demonstration efforts that evaluate their feasibility.

Conclusion

The U.S. military has enjoyed unrivaled superiority since the end of the Cold War, but the technological and operational advantages it has relied upon are quickly eroding in the face of proliferating weapons and widely available commercial technology. DoD and civilian research and analysis efforts offer the potential to sustain and enhance DoD's advantages in support of a Third Offset Strategy. In its implementation, however, the DoD's current initiatives perpetuate today's diffused and unfocused efforts to develop new capabilities. Unless it changes, the result will be a shrinking number of expensive weapons using Cold War-era technology, a decline in American influence, and allies unsure of America's ability to protect their interests.