Rethinking Approaches to Strategic Stability in the 21st Century

Workshop Summary

February 2017

CGSR
Center for Global Security Research

LAWRENCE LIVERMORE NATIONAL LABORATORY

Rethinking Approaches to Strategic Stability in the 21st Century
Summary Report

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Introduction

Lawrence Livermore National Laboratory (LLNL) hosted a two-day conference on rethinking approaches to strategic stability in the 21st century on October 20-21, 2016 in Livermore, CA. The conference was jointly convened by Lawrence Livermore, Los Alamos, and Sandia National Laboratories, and was held in partnership with the United States Department of State's Bureau of Arms Control, Verification and Compliance. The conference took place at LLNL's Center for Global Security Research (CGSR) and included a range of representatives from U.S. government, academic, and private institutions, as well as representatives from U.S. allies in Europe and Asia.

The conference had four objectives: (1) to reexamine U.S policy approaches to strategic stability in light of a changed and changing security environment; (2) to explore the impacts on strategic stability of an increasingly multipolar security environment; (3) to explore the impacts on strategic stability of the increasingly multidimensional nature of international conflict, with the emergence of new forms of competition and new domains; and (4) to assess how the technical community can better assist the policy community in developing needed insights and approaches.

The conference reviewed the strategic stability approach taken by the Obama administration in its first year, and as subsequently adapted to changed circumstances. It then examined how subsequent developments in the Euro-Atlantic and Asia-Pacific security environments have impacted thinking about strategic stability. It continued with an exploration of the distinct challenges to strategic stability posed by a more multipolar nuclear order in Asia. It also explored the particular challenges to strategic stability of military competition in the "new domains" of cyberspace and outer space as well as the challenges posed by other disruptive technologies. The conference concluded with a discussion of key lessons learned and the implications for U.S. efforts to promote stability.

The following summary covers topics and discussions from each of the panels. It is not intended to capture every point in detail, but seeks to outline the range of views on these complex and inter-related issues while providing a general overview of the panel topics and discussions that took place. The conference was held under the Chatham House rule and does not attribute any remarks to any specific individual or institution. *The views reflected in this report do not represent the United States Government, Department of State, or the national laboratories.*

Reviewing the U.S. Policy Baseline

Early Obama administration policy initiatives, such as the Prague Agenda's goal to "seek the peace and security of a world without nuclear weapons," were the basis for the U.S. policy affecting strategic stability. President Obama's long term goals were for the United States to maintain a safe, secure, and effective deterrent as long as nuclear weapons exist. The President sought to assure U.S. allies by strengthening extended deterrence, while also pursuing constructive steps toward new bilateral strategic nuclear arms reductions with Russia. Additionally, the administration sought to strengthen the Non-Proliferation Treaty (NPT), to pursue ratification of the Comprehensive Test Ban Treaty (CTBT), and open negotiations on a new treaty to prevent and control the spread and development of fissile materials. The Department of Defense attempted to operationalize these policy objectives in the 2010 Nuclear Posture Review (NPR) and subsequent policy review processes. The main ideas set out on strategic stability include the following:

- In the strategic relationships with Russia and China, strategic stability has replaced mutual deterrence as the foundational concept. This reflected an assessment of the mixed but generally improving relationships with Moscow and Beijing in the period after the Cold War and a desire to re-focus attention away from strategic competition and toward cooperation in defense of shared interests.
- In the U.S.-Russian strategic relationship, the administration accepted mutual vulnerability as the basis of the strategic relationship and negotiated an arms control agreement that would reduce force levels but not jeopardize each country's perception of the requirements of stable deterrence.
- In the U.S.-Chinese strategic relationship, the administration emphasized its commitment to strategic stability and extended an invitation to Beijing to conduct an official dialogue in order to strengthen bilateral cooperation for strategic stability. This reflected an assessment that the two countries needed to work together to define common interests in stability and common, or at least complementary approaches, to its preservation. The administration was unwilling to address publicly China's questions about whether the United States accepts or rejects mutual vulnerability with China, though it clearly stated a missile defense policy that does not seek to raise questions about the credibility of China's strategic deterrent.
- When confronting regional challengers, such as North Korea and Iran, the administration, like its predecessors, rejected mutual vulnerability and continued the project of assembling the needed military capabilities toward that end on the traditional premise that it could do so without jeopardizing strategic stability with Russia and China.
- Extended deterrence and assurance play a role in promoting strategic stability by helping to constrain the pathways to regional proliferation and regional conflict involving weapons of mass destruction.
- More generally, a strengthening of the nonproliferation regime was seen as a high priority for strategic stability, at a time when the highest risk of nuclear employment was assessed

to come from proliferation to regional challengers and the theft of weapons by non-state actors.

Strategic Stability in the Contemporary Security Environment

Strategic stability is no longer defined by the "two-state, one weapon" model of the Cold War. Instead it involves multiple states and a wide range of capabilities that are no longer limited to nuclear weapons, ballistic missile defenses, and conventional capabilities. Today space, cyber, and other emerging technologies also have strategic effects. Arms control contributes to strategic stability as a tool to manage relationships, address new strategic capabilities, and increase decision space with both allies and adversaries through increased transparency and cooperation. Tradeoffs are inherent when promoting strategic stability, deterring threats, and reassuring allies so each of these elements may be prioritized in different contexts or different bilateral relationships. These tradeoffs lead to questions about nuclear deterrence and reassurance, including how to square extended deterrence commitments with nuclear reductions and how to develop adequate capabilities to deter a range of threats. The creation of a standing body that could consider strategic stability issues in an interagency context may be needed as a means to improve coordination, introduce new thinking, and avoid organizational stovepipes through dialogue and exercises.

Using Quantitative Methods and Modeling to Understand Contemporary Challenges to Strategic Stability

Models, used extensively during the Cold War by both the United States and the Soviet Union, were created to address the most narrow form of strategic stability — first strike stability — and as such were focused on capabilities and consequences of different force structures on the decision calculus of the adversary. However, contemporary definitions of strategic stability are broader in scope, and include crisis escalation stability and, in some cases, the stability of the global or regional order. Due to this complex nature, little quantitative data or research exists on the broader scope understanding of strategic stability. At the same time, the ultimate goal of modeling is fundamentally the same—to provide perspective on potential outcomes and decisions. The questions remain broadly the same in interpreting an adversary's decision-making. What do they want? How do they make decisions? What are their perceptions? What might they do? What are the consequences?

Several challenges exist in attempts to model contemporary strategic stability. First, analysis is no longer focused on existential threats alone but is also concerned with limited threats or limited nuclear use. Second, the conflicts and actors involved are wider in scope. Moving beyond traditional two-actor models radically complicates the operational space and the models needed to map possible outcomes. Third, timelines are shorter and the status quo is more volatile. Rapidly changing problems, objectives, and potential outcomes complicate modeling. This requires more thorough analysis of what might happen in a given scenario. Finally, there are fewer opportunities for modeling to be integrated into policy. During the Cold War, analysts were able to develop models over time in a more stable, long-term security environment.

First, analysts and policymakers should bring more quantitative approaches to addressing uncertainties, and link these approaches to what modeling the quantitative analytical community already does on consequences and capabilities. This will necessarily broaden the scope of what is modeled. Second, modelers should work on the complexities we have in the contemporary multilateral security environment. This means focusing work on issues like nuclear trilemmas, escalation dynamics, limited nuclear use, or how crises escalate and deescalate. Third, policymakers and analysts must recognize that identifying consequences in other domains will be hard, but there is a need to work through this. Fourth, there remains a need to work with others, particularly potential antagonists through either Track 1 or Track 2 forums, to increase the accuracy of prescriptive models. There are examples of such engagement during the Cold War that should be revisited.

Looking forward, there are questions regarding the feasibility of the post-Cold War "Goldilocks approach" toward strategic stability and deterrence adopted after the Cold War—whereby the U.S. could adjust nuclear posture and non-nuclear capabilities to deter regional adversaries and reassure allies in different environments while also assuring major powers and reducing the role of nuclear weapons. Strategic stability in the contemporary security environment is fundamentally about trade-offs, and requires recognition that negative effects in some relationships should be expected to result from actions perceived to be stabilizing in others. Analysis of these potential second and third order effects, specifically those that occur across domains, is a priority for success in crafting stabilizing policies and enhancing strategic stability.

Rethinking Strategic Stability with Russia

There are significant issues regarding how the U.S., NATO, and Russia perceive strategic stability, and each of these actors brings with them a different hierarchy of needs. Whereas Thomas Schelling and others described strategic stability in positive terms, the contemporary security environment has turned it into a battle cry. Both the United States and Russia use the broad framework of strategic stability to pressure the other. Russia, in particular, has mastered this and uses harsh rhetoric to link nearly everything from space to sanctions to perceived manipulation of color revolutions in Russia's periphery back to strategic stability and the prospect of nuclear use. This linkage of issues offers important insight into how Russia views strategic stability and how Russia invokes it as part of an overall strategy.

Perceptions of what constitutes strategic stability are deeply ingrained in both Russia and the United States. It has been the longstanding view of Russia's leaders that the U.S. is an aggressive military power, intent on encircling Russia and blunting its strategic forces. Meanwhile, the conventional view in the U.S. is that Russia seeks to undermine the credibility of U.S. nuclear and extended deterrence, is intent on moving toward regional dominance, and may be moving towards an effective nuclear war-fighting strategy. While recent Russian aggression in Crimea and Ukraine present real dangers, strategic stability with Russia has never been easy, and the complex security environment presents imperfect tradeoffs. These tradeoffs may, however, lead to innovative and practical improvements through engagement.

Both geopolitical and technical ambiguities present unique strategic stability challenges between Russia and the West. From Russia's perspective, NATO is a Western instrument for containment with its forces on Russia's doorstep. NATO's plans for continued enlargement further complicates the issue. The support that the United States and NATO provide to non-NATO allies on Russia's periphery are seen as further examples of containment and encirclement by the West. Military operations conducted by the U.S. and NATO without a United Nations mandate is seen as further proof of this containment effort.

The stability Russia seeks is a predictable environment. It seeks to restrict technologies that may undermine its nuclear deterrent. It seeks to prevent regime change in client states while maintaining a weak periphery. It seeks to retain the privileges of being a recognized nuclear weapons state and P5 member.

New means of warfare make strategic stability harder to define and maintain. For example, the notion that actions in the cyber domain could trigger NATO Article V has pushed Russia and the West toward lower levels of conflict and hybrid forms of warfare.

From a NATO perspective, there are few opportunities to enhance strategic stability. NATO must be seen as ready to engage with Russia while maintaining a robust defensive posture that includes nuclear and conventional deterrence. This means NATO has to defend its extended deterrence requirements in the face of scrutiny by Russia as well as Western disarmament advocates. These critics argue that forward basing, short flight times, and missile defense erode strategic stability. Workshop participants expressed concern that if there was a reduction or removal of some of these capabilities, or a rolling back of U.S. and NATO conventional forces, this may embolden Russia to act more aggressively.

For the time being, bilateral engagement between the United States and Russia must remain the focus. Due to the deterioration of U.S.-Russian relations, finding a trusted interlocutor that can reliably speak with the Russian side presents a significant problem. In the absence of a demand for formal arms control negotiations (which the Russians value), those who engage with Russia should revisit basic background materials on Russian negotiating behavior. There is a need for discussions to be frank and open, with technical experts allowed to engage early, and time provided for informal discussions, which are critical to advancing discrete tasks. Finally, the United States should think simultaneously in terms of both near and long term objectives. Engagements on strategic stability between the United States and Russia exist, but they have not been effective and are largely antagonistic. Frank discussion, including on redlines, may be the best means to abate miscalculation in the current security environment.

Rethinking Strategic Stability in Northeast Asia

China is reluctant to discuss strategic nuclear issues in any detail at the government level. It claims to believe that strategic stability is appropriate only between nuclear equals, and since it does not view itself as a nuclear equal with the United States, the term confuses them when the United States attempts to apply it to China. China views strategic stability in much more expansive terms

than the United States, and includes diplomatic and economic factors in its assessments of stability. This has caused some to question whether the term (but not the concept) has lost its utility in the U.S.-China relationship. It was discussed that strategic stability may be more useful as a guiding concept for risk management, and the concept of strategic stability may be overvalued by both countries.

Strategic stability, narrowly defined, exists between the U.S. and China. China can reliably destroy a small number of U.S. cities and believes that there are no U.S. interests important enough for the United States to risk that outcome. As such, de facto mutual vulnerability between the United States and China likely exists. China's core concerns are that U.S. national missile defense and U.S. emerging counterforce capabilities may negate the viability of its strategic forces. Consequently, China prioritizes qualitative responses — better penetration of defenses, concealment, and mobility of launchers — to thwart these concerns. These dynamics further complicate policy and regional conceptualization of strategic stability.

In comparison to Russia, China is far less provocative and destabilizing on the nuclear level. China views its declared no first use policy as a core element of a strategically stable relationship with the United States. However, China may be (even) more geopolitically destabilizing at the conventional level. Aggressive Chinese operations in the maritime domain are a core concern. While the United States and its allies and partners in the region view Chinese actions as provocative, China probably doubts these actions will lead to conflict, especially not a major confrontation with the United States.

Three steps may be offered to address strategic stability in the U.S.-China relationship. First, the United States should offer China some of the confidence-building measures on national missile defense that it proposed to Russia. Second, it should assume that Track 1 and Track 2 dialogues will continue to provide the majority of U.S. insights into Chinese thinking and, therefore, the U.S. government must be more systematic about capturing and integrating the results of such dialogues. Finally, the United States needs to do much more thinking about the strategic stability implications of China's new operational aggressiveness at sea.

On North Korea, there is uncertainty as to whether a nuclear-arming North Korea actually presents a direct challenge to strategic stability with the United States. Instead, North Korea may be a catalyst for issues that impact strategic stability in the region. A core source of this uncertainty is Kim Jong Un himself. There is little reliable information about how Kim processes information and his overall tolerance for risk. While Kim Jong Un uses reckless and irresponsible rhetoric, his actions appear carefully crafted to avoid actual hostilities. However, the ruthlessness of Kim's consolidation of power suggests that his subordinates may be very reluctant to challenge his decisions or analysis. Further, there is no evidence that he or his top leaders understand the West. Thus any risk to stability is likely to be the result of miscalculation and, therefore, difficult to thwart or to manage.

A singular complicating factor is that North Korea's technical progress has often surprised the United States and the rest of the world. The sophistication of their enrichment facilities and the

pace of their nuclear and missile test programs, including submarine-launched systems, is increasing. The impact on strategic stability from these rapid developments may in fact be global rather than regional — presenting a significant proliferation risk once Kim Jong Un believes he has met his deterrence requirements.

The United States has succeeded in isolating North Korea and should continue its policy of regarding it as a pariah state with an illegal weapons program. The U.S. should continue to maintain a robust national missile defense and strong theater defenses of South Korea, Japan, and Guam as a hedge against North Korean miscalculation in a crisis. To reduce the continued North Korean proliferation risk, the U.S. should resurrect creative ideas to force the inspection of aircraft and ships. Noting that North Korea is progressing through its technological development process without any information exchanges, it may be in the interest of the United States to consider direct engagement with the North as its capabilities continue to increase but it is important to acknowledge that little progress can be made in these areas without China.

In looking at the role of nuclear deterrence and ballistic missile defense in preserving and influencing strategic stability in the Asia-Pacific region, the conventional wisdom may be right — that nuclear deterrence reduces the chance of major war by making it too dangerous and increases stability by reducing allied incentives to acquire nuclear weapons themselves. While missile defense worries China, limited deployment of missile defense in cooperation with U.S. allies in the region is necessary to deter and defend against North Korea. Alternatively, nuclear deterrence and ballistic missile defense do not contribute to strategic stability in the region to the degree they are commonly ascribed. Ballistic missile defense and U.S. conventional counterforce capabilities contribute to long term regional instability with the Chinese, who are likely to continue to diversify their nuclear and non-nuclear capabilities and postures to address perceived U.S. advantages. Additional trends such as the continued comingling of conventional and nuclear command and control nodes, when combined with a contentious Chinese maritime strategy, have the potential to drive nuclear escalation risks to lower thresholds. Nuclear and extended deterrence, while latent and in the background of Northeast Asian geopolitical dynamics, is ultimately about controlling escalation in a crisis. Waning U.S. conventional superiority in the region may be a more significant driver of escalation and instability in the region.

There are several sources of instability in Northeast Asia. First and foremost, is the low probability, but high impact, of the collapse of the North Korean regime. China, the United States, and South Korea would all want to see order restored and the North Korean nuclear arsenal seized and secured. The three states would all have different priorities and the possibility of confrontation is high. Preventing such confrontation will be difficult at best and probably impossible without some advanced coordination. A second major source of instability would be the development of either a South Korean or Japanese nuclear weapon. While confidence in U.S. extended deterrence should prevent this, and significant domestic political challenges remain in each country, quiet thinking about how the United States would react to such proliferation would be a useful exercise. Lastly, intensified South Korean rhetoric and revelations of a decapitation

strategy in the event of an impending North Korean nuclear strike may be another source of instability.

Exploring Multipolarity in Asia

While strategic stability in Northeast Asia is pessimistic, the multipolar view of strategic stability in Asia is far worse. First, there is inherent instability in multipolar studies and quantitative models. Second, the diversification of strategic weapons across Asia, and the different ways countries think about their role is also destabilizing. Third, many of the red lines that exist in these multipolar dynamics become tangled, leading to security trilemmas that are cause for concern.

There are three security trilemmas in particular. First, the U.S.-Russia-China relationship demonstrates how multipolarity may impede next steps in arms control as well as the potential for a sprint to parity. Second, the China-India-Pakistan relationship demonstrates how a deterrence relationship between two states, or the development of new offensive or defensive capabilities or shifts in posture, may impede stability with the third. Third, the U.S.-North Korea-China-India relationship demonstrates how defensive capabilities put in place to defend against a limited threat may create a change in posture in a third country, which may extend to the deterrence relationship of a fourth.

Additionally, the proliferation of advanced conventional capabilities to U.S. adversaries and allies alike creates a degree of complexity that was absent during the Cold War. These complexities suggest the need for even more cautious and conservative U.S. foreign policies in the region, including placing a priority on managing allies and encouraging tacit restraint. The U.S. should place a premium on remaining a constructive player in the region, particularly during times of crisis. Joint education and engagement are critical to maintaining this role.

A more focused discussion took place on South Asia, and the impact that China and the United States have on the stability of the India-Pakistan nuclear relationship. While much of the focus on South Asia remains with India and Pakistan, the poles in the regional nuclear order exist outside the region. Pakistan's nuclear posture, for example, is focused on India. However, the reverse is not true. India's nuclear posture is much more intently focused on China as a long-term peer competitor. China outmatches India on several fronts, including defense budget, size of the military, nuclear arsenal size and posture, and India adjusts its own nuclear posture accordingly. Additionally, China's nuclear posture is driven not by India, but by the United States. Chinese capabilities are postured to counter U.S. ballistic missile defenses and emerging conventional strike capabilities. The result is a highly complex, multipolar environment with a number of sources of instability.

To counter these sources of instability, each country is taking specific steps. China is expanding its sea-based deterrent as well as the mobility of its forces, and may also be contemplating a shift to a launch on attack/launch on warning posture. India is responding with quantitative and qualitative improvements of its own, including land and sea-based delivery systems and the expansion of reach to cover all parts of China. Pakistan, too, is improving its nuclear capabilities,

though it is driven by improvements in India's conventional capabilities and improvements in its ability to conduct integrated military operations that Pakistan views as threatening to its strategic forces. As such, Pakistan relies much more heavily on nuclear weapons to deter India, and adopts a posture that threatens rapid escalation to the nuclear level. While Pakistan views this as a credible deterrent, it is a significant source of instability that may drive India to pursue similar capabilities or postures.

While each of these steps are arguably reversible, they offered little optimism that the U.S. can do much in South Asia beyond attempts at managing the issue. With China, there may be trickle down effects of a U.S. acceptance of mutual vulnerability with China, which could reduce pressures on China to improve its capabilities and therefore pressures on India. However, this comes with potentially significant tradeoffs in other regions, particularly with respect to allies in Northeast Asia. The United States could also continue to communicate with Pakistani leaders about the dangers of their current posture and actions. There has been some of this at the Track 1.5 and Track 2 levels, though questions remain regarding the impact of these dialogues. Further, the United States could encourage India to roll back its Cold Start posture, however Indian leaders repeat that the posture is for deterrent purposes and that it is not India's responsibility to make Pakistan more secure. Finally, in the event of an India-Pakistan crisis, the United States could again intervene diplomatically, however, the United States should be clear that it is not responsible for diffusing the crisis. There are virtually no prospects for arms control in South Asia in the near future. India and Pakistan do not want their capabilities to be limited. While both countries appear to understand the other's nuclear doctrines and postures well, there is real risk that India and Pakistan are overconfident in their ability to manage escalation in the region.

Assessing the Impact of Cross Domain Competition on Stability

Hybrid warfare, asymmetric warfare, or cross domain competition are, in general, a grouping of *ad hoc* strategies crafted by regional and global adversaries of the United States that have evolved into a coordinated effort to erode a U.S.-dominated global order. Each views a U.S.-dominated international order to some degree as an existential threat, and as such, each must approach any attempt at regional expansion or dominance in a way that preserves regime control, decreases U.S. control, and do so without risking a major conflict with the United States by avoiding or subverting U.S. power projection and capabilities. This necessarily led to strategies and tactics that fall outside the traditional domains of air, land, and sea, while capitalizing on new domains, such as space and cyber. In recent history, the principle actors in this domain have been Russia, China, Iran, and to a lesser extent, North Korea.

In the United States, integrated and effective strategies for conducting cross domain deterrence are also new and still emerging. Even in cases where the United States has indicated it implemented a cross domain deterrence strategy, the response often occurs within the same domain. In the cyber domain, the United States has no coherent deterrence strategy or declaratory policy that governs the use or response to the use of cyber capabilities. In the space domain, the vulnerability of U.S. satellites to a range of attacks has prompted new emphasis on

building up the resiliency and redundancy of space systems. New developments and practices in each domain remain highly classified.

Cross domain competition is also evolving. Between major powers, the integration of military forces with intelligence capabilities across the space, cyber, and traditional domains continues to grow. At the policy level, the U.S. government is in the middle of trying to establish norms of behavior in the space and cyber domains. Competition between states is fierce. Russia and China are each competing with the United States to upset U.S. dominance in precision-strike, space-enabled integration with military operations, and the integration of real-time intelligence, surveillance, and reconnaissance (ISR). While the Defense Department's Third Offset strategy remains nebulous, there is no question that a driving factor is the continued improvement of the U.S. ability to make decisions during a conflict with speed and accuracy—in large part, a reaction to growth in Russian and Chinese anti-access and area denial (A2/AD) capabilities. If cross domain competition continues to evolve along the same trend lines, U.S. policymakers can expect greater uncertainty, greater first-strike instability, and greater risk to regional security. This competition extends to strategic stability, escalation stability, and the nuclear balance.

For Russia and China, the evolution of cross domain competition and cross domain deterrence is set against the backdrop of several key shifts over the last 15-20 years. These include the U.S. withdrawal from the Anti-Ballistic Missile (ABM) Treaty, the development of national missile defense, and advancements in precision strike capabilities. These set the tone for major power competition and created significant uncertainty in both countries regarding the intentions and developing capabilities of the United States. Coupled with rapid economic growth in both Russia and China, this led to an increase in their own military capabilities to blunt U.S. advantages in missile defense and precision-strike, including A2/AD, anti-ship missiles, and space-enabled capabilities. Both countries have also expanded counter-space capabilities and are undergoing nuclear modernization programs with a focus on multiple independently targetable warheads (MIRVs) and concealment and mobility of launch systems. China in particular has been more focused on precision strike and space as part of its A2/AD strategy. Russia and China are also making headway in ballistic missile defense, though China appears to be taking an "anti-satellite (ASAT) first" approach, capitalizing on the similarities between ASAT and ballistic missile defense technology.

A final shift has been a transition into a "golden age of signals intelligence (SIGINT)." The information technology revolution enabled the collection of vast amounts of data, and the emergence of malicious programs such as Stuxnet signaled a major shift in the international security environment where digital code has the ability to impact the physical world. On the "soft" side of cyber, both the Russians and the Chinese have used cyber as a critical part of information dominance operations that seek to (falsely) undermine the legitimacy of regimes in order to meet strategic or regional goals.

The United States is reluctantly getting pulled into counter-space strategies, and military leaders are beginning to view space as a real war-fighting domain. A key reason for this appears to be that the United States would be loath to cede escalation dominance in any domain.

There are key differences between the space and cyber domains. First, space is a strategic asset for the United States, whereas cyber capabilities have manifested in more tactical ways. Space capabilities underlie nearly all elements of U.S. power projection, including nuclear command, control, and communications (NC3); electronic warfare; positioning, navigation, and timing (PNT); and near-real time ISR for situational awareness and precision strike. Cyber is becoming a mature war-fighting capability, and we have become more aware of cyber vulnerabilities across all domains. While there has been healthy debate (and hype) in the United States about how cyber has evolved, there has been much less debate about space, despite its fundamental role and increasing vulnerability.

Second, escalation in the space and cyber domains is different. Vulnerability in space is compounded by the fact that space is an offense-dominant domain. Adversary ASAT systems currently in place or nearing development can hold targets at risk in nearly all orbits. Cyber, while often considered to be offense-dominant, may be less so. Significant resources and labor go into discrete offensive cyber capabilities that are rendered ineffective after their first use. Attacks in space are less well understood, and may be at greater risk of first-strike instability leading to escalation that quickly spirals out of control. Counter-space systems increase this uncertainty. In the cyber domain, there has been less evidence of the potential for escalation to other domains. This may be in part due to the emergence of cyber as a soft power or political tool, rather than a tool of hard power as is seen in the space domain. As such, space may be more susceptible to conflict escalation, whereas cyber may be a more fundamental threat to regime stability and legitimacy.

Prospects for engagement on strategic stability across domains are likely to be episodic, and there are many inhibitors to direct dialogue. A key issue is that many of the policy discussions on deterrence, offense and defense, and general policies in these domains remain behind closed doors. Further, there are competing viewpoints among the United States, Russia, and China on what each domain is best suited to do, and what escalation and response in each of these domains looks like.

Russia and China view the cyber domain as a critical tool for information warfare and shaping the political environment in steady state and "pre-war" operations. The United States thinks of cyber in terms of a thin slice of signals intelligence and the potential for hard kinetic effects. U.S. efforts to set international norms in this domain have been largely unsuccessful. The cyber domain is useful to the Russians and the escalation risks for such operations appear minimal. Uncertainties regarding attribution, the ability to create a tailored effect, and assessments of the impact of offensive cyber operations are also factors that inhibit discussion.

In the space domain, some limited progress has been made. In May 2016, the United States and China held their first-ever space security exchange. The dialogue was formed out of the necessity surrounding the establishment of a direct link with the Chinese on conjunction notifications and mutual vulnerability to space debris. There are prospects for additional opportunities for dialogue as mutual vulnerability and mutual reliance on space capabilities increase.

Exploring the Impact of Technology Development on Stability

Additive manufacturing is being used to advance almost all existing nuclear weapons programs and many nuclear energy programs. The incentives to use the technology and the potential for whether additive manufacturing will yield meaningful impact or little impact on a weapons program, depends on several factors. A critical variable is whether a state is an advanced nuclear power, an emerging nuclear power, a new nuclear weapons state, or a latent nuclear weapons state.

Advanced nuclear powers, such as the United States, Russia, or China, possess sophisticated nuclear enterprises and are tasked with ensuring the reliability of aging weapons and old production lines. They are motivated by the desire to modernize and recapitalize specific capabilities, and provide a hedge capacity to anticipate and respond to potential technical and political shifts. One hypothesis is that the incorporation of additive manufacturing in these advanced nuclear programs will yield little or no meaningful impact. While such capabilities may be adopted in the small scale to some evolutionary effect, financial, organization, and bureaucratic pressures were likely to restrict large-scale adoption of the technology. Erosion of stability in these examples is likely restricted to if other states fail to invest in additive manufacturing technologies, thereby generating a window of opportunity for a lagging competitor to achieve parity or an asymmetric advantage in nuclear capability. More likely, competitors such as Russia and China will utilize the technology as a means to keep pace with the United States' own investment in additive manufacturing.

Emerging nuclear weapons states such as Pakistan and North Korea have smaller, nimbler, and simpler nuclear weapons enterprises. As such, they have less robust technology, but have the potential to be more innovative with their technologies. They are also highly motivated to move from small complexes to larger, more complex nuclear weapons programs. Here, it is especially important to consider the null hypothesis. While such states may be motivated to expand their programs, their capacity for innovation is unclear. Both Pakistan and North Korea have demonstrated the capacity to adopt foreign technologies. If they were able to absorb additive manufacturing, the question remains to what extent these actors could use it to field larger, more diverse nuclear weapons programs.

The impact of additive manufacturing on new nuclear weapons states is likely a longer term issue, but it may lead to meaningful advancements in a latent nuclear program. This would be particularly true if additive manufacturing technologies were to lead to any meaningful advancements in fissile materials production. However, it could also lead new nuclear weapons states down unproductive paths, with greater points for foreign sabotage or cyber vulnerabilities.

Similarly, the value of additive manufacturing for latent nuclear programs would be dependent upon whether such technologies could aid in the production of fissile materials at scale or reduce the probability for detection. As acquisition of fissile materials is central to the process of developing a nuclear weapon, a critical factor is likely whether—and how much—fissile material a country already has in its possession. A state with little fissile material on hand might find little

value in additive manufacturing, whereas a country with significant stockpiles of enriched uranium or plutonium may benefit significantly. However, additive manufacturing is unlikely to have a significant impact on the fundamentals of the nuclear fuel cycle, which is likely to remain the principal barrier to a nuclear weapons program.

Discussions of advancements in disruptive technologies yield some implications for the survivability of nuclear forces and for analyzing the impact of technologies on strategic stability.

Historically, there are examples of advancements in fundamental technologies such as early computing and networking that have had significant implications for a range of national security priorities. First, during the Cold War, the combination of undersea sensors with advanced computing via the SOSUS system enabled the United States to network data with anti-submarine aircraft and attack submarines to hold nearly the entire Soviet ballistic missile submarine fleet at risk. Similar technologies have been used successfully in tagging, tracking, and locating programs by defense and law enforcement in urban environments, and unattended sensors have been used to great effect in counterinsurgency operations.

Other technologies enabled by information technology have aided holding second strike platforms at risk in new ways. First, the accuracy revolution through improved navigation systems and enabled by multispectral imaging makes it increasingly possible to hold mobile and concealed forces at risk with low collateral damage. This can conceivably be applied to land-based strategic mobile launchers. Additionally, networked and autonomous unmanned underwater vehicles (UUVs) present the United States and adversaries alike with the opportunity for continuous, non-acoustic trailing of ballistic missile submarines.

While these developments cause significant concerns regarding whether adversaries may at some point in the future be able to hold U.S. second strike capabilities at risk, many emerging technologies have the significant disadvantage of being dependent on networked computers. This reliance on networks presents numerous opportunities for exploitation of cyber capabilities. While opportunities are growing for emerging capabilities to undermine traditional strategic stability, so too are the nontraditional means to disrupt these capabilities. Further, it is incredibly difficult to conduct thorough, open-source assessments of some of these emerging technologies because many are highly classified, compartmentalized programs.

While there are few prospects to address the development of these emerging technologies through formal processes such as arms control, there may be opportunities to address the problem of opacity through other means, including deception. For example, the United States could hypothetically "reveal" a new cyber capability to interfere with advanced integrated air defenses but sell the capability as a new form of stealth technology. However, the extreme compartmentalization of some new and innovative technologies may prove an impediment to their use, particularly if planners or policymakers are not cleared to view, and therefore implement, the programs. Using the technology also carries its own consequences, since in some cases, technology demonstration may even be a one-time event, as the revelation of some capabilities may lead to the rapid development of countermeasures.

Assessing Implications for U.S. Strategies to Promote Stability

Deterrence and arms control have been and remain critical to maintaining strategic stability, and the 2010 Nuclear Posture Review offers a sound starting point to consider strategic stability. However, the decline in U.S.-Russian relations and China's rise pose fundamental challenges to strategic stability in the future and impeded the Obama administration's progress in these areas. Further, questions of reciprocal restraint between states appears limited as many of the technologies discussed are dual use or are seen as critical in the perceptions of the United States and its allies for defense and deterrence. Moreover, the multipolar environment complicates formalized processes and agreements on restraint. Instead, informal processes and the development of norms, such as prospects for space or cyber codes of conduct or the possibly of limiting ASAT flight testing are areas where there may be some promise. While the prospects for arms control are slim, they still need to be pursued as the United States thinks through the full range of capabilities from deterrence to arms control and nonproliferation. The United States cannot and probably will not be able to provide effective responses to all strategic threats from technology in all domains, and, as such, cross domain strategies will probably need to be considered moving forward. The national laboratory system supports the U.S. government in this way and provides a necessary hedge against these uncertainties that come from this remarkable new threat environment.

There are some principles that could serve as a basis for thinking about strategic stability moving forward. First, stability only makes sense with some kind of equilibrium or some kind of mutual restraint. Second, strategic stability is based on some degree of mutual vulnerability. Third, strategic stability should be tied to a structural mechanism, and as such, some degree of formal engagement between actors is necessary. A system must be stable enough to fall back on when tested.

There could be three key challenges to strategic stability. First is the future of strategic arms limitation. While parties to arms control agreements pledge to make reductions, they often improve upon technologies that may upset strategic stability. A second challenge is the diversity of players with strategic capabilities. The diversity of these players' strategic capabilities also complicates the ability of the United States to respond to individual threats without upsetting some other aspect of the multipolar strategic balance. This is a reality that could drive some limited arms build-ups. A prime example of this dynamic is the question of whether to continue with limited missile defenses against North Korea. A third challenge is that changes in strategic capabilities are increasingly available to major powers. This has the potential to upset the strategic balance through large scale or debilitating attacks on strategic assets or supporting systems. These capabilities must be considered in terms of incentivizing a first strike.

Narrow definitions continue to drive the issue — above all the preservation of second strike forces and lowering the probability of a large scale war. Confidence- and security-building measures (CSBMs) are critical to this process. However, they share similar constraints as arms control, in that, they only work if the parties are committed to making them work, and they are

limited in their effectiveness by their construction. For example, under the Vienna Document, states are required to provide notifications in advance of military exercises and activities exceeding certain amounts of equipment. Russia, however, has been engaged in regular snap exercises, including with strategic forces, which sometimes exceed 50,000 to 90,000 troops. NATO, on the other hand, provides ample notice of its exercises and invites observers from other countries, including Russia. Russia's recent withdrawal from several nuclear agreements and suspected violation of treaties, including the Intermediate-Range Nuclear Forces (INF) Treaty, calls Russia's commitment to CSBMs into question. Participants offered that CSBMs may be viewed as tools for both cooperation and competition. While it is in the interest of all parties to find ways to cooperate, if one party becomes more wedded to any agreement, another party may generate leverage by walking away.

Lessons Learned

In looking at the discussion, some lessons were highlighted. For example, the United States considers strategic stability to be an overarching strategic goal, a shift from punishment and denial to a world with mutual restraint. To some extent, that was plausible during the Cold War, however, the current security environment represents a fundamental change in attitudes and aggression of U.S. adversaries. This includes an increased reliance on nuclear weapons by Russia, changes in technologies, and drastically reduced future prospects for arms control. Tools such as CSBMs seem to be an unrealistic option in the near term because they would disadvantage the United States. Therefore, a narrow focus for strategic stability, that includes deterring or containing grave harm against U.S. and allies, is likely the most useful way to approach the concept in the near term. This leads back to deterrence in the traditional nuclear sense, which depends on capability and credibility. Credibility in particular is challenging, and it depends on a plausible willingness to escalate. This may force the United States to look beyond nuclear capabilities to conventional forces. There is an intimate link between escalation and deterrence at the non-nuclear level, and emerging capabilities in the cyber, space, and conventional domains will be a critical part of reassuring allies. A critical piece of this is close consultation with allies.

Relationships between Arms Control, Deterrence, and Strategic Stability

Getting the U.S. approach on strategic stability right will be one of the important tasks of the next administration. Strategic stability is a complex, multifaceted concept that incorporates complicated geopolitical dynamics stemming from an increasingly multipolar security environment and advancements in emerging non-nuclear technologies with implications at the strategic level.

A key challenge is the intellectual decoupling of the complementary concepts of deterrence and arms control over the last decade or two. Deterrence and arms control both share the goal of enhancing stability. Deterrence addresses the task by seeking to constrain threats. Arms control enhances stability by reducing threats. Each aspect has become more complex in its own way.

Deterrence in the contemporary security environment has become more complex for a variety of reasons. The United States must now deter multiple adversaries and provide assurances to allies with a range of nuclear and non-nuclear capabilities. Russia and China are modernizing their nuclear programs, as are India, Pakistan, and North Korea. Iran continues to expand its ballistic missile programs. Additionally, advancements in space and cyber capabilities by a range of new actors impacts strategic stability significantly. The United States must consider these capabilities in order to shape a dynamic security environment.

Arms control has become more complex because of the shifting political relationships among major powers. Effective, verifiable arms control measures can contribute to international stability by limiting the development, deployment, and stockpiling of certain weapons. They can help to foster understanding, cooperation, and even trust between the actors engaged in implementing such agreements, and can shift the relationship between states from one characterized by uncertainty to one characterized by restraint. While U.S.-Russian relations have deteriorated since New START was signed in 2010, strategic arms control has continued to provide a measure of stability in the relationship—at the very least through enhancing U.S. insights into Russian capabilities.

The effective integration of these two means requires that the U.S. government be organized in a way that fosters better integration of thinking and work on arms control and deterrence. Currently, such work is distributed among many assistant secretaries and senior directors at the Departments of Defense and State as well as the White House. Comprehensive thinking by U.S. allies on nuclear deterrence and nuclear arms control is also needed. Third, new thinking on cross domain deterrence — particularly the role of non-nuclear capabilities in strategic stability — should continue in the non-governmental and research communities. Bureaucratically, participants recommended that the next administration needs to examine where the seams are between deterrence, arms control, nonproliferation, new global and regional actors, and non-nuclear and emerging technologies like space, cyber, and missile defense. The intersection of these issues are precisely where stovepipes form and where issues get complicated.

Advancing strategic stability in the contemporary security environment will be difficult and will require creative thinking on both the arms control and deterrence sides. Specifically, it will require acknowledgement of the bond between the two issues. Arms control, nonproliferation, and deterrence are all valid instruments of national security that must not be pitted against each other. Instead, they should be leveraged to enhance strategic stability as part of a comprehensive strategic analysis and not as preconceived notions.