The Role of Nuclear-Conventional Intermingling on State Decision-making and the Risk of Inadvertent Escalation

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Question "F":[2]

1) What are the implications of nuclear and conventional intermingling on **crisis stability** and the potential **risk of miscalculation**?
2) Specifically, how might entanglement influence US and competitor decision making during crisis and conflict?

Framing the problem

In practice, there are three main forms of nuclear-conventional intermingling.[3] First, intermingling between nuclear and non-nuclear weapon systems can occur via the fielding of dual capable delivery systems like missiles or aircraft. Second, intermingling can happen due to the co-location of nuclear and non-nuclear forces and their support structures—for example, the co-location of strategic bombers and general-purpose aircraft, or the co-location of strategic submarines and general-purpose vessels. Third, intermingling can occur via convolving nuclear and conventional military command and control systems, to include ballistic missile early warning and potentially space surveillance systems as well.

All three forms of nuclear-conventional intermingling have significantly increased since the end of the Cold War, driven by both technological and doctrinal changes.[4] However, there are important differences in the rationale behind, and also the risks associated with these three different forms of intermingling. The mere existence of dual capable systems is not new—deploying such systems can increase the effectiveness of forces, and it can also provide more flexibility. The major powers have both employed and threatened with dual capable systems for decades, and they have done so without nuclear escalation.[5] Similarly, the major powers co-

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[2] The research for this question was conducted in support of a Strategic Multilayer Assessment study in support of USSTRATCOM. This effort was initiated to address questions regarding the implications of the increasing numbers, and expanding capabilities, of US nuclear adversaries many of whom have integrated nuclear weapons into operational concepts for future warfare.

[3] Acton, James M. (ed.) "Entanglement—Russian and Chinese perspectives on Non-Nuclear Weapons and Nuclear Risks," Washington, DC: Carnegie Endowment for International Peace (2017). https://carnegieendowment.org/files/Entanglement_interior_FNL.pdf.

[4] Acton, James M. "Escalation through Entanglement," *International Security* 43, No. 1 (Summer 2018): 56–99.

[5] Kroenig, Matthew and Mark J. Massa. "Entanglement and Inadvertent Escalation," Washington, DC: Atlantic Council (June 2021). https://www.atlanticcouncil.org/wp-content/uploads/2021/06/Nuclear-Entanglement-IB-v7.pdf.

located nuclear and conventional systems in the Cold War, and they did so for variety of reasons that had nothing to do with complicating the adversary's risk calculus. The Soviet Union, for example, decided to co-locate its nuclear and conventional forces for economic and administrative reasons. Although today it might be recognized as a useful deterrent tool, it was not their primary intention. Major powers want to convince rivals that the co-location of forces creates a high bar for targeting and raises the risk of nuclear escalation, but they also want to have the flexibility of this not being true in an actual crisis or conflict.

Thus, we believe that the front-line of risks is not the weapons systems themselves, or the co-location of nuclear and conventional forces. Instead, the key drivers of instability are the threats to dual purpose command and control and military situational awareness systems. Technological developments in the cyber and outer space domains created a number of new non-nuclear threats against both nuclear forces and their command and control systems. With the rapid advancements in conventional precision-strike capabilities, today there is a wide array of kinetic and non-kinetic threats that could undermine the effectiveness of nuclear deterrence and create new sources of crisis instability. As a result of the growing number of threats, command and control systems have also become more vulnerable. Since the end of the Cold War, many redundancies have been eliminated in command and control systems, making them less resilient, and creating strong incentives to strike first in a crisis. Although these actions remain risky, there is a strong potential for a high pay-off. In parallel to these changes, the United States, Russia and China have all increased their reliance on dual use command and control assets that support both conventional and nuclear operations. These overlaps make it more likely that nuclear command and control would be under threat from the early onset of a conventional conflict between the great powers. Lastly, important doctrinal changes have also contributed to increased nuclear-conventional intermingling. All three major powers have military doctrines that in case of a conventional conflict would call for attacks on space- and land-based command and control systems. Due to the dual use nature of these systems, this could also include assets that are essential for nuclear operations, like for example early-warning radars. As a result of these factors, nuclear-conventional intermingling is likely to be a salient factor in U.S. and competitor decision making in crisis and conflict, and threats to dual use command and control will be the significant factor driving up the risk of miscalculation.

The emerging strategic environment between the U.S., Russia and China with cyber and counterspace weapons backed by kinetic strike capabilities presents a new set of options to strike at command and control systems. These threats to command and control present new avenues to first strike instability, in that military actions grounded in emerging doctrine and force structure at the outset of a conventional conflict could very conceivably result in

inadvertent nuclear escalation.[6,7] In a crisis, each side will be considering what risks they can take that will gain them an upper hand in bargaining and a greater potential to win if the crisis escalates. One of the early risks each side will consider is whether to attack the other side's command and control, specifically using cyber or counterspace capabilities that are largely unseen by the public eye and by third parties. Attacks against these systems that are either reversible or of limited scale—limited to a region rather than the system as a whole—are likely to be attractive as they convey a willingness to run risks in a way that is both unseen by the international community, and that provides a military advantage for the next stage of the crisis. Besides, such attacks can also create disruptive effects without directly resulting in casualties, and the likelihood of delayed attribution could further benefit the attacker. As crisis turns to conflict, these same systems will likely become targets for kinetic or irreversible attack, as will the end weapon system platforms themselves. Thus, dual-purpose command and control is the key intermingling driver for crisis instability and miscalculation in the years ahead, not the co-location of nuclear and conventional forces nor the fielding of dual capable systems.

This report will proceed in four parts. First, we will assess the nature of nuclear-conventional entanglement on the U.S., Russian and Chinese sides. Second, we will assess each state's means of potential attack against these systems. Third, we will evaluate how these attacks may affect decision making, as well as crisis stability and the potential of miscalculation. And fourth, we will discuss measures that each state can take to reduce these new risks.

Nuclear-Conventional Intermingling: Red and Blue

The U.S. military has long undertaken nuclear and conventional comingling in a number of ways, and increasingly Russian and Chinese counterparts are doing the same. The U.S. Air Force has long used dual capable aircraft as well as strategic bombers, some of which can carry both conventional and nuclear weapons systems. Further, individual weapon systems like the Tomahawk Land Attack Missile (TLAM) have had dual nuclear and conventional versions. The comingling of nuclear and conventional weapons for the U.S. air and sea legs of the triad makes for a more flexible and more effective force. However, to support this more flexible force the U.S. Air Force—and now also the U.S. Space Force—has also had to field a command and control system which, in turn, also has dual purpose nuclear and conventional capability riding on it. And further, the Space Force also has long utilized a system of ground-based radars used for both space surveillance and early warning, as well as an architecture of overhead infrared

[6] First strike stability conceptualized by David Thaler and Glenn Kent, is defined as "a measure of the countries' incentives not to preempt in a crisis, that is, not to attack first in order to beat the attack of the enemy." First-strike stability is driven by each side's force posture and the balance of capabilities and vulnerabilities that could make a crisis unstable in a contingency.

[7] Inadvertent escalation occurs when a combatant's intentional actions are unintentionally escalatory, usually because they cross a threshold in a confrontation that matters to the adversary but appears insignificant or is invisible to the party taking the action.

satellites for missile launch warning in high orbits that have strategic, tactical and intelligence missions.[8] As a whole, the U.S. has long utilized comingling to make its force more effective, more flexible, and at a lower cost. And to protect itself doctrinally, the US has declared that both nuclear and non-nuclear attacks against command and control systems—including space assets—could yield a nuclear response.

Russia similarly has long comingled some of its key tactical weapon systems, namely the Iskander theater missile system as well as their Kalibr cruise missiles, to name a few. Russia continues the Soviet tradition of co-locating its nuclear and general-purpose forces in the sea and air legs. Russia keeps its strategic submarines and bombers at the same bases as general purpose naval vessels and aircraft. In case of a conventional conflict with NATO, strikes that target Russia's conventional forces could accidentally destroy nuclear assets, which would have serious escalatory potential to a nuclear war—although the Russian side would likely understand that attacks against predominantly conventional force locations would not necessarily signal an incoming, overwhelming strategic attack. While details on Russia's command and control systems are more scarce, it is similarly plausible that they too have space-based and terrestrial systems which carry both strategic and tactical command and control. Its strategic early warning radars have a dual purpose role in space surveillance, potentially making them a target of early U.S. strikes in a conflict to blunt ability to use its Russia's counterspace weapons. The Russian Federation's 2020 nuclear policy update discusses in detail the risks it perceives to its deterrent from missile defense, conventional precision strike and directed energy weapons and threatens preemptive nuclear use if their critical government or military sites enabling nuclear response come under attack, or if the fundamental existence of the state is threatened with conventional weapons.[9]

China's intermingling of nuclear and conventional systems is less clear, in line with their general approach of opacity when it comes to nuclear issues. However, it is clear that China is also building up missile defense radars and space surveillance systems, as well as the general capability to support a potential future launch on warning capability.[10] China's PLA Rocket Force is also fielding the dual capable DF-26 missile system with intermediate range, which also ostensibly must have dual strategic and theater communications supporting infrastructure. Although China likely did not intentionally entangle its nuclear and conventional forces to deter

[8] Lockheed Martin. "Space based Infrared System website" (2021). https://www.lockheedmartin.com/en-us/products/sbirs.html.

[9] The President of the Russian Federation. "Basic Principals of State Policy of the Russian Federation on Nuclear Deterrence," Moscow: Russian Ministry of Foreign Affairs, Executive Order No. 355 (2020). https://www.mid.ru/en/foreign_policy/international_safety/disarmament/-/asset_publisher/rp0fiUBmANaH/content/id/4152094.

[10] Office of the Secretary of Defense. "Military and Security Developments Involving the People's Republic of China 2020," Washington D.C.: U.S. Department of Defense, Annual Report to Congress (2020). https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

its adversaries from attacking the latter, it has discovered benefits of such intermingling and may believe that separation would increase the vulnerability of its conventional assets.[11]

The Ways and Means of Attacking Intermingled Systems

The U.S. is continuing to expand both its strategic missile defense and counterforce capabilities. Planned missile defense capability improvements include fielding the long range discriminating radar which will improve the lethality of missile defense interceptors, increasing the number of deployed mid-course interceptors—going from 44 to 63 Ground-based Interceptors as early as 2023, and potentially up to 100 in the outyears—while also improving the Aegis SM-3 block IIA which could have future ICBM intercept capability.[12] The U.S. is also investing in expanded missile capabilities like the multi-object kill vehicle for MIRV intercept, the space-based sensing layer, and possible future boost phase intercept concepts.[13] For conventional precision strike, the U.S. has been advancing hypersonic weapons to include "Conventional Prompt Strike" for Virginia class submarines and guided missile destroyers, as well as U.S. Air Force concepts for air-launched hypersonic weapons.[14] These conventional kinetic weapons have intermediate class ranges from aircraft or navy vessels operating near adversary air defenses, likely making them capable of attacking adversary nuclear forces if they are enabled by near real-time and highly persistent reconnaissance data. Lastly, the U.S. has also developed world leading cyber attack capabilities through U.S. CYBERCOM, and it has also deployed an offensive electronic attack capability called the "Counter Communications System" fielded by the U.S. Space Force.[15]

Russia has been modernizing its longstanding silo-based strategic missile defense system around Moscow, with 68 nuclear-armed interceptors, as well as hundreds of S-300 and S-400 launch vehicles, each capable of firing four interceptor missiles. Russia is also developing the S-500 as an even more modern and technologically advanced air and missile defense

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[11] Acton, James M. (ed.) "Entanglement—Russian and Chinese perspectives on Non-Nuclear Weapons and Nuclear Risks," Washington, DC: Carnegie Endowment for International Peace (2017): 5.

[12] Office of the Secretary of Defense. "Missile Defense Review," Washington D.C.: U.S. Department of Defense (2019): XI. https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/The%202019%20MDR_Executive%20Summary.pdf.

[13] Ibid.

[14] Vergun, David. "Defense Officials Outline Hypersonics Development Strategy," Washington, DC: Department of Defense (February 2021). https://www.defense.gov/Explore/News/Article/Article/2518370/defense-officials-outline-hypersonics-development-strategy/. See also Eckstein, Megan. "Navy Confirms Global Strike Hypersonic Weapon Will First Deploy on Virginia Attack Subs," Annapolis, MD: U.S. Naval Institute (February 2020). https://news.usni.org/2020/02/18/navy-confirms-global-strike-hypersonic-weapon-will-first-deploy-on-virginia-attack-subs.

[15] U.S. Space Force. "Counter Communications System Block 10.2 achieves IOC, ready for the warfighter," Los Angeles, CA: U.S. Department of Defense (2020). https://www.spaceforce.mil/News/Article/2113447/counter-communications-system-block-102-achieves-ioc-ready-for-the-warfighter/.

system to augment the S-300 and S-400.[16] Russia appears to be completing the modernization of its missile defense radars and has launched three infrared early warning satellites since 2010.[17]

Russia is also developing and deploying a range of reversible and kinetic conventional strike systems to counter the U.S.'s precision strike advantage. In 2018, Russia delivered a laser weapon system to the Aerospace Forces that is likely intended for an anti-satellite mission. In public statements, President Putin called it a "new type of strategic weapon," and the Russian Defense Ministry stated that it is capable of "fighting satellites in orbit" and that it is being deployed to mobile missile garrisons to cover their maneuvering positions.[18] Since at least 2010, the Russian military has also prioritized the development of forces and capabilities, including cyberspace operations, to pursue information superiority. Russia continues to research and develop co-orbital capabilities that could conduct an attack resulting in temporary or permanent damage. Russia is also likely developing a ground-based, mobile missile system capable of destroying space targets in lower orbits as well as ballistic missiles. This weapon system is expected to be operational within the next several years.[19]

China is developing nascent strategic missile defense systems as well as counterspace weapons to both disrupt and destroy U.S. space-based command and control. Given that China's nuclear use posture has long been countervalue oriented—targeting cities rather than military systems—it is unlikely that its few hundred nuclear missiles that can reach the continental U.S. (some with multiple warheads) could attrit more than a small portion of the combined U.S. ICBM and bomber force, even with aggressive assumptions about accuracy of their missiles and the sophistication of their warhead fusing systems. The PLA has not yet moved to deploy intercontinental range, precision strike conventional systems that could give them non-nuclear, kinetic counterforce capabilities against U.S. strategic forces.

China is developing kinetic-kill vehicle technology to field a mid-course missile defense interceptor, which will form the upper layer of a multi-tiered missile defense system.[20] It is also developing the HQ-19 mid-tier interceptor based on the Russian S-300 system. The U.S. Defense Intelligence Agency (DIA) reports that China is developing sophisticated on-orbit

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[16] Office of the Secretary of Defense. "Missile Defense Review," Washington D.C.: U.S. Department of Defense (2019): 20.

[17] The Russian Nuclear Forces Project. "Russian Strategic Forces," (2020). http://russianforces.org/sprn/.

[18] Chief of the General Staff of the Russian Armed Forces. "Chief of the General Staff of the Russian Armed Forces - First Deputy Minister of Defense General of the Army Valery Gerasimov Meets with Representatives of the Military Diplomatic Corps Accredited in Russia," Moscow: Russian Federation Defense Ministry, Press Release (December 2019). http://eng.mil.ru/en/news_page/country/more.htm?id=12267331.

[19] Defense Intelligence Agency. "Challenges to Security in Space," Washington D.C.: U.S. Department of Defense (2019): 29. https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

[20] Office of the Secretary of Defense. "Military and Security Developments Involving the People's Republic of China 2020," Washington D.C.: U.S. Department of Defense, Annual Report to Congress (2020): 52.

capabilities to enable future counterspace weapons, which will form the foundation for on-orbit weapons to counter U.S. command and control assets in high orbits. The PLA has an operational ground-based anti-satellite missile intended to target satellites in low orbits, and has formed units that train with anti-satellite missiles perhaps in part to counter U.S. precision strike targeting. China probably intends to pursue additional anti-satellite weapons capable of destroying satellites up to geostationary orbit, such as U.S. dual missile warning and command and control satellites.[21] This would be a notable development because if China moves to deploy longer range kinetic anti-satellite weapons, it could target critical strategic U.S. military satellites that link forward deployed nuclear forces, like strategic bombers or submarines, to the National Command Authority in the continental U.S. Additionally, China is developing jammers to target satellite communications over a range of frequency bands, including military protected extremely high-frequency communications.[22]

And as we have already mentioned, the observation that China is rapidly expanding their silo-based ICBM force along with a launch under attack capability could allow them to hedge against U.S. conventional damage limitation capabilities by requiring a large-scale nuclear attack to have a credible ability to disarm their nuclear forces. The question is whether these more aggressive nuclear use postures are credible in a conventional counterforce exchange, which the Chinese have left vague through their policy of limited ambiguity.

Implications for Crisis Stability, Decision Making, and Miscalculation

In our judgment the U.S. and Russia are continuing a long tradition of intermingling nuclear and conventional systems, and the Chinese—while sufficiently opaque—may also be entering this fray. However, different forms of intermingling carry different levels of risk. As we argued earlier, the primary source of concern is not the possession of dual capable weapons systems, but rather dual purpose command and control and military situational awareness systems.

The new urgency on this topic is driven by three important changes in the security environment. First, China's recent moves toward strategic symmetry with the U.S. and Russia via the enormous growth of its strategic silo based nuclear force and its in-process shift to a launch on warning posture—which will rely on prompt command and control and ballistic missile early warning—to enable silo force survivability, 2) the rapid emergence of U.S., Chinese and Russian counterspace and cyber weapons which can target C2 and ballistic missile early warning, and 3) the shared perception that these new weapons are threats to nuclear command and control, therefore driving a shared sense of strategic instability and fear over

[21] Defense Intelligence Agency. "Challenges to Security in Space," Washington D.C.: U.S. Department of Defense (2019): 20–23.

[22] Defense Intelligence Agency. "Challenges to Security in Space," Washington D.C.: U.S. Department of Defense (2019): 20–21

surprise attack.

Russia and China develop missile defense and counterforce capabilities of their own to create symmetry with the U.S. in force structure. These capability developments will destabilize the competition unless the U.S. is able to prioritize defensive investments to secure its nuclear forces and command and control. However, highly effective Russian and Chinese counterforce and missile defense capabilities are very unlikely to emerge before 2030.

The anarchic nature of the international system often puts states at tension with one another over geopolitical disputes. Accordingly, states may find themselves in politically strained situations with other nuclear armed nations, in which the amorphous nature of military capabilities makes them feel threatened by the other and stumble into spirals of hostility and competitive military preparations. Thus, fears over surprise attack can be an engine of significant escalation in a conventional war among nuclear states. The ingredients of such escalation are as follows:

- In a crisis, militaries on each side will be watching closely for signs of attack against their nuclear forces and supporting infrastructure, as they are a vital interest for state survival if a conflict breaks out.
- Conventional operations seeking only to produce theater effects may also have deleterious consequences for nuclear forces, either through direct attacks on dual nuclear-conventional weapons systems, or through attacks on dual nuclear-conventional infrastructure like command and control or early warning systems. In this way, even conventional force operations that are designed to solely have conventional force impacts may also accidentally or inadvertently affect nuclear forces.
- These impacts on nuclear forces may be sufficiently obscure that they are not foreseen by military planners or understood by civilian authorities.
- Harsh reactions by the threatened party may be perceived as some new malign intent rather than as a reaction to the other's own hostile conventional force operations.
- As conventional conflict is already underway, a spiral of action and reaction may be much more extreme than in peacetime.

Another factor that contributes to the risk of unintended escalation is the lack of more awareness of this problem among strategic thinkers. Both the Russian and the Chinese strategic communities underestimate the potential dangers of inadvertent escalation due to nuclear-conventional intermingling. In the Russian case, the primary reason is the strongly held belief that the use of force, especially the use of nuclear weapons, would be the result of a rational, deliberate decision. Since Russia has more low-yield nuclear options than the U.S. does, they are likely more prone to thinking that they can escalate a regional conventional war into a nuclear conflict, forcing the U.S. to choose between also escalating with nuclear weapons or

capitulating. The Russian belief that there is a difference in stakes and also a difference in low-yield options makes them more risk-taking and also more confident that they have an upper hand in managing escalation. Similarly, in the Chinese case, inadvertent escalation has been mostly missing from the strategic discourse. This is partly due to their more limited experience with nuclear crises, and also due to the belief that China's no-first use policy greatly reduces the dangers of inadvertent escalation. Although both Russia and China have started to pay more attention to the problem in recent years, their strongly held confidence in their ability to control escalation creates a false sense of security, and incentivizes dangerous risk-taking strategies in a crisis.[23]

Potential Avenues to Reduce Risk

1) Create risk reduction stakeholders within each side's military

The simplest risk-reduction measure would be to raise awareness, within governments and militaries, of the challenges created by entanglement for assessing an adversary's intent and, importantly, for the adversary in assessing the state's own intent. Given that crisis instability and misinterpreted warnings are mediated by perceptions—or rather misperceptions—about the intent behind incidental strikes or threats, drawing the attention of decisionmakers to the difficulties of assessing intent might encourage restraint in a conflict and so help counteract inadvertent escalation pressures. Greater awareness of the risks could also catalyze peacetime preparations, such as enhancing the survivability of command and control assets, that might reduce the dangers associated with incidental strikes should a war occur.

To this end, China, Russia, and the United States could set up dedicated nuclear risk-reduction teams within their general command staffs, or in US's case on the JCS or at STRATCOM. Most importantly, during crises or conflicts, these teams could advise national and military leaders on the risks associated with different operational COAs, likely risk-taking measures by the adversary, and on how to manage these contingencies. In peacetime, they could be tasked with ensuring that escalation risks were factored into both war planning and acquisition decisions for new strategic weapons and command and control capabilities. The teams could, for example, assess the different alternatives under consideration for their escalation implications, and be entitled to propose other options, or object entirely.

Ultimately, high-level civilian or military leaders would be responsible for making decisions after considering escalation risks alongside more traditional strategic, military, and financial considerations. Risk-reduction teams, therefore, would have to be bureaucratically empowered (by being led by a suitably senior official, for example) to ensure their advice was heard. Such teams would also benefit from the inclusion of a broad range of experts, including

[23] Acton, James M. (ed.) "Entanglement—Russian and Chinese perspectives on Non-Nuclear Weapons and Nuclear Risks," Washington, DC: Carnegie Endowment for International Peace (2017).

civilian strategists, military planners, and intelligence officials with deep knowledge of potential adversaries' thinking.

2) Broaden declaratory policy

Declaratory policy is a useful tool to clarify escalatory thresholds and to deter incidental attacks on command and control assets by underscoring the risks. It is possible that civilian officials or military officers responsible for authorizing such attacks might not appreciate the potential for their intentions to be misinterpreted. Such officials could hold very senior positions and might not know that such assets were typically dual use; even if they did, they might not appreciate the implications.

The 2018 U.S. Nuclear Posture Review's threat to use nuclear weapons in response to attacks on nuclear command and control assets is presumably an attempt to warn competitor nations about these implications. The disproportionate nature of this threat, however, carries the risk that it is being dismissed as bluster. Instead, a somewhat vaguer formulation might ultimately prove more effective. For example, each side could state that it considers dual use communication and early-warning assets an integral part of its nuclear support system and would respond to attacks on them accordingly. As with all declaratory policy, such statements might influence the other's thinking more effectively if they were repeated periodically by very senior officials.

3) Develop a more resilient command and control architecture

Over the longer term, states could also develop command and control architectures that were both less likely to be subject to incidental attacks and more survivable if they were. Some analysts have suggested creating at least two separate command systems—one for nuclear or "strategic" operations and one (or more) for all other operations. Even putting the substantial increased cost of this idea aside, such disaggregation would reduce risks only if each side could convince the other that it had separated nuclear and non-nuclear functions, which would be no easy task. If they fail to do so, disaggregation could increase risks because the escalation consequences of the other side attacking command and control assets that were involved only in nuclear operations—out of the incorrect belief that they also enabled conventional operations—could be more severe than the consequences of attacking dual use assets.

A somewhat different approach for early warning would be to create space-based capabilities that were less likely to be subject to incidental attack because they were incapable of contributing significantly to any mission other than detecting the launch of the other side's missiles (whether nuclear or non-nuclear). In particular, reducing the size or increasing the distance to target of infrared sensors would clearly limit the resolution of these systems and as a result, it would also greatly reduce their non-strategic utility. Because this limitation would be the result of an observable and (roughly) immutable property of the hardware or its location,

each side might be able to persuade the other that the nonstrategic utility of these systems was severely limited. This could potentially then be reinforced by more explicit declaratory policy, if so needed.

Reducing incentives to launch incidental attacks against space-based communication assets would be more difficult. Although a system that was capable of transmitting data only at low rates would be somewhat more useful for nuclear than nonnuclear operations, there would be no obvious way of demonstrating that such a limitation was real and permanent. Instead, risk-reduction efforts could focus on mitigating the consequences of incidental attacks against space-based communication assets by enhancing their resilience. One approach would be to host small communication transponders for nuclear operations on many satellites used for other purposes.

4) Pursue cooperative risk reduction measures

In order to create a cooperative framework between the great powers, first it is essential to have official Track 1.5 discussions—seeking to develop dialogue at Track 1--that would help the great powers better understand each other's threat perceptions. A joint assessment of the escalatory risks of nuclear-conventional intermingling would be an important initial step to raise awareness of the problem.

Once all three major powers come to realize these risks, there are a number of measures they could undertake in a cooperative risk reduction framework. These could span from informal joint declarations to an actual legal ban on certain dangerous behaviors. Arms control advocates have already produced a long list of possible measures that are aimed at reducing the dangers of intermingling.[24] These ideas include: a ban on cyber interference with nuclear command and control systems, a moratorium on testing and deploying dedicated kinetic ASAT weapons, bringing intercontinental boost-glide systems under strategic arms control, or implementing transparency measures. Although at the moment, none of these measures seem realistic, but a more cooperative environment or a dangerous future crisis could trigger such discussions.

[24] Acton, James M. (ed.) "Entanglement—Russian and Chinese perspectives on Non-Nuclear Weapons and Nuclear Risks," Washington, DC: Carnegie Endowment for International Peace (2017).