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Conference Report

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Time-Sensitive Targets, Space and Missile Defence

RUSI HELD ITS 20th Missile Defence and Space Conference on 26 and 27 February 2020, at which issues around space as an operational domain were integrated into the programme for the first time. The immediate catalyst for this has been the proliferation of conventional threats to time-sensitive targets, the strains that these threats will place on traditional missile defence architectures, and the need to assess both the role of space-based assets and how developments in the space environment can put these assets, and the systems which are dependent upon them, at risk.

The discussions that took place over the course of the conference generated four key themes:

1. The threat posed by hypersonics and increasingly accurate conventionally armed ballistic missiles at both the operational and strategic level will require a response that mixes elements of offence and defence, with the latter buying windows of opportunity in which strike assets can deliver effects. Space-based assets will likely be critical to both aspects of this approach.
2. Outstanding issues regarding strategic stability remain, particularly given the fact that adversaries with different strategic cultures may respond to the threat posed by Western space-based assets in unpredictable ways.
3. The threat environment is splitting into two distinct components – a precision and speed-centric operational and strategic threat environment and a close-in battle in which mass, as opposed to precision, dominates. This latter environment will be dominated by rockets, artillery and mortars (RAM) and UAVs, along with increasingly accurate and cheap tactical ballistic and air-breathing missiles fired en masse. Enabling manoeuvre will require a response to both kinds of threat.
4. Outstanding questions remain regarding the organisational challenges of generating integrated forces within states and across alliances, as well as questions of conceptual integration regarding space operations.

Response to Hypersonics and Increasingly Accurate Ballistic Missiles

The conference heard from Lieutenant General Henry Obering III that victory in salvo competitions requires the equivalent of the Powell doctrine in space. The Powell doctrine, developed as a response to the military gradualism of the Vietnam era, emphasised the need to use decisive force in short windows for discrete well-defined objectives to achieve strategic effects.[1] In the rubric outlined by Obering, effective command of space – accomplished through measures to both deny it to adversaries and leverage it to strategic effect – can deliver decisive effects in salvo competitions at the theatre and strategic levels. For example, the conference heard that distributed constellations of nanosatellites with modular payloads based on commercial off-the-shelf (COTS) technology can coordinate to swarm in order to create synthetic aperture radar constellations capable of birth-to-death tracking against a range of threats. This would require artificial intelligence-enabled coordination and 'processing at the edge' – distributed processing that does not rely on distinct data-fusion nodes in order to deliver persistent tracking against manoeuvring threats. Approximately 1,000 20-kg nanosatellites, which would deliver such effects against a range of manoeuvring threats, would cost around $20 billion – a significantly lower cost than the investments made in existing homeland defence assets by the US.[2] The utility of space-based assets with regard to delivering extended track quality data was also noted by Rear Admiral (rtd) Brad Hicks, who cited the example of a 2014 test intercept of a target simulating the trajectory of an intermediate-range ballistic missile from an *Arleigh Burke*-class destroyer using offboard data from a satellite. The interceptors aboard vessels such as the USS *Arleigh Burke* exceed the range of their organic radar by some degree, meaning that offboard sensors could unlock their untapped potential.

The importance of onboard processing within a distributed satellite constellation and the utility of disaggregated satellites using COTS technology against threats such as hypersonics was reiterated by Jerome Dunn, chief architect of counter-hypersonics at Northrop Grumann, who also laid out the utility of such constellations in both active defence and left-of-launch operations. In addition to extending the situational awareness of targets such as carriers at sea beyond the effective range of the radar onboard the task group's vessels, space-based assets tracking the infrared signatures from launches could enable the offensive use of conventionally armed hypersonics to knock out launchers before they could be reloaded. The importance of a mix of offensive and defensive assets was reiterated by Melanie Marlowe of the Center for Strategic and International Studies (CSIS) and, in a later panel on European security, by Rear Admiral Archer Macy, former director of the US Joint Integrated Air and Missile Defense Organization. Speakers converged on the consensus that active defences alone would eventually be overwhelmed and that their role in an operational framework is to deliver windows of opportunity for strike assets to be mobilised. Given the escalatory potential inherent to striking

1. Christopher Gacek, *The Logic of Force: The Dilemma of Limited War in American Foreign Policy* (New York, NY: Columbia University Press, 1994), pp. 12–13.
2. See, for example, Arms Control Association, 'Current US Missile Defense Programs at a Glance', <https://www.armscontrol.org/factsheets/usmissiledefense#gbmd>, accessed 9 March 2020.

command-and-control (C2) nodes, Transporter Erector Lunchers (TELs) emitting infrared signatures were identified as targets of choice – particularly as responses to 'shots across the bows' in the context of grey-zone conflicts.

A cautionary note was sounded, however, by Frank Rose of the Brookings Institute, who noted that the costs and technical viability of space-based assets in a missile defence role are yet to be definitively established. An analysis by Todd Harrison of CSIS noted that 'intercepting enemy missiles from space would require a number of steps'.[3] Although technology may not be the biggest hurdle, the number of satellites required and the associated costs could prove a stumbling block. Rose also noted the challenges present within the space environment that pose a threat to these assets, such as space debris and the actions of other space users, particularly within the current context where there is a lack of an overarching legal framework and a reliance on voluntary norms of behaviour, thus highlighting the need for conceptual understanding across domains.

Strategic Stability

An interesting point was raised by Bleddyn Bowen of the University of Leicester, who questioned the importance of missile defence when considered within the broader context of a major conflict. For example, space-based assets may either become unavailable or repurposed to support other operations, impacting on missile defence capabilities. The key takeaway from this perspective is the need to consider where and how missile defence fits within a conflict and the impact that orbital conflict (however this is defined) may have on both missile defence-related space assets and left-of-launch activities. It is therefore necessary to understand space from a strategic stability viewpoint as well as the ways in which adversaries conceptualise space operations.

Rose noted that opponents such as Russia may well view space-based assets – particularly interceptors – as a threat to their second-strike capabilities. This problem is likely compounded by ambiguity in official US statements. For example, while the 2019 Missile Defense Review stated an interest in defeating only the theatre-level salvos of peer competitors, statements by President Donald Trump have evinced a desire to defeat any missile salvo aimed at the US or its forces.[4] It is worth considering whether recent Russian efforts to develop capabilities such as the Poseidon nuclear torpedo and China's unveiling of its next generation DF-41 ICBM reflect concerns regarding this vulnerability and whether the employment of space-based assets for missile defence might produce destabilising behaviour from both states which is driven by fear rather than opportunism.

3. Jon Harper, 'Special Report: Pentagon Reexamining Space-Based Interceptors', *National Defense*, 22 April 2019, <https://www.nationaldefensemagazine.org/articles/2019/4/22/special-report-pentagon-reexamining-space-based-interceptors>, accessed 19 March 2020.
4. US Department of Defense, 'Missile Defense Review', 2019, pp. 26–31; David E Sanger and William J Broad, 'Trump Vows to Reinvent Missile Defenses, but Offers Incremental Plans', *New York Times*, 17 January 2019.

The influence of psychology is critical here, particularly as cognition differs across cultures. As the conference heard from Nick Wright of UCL, high-context cultures such as those in East Asia tend to view terms such as deterrence and stability as being specific to situations.[5] Thus, for example, the Chinese framework for deterrence includes offensive actions in order to restore psychological deterrence between two parties. Similarly, the question of whether assets such as space-based infrared systems (SBIRS) ought to be viewed as a legitimate conventional target or a component of the US's nuclear early-warning system depends, for the Chinese, on context. If, for example, space-based assets such as SBIRS and other space-based sensors enable offensive left-of-launch interception against TELS launching conventional salvos, Chinese strategists might view targeting them as legitimate and necessary. Escalation spirals can therefore be caused both by the universal action–reaction dynamic of strategy and by the particular features of an adversary's strategic culture.

Dealing with the operational and strategic threat, then, will require limited missile defence and counterforce to be balanced with measures to both reassure adversaries of the safety of their second-strike capabilities and to visibly disaggregate assets used in conventional operations from those on which nuclear security depends. As such, missile defence might be conceptually integrated with nuclear deterrence in the policymaking process as part of an integrated deterrence framework.

The Splitting Threat Environment

The challenge to Western power projection identified in the emerging operating environment is twofold.

In the context of competition short of war, several speakers discussed how adversaries can use conventionally armed missiles, including hypersonics, coercively. For example, it was suggested by Jerome Dunn that a hypersonic weapon could be fired over, as opposed to at, an opponent's territory as a 'shot across the bows' to demonstrate intent and to deter Western intervention in a regional crisis. Other speakers, such as Uzi Rubin, former director of the Israel Missile Defense Organization noted the way in which states such as Iran have created local skunkwork projects in territory controlled by non-state proxies, where Iranian cruise missiles have been replicated using a combination of imported and local kits. This has allowed Iran to conduct strikes through proxies such as the Houthis and to generate ambiguity when it chooses to conduct a limited strike directly, as was the case following the recent Iranian attacks on Abqaiq and Khurais, for which the Houthis claimed responsibility.[6]

5. It is worth noting that Russian culture is also classified as high context. See, for example, Dima Adamsky, *The Culture of Military Innovation: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the US, and Israel* (Stanford, CA: Stanford University Press, 2010), pp. 24–57.
6. Ben Hubbard, Palko Karasz and Stanley Reed, 'Two Major Saudi Oil Installations Hit by Drone Strike, and U.S. Blames Iran', *New York Times*, 14 September 2019.

In the context of high-intensity operations, the ability of adversaries to cripple manoeuvre-centric operations using precision at operationally relevant ranges and mass over the course of the close-in battle was discussed. At medium and intermediate ranges, increasingly accurate manoeuvring hypersonic threats such as the Chinese DF-17 and the Russian Zircon hypersonic cruise missile can hold maritime power projection assets, C2 nodes and critical infrastructure at risk. The ability of these threats to manoeuvre at hypersonic speeds significantly reduces the warning times available to missile defenders as well as their ability to track and intercept a target. Moreover, as was noted by Daryl Press of Dartmouth University in the context of the European balance, by holding airfields near the theatre of conflict at risk, precision-strike assets such as Russian cruise missiles can force Western forces to operate from further out and thus rely more heavily on assets such as tankers, which are few in number, difficult to hide and vulnerable to destruction by longer-range strike assets such as conventionally armed ballistic missiles.

As forces near the operational and tactical support areas, the threat shifts from a precision-centric one based on fewer assets such as hypersonics to massed salvos of short-range ballistic missiles, artillery and rockets. Though not as accurate as operational-level assets, tactical situational awareness conferred by UAVs, coupled with the ability to retrofit older rockets with GPS kits, has rendered these massed threats significantly more accurate and lethal than has previously been the case.[7] Thus, as forces close in on the tactical support and close-in areas, they face a different threat – massed fires in tandem with shorter-range precision-strike assets.

Lieutenant Colonel Jonathan Parrott of Army CAP-GM noted that the threat environment facing manoeuvre units has morphed into one where traditional threats, such as enemy aircraft, are joined by UAVs, massed rocket and artillery fire and a range of short-range tactical ballistic and cruise missiles. While these threats are not new individually, their integration by peer competitors and, increasingly, less sophisticated actors has created a whole that is more than the sum of its parts. This is evidenced, for example, by the way in which Russian UAVs at Debaltsev'ye acting as spotters and operating kinetically to canalise Ukrainian forces radically increased the accuracy and lethality of Russian artillery and rocket fire.[8]

Speakers such as Rubin also noted that competitors, including non-state actors such as Hizbullah, are, with Iranian help, retrofitting inaccurate rockets such as the Nazeat-10 with GPS kits. This drastically increases the lethality of massed rocket fire and, in smaller theatres, allows such weapons to deliver effects beyond the tactical support and close-in areas. Coping with this challenge, given the firepower that even relatively weak opponents can bring to bear in this area, will require short-range air defences (SHORAD) and mobile SHORAD to increasingly rely

7. The retrofitting of rockets with GPS kits was noted by Uzi Rubin, who illustrated how Iran and its proxies have used this method to effectively turn longer-range rockets into auxiliary short-range ballistic missiles.
8. This was discussed in Jonathan Parrott's presentation.

on offboard sensors in the air, at sea and potentially from nanosatellite constellations to extend situational awareness and accuracy.

Open architecture battle management systems such as BMC4I will be critical to allowing the joint force to operate on 'any sensor, best shooter' principles. That said, the sheer volumes of fire entailed will likely necessitate offensive operations against launch platforms. Considerations regarding the best means by which massed fires can be delivered for the close-in battle, as well as how integrated offensive and defensive operations can be conducted in a fragmented information-denied environment, will be key. Extending the range of army fires and incorporating increasingly cheap loitering munitions might be one way to achieve the former objective.[9] In terms of the latter objective, using nanosatellites and stratospheric balloons to create localised tactical data relay systems that assets such as the F-35 can rely on to share data without using Link 16, as well as leveraging edge processing to enable more effective tracking of ground-based assets, might represent some ways of meeting this challenge.

It is worth noting that the distinctions drawn between operationally and tactically relevant assets is somewhat less relevant in theatres such as the Middle East where countries lack strategic depth. As Anthony Cordesman, Arleigh Burke Chair at CSIS, noted, the fragility of the critical infrastructure in Gulf states, coupled with the fact that most of them (barring Saudi Arabia) lack geographical depth, enables a range of Iranian assets, including relatively short-range ones, to deliver strategic effects. This is also true of Israel, which has to treat the full gamut of Iranian and Hizbullah strike assets – including GPS kit-enabled rockets – as a strategic threat given that its homeland is the front line. As both Cordesman and Rubin noted, the remarkable progress made by Iran in terms of developing extremely precise short- and medium-range ballistic and cruise missiles such as the Zolfaghar and the Ra'ad, along with the need to hit only a few key sites such as the Al-Jubail desalination plant or a handful of key Saudi refineries, confers significant leverage upon Iran in its interactions with Gulf states. A similar point was made by RUSI Research Fellow Sam Dudin, who noted that the improving accuracy of Iranian missiles – which mean that fewer missiles will need to be used in a single raid to deliver a high likelihood of success – will make generating sorties from land bases in the Gulf increasingly difficult.

Challenges to Integration

A number of obstacles to effectively delivering effects across a joint force were noted by panellists. At the organisational level, speakers such as Kaitlyn Johnson of CSIS noted the ongoing debates within the US regarding whether the Missile Defense Agency or Space Development Agency should direct the creation of a space-based sensor layer. Moreover, while the emerging US Space Force will integrate many presently disparate assets and functions by 2022, the question of integrating existing assets and C2 structures that are owned by individual services remains. By contrast, Motonobu Fujita from the Japanese Ministry of Defence's Acquisition Technical and Logistics Agency outlined an alternative framework revolving around a 'push' rather than a 'pull'

9. For more on this, see T X Hammes, 'Expeditionary Operations in the Fourth Industrial Revolution', *MCU Journal* (Vol. 8, No. 1, 2017), pp. 82–107.

model. In this, the Japanese Ministry of Defence makes procurement decisions centrally with advice from the Joint Staff before pushing assets out to the services – a model that helps resolve issues of interoperability, albeit at a cost in terms of agility. It is noteworthy that states such as China – which has integrated space, cyber and electromagnetic activities and psychological warfare under the remit of the Strategic Support Force – seem to have opted for a compromise between the two models, pushing decision-making below the ministerial level but creating a single service to manage it.[10]

A second issue, pertinent to generating capacity, was noted by Tom Karako of CSIS, who stated that projects such as the next-generation interceptor have stripped much-needed budgetary allocations from efforts to improve the capacity and capabilities of US forces in the Pacific in terms of missile defence. This, in the authors' opinion, raises a paradoxical issue – to retain political support, missile defence needs to be linked to the homeland defence mission, despite the fact that it is at the theatre level that it will be critical. Indeed, the cost of significantly improving homeland defence, particularly against ICBMs, is likely to detract from this mission.

A third set of issues that emerged in the context of alliances such as NATO were the perennial problems of prioritisation and burden-sharing. As Henning Andersen of NATO's Defence Investment Division noted, the assets of NATO's integrated air and missile defence (IAMD) system are nationally owned, with NATO providing a C2 system once a joint force air component commander has been stood up in wartime. The question of whether this federated system can respond adroitly in a crisis is an open one. Moreover, NATO's ballistic missile defence (BMD) system – built around two aegis ashore sites, US destroyers homeported at Rota and an AN TPY-2 site in Turkey – is still exclusively oriented towards rogue state launches from the Middle East. Moreover, as Rear Admiral (rtd) Brad Hicks noted, exercises such as *Formidable Shield* demonstrated the extent of the gap between the US and many of its partners in terms of BMD capabilities.[11] While there was a consensus that this system would struggle to cope with multiple layers of Russian standoff, the question of what form of response might best enable adaptation to the new operating environment remains. One option might be sub-regionally focused IAMD complexes, built around organisations such as the Joint Expeditionary Force, which can fit into an overarching NATO framework.

An alternative option was suggested in Press's presentation, which proposed that the primary risk to NATO's air operations in a conflict with Russia was not the suppression of fighter aircraft in Hardened Air Shelters (which are too numerous for Russian missiles to target), but rather the destruction of tanker aircraft on the ground by Russian cruise or ballistic missiles. A limited investment in NATO-owned missile defences for the states to the far west of the Alliance (where

10. On the strategic support force, see Kevin L Pollpeter, Michael S Chase and Eric Heginbotham, *The Creation of the PLA Strategic Support Force and its Implications for Chinese Military Space Operations* (Santa Monica, CA: RAND Corporation, 2017).
11. For a brief background on *Formidable Shield,* see Thales, 'Formidable Shield: The Most Important Exercise in Years', <https://www.thalesgroup.com/en/formidable-shield-most-important-naval-exercise-years>, accessed 7 April 2020.

tankers would be based to remain out of range of most Russian threats) might well be politically viable. Alternatively, states to the west of the Alliance's territory, such as the UK, might invest in limited IAMD assets to counter the relatively limited number of Russian conventional strike assets that can reach them.

The problem of political coordination is not a distinctly European one. As Cordesman pointed out, significant investments in regional missile defence assets in the Persian Gulf will likely be of limited value due to the reluctance of local states to share data with each other or, in some cases, the US. This means that their situational awareness, coverage and reaction times are heavily compromised. Moreover, as RUSI Research Fellow Jack Watling noted, deficiencies in crew training and idiosyncratic C2 arrangements which place air defences in the hands of the Ministry of Interior in states like Saudi Arabia further complicate the conduct of a successful defence. In the absence of political cooperation and institutional military reform, technical fixes can offer only limited results.

Conclusions: The Need for Conceptual and Policy Integration

The key takeaways of this conference were that missile defence needs to be conceptually integrated with broader concerns at both the strategic and operational levels. At the strategic level, understanding how active defences and the space-based assets that enable them fit with efforts to maintain nuclear stability and deliver competitive overmatch will be critical. One might consider following Russia's lead in generating an integrated aerospace defence concept subordinate to an integrated deterrence framework.

At the operational level, the Multi-Domain Operations framework will need a coherent subcomponent regarding the delivery of overmatch in salvo competitions. Hypersonics, ballistic missiles, air-breathing threats and RAM will all blend into a single integrated reconnaissance strike complex capable of delivering disruption at the operational level and overwhelming mass in the close-in area. This complex ought to be viewed in synthetic terms of delivering a single 'pulse' of fire to disintegrate western military systems of systems using precision and destroy their components with mass. Integrating missile defence with the use of long-range precision fires and shorter-range massed fires will be critical here. Arguably, the three components ought to be integrated into a single campaign-level task – winning salvo competitions – to which all three capabilities, as well as the development of operationally and tactically relevant space-based enablers, should be subordinated.

Finally, political obstacles to effective integration will likely remain a hurdle across multiple regions. In certain cases, this may require downsizing ambitions, for example by focusing on bilateral and minilateral groupings as an avenue for development. Moreover, organisational obstacles to integration within nations remain and the heterogeneity of solutions to these obstacles will provide rich empirical data regarding the strengths and weaknesses of each model, thus representing a fruitful avenue for further study.

About the Authors

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