Beyond Bursting Bubbles

Understanding the Full Spectrum of the Russian A2/AD Threat and Identifying Strategies for Counteraction

Michael Jonsson and Robert Dalsjö (eds)

FOI

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Sammanfattning

Stater som har förmågan att använda en kombination av sensorer och långdistans-robotar för att hindra antagonister från att operera inom en exkluderingszon sägs besitta avreglingsförmåga (eng. A2/AD). Denna studie fördjupar analysen av Rysslands A2/AD-förmåga, med utgångspunkt i en FOI-rapport publicerad 2019 (*Bursting the Bubble*). Tio internationella experter bidrar med kapitel om fem teman – rysk avreglingsförmåga idag och i framtiden; handlingsoptioner för att motverka rysk A2/AD i Europa; koncept för att försvara eller återta territorium inom en fientlig exkluderingszon; metoder att hantera hotet från långräckviddig precisionsbekämpning; samt hur rysk avreglingsförmåga påverkar maktbalansen i Europa.

Studien utmynnar inte i någon enskild, övergripande slutsats, men betydande samsyn föreligger hos merparten av författarna. Å ena sidan kan Ryssland *inte* skapa ogenomträngliga "bubblor" där Västs stridskrafter inte kan operera. Å andra sidan bedöms motåtgärder mot rysk A2/AD vara komplexa, resurskrävande och behäftade med risker för höga förlustsiffror. De kritiska faktorerna är vilka förmågor som krävs, förväntade förlustsiffror, realistiska tidshorisonter – och politisk vilja att axla de kostnader och risker som krävs. Flera av författarna menar att rysk A2/AD-förmåga vore svårast att hantera under ett snabbt krisförlopp – till exempel ett landangrepp i Baltikum – där förstärkningar och luftunderstöd krävs omgående, varför motåtgärder behöver vara väl förberedda.

Jämfört med *Bursting the Bubble* breddas analysen med t ex elektronisk krigföring, cyber och icke-militära metoder, samt fördjupas. Betydande osäkerhet eller oenighet kvarstår även kring temata såsom nivån av integration inom ryskt luftvärn; påverkan av smygförmåga; känsligheten för elektronisk krigföring m.m.

Nyckelord: Avreglingsförmåga; A2/AD; Baltikum; Nato; Ryssland; sjömål; markmål; luftmål; radar; motmedel; skenmål; Iskander; S-400; Bastion

Summary

States with the ability to use a combination of sensors and long-range missiles to prevent adversaries from operating and thus creating an exclusion zone, are said to possess anti-access/area denial (A2/AD) capabilities. This collection of essays uses our previous FOI report on Russian A2/AD capabilities (*Bursting the Bubble*) as a point of departure. Ten experts analyse five themes: Russian A2/AD capabilities today and in the future; options for counter-A2/AD operations in Europe; concepts for defending or reconquering territory under a hostile A2/AD umbrella; different approaches to managing the long-range precision strike threat; and the impact of A2/AD on the balance of power in Europe.

The study does not arrive at any single, overarching conclusion, but there is significant convergence of views amongst a majority of the authors. On the one hand, Russia *cannot* create impenetrable "bubbles" where NATO forces cannot operate. On the other hand, counter-A2/AD operations are complex, requiring significant assets and capabilities, and carry significant risk of high attrition rates. The critical factors are the assets required, expected attrition rates, the time frames needed – and political will to shoulder costs and risks. A majority of the authors also argue that Russian A2/AD would be at its most troublesome during a short, sharp war, making well-rehearsed countermeasures essential.

Compared to *Bursting the Bubble*, the multi-domain character of counter-A2/AD operations, including i.a. electronic warfare and non-military means, is emphasised, thus deepening the granularity of the analyses. Considerable uncertainty or disagreement remains on topics such as the level of integration within Russian air defences, the impact of stealth, and electronic warfare.

Abbreviations

A2/AD	Anti-access/Area Denial
AAM	Air-to-air missile
AB	Adaptive Basing
ABM	Anti-Ballistic Missile
ACE	Agile Combat Employment
AESA	Active Electronically Scanned Array (radar)
AI	Artificial Intelligence
ASAT	Anti-Satellite
AWACS	Airborne Warning & Control System
BMD	Ballistic Missile Defence
BTGr	Batallion Tactical Group
C2	Command and Control (C2).
C3I	Command, Control, Communications, and Intelligence
C5ISR	Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance
CCP	Chinese Communist Party
CEC	Cooperative Engagement Capabilities
DEAD	Destruction of Enemy Air Defences
DFE	Dynamic Force Employment
EDA	European Defence Agency
eFP	enhanced Forward Presence
EPAA	European Phased Adaptive Approach
EMS	Electromagnetic Spectrum
EU	European Union
EW	Electronic Warfare

FARP	Fighter Arming and Refueling Points
FOB	Forward Operating Bases
GPS	Global Positioning System
GRU	Russian Main Intelligence Directorate (*Glavnoye Razvedivatelnoye Upravlenie*)
HF	High Frequency
HQ	Headquarters
IADS	Integrated Air Defence Systems
IIR	Imaging Infra-Red
INF	Intermediate Nuclear Forces
ISR	Intelligence, Surveillance and Reconnaissance
JEF	Joint Expeditionary Force
LoR	Launch on Remote (LoR)
MALD	Miniature Air-Launched Decoy
MANPADS	Man-Portable Air Defence Systems
MDO	Multi-Domain Operations
MFI	Multirole Fighter/Interceptor
MOB	Main Operating Bases
NATINAMNDS	NATO Integrated Air and Missile Defence System
NATO	North Atlantic Treaty Organization
NATO IAMD	NATO Integrated Air and Missile Defence
NDS	National Defense Strategy
NFIU	NATO Force Integration Units
NTM	National Technical Means
OTH	Over-the-horizon
PESCO	Permanent Structured Cooperation
PLAAF	People's Liberation Army Air Force
P_K	Probability of Kill
PRC	People's Republic of China

ROE	Rules of Engagement
SAM	Surface-to-air missile
SATCOM	Satellite communications systems
SEAD	Suppression of Enemy Air Defences
SOF	Special Operations Forces
SLOC	Sea Lines of Communication
SPOD	Seaports of Debarkation
SwAF	Swedish Air Force
TEL	Transporter Erector Launcher
TELAR	Transporter-Erector Launcher and Radar
UAV	Unmanned Aerial Vehicle
USAFE	US Air Forces in Europe
VDV	Russia's Airborne Troops [*Vozdushno-desantnye voiska*]
VHF	Very High Frequency
VKS	Russian Aerospace Forces [*Vozdushno-kosmicheskie sily*]

Contents

Preface

FOI's Defence Policy Studies Project analyses selected issues of relevance for Swedish defence policy, under contract from Sweden's Ministry of Defence. These issues include operational capabilities, military intelligence, civil defence, deterrence and threat analysis, and nuclear weapons. This report represents the proceedings of an international research conference initiated and organised by FOI and held in Stockholm on December 5–6, 2019. The conference was a follow-on event to our noted report on Russian A2/AD capabilities, *Bursting the Bubble*, and was intended to further deepen our understanding of various aspects of Russian anti-access/area denial, A2/AD. The conference was attended by invitation only and held under the Chatham House Rule. As such, the individual chapters in this report are not comprised of what was said during the conference itself, but are based on texts that the authors submitted ahead of the event and have finalised afterwards.

Ten speakers were invited to deliver presentations on five topics, with the aim of providing complementary takes on a specific theme, and the report has been organised following the same logic. The contributors also purposely represent a mix between scholars and practitioners. Although the chapters have undergone reviews (including of their more technical aspects) according to standard FOI procedures, the authors have retained the final say on their texts and they answer personally for the claims made. Hence, the chapters represent the views of the individual authors, but not necessarily those of FOI, neither as a research institution, nor as a government agency.

The editors would like to express their gratitude to Jan Frelin for reviewing the manuscript, and to Richard Langlais for excellent language editing. We also wish to thank Lena Engelmark for very quickly and ably helping us with the layout of the report. Furthermore, we are highly grateful to a number of colleagues who provided invaluable feedback on various drafts of the report, including Mårten Sundmark, Andreas Hörnedal, Erik Berglund, Malek Khan, Johannes Malminen, Fredrik Lindvall and others. But, above all, we are most grateful to all of the contributing authors, for uniformly submitting excellent and thought-provoking chapters, delivering fascinating presentations, and patiently bearing with us during the review process.

Stockholm, June 2020
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1. Beyond Bursting Bubbles

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Introduction

On March 4, 2019, FOI published the report, *Bursting the Bubble – Russian A2/AD in the Baltic Sea Region: Capabilities, Countermeasures, and Implications*.[1] Initiated almost two years earlier, the study had originally been intended as a brief open-sourced primer for non-specialists, explaining why security analysts should not accept inflated claims regarding Russia's ability to create impenetrable anti-access/area denial (A2/AD) "bubbles" – often represented on maps by large red circles – using long-range sensors and missiles. As work progressed, however, we found it increasingly necessary to drive home *why* this was the case, so the study continuously expanded in volume, especially towards explaining the technical limitations of the main systems, the wide array of possible countermeasures available, and the strategic considerations, which together limit Russia's ability to impose large "no-go zones." Conversely, Russia has strong incentives – political as well as economic – for creating exactly this impression, which is why claims about the maximal capabilities of its main systems (such as the long-range air-defence system S-400) should be taken with a healthy dose of scepticism, rather than simply accepted at face-value.[2]

While neither of us are rocket scientists, electronics engineers, nor Russian area specialists, our work benefited greatly from the fact that FOI has in-house top-notch specialists in these fields who could aid and augment our analysis. Moreover, parallel studies – relying on complementary sources – of Russia's A2/AD capabilities further reinforced several of the findings from our open-source analysis.

Published at an opportune time, *Bursting the Bubble* quickly garnered an inordinate amount of attention, at least by the standards of an FOI publication. The report became by far the most widely downloaded FOI publication in 2019; it was cited and debated in numerous specialist and non-specialist publications and attracted

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[1] Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region – Capabilities, Countermeasures, and Implications*, report, FOI-R--4651--SE (Stockholm: FOI, March 2019), https://150.227.2.8/rapportsammanfattning?reportNo=FOI-R--4651--SE.

[2] For an abbreviated version of the arguments, see Robert Dalsjö, Michael Jonsson, and Christofer Berglund, "Don't Believe the Russian Hype," *Foreign Policy,* March 7, 2019. Also, see the ensuing debate, Mikheil Saakhasvili, "Russia's Next Land Grab Won't Be in an Ex-Soviet State. It Will be in Europe," *Foreign Policy*, March 15, 2019, https://foreignpolicy.com/2019/03/15/russias-next-land-grab-wont-be-in-an-ex-soviet-state-it-will-be-in-europe-putin-saakashvili-sweden-finland-arctic-northern-sea-route-baltics-nato/; Jyri Raitasalo, "Scandinavia Won't Be Russia's Next Target," *Foreign Policy*, March 27, 2019, https://foreignpolicy.com/ 2019/03/27/scandinavia-wont-be-russias-next-target-putin-nato-finland-sweden-defense-saakashvili-georgia/; Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *Parameters,* Vol. 49 No. 1-2 Spring-Summer 2019.

attention from practitioners and policymakers alike.[3] Perhaps most encouragingly, the report seemed to break the spell surrounding Russian A2/AD capabilities, as even the harshest critics of the study accepted its basic arguments: that Russia cannot create impenetrable bubbles; that the maximum nominal range of its systems should not be confused with their substantially shorter effective range; and that much of the public debate on the topic had up to that point been simplistic to a fault.

That being said, in spite of the wide scope of *Bursting the Bubble*, we were always cognisant that it was by no means the last word on Russian A2/AD capabilities.[4] Firstly, the study primarily analysed the main Russian systems (the aforementioned S-400, the sea-target missile Bastion P, and the Iskander-M ballistic missile) in depth. While the report certainly mentioned and considered a number of capabilities – the wide array of complementary shorter-range land-based systems, the long-range cruise missiles, the Russian Aerospace Forces (VKS), and the support functions – the additional capability they provide and the complex "system versus system" aspect of a counter-A2/AD campaign was not explored in full depth.[5] Secondly, additional factors that go beyond the three traditional domains of warfare, again, although mentioned and considered, were not explored in full detail. These factors include the non-military means of A2/AD, cyber, and electronic warfare (EW), as well as Russian doctrine and historical experiences from the suppression of other enemy air defence (SEAD) campaigns than those mentioned in the study. This omission was not an oversight, but simply reflected a decision to eat the elephant one bite at a time. Already as it was, the project stretched time, energy, and financial resources to the limit. Lastly, and perhaps most importantly, we were aware of the risk of being misinterpreted, moving the public debate in a pendulum swing from one of exaggerated fears towards one of equally unwarran-

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[3] See, for instance, David Axe, "A New Report Claims that Russia's Mighty Missiles Might Not be so Mighty After All," blog, *The Buzz*, The National Interest, March 7, 2019, https://nationalinterest.org/blog/buzz/new-report-claims-russias-mighty-missiles-might-not-be-so-mighty-after-all-46392; Douglas Barrie, "Anti-access/Area Denial: Bursting the 'No-go' Bubble?" March 29, 2019, blog, *Military Balance*, International Institute for Strategic Studies, https://www.iiss.org/blogs/military-balance/2019/04/anti-access-area-denial-russia-and-crimea; Michael Kofman, "It's Time to Talk about A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge/; Anders Puck Nielsen, "Russia's A2/AD Strategy is a Myth," conference paper, MAST Northern Coasts 19, September 4, 2019, https://romeosquared.eu/2019/09/09/russias-a2-ad-strategy-is-a-myth/; Carla Anne Robbins "There's Something About Putin," The American Interest, July 8, 2019, https://www.the-american-interest.com/2019/07/08/theres-something-about-putin/.

[4] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 79.

[5] Ibid., 25–29, 79.

ted dismissiveness. Dismissing Russia's A2/AD capabilities was never the objective nor the argument of the study, a qualification clearly and repeatedly emphasised,[6] but some nonetheless managed to read such conclusions into its findings.[7]

Purpose and Organization of the Report

Continuing the analysis where *Bursting the Bubble* left off is the aim of this edited volume. Published as a report, it represents the proceedings of a conference organised by FOI and held in Stockholm, December 5–6, 2019. The purpose of the meeting was threefold: firstly, to expose our study and its findings to critical scrutiny from a wide spectrum of experts; secondly, to identify areas of common ground amongst leading researchers and practitioners; and, thirdly, to map out the areas of remaining disagreement or uncertainty for future research. The workshop was organised into five panels, covering topics that we had already deemed as needing further analysis, with two panellists to discuss each topic:

- *Status and Future of Russian A2/AD Systems and Capabilities.* Justin Bronk (RUSI) and Douglas Barrie (IISS).

- *Options for Counter-A2/AD SEAD in Europe: Tactics, Techniques, and Necessary Assets.* Jamie Meighan (RAF, Maxwell AFB); Karl Mueller (RAND).

- *Concepts for Defending or Reconquering Territory under a Hostile A2/AD Umbrella.* Anders Puck Nielsen (Danish Defence College); Ilmars Lejins (Latvian Army).

- *Different Approaches to Managing the Long-Range Ballistic and Cruise Missile Threat.* Robin Häggblom (FI); Luis Simon (Vrije Universiteit Brussel).

- *Impact of A2/AD on the Emerging Balance of Power in Northern Europe?* Ben Hodges (CEPA); Keir Giles (Chatham House).

The conference was attended by invitation only and held under the Chatham House Rule. As such, the chapters in these proceedings are based on papers that the speakers submitted ahead of the conference and finalised afterwards, rather than on primarily or directly what was said during the conference itself.

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[6] Ibid., 11, 19, 29, 65–66, 78.

[7] Michael Kofman, "Russian A2/AD: It Is Not Overrated, Just Poorly Understood," blog, *Russia Military Analysis*, January 25, 2020, https://russianmilitaryanalysis.wordpress.com/2020/01/25/russian-a2-ad-it-is-not-overrated-just-poorly-understood/. On Kofman's claim that, "Much of the writing presumes that Western forces can fight the S-400 on its own," see, for instance, Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 25–29, which outlines the full range of Russian ground-based systems that Kofman believes have been omitted from the analysis.

Understanding and counteracting Russian A2/AD capability is a quintessential politico-military challenge, which requires both an intimate knowledge of technical details as well as grand strategic calculations. Thus, the contributors to this edited volume purposely represent, on the one hand, a mix between scholars and practitioners, with backgrounds in different services, and, on the other, between military experts and those focused on broader security and defence policy.

Crucially, the report does *not* strive to arrive at any manufactured consensus, or to reinforce the findings and arguments put forth in *Bursting the Bubble*. On the contrary, the contributors were actively encouraged to take issue with earlier findings, if they found reason to do so. As such, careful readers will notice that some of the assessments by individual contributors differ, either with each other or with our original study, on specific points. All chapters have undergone in-house reviews, following standard FOI procedures; this has also pertained to any technical aspects. Nonetheless, the authors have retained the final say on their texts and answer personally for any claims made. Therefore, the chapters represent the individual authors' views, which do not necessarily reflect those of FOI as either a research institution or a government agency.

As a whole, the report seeks to advance the open-source debate on Russian A2/AD capabilities, while narrowing the scope of reasonable disagreement. Hence, our hope is to accomplish two things. Firstly, we wish to present the full spectrum of the Russian A2/AD threat, including all the arenas in which it might play out and hence needs to be counteracted, along with a fuller and more detailed description beyond the major, most well-known systems that constitute its core. Secondly, we hope to have discarded, once and for all, both the inflated and the dismissive views of the threat, hence narrowing the scope of disagreement and moving towards a more constructive, nuanced debate of the key topics on which there is genuine disagreement or insecurity. While some conclusions are presented in the final chapter, further discussion on what the ensuing implications might be will surely continue in the academic literature.

The Current Debate

Following Russia's annexation of Crimea and the onset of its poorly disguised war of aggression in southeastern Ukraine, the North Atlantic Treaty Organization (NATO) swiftly began shifting its focus away from expeditionary stability operations and back to territorial defence. As it did so, it was quickly recognised that the Baltic countries are the most exposed and vulnerable members of NATO, and as such at risk of becoming the next targets of Russian revisionism.[8] As the military geography and balance of forces in the region look far from favourable for those intent on defending the sovereignty of the Baltic countries, it quickly

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[8] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 13.

became clear that outside reinforcements would be necessary in the event of a crisis or war. [9] There was a growing concern, however, that Russian long-range anti-aircraft and anti-ship missiles based in the Kaliningrad exclave, together with more capable ballistic and cruise missiles, might make such reinforcements prohibitively dangerous and time-consuming.[10] Albeit originally based on factual observations of improved capabilities, descriptions of Russian A2/AD in the Baltic Sea region quickly veered towards exaggeration and threat inflationism, often illustrated by maps of "A2/AD bubbles" creating no-go zones reaching 400 km from Kaliningrad and islands in the Baltic Sea.[11] If true – or just believed to be true – this could have major consequences militarily, as NATO might be unable or unwilling to accept the costs and risks of reinforcing its most exposed members.[12]

Hence, a key purpose of *Bursting the Bubble* was to undertake a sober, realistic, and critical assessment of Russia's A2/AD capabilities in the Baltic Sea region and their implications for the region and NATO. The key finding was that Russian A2/AD capabilities had been exaggerated, for three principal reasons. Firstly, analysts often confused the maximal, nominal range of missiles with the much more modest effective range of the systems. Secondly, reports frequently disregarded the inherent problems of seeing and hitting a moving target at a distance, especially for targets below the radar horizon. Lastly, claims of impenetrable bubbles typically underestimated the potential for countermeasures. [13] Taken together, the conclusion was that Russia's "A2/AD bubbles" are smaller than was often claimed, posing a significant threat, but one that, arguably, is ultimately

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[9] Robert Dalsjö, *Brännpunkt Baltikum*, report, FOI-R--4278--SE (Stockholm: FOI, June 2016); David Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics*, Research Reports, RR-1253-A (Santa Monica, CA: RAND, 2016).

[10] Stephan Frühling and Guillaume Lasconjarias, "NATO, A2/AD and the Kaliningrad Challenge," *Survival*, April-May 2016; Luis Simón, "The 'Third' US Offset Strategy and Europe's 'Anti-access Challenge,'" *Journal of Strategic Studies* 39, no 3 (2016).

[11] See, for instance, Bret Perry, "Entering the Bear's Lair: Russia's A2/AD Bubble in the Baltic Sea," The National Interest, September 20, 2016; Loic Burton, "Bubble Trouble: Russia's A2/AD Bubble in the Baltic Sea," blog, *Foreign Policy Blogs*, Foreign Policy Association, October 25, 2016; Robbie Gramer, "This Interactive Map Shows the High Stakes Missile Stand-off Between NATO and Russia," *Foreign Policy*, January 12, 2017; Sidney Freedberg, "Russians In Syria Building A2/AD 'Bubble' Over Region: Breedlove," Breaking Defense, September 28, 2015, https://breakingdefense.com/ 2015/09/russians-in-syria-building-a2ad-bubble-over-region-breedlove/; David Filipov, "These Maps Show How Russia Has Europe Spooked," *Washington Post,* November 23, 2016; Giulia Paravicini, "'New Chess Game between West and Russia': Moscow's Investment in 'Access Denial' Military Systems Calls into Question the Alliance's Ability to Defend Baltics – and Divides It Politically," Politico, January 7, 2016, https://www.politico.eu/ article/natos-struggle-to-close-defence-gaps-against-russi-a2ad/.

[12] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 15–16. This danger was also highlighted in Giles and Boulegue, "Russia's A2/AD Capabilities: Real and Imagined,".

[13] Ibid., 2–3. See, also, Jyri Raitasalo, "It Is Time to Burst the Western A2/AD Bubble," blog, *Defence and Security*, Royal Swedish Academy of War Sciences, June 16, 2017, https://kkrva.se/it-is-time-to-burst-the-western-a2ad-bubble/; Barrie, "Anti-access/Area Denial: Bursting the 'No-go' Bubble?"; Nielsen, "Russia's A2/AD Strategy is a Myth."

manageable – provided Western nations invest sufficient resources in procurement, exercises and planning, and preparations.[14]

As mentioned above, the report was unusually well-received, with numerous citations and speaker invitations. Crucially, once the argument had been unpacked and critically examined, virtually no one has reiterated the claim that Russia could create impenetrable "no-go zones." To the contrary, there is now fairly wide agreement that any Russian A2/AD bubble could be picked apart over time, with the critical components being the assets necessary, expected attrition rates, the time frames needed – and the political will to shoulder the inevitable costs and risks. As a corrective to threat inflationism, the study was thus successful.

Inevitably, however, the study also received some criticism and questioning. Some argued that the study underestimates the ability of different subsystems to share radar data between them through networking, and the efficacy of such point-defence systems as Pantsir and Tor.[15] Others partly created a strawman, arguing that the report overlooked complementary ground-based systems, which suggests a not-so-careful reading. [16] Some commentary also pointed out some of the remaining unknowns in this field – the modularity of the individual components of the Russian air defences;[17] the effect of 5th generation stealth fighters on counter-A2/AD campaigns;[18] and the extent to which systems such as Pantsir can be expected to perform better on Russian soil than has been seen to date in Syria and Libya, for instance.[19] Michael Kofman also argued that the concept of "A2/AD" misstates Russian operational strategy, which aims for the protection of strategic assets and attrition of a massed air assault, not a swift land grab followed by a stationary A2/AD defence.[20] However, whether its nominal doctrine inevitably precludes Russia from engaging in a small war, followed by an attempt to de-escalate swiftly, definitely remains an open question. This is especially so as a high-intensity conflict against the entirety of NATO would inevitably be a losing

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[14] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 65–66.

[15] Charlie Gao, "Is Russia's S-400 a Paper Tiger or a Real Air Force Killer?" blog, *The Buzz*, The National Interest, March 9, 2019, https://nationalinterest.org/blog/buzz/russias-s-400-paper-tiger-or-real-air-force-killer-46477. However, since then, neither Pantsir nor Tor have fared particularly well in combat service. Declan Walsh, "In Stunning Reversal, Turkey Emerges as Libya Kingmaker," *New York Times*, May 21, 2020; BBC, "Iran Plane Crash: Tor M1 Missiles Fired at Ukraine Jet," January 21, 2020.

[16] Kofman, "Russian A2/AD: It Is Not Overrated"; Cf. Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 25–29. Also, see Robin Häggblom, "Russian A2/AD: Overrated, Underrated *and* Poorly Understood," Corporal Frisk, January 28, 2020, https://corporalfrisk.com/2020/01/28/russian-a2-ad-overrated-underrated-and-poorly-understood/

[17] Robin Häggblom, "Russian A2/AD"; Gao, "Is Russia's S-400 a Paper Tiger?"

[18] Kofman, "Russian A2/AD: It Is Not Overrated"; Robin Häggblom, "Russian A2/AD."

[19] Gao, "Is Russia's S-400 a Paper Tiger?"; Walsh, "In Stunning Reversal."

[20] Kofman, "It's Time to Talk about A2/AD."

gambit, whereas Russia could temporarily achieve regional superiority of forces in the Baltics.[21]

Conscious of the insufficient granularity in certain areas of *Bursting the Bubble*, we sought out some of the leading thinkers in each field to deepen and broaden the analysis. This included analysing complementary ground-based surface-to-air missile (SAM) systems (Bronk) and the role of VKS in air defence (Barrie); options and requirements for effective SEAD (Meighan and Tangredi, respectively); fighting inside an A2/AD bubble in the maritime (Nielsen) and land (Lejins) domains; options for dealing with the ballistic and cruise missile threat, either through air defence and passive measures (Häggblom), or by improving the missile balance (Lanoszka and Simón); and, lastly, taking stock of the impact on the balance of power in Europe of Russian A2/AD capabilities (Hodges) and how non-military means might be used to augment those capabilities (Giles). While still a fair bit away from having devoured the entire elephant, taken together these contributions are an improvement on our original study in ways that we as individual analysts could not have achieved, and for that we are very grateful towards all participants.

The Contributions to This Report

Each of the chapters presented in this edited volume advances our understanding of the strengths and limitations of Russian A2/AD in important ways, thus adding to the analysis in the original report. In Chapter 2, "Status and Future of Russian A2/AD Capabilities," Justin Bronk, from the Royal United Services Institute (RUSI), argues that the presence of Russia's Integrated Air Defence Systems (IADS) is "the most problematic element of the country's A2/AD capabilities for NATO." He also cautions against overly optimistic assumptions, as short- and medium-range SAM systems complement the S-300V4 (SA-23) and S-400 (SA-21) systems, making them much harder to swamp during a saturation attack, and sensor data may be supplied by other sources than their resident radars. In Chapter 3, "Russian Air-to-Air Power: Re-Make, Re-Model," Douglas Barrie, from the International Institute for Strategic Studies (IISS), argues that, "the air power Moscow now has at its disposal . . . is more capable, and with more operational experience, than at any time since the end of the Cold War." Possession of upgraded combat aircraft and improved air-to-air missiles (AAMs) is a marked improvement, albeit from a comparatively low baseline. This means that while the VKS cannot match the numerical strength of NATO combat aircraft, it may still be able to achieve local or regional numerical superiority, and could likely present a credible challenge in a short, limited war.

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[21] Many other researchers have certainly considered that this is a plausible scenario. See, for instance, Shlapak and Johnson, *Reinforcing Deterrence*; Krister Pallin, ed., *Västlig militär förmåga: En analys av Västeuropa 2017*, report, FOI-R--4563--SE (Stockholm: FOI, January 2018).

In Chapter 4, "Adaptive and Dispersed Basing within an A2/AD Environment: Opportunities, Threats and Concepts," Wing Commander Jamie Meighan argues that, "adaptive basing may provide an opportunity to erode advantages Russia may have in its A2/AD posture within the Baltics." Such a strategy is taxing, requiring for instance increased access to air bases or improvised air bases, e.g., civilian fields or highways, storage and handling space to allow for prepositioned and/or supporting fuel, munitions, maintenance, and force protection capabilities. Importantly, adaptive basing also necessitates greater use of mission command, delegating decisions to lower levels of command. But if successful, adaptive basing could reinforce deterrence and reassure key allies by showing deep commitment and by drastically reducing the vulnerability of Western air power to long-range precision strikes. In Chapter 5, "A2/AD Lessons Encountered: Applying Historical Attributes of Anti-access Strategies to Current Analysis," Sam Tangredi, of the US Naval War College, explores nine historical cases of anti-access/area denial warfare, to derive lessons for today's context. He argues that when A2/AD is successful, it is not because a globally capable out-of-area power is defeated, but that strategically superior forces may simply give up as costs are deemed to be high. Furthermore, history suggests that counter-A2/AD campaigns begin by blinding an opponent's Intelligence, Surveillance, and Reconnaissance (ISR) networks; that flanking attacks are key to overcoming geography-facilitated defence; that counter-A2/AD campaigns have a prerequisite maritime and aerospace phase; and that aggressors executing A2/AD campaigns seek to keep interventions short and limited. All factors ring eerily familiar in a contemporary context and the historical record does not guarantee success – in nine cases of counter-A2/AD campaigns, only four were successful.

In Chapter 6, "Defeating the A2/AD Umbrella – Concepts for Exploitation of Russia's Operational Weaknesses," Anders Puck Nielsen, of the Danish Defence College, argues firstly that Russia's ability to enforce a maritime A2/AD zone underestimates the difficulty of target acquisition at the tactical level and the vulnerability of target reporting units. Secondly, he argues that, at the operational level, a strict enforcement of A2/AD over a prolonged period will have a range of undesirable political effects, ultimately making it an unviable strategy for Russia.

In Chapter 7, "Thoughts on Fighting inside an Enemy A2/AD Bubble," General Ilmars Lejins, of the Latvian army, analyses the practicalities of potential warfare in the contemporary European theatre and, specifically, "conducting land battle against an overwhelming force within an A2/AD bubble." He argues that, "land-based systems can finally impact sea and air platforms reducing their freedom to shape the land domain at will," which, in turn, "changes the conduct of land battle." For instance, "the safe rear area no longer starts from 10 km behind the lines but 200–500 km behind, because of the range of sensors and theatre missiles," and, consequently, "could induce operational paralysis." As a response, Lejins argues that the limiting of emissions, the dispersed battlefield, avoiding decisive

engagements, and mission command will be key to the survival and relevance of a defending army that faces unfavourable force ratios while fighting inside an enemy's "A2/AD bubble."

In Chapter 8, "Different Approaches to Managing the Long-Range Ballistic and Cruise Missile Threat," Robin Häggblom explores how Finland and Sweden differ in countering the long-range precision strike threat from Russia. He argues that Finland has been adapting to Russian A2/AD capabilities since the Cold War, in part by relying on passive measures, such as "dispersion, movement, concealment, entrenchment, and deception," and in part by creating robustness by minimizing critical vulnerabilities and adding some redundancy in the amount of nodes. For active measures, Finland has ground-based air defence systems and fighter aircraft that can be used against cruise missiles, but has foregone costly ballistic missile defence (BMD) capability. By contrast, Sweden has acquired the Patriot air defence system, but in limited numbers, alongside a small number of short-range IRIS-T ground-based missiles and air-defence fighters, which can be used against cruise missiles. Häggblom argues that this means that Sweden has some limited-area BMD capability, but arguably much less of the area coverage and quantities needed for systems that counter cruise missiles.

In Chapter 9, "The Case for NATO Theatre-Range Missiles in Europe," Alexander Lanoszka, of the University of Waterloo, and Luis Simón, of Vrije Universiteit, Brussels, argue that NATO should improve the "missile balance" by stationing ground-based, land-attack, theatre-range missiles in Europe. This, they argue, would "help produce stability by dampening fears about decoupling in the European context"; "strengthen conventional deterrence in NATO's northeastern flank"; put strategic pressure on Russia and "encourage [it] to make costly investments aimed at improving its own capabilities"; and, finally, "would create a new source of leverage that the United States and NATO could use in order to bring Russia back to arms control."

In Chapter 10, "Missiles Are Not the Only Threat," Keir Giles of Chatham House argues that military mobility can also be very effectively impeded by non-military methods and factors - a point vividly demonstrated since the time of writing by the coronavirus pandemic. He explores covert methods Russia could employ in a crisis: not restricted to actions by Russian state agencies, these could also include oligarchs sponsoring political subversion; cyber criminals; organisations working with Russian "compatriots" abroad; ownership of private sector logistics chains; and agents of influence in the target country. He argues that this problem set "point[s] to a gap in the joint defence of Europe," because while military defence is the purview of NATO, counteracting non-military measures "at present consists of national measures of widely varying effectiveness and commitment (…); while the consensus nature of the EU leads to the lowest common denominator response."

In Chapter 11, "Deterring Russia on NATO's Eastern Flank," Lt. General (retd.) Ben Hodges, of the Center for European Policy Analysis, argues that Russian revisionism calls for more robust NATO deterrence along its eastern flank. This, Hodges argues, is best achieved through alliance cohesion and coherence, including adoption of a concept of Forward Presence for the entire eastern flank, including the Black Sea region. Equally important is the need for speed in recognition (including the improvement of intelligence-sharing with non-NATO partners, such as Sweden, Finland, Ukraine, and Georgia); speed of decision (necessitating a common definition of aggression and what constitutes a violation of Article 5); and speed of assembly (swift improvement of military mobility in Europe). Last, but not least, General Hodges argues that a joint command, responsible for the Baltic Sea, is needed, as is one for the Black Sea Region.

In Chapter 12, we conclude the anthology by drawing preliminary conclusions about what can be learnt from the conference. Crucially, we argue that the scope of disagreement can be narrowed considerably, as significant areas of agreement can be found amongst leading scholars and practitioners in approaching Russian A2/AD from a variety of differing viewpoints. Equally important, however, considerable uncertainty or analytical disagreement remains on topics such as the level of integration within Russian air defences, the impact of stealth, and electronic warfare. And whilst the scope of disagreement is narrowing, differing assessments of these issues could nonetheless yield very different outcomes in system-versus-systems scenarios. Hence, although the chapters in this anthology significantly further our understanding of Russian A2/AD, the topic remains in vital need of further research, including both broad simulations and in-depth technical analysis of individual subsets or components of the systems involved.

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2. Status and Future of Russian A2/AD Capabilities

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There is currently only one credible military threat to the North Atlantic Treaty Organization's (NATO's) territorial integrity, that posed by the Russian Federation, on the Alliance's Eastern flank. Ever since Russia's illegal annexation of Crimea and, since 2014, ongoing hybrid warfare in Donetsk and Luhansk Oblasts against the government of Ukraine, the potential for military aggression against eastern NATO member states has been a serious concern. The Baltic States would be the easiest members for Russia to attack and the hardest for other NATO members to reinforce; two of them also contain significant Russian-speaking minority populations. As a result, planning for the defence of the Baltics in any such scenario has become a commonplace NATO exercise since 2014. Poland is also concerned about potential Russian military aggression onto its territory, as are the NATO partner nations of Finland and Sweden.

For all these scenarios, Russia's so-called anti-access, area denial (A2/AD) capabilities constitute a significant part of the challenge facing NATO. Almost all the major military players within the Alliance have a strong expeditionary focus for their force designs, meaning that they are not well configured for heavily armoured forward deployments in Eastern Europe. Instead, NATO relies on being able to rapidly move forces to a threatened member state and allow them to – theoretically – take on more heavily armoured Russian formations with support from overwhelming tactical air power. To prevent this, and to deter what could if left unchecked build into a major NATO military force on its borders, Russia has developed and deployed a broad set of capabilities in the Western Military District, on its borders with the Baltic States and Finland, as well as in its heavily armed exclave of Kaliningrad. The first and perhaps most notable of these capabilities is its integrated air defence system (IADS), which includes ground-based radar stations, several types of mobile surface-to-air missile (SAM) systems, as well as airborne elements from Russia's Aerospace Forces (VKS). The second capability is a range of missile and special-forces capabilities aimed at denying NATO use of airbases and major transport hubs within the immediate vicinity of the Baltics and Poland.

Russia's Integrated Air Defence System

The Russian IADS is the most problematic element of the country's A2/AD capabilities for NATO for several reasons. The most obvious is that NATO relies extremely heavily on combat aircraft for the bulk of total Alliance firepower, especially against forces equipped with modern armoured vehicles. Thus, if NATO air forces can be kept at arm's length during any short sharp conflict in the Baltics

then Alliance ground forces will find themselves substantially outgunned as well as locally outnumbered by Russian forces. The second reason is that the IADS is a politically ambiguous tool for Russia, in that it is ostensibly purely defensive in nature, despite the fact that the long range of some of the systems allows it to threaten aircraft deep inside NATO territory. The third, linked, reason is that in a conflict scenario where political risk appetite precludes putting kinetic rounds on Russian soil – as Ukraine was forced to fight in the Donbass – Russia's strategic surface-to-air missile (SAM) systems can still hold NATO air assets at threat significantly inside their own territory whilst never crossing a border and, therefore, remaining safe from strikes. This does not mean, however, that the IADS is a stationary threat in most scenarios involving Russian aggression beyond its borders. The IADS consists of a great deal more than the very long-range S-300V4 (SA-23) and S-400 (SA-21) systems, which are the ones generally discussed among policymakers in the West.

Figure 1. S-400 Triumph (SA-21 Growler) Transporter erector launchers (TELs). Photo: Sergei Malgavko/Getty Images.

The Russian ground forces deploy a range of short- and medium-range SAM systems, which are highly mobile and designed to move with battalion tactical groups (BTGrs) during ground manoeuvres, whether on the attack or defence. The three most important of these are the medium-range BUK-M2 (known as the SA-17 Grizzly, in NATO parlance), the short-range 9K332 Tor-M2 (SA-15), and the point defence Pantsir S-2 (SA-22)[22] Both SA-22 and SA-15 are highly lethal

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[22] For outline details on SA-17, see Army Recognition, "BUK-M2 SA-17 Grizzly 9K317 9A317E," January 11, 2019, https://www.armyrecognition.com/russia_russian_missile_system_vehicle_uk/sa-17_grizzly_buk-m2_9a317e_missile_technical_data_sheet_specifications_description_pictures.html.

against low-flying aircraft and helicopters within around 15 km, but their core role is to destroy incoming cruise missiles, direct attack munitions, and anti-radiation missiles. In Syria and Libya, SA-22s operating outside a broader IADS have been shown to be vulnerable to unmanned aerial vehicles (UAVs) used in combination with electronic warfare techniques, especially when caught powered down or in transit.[23] Nevertheless, when used as intended, both SA-22 and SA-15 can engage multiple targets in quick succession down to ground level and make it much harder to swamp the self-protection capabilities of larger, longer-ranged SAM systems in their vicinity. Both systems can themselves be swamped by multiple threats arriving from different directions in short order, or by exhausting their ammunition before an attack is over, but achieving this places much greater demands on a SEAD effort.[24] Moving with Russian ground formations, they are also a very significant potential threat to the transport and attack helicopters that still form a significant part of the advanced mobility; intelligence, surveillance and reconnaissance (ISR); and firepower capabilities of NATO armies.

Figure 2. Pantsir S-2 (SA-22 Greyhound). Photo: Vitaly V. Kuzmin/Wikimedia Commons.

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[23] For example, see Seth Frantzman, "How Did Turkish UAVs Outmaneuver Russia's Pantsir Air Defense in Libya[?]: Lessons and Ramifications," Middle East Center for Reporting and Analysis, May 28, 2020, https://www.mideastcenter.org/post/how-did-turkish-uavs-outmaneuver-russia-s-pantsir-air-defense-in-libya-lessons-and-ramifications.

[24] For example, see IDF destruction of Syrian Pantsir system: "Israel Destroys Pantsir-S1 Air Defense System in Syria," YouTube, January 26, 2019, https://www.youtube.com/watch?v=NI0REqlYhmc.

Figure 3. Tor-M2 (SA-15 Gauntlet). Photo: Vitaly V. Kuzmin/Wikimedia Commons.

The medium-ranged SA-17, on the other hand, makes a significant contribution to the wider IADS, with a much longer effective range of up to 50 km against higher-flying targets and a large 9S18M1 Snow Drift wide-area scan/track and mast-mounted 9S36 PESA low altitude acquisition/engagement fire control radar in each battery.[25] Each Transporter-Erector Launcher and Radar (TELAR) vehicle also carries its own tracking and illumination radar, which allows the whole battery to engage more targets simultaneously, or each TELAR to conduct limited engagements even if the main Snow Drift and mast-mounted 9S36 battery radars have been destroyed or denied. The latest variant of the SA-17 TELAR carries the same 9S36 PESA radar as the main battery fire-control mast-mounted set, with similar capabilities but on a larger scale than the Irbis-E PESA radar mounted on Russia's Su-35S Flanker-E air-superiority fighter. Acquisition ranges are limited by the radar horizon, but against conventional fighter-sized targets flying at medium or high altitudes, the 9S36 is likely to have a range of well in excess of 100 km.[26] Crucially, this means that as long as an SA-17 battery still has TELARs active alongside forward-deployed Russian ground forces formations, it can feed

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[25] Carlo Kopp, "NIIP 9K37/9K37M1/9K317 Buk M1/M2 Self Propelled Air Defence System/SA-11/17 Gadfly/Grizzly," in *Engagement and Fire Control Radars*, Technical Report APA-TR-2009-0102, Air Power Australia, January 27, 2014, https://www.ausairpower.net/APA-9K37-Buk.html.

[26] See Carlo Kopp, "NIIP 9S36/SA-17 Grizzly," in *Engagement and Fire Control Radars*, Technical Report APA-TR-2009-0102, Air Power Australia, January 27, 2014, https://www.ausairpower.net/APA-Engagement-Fire-Control. html#mozTocId926428.

surveillance and target track information back to the nearest long range SA-21 or SA-23 battalion's command and control post via its own 9S470 command post vehicle. SA-17 batteries are expected to move with Russian ground forces' BTGrs during any offensive or defensive operations, and so can be expected to be encountered by NATO forces significantly further forward than the more commonly discussed long-range SA-21 and SA-23, whilst remaining connected to the latter and contributing to their radar picture.

Figure 4. Buk-M2E TELAR (SA-17 Grizzly). Photo: Zumlik/Wikimedia Commons.

The most modern Russian long-range SAM systems are the S-400 (SA-21) and S-300V4 (SA-23). Both are mobile systems that are designed to fire a variety of missiles to give a broad range of capability throughout the engagement envelope. The SA-21, for example, fires the highly agile 9M96D missile for short- to

medium-ranged engagements against aircraft and cruise missiles, out to a maximum range of 120 km. The larger and more expensive 48N6DM is used against some ballistic missile threats as well as aircraft and cruise missiles out to a maximum range of 250 km. Beyond this, both the SA-21 and SA-23 are being equipped with a smaller quantity of much larger 400 km-range-class 40N6 and 9M82MD missiles, respectively.[27] The 40N6 and 9M82MD are both equipped with active rather than more traditional semi-active radar seeker heads.[28] A traditional semi-active SAM engagement involves the target aircraft being "painted" with radar energy by the fire control radar of the launch battery, which gives the missile reflected radar energy to home in on. Active missiles carry their own radar, which can scan for and then lock onto targets that are not being illuminated by an external fire-control radar. The 40N6 is designed to cruise at extremely high altitudes before descending whilst in active search-and-destroy mode, giving its nose-mounted radar broad view to scan for targets at a wide range of altitudes during that descent.

Figure 5. S-300 V4 (SA-23 Gladiator/Giant). Photo: Igor Dolgov/Shutterstock.

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[27] For more information on the component parts of the S-400 system, see, "S-400 Triumph Air Defence Missile System," Army Technology, n.d., https://www.army-technology.com/projects/s-400-triumph-air-defence-missile-system. For the 9M82MD, see TASS, "Russia's New S-300V4 Air Defense System to Get Three Types of Hypersonic Missiles," September 9, 2016, http://tass.com/defense/898884.

[28] Andrei Akulov, "40N6 Interceptor Added to the Russian Military's Arsenal: A Qualitative Leap Forward in Air-Defense Technology," Strategic Culture Foundation, November 2, 2018, https://www.strategic-culture.org/news/2018/11/02/40n6-interceptor-added-russian-military-arsenal-qualitative-leap-forward-in-air-defense-technology/. Also informed by author's interviews with subject matter expert at the UK's Defence Science and Technology Laboratory (DSTL), May 23rd 2019.

There are disadvantages to active missile engagements over semi-active or other methods like command wire guidance. The first and perhaps most serious is that the missiles are relatively "dumb" and will home in on whatever target they find that best conforms to the position and track anticipated, whether friend, foe, or civilian, once they turn on their own radar (called going active, or going "Pitbull," in NATO parlance). The second is that the active seeker heads are limited in size, maximum active time, and power output compared to a large ground-based radar and so can only detect and lock onto targets at shorter ranges and in a limited search cone ahead of the missile. However, the major upside is that active seeker-equipped missiles can engage targets that are not within direct radar range of the fire control radar in the parent SAM battery, whilst still being capable of semi-active engagements at closer distances. The missile can be launched towards a predicted intercept point for a distant target and set to go active when diving down from high altitude, scanning the airspace below for targets and locking onto (depending on launch mode and rules of engagement, ROE) either the first one it finds, or one that confirms sufficiently closely to a specific anticipated target heading and velocity. The Probability of Kill (P_K) for missiles fired in this way against manoeuvring targets would drop significantly compared to semi-active mid-course guidance. To counter this, Russian doctrine involves at least two missiles at each target to increase overall engagement P_K, although this practice may be limited by available ready-to-fire missiles.

Furthermore, very long-range Russian SAMs such as the 40N6 are fired on quasi-ballistic trajectories, reaching apex at extremely high altitudes in flight of between 130,000 ft and 100,000 ft.[29] Such high altitudes mean that when the missiles go active and seek to acquire targets during the descent phase, the seeker head has a very large potential field of view against targets flying at lower altitudes.[30] In practice, the actual seeker field of regard (active search area) and P_k will depend on a variety of factors including pre-launch anticipated target track accuracy and ROE, missile descent angle, seeker activation timings and target altitude. The ability of the missile to intercept a detected target will further depend on the target's velocity, relative position to the missile's track, and remaining missile kinetic energy. However, one of the advantages of the 40N6's high-loft quasi-ballistic trajectory is that it has much more potential and kinetic energy remaining

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[29] Author's discussions with missile experts in London, Washington, DC, and at DSTL Portsdown West, Fareham, UK, 2019.

[30] For illustrative purposes; assuming a standard 60° field of view for a 40N6 seeker head, a vertical view from 30,480 m (100,000 ft) would give a field of view diameter of 35.17 km (115,400 ft) at ground level, giving a potential maximum field of regard (seeker search) area at ground level of 973 km^2. In practice, the field of regard is likely to be significantly more restricted to improve scan rates within a narrower predicted target area, as well as improve the ability of the missile to avoid locking onto unintended or spoof tracks. As the missile descends, the field of view will decrease, and the higher a potential target is off the ground, the smaller the effective search cone would be. In reality, descent angles will generally be shallower than this, giving a more complex but not necessarily smaller field of view calculation.

in the post-apex active acquisition phase than older long-range missile designs, which rely on aerodynamic cruise at lower altitudes. The key takeaway is that the quality of pre-launch track resolution required to potentially get a long-range missile shot to within active seeker acquisition parameters of airborne targets is not overly demanding. To further the ability to make use of long-range active missiles, SA-21 and SA-23 have also been designed to be fed situational awareness data from a wide variety of radar systems.

Radar horizon issues significantly restrict the semi-active engagement range of these systems if looked at as individual batteries, down to as little as 40 km for very low-flying targets.[31] The earth is curved, terrain is seldom entirely flat, and masts such as the 40 m 40V6MD mobile mast system for the S-400 only increase the range against targets at 150 m to just under 80 km and take additional time to set up when conducting rapid shoot and scoot operations.[32] Some studies have assumed these radar horizon limitations would allow Western aircraft and/or cruise missiles to approach to within several tens of kilometres of SA-21 and SA-23 batteries whilst avoiding detection, and then destroy them. This assumption is problematic for several reasons.[33]

Firstly, aircraft and cruise missiles are themselves restricted in terms of sensor picture by terrain and radar horizon limitations when flying at very low altitude. Given that all modern Russian SAMs are mobile and in combat scenarios frequently relocate, especially if standoff weapon launches are detected, this means attackers could not simply rely on pre-flight/pre-launch target coordinates to remain valid. The need for real-time ISR to dynamically track and target mobile SAMs means low-flying aircraft and cruise missiles' own offensive options against such targets rely to a large extent on receiving real-time off-board targeting data, which will be made harder by extensive Russian electronic warfare capabilities.[34] Fuel efficiency and speed also suffer compared to flight at medium and higher levels, and exposure to the dense ground fire and man-portable air defence systems (MANPADS) that any Russian combat unit can generate becomes

[31] Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region: Capabilities, Countermeasures, and Implications,* report, FOI-R--4651--SE, (Stockholm: FOI, March 2019), 16–18, https://www.foi.se/rest-api/report/FOI-R--4651--SE.

[32] For the 40V6M/MD, see Carlo Kopp, *NKMZ 40V6M/40V6MD/40V6MT Universal Mobile Mast*, Technical Report APA-TR-2009-0504, Air Power Australia, April 2012, https://www.ausairpower.net/APA-40V6M-Mast-System.html. It is worth noting that 127 ft is the height of the 40V6MD mast itself, whilst Russian literature lists the elevation of the antenna centre itself as 40 m. For radar horizon mathematics, see Unit Converter, "Radar Horizon and Target Visibility Calculator," https://www.translatorscafe.com/unit-converter/EN/calculator/radar-horizon/?hr=10&ht=15&u=m.

[33] For example, Jyri Raitasalo, "It is Time to Burst the Western A2/AD Bubble," blog, *Defence and Security*, Royal Swedish Academy of War Sciences, June 16, 2017; and Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 17–19.

[34] Igor Sutyagin and Justin Bronk, *Russia's New Ground Forces: Capabilities, Limitations and Implications for International Security* (London: RUSI, 2017), 80–82.

a major issue below 4600 m. At that height the radar horizon for a Russian SA-21 or SA-23 battery using a 40V6MD mobile mast for its search and target acquisition radar is over 300 km.[35]

Figure 6. KU-RLK Command vehicle and RLM-M modules from Nebo-M radar complex. Photo: Vitaly V. Kuzmin/Wikimedia Commons.

Secondly, Russia's SA-21 (and SA-23) has been designed with a system architecture optimised to make use of sensor data from a wide variety of radars beyond the 92N6E (Gravestone) fire control and target tracking radar, 96L6 (Cheese Board) surveillance and tracking radar, and 91N6E (Big Bird) acquisition and battle management radars that are part of each complex.[36] Inputs from more exotic radars optimised for over-the-horizon early warning, passive tracking, or countering stealth aircraft, such as the 3D Multiband Radar RLM-M Nebo-M can all be fed into an SA-21 or SA-23 battalion via their respective command post vehicles.[37] Furthermore, updates on incoming targets picked up by SA-17 and other SAM systems deployed further forward will also be fed into the picture wherever possible.

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[35] Unit Converter, "Radar Horizon and Target Visibility Calculator."

[36] For more information on the component parts of the S-400 system, see Army Technology, "S-400 Triumph Air Defence Missile System," n.d.

[37] For RLM-M Nebo-M and over-the-horizon radars, see Konstantinos Zikidis, Alexios Skondras, and Charisios Tokas, "Low Observable Principles, Stealth Aircraft and Anti-Stealth Technologies," *Journal of Computations & Modelling* 4, no. 1 (2019): 153–155.

Finally, Russia is actively experimenting with feeding real-time radar data from airborne VKS surveillance assets such as the modernised A-50M Mainstay and new A-100 airborne warning & control system (AWACS) aircraft and Mig-3BM/BSM interceptors to its long-range SAM network.[38] This would signify-cantly alleviate radar horizon range limitations for SAMs within the Russian IADS whilst such assets were on station. Data does not necessarily have to be sufficiently high fidelity, constantly updated and transmitted in real time to create an equivalent to Western cooperative engagement capabilities (CEC). With a rough indication from periodic updates of the coordinates, vector, and altitude of an incoming strike package, SA-21 and SA-23 batteries could potentially fire the active radar seeker-equipped 40N6 and 9M82MD missiles on a predicted trajectory for a terminal phase acquisition of targets far outside the direct radar line of sight of that battery's own sensors. The P_K would drop significantly compared to a semi-active guidance or beam-riding launch profile, but is still potentially a significant threat to even low-flying Western aircraft, especially larger and slower assets such as transports, tankers, and ISR enablers. Continuing to work on the development of full CEC, as well as optimising existing techniques to exploit datalink updates and active seeker-heads for beyond-battery-radar-horizon engagements is a major priority for the Russian armed forces.

There are several caveats to mention at this stage. The first is that there is still considerable debate in Western expert circles about whether the 400-km-class 40N6 and 9M82MD missiles are yet operational with the SA-21 and SA-23, respectively. However, the Russian military officially accepted the 40N6 for service in October 2018 and the missile has already been sold and shipped to China as part of the latter's S-400 purchase order.[39] The 9M82MD is a much more obscure weapon, but Russia has repeatedly proven capable of developing highly impressive long-range missiles, and with the 40N6 now in service and a long-range

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[38] Joseph Trevithick, "Bristling with Antennas, Russia's A-100 Is Likely More Than Just a New Radar Plane," The Warzone, November 21, 2017, https://www.thedrive.com/the-war-zone/16281/bristling-with-antennas-russias-a-100-is-likely-more-than-just-a-new-radar-plane. For technical information on the A-100, see "Beriev A-100 Airborne Early Warning and Control (AEW&C) Aircraft," Airforce Technology, November 29, 2018, https://www.airforce-technology.com/projects/beriev-%d0%b0-100-airborne-early-warning-control-aewc-aircraft/. For Mig-31BM/BSM datalink capabilities, see Andrei Akulov, "Unique Capabilities of MiG-31BM Fighter Strike Imagination," Strategic Culture Foundation, August 16, 2017, https://www.strategic-culture.org/news/2017/08/16/unique-capabilities-mig-31bm-fighter-strike-imagination/.

[39] TASS, "Advanced Long-range Missile for S-400 System Accepted for Service in Russia," October 18, 2018, https://tass.com/defense/1026630; Franz-Stefan Gady, "China's Military Accepts First S-400 Missile Air Defense Regiment From Russia," The Diplomat, July 26, 2018, https://thediplomat.com/2018/07/chinas-military-accepts-first-s-400-missile-air-defense-regiment-from-russia/; Joseph Trevithick, "Is a Batch of Russia's Most Advanced Surface To Air Missiles Sitting on the Sea Floor?" The Warzone, February 18, 2019, https://www.thedrive.com/the-war-zone/26540/is-a-batch-of-russias-most-advanced-surface-to-air-missiles-sitting-on-the-sea-floor; Akulov, "40N6 Interceptor Added."

equivalent for the SA-23 a clear priority, it will likely enter service in the near future, if it has not already done so.

The second caveat is that Russian datalink and military digital electronics capabilities in general remain on average at least a decade behind the West due to limitations of the Russian industrial base and the impact of Western sanctions since 2014.[40] This means that their ability to reliably link their SA-21 and SA-23 command post vehicles with batteries of other SAMs further forward in the battle zone, let alone with fast-moving air assets such as A-50Ms and Mig-31BM/BSMs, is likely to be unreliable and bandwidth-limited at present, in comparison with the latest CEC capabilities fielded within NATO's air and naval forces. However, it should also be remembered that limited scope CEC engagements have been conducted by US forces since at least the mid-2000s.[41] Furthermore, the Russian IADS draws on "redundant modern communications tools, including satellite communications, 4G (and now 5G) cellular networks, public switch telephone networks, data links, Wi-Fi networks, cloud computing, and others" to connect the various command centres, SA-21 and SA-23 command vehicles, and forward medium- and short-range assets.[42] In other words, with the IADS based on Russian territory, there are a large number of redundant connectivity options to draw on. Given that, it would be risky to simply assume away Russian ability to make these integrated engagement techniques work with the long-range SAMs that form such a core part of their national military strategy.

This has important implications for the early stages of any attempt by NATO forces to suppress the IADS component of Russia's A2/AD network. In such a scenario, SA-21 and SA-23 systems would be able to disrupt strike packages and enabler aircraft orbits out to several hundred kilometres, despite radar horizon limitations by cueing in active seeker missiles using radar data provided by forward-deployed SAM batteries and aerial surveillance platforms. Attacks using standoff munitions alone are unlikely to bring success, since all modern Russian SAM complexes are mobile, able to shoot and scoot in under 5 minutes, meaning that a subsonic cruise missile launched from outside their range would leave plenty of time for them to move between launch and impact. Furthermore, modern Russian SAMs can operate with battery vehicles significantly dispersed to make enemy targeting more complex, and multiple radars in each battery add a level of redundancy to absorb some strikes whilst remaining operational. Decoys are also

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[40] For more detail on Russian military electronic components import dependence, see Sutyagin and Bronk, *Russia's New Ground Forces*, 85–88.

[41] Author's interview with senior US Air Force aircrew officer with extensive fast jet combat and testing experience, London, May 29, 2019.

[42] Peter Mattes, "What is a Modern Integrated Air Defense System?" *Air Force Magazine*, October 2019, http://www.airforcemag.com/MagazineArchive/Pages/2019/October%202019/What-is-a-Modern-Integrated-Air-Defense-System.aspx.

used in large numbers to force an attacker to waste munitions,[43] and the presence of SA-22 Pantsir point defence systems means multiple near-simultaneous missile strikes would be needed to ensure a high P_K. Attempts to fly low-level attack profiles with aircraft and cruise missiles against these SA-21 and SA-23 batteries would have to run a gauntlet of dense SA-17, SA-15, SA-22, and MANPADS on the way to their targets. They would have to do this with limited options for early threat detection, using on-board sensors or evasive manoeuvres due to the constraints inherent in low-level flying. Ultimately, any IADS can be attrited with sufficient time, SEAD/DEAD (suppression of enemy air defences/destruction of enemy air defences) assets, and munitions, but the modern Russian IADS can inflict significant campaign delays, political risk, and aircraft losses on any NATO attempt to do so.

Looking to the future, Russia will continue to place a premium on keeping its IADS as modernised as possible, with an emphasis on improved anti-stealth radars, missile types, seeker heads, better datalink, and CEC capabilities. The next-generation follow-on from the S-400 (SA-21), predictably christened the S-500, is already in testing and incorporates even longer range and also claimed improvements in anti-ballistic missile defence capabilities. A prototype S-500 system successfully destroyed an aerial target from almost 500 km away during testing in 2018.[44]

Russian Long-Range Precision Fires and Spetsnaz Capabilities

The second major component of Russia's A2/AD capabilities in Eastern Europe is its cruise and ballistic missile forces and deep-infiltrating special forces. Moscow can deploy a wide range of cruise missiles, including the ubiquitous long-ranged 3M-54 Kalibr series, which comes in submarine-, surface vessel-, land-, and air-launched variants; the air- and submarine-launched Kh-55 series; and the new, extremely long-ranged, reduced radar-cross-section air-launched Kh-101.[45] All these missiles are produced in conventional and nuclear-armed versions and can attack land and naval targets with a range of subsonic and supersonic dash terminal profiles. Using Kalibr and Kh-101 variants, Russian forces could potentially crater almost any runway in Europe, with ranges well in excess of 1000 km and a broad range of launch platforms and axes of attack to choose from. This might not be enough to prevent a speedy repair and return to operations without follow up strikes or very heavy salvo concentrations on individual airfields, however, as

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[43] Sutyagin and Bronk, *Russia's New Ground Forces*, 72–73.

[44] Marc Bennetts, "New Russian S-500 Prometheus Missile Flies Further Than Ever before," *The Times*, May 26, 2018, https://www.thetimes.co.uk/article/new-russian-s-500-prometheus-missile-flies-further-than-ever-before-7z7nkd2kh.

[45] For a list of Russian cruise and ballistic missile types, with technical specifications, see Missile Defense Project, "Missiles of Russia," Missile Threat, Center for Strategic and International Studies, June 14, 2018, https://missilethreat.csis.org/country/russia/.

shown by the return to flight operations within hours by Syrian regime jets from Shayrat, following a strike with 59 American BGM-109 Tomahawk cruise missiles in April 2017.[46] Furthermore, accuracy, reliability, and the element of surprise would all degrade over such long ranges compared to concentrating on the main military airbases, munitions and supply depots, and potential key bridging areas within Eastern and perhaps Central Europe.

Cruise missiles can be intercepted in flight provided sufficient ground-based and aerial defence capabilities are available and early warning of launch and in-flight tracking can be established by AWACS and ground-based surveillance stations. However, they are small targets that fly relatively low and can be launched in large salvos, so NATO's ability to do more than defend particularly key bases against limited salvos is questionable. Whether Russia would risk the politically explosive escalation all but guaranteed by firing hundreds of cruise missiles into targets throughout Europe is also highly context-dependent. During a clash in the Baltic region, the Kremlin would certainly wish to keep hostilities geographically contained and avoid directly threatening as many NATO members as possible, to slow and fracture Alliance decisionmaking. Nonetheless, the capability to seriously damage NATO's key air bases, supply depots, and other critical nodes with cruise missiles during a short, sharp, flashpoint conflict, or a wider confrontation, is technically well within Russia's means.

On the much more subtle end of the A2/AD spectrum, Russia can also draw on an extensive and growing number of special purpose reconnaissance (Spetsnaz) units. There are seven Spetsnaz brigades and one independent regiment fielded within the Russian Main Intelligence Directorate's (*Glavnoye Razvedivatelnoye Upravlenie* – GRU) military intelligence branch, with another brigade and nine independent companies in the Airborne Troops (*Vozdushno-desantnye voiska* – VDV).[47] Furthermore, following the great success of Spetsnaz operations deep behind the frontlines in Ukraine, a company is now attached to each regular Russian Army BTGr, and 12 Spetsnaz battalions are being formed to sit within the remaining divisional strength Army formations.[48] These units are all trained in "reconnaissance combat actions," which involve operating deep behind the enemy front line of troops to find and, where possible, attack key communication, command and control, supply, and transportation nodes.[49] Equipped with modern weaponry, excellent training, and combat experience in Ukraine and Syria, Spetsnaz units conducting reconnaissance combat actions would constitute a serious threat during any clash, and are doctrinally oriented towards aggressive

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[46] Josie Ensor, "Syrian Warplanes Take Off Once Again From Air Base Bombed by US Tomahawks," *Telegraph*, April 8, 2017, https://www.telegraph.co.uk/news/2017/04/08/syrian-warplanes-take-air-base-bombed-us-tomahawks/.

[47] Sutyagin and Bronk, *Russia's New Ground Forces*, 57.

[48] Sutyagin and Bronk, *Russia's New Ground Forces*, 57.

[49] Ibid., 54–58.

deep penetration operations to tie down as many enemy regular forces behind the front lines as possible. They would be a particular menace for soft-skinned, high-value, and high-visibility assets such as radar installations, air defence sites, airbases, and resupply-line choke points throughout the Baltic region and large areas of Poland.

The final element of Russia's A2/AD threat to land-based assets is her arsenal of ballistic missiles and ballistically lofted hypersonic glide vehicles. These weapons provide greatly reduced warning time and are much harder to intercept for hostile forces than cruise missiles. The Iskander-M short range ballistic missile is capable of striking targets within 500 km and a battalion has been permanently deployed in Kaliningrad since 2018, placing almost all of Poland and the Baltic States within range.[50] In order to increase the capability of the system to overcome any Patriot PAC-3 batteries that NATO might deploy in the region to protect key installations, the Iskander-M is reportedly capable of significant terminal phase manoeuvres to make it harder to intercept. However, an even more capable air-launched Iskander derivative, called the KH-47M2 Kinzhal, was first seen in early 2018. This weapon appears to be an Iskander missile body adapted for launch from a Mig-31K interceptor and capable of evasive manoeuvres at all stages of flight, and hypersonic speeds of up to Mach 10.[51] These capabilities allow the Kinzhal to hit targets previously protected by current generation NATO ballistic missile systems, and an air-launch from high altitude from the supersonic Mig-31 would greatly increase the range and potential launch points for Russia's theatre ballistic missile capabilities over those previously fielded in the shape of Iskander and earlier Tochka missiles.[52]

Conclusions

Between Russia's cruise and ballistic missile arsenal and extensive Spetsnaz forces, NATO combat aircraft would be at extremely high risk if based any further east than the Polish-German border during any military clash. This could have significant adverse effects on NATO's ability to rapidly conduct a SEAD/DEAD campaign and establish air superiority over an Eastern European area of operations. Air-to-air refuelling tanker numbers become a sortie generation bottleneck, and even bases further back into Europe will remain at risk from Russian missile strikes at any time during a conflict, even if political calculations make the Kremlin

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[50] Missile Defense Project, "SS-26 Iskander," Missile Threat, Center for Strategic and International Studies, August 1, 2019, https://missilethreat.csis.org/missile/ss-26-2/.

[51] For more detail on the KH-47M2, see Tyler Rogoway, "Putin's Air-Launched Hypersonic Weapon Appears To Be a Modified Iskander Ballistic Missile," The Warzone, March 2, 2018, https://www.thedrive.com/the-war-zone/18943/putins-air-launched-hypersonic-weapon-appears-to-be-a-modified-iskander-ballistic-missile.

[52] For detail on the Tochka, see Missile Defense Project, "SS-21 (OTR-21 Tochka)," Missile Threat, Center for Strategic and International Studies, July 23, 2019, https://missilethreat.csis.org/missile/ss-21/.

refrain from such strikes during the opening phases. Within this context, the IADS that Russia has built up within its Kaliningrad exclave and in the Western Military District as a whole represents a very difficult challenge for any Alliance attempt to reinforce eastern member states in the event of a conflict. The multi-layered and mobile nature of the SAM systems make stand-off strikes an insufficient answer given the number of targets and limited missile stocks available. The long-range "strategic" SA-21 and SA-23 systems will mean traditional medium-high altitude ISR, tanking, and fast jet operations are at risk hundreds of kilometres into NATO territory, whilst dense short- and medium-range mobile systems will ensure that any attempt to fly under the radar will suffer significant attrition. That is not to say that the Alliance could not get through, but it would require a concerted campaign using a high proportion of the US Air Force's exquisite stealth fleets, along with pre-planned strike packages, to generate temporary penetrations and long-term degradation of the IADS over time. Whether this would be possible in time to prevent Russian forces achieving a *fait accompli* on the ground against NATO troops operating without regular air support remains an open question.

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3. Russian Air-to-air Power: Re-make, Re-model

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Russia's Aerospace Forces (VKS) bear little resemblance to Soviet air power of the 1980s. They also, however, have little in common with the barely operational service that struggled through the 1990s and early 2000s. This chapter examines recent developments in Russia's combat air power in the air-to-air arena.

The air power Moscow now has at its disposal, were it to consider military action on its northwestern borders, is more capable, and has more operational experience, than at any time since the end of the Cold War. While far smaller in size, both in personnel and platforms, it would likely present a credible challenge if there were to be a limited war in the region.

The most capable aircraft now in the inventory for the air defence and air superiority missions are the single-seat Su-35S Flanker M and two-seat Su-30SM Flanker H, while the MiG-31BM Foxhound C would be used in the interceptor role, including for cruise missile defence. Airborne early warning and control would be provided by the Beriev A-50M Mainstay and the Beriev A-100, when it enters the inventory. In the near term, the primary air-to-air weapons would be the R-74M (AA-11b) short-range infra-red guided missile, the R-77-1 (AA-12b Adder) medium-range missile, and the R-37M (AA-13a Axehead). These missiles would be supplemented by the basic R-73 (AA-11a Archer) short-range weapon, and some at least of the R-27(AA-10a/b/c/d/e/f) family of medium-range semi-active, infra-red, and passive homing missiles the R-77 was designed to replace.[53]

The 6th Air Force and Air Defence Army provides the resident air power for Russia's Western Military District. As of late 2019, the 14th Guards Interceptor Regiment was based at Khalino, operating two squadrons of Su-30SM Flanker H multi-role fighters, while, at Besovets, the 159th Guards Interceptor Regiment has two squadrons of Su-35S Flanker M and one of Su-27SMs. The 790th Interceptor Regiment, at Khotilovo, has two squadrons of the MiG-31BM Foxhound C and one of the Su-35. The first front line squadron of the Su-57 Felon is unlikely to reach an initial operational capability until 2023, with up to a further five squadrons to be delivered by the end of 2027, if the May 2019[54] "acquisition plan" is to be met, while continuing technical issues continue to threaten this goal. The availability of one or two regiments of the Felon would mark a further improvement in the air force's combat capability by the latter part of the 2020s.

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[53] The International Institute for Strategic Studies *Military Balance 2019* (London: Routledge, 2019), 202.

[54] TASS, "Putin says 76 Su-57 jets to be purchased before 2028," May 15, 2018, https://tass.com/defense/1058494.

Difficult Decades

The collapse of the Soviet Union, and the ensuing implosion of the Russian economy throughout the rest of the 1990s starved the service of resources.[55] Flying hours tumbled well below the point at which solo flights were a risk to the pilot: as few as twenty hours a year marked the low point. The combat aircraft and weapons development and acquisition plans of the 1980s were abandoned,[56] as the air force and the air defence force (PVO) struggled simply to survive.

Russia's 2015 intervention in Syria to shore up the regime of Bashar al Assad[57] provided an opportunity and a risk for the air force element of the VKS. If it succeeds, and the air campaign proves to have been key to sustaining the regime, then a decade of investment will have been justified; fail, and fall out of favour with President Vladimir Putin.

In the event, the service's performance in Syria has played a central role in sustaining the regime, providing Assad with a far more capable and better equipped "air force" than the rump of his own service has been. Combat air was also arguably the discriminator in rolling back the opposition that up until Moscow interceded threatened to end Assad's tenure.

Ambition and Available Resource

The performance in Syria was built on the basis of a decade-old reform programme and the associated equipment state armament plan. Defence Minister Anatoly Serdyukov unveiled his New Look (Novy Oblik) reform plan in October 2008,[58] in the wake of Russia's intervention in Georgia. At the heart of the reform was the aim of shifting the Russian military from a mass mobilization force to a smaller, predominantly professional military with units at a higher readiness state. The structural reform of the air force saw the division and regiment replaced by brigades built around the concept of "Aviabasa," or airbases.[59]

To support the air force goals of the Novy Oblik, funding was to be made available to allow the service to begin to coherently recapitalise its aircraft, systems, and weapons inventories, enshrined in the 2020 State Armament Programme (GPV). Each armament programme covers a ten-year period, the first five years of which are detailed, the latter five far less so.[60] They are generally refreshed after the initial

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[55] Marcel de Haas, "Russia's Military Reforms: Victory after Twenty Years of Failure?" Clingendael Paper No. 5 (The Hague: Netherlands Institute of International Studies, November 2011), 8.

[56] IISS, *Military Balance 2019*, 23.

[57] Valery Polovinkin, ed., *Russian Weapons in Syrian Conflict* (Moscow: STATUS, 2017).

[58] Katri Pynnoniemi, "Russia's Defence Reform: Assessing the Real 'Serdyukov Heritage,'" FIIA Briefing Paper 126, March 2013, 3.

[59] Mikhail Barabanov, ed., *Russia's New Army*, Foreword by David Glanz (Moscow: Centre for Analysis of Strategies and Technologies, 2011), 54, http://www.cast.ru/files/book/NewArmy_sm.pdf.

[60] Julian Cooper, *The Russian State Armament Programme 2018–2027,* Russian Studies 01/18 (Rome: NATO Defense College, May 2018), 2, http://www.ndc.nato.int/news/news.php?icode=1167&lang=en.

five years, although in the case of GPV 2027, this took until late 2017.[61] The multiple documents describing the GPV are classified, but the broad approach and procurement goals have generally been made public.

The previous GPV (GPV 2015) had included renewed emphasis on procurement, but funding was inadequate. Instead, it fell to the follow-on programme to be the focus for a long-overdue recapitalisation programme. A common thread in all of the previous state armament programmes was the failure to match ambition with the available resource; GPV 2020 was the first to broadly match the two.[62]

Recapitalisation Renewed

While sometimes portrayed in the general press in terms of Russian re-armament, what has happened since 2010 is, in one sense, a twenty-year deferred modernization. Most of the combat aircraft types and associated weapons had their origins in the 1980s, and were intended to enter service with the Soviet Air Force in the 1990s.

By the mid-1980s, the Soviet Air Force had projects underway to develop next-generation medium and heavy multi-role combat aircraft and a next-generation interceptor. Associated with these programmes were several air-to-air missile projects to replace the extant inventory. At the same time, mid-life upgrading of in-service combat aircraft was pursued as an interim until the new types entered the inventory in sufficient numbers.

The plan only ended up on the Soviet aerospace scrapheap. Ambitious even at the height of Soviet defence spending, in the economic turmoil of the 1990s it was a pipe dream. The MiG-29M, Su-27M (Flanker E), and the MiG-31M (Foxhound B) mid-life upgrade projects were shelved. The successor medium-fighter project had fallen into abeyance sometime in the latter part of the 1980s, while the MiG 1.42 project, to meet the air force's Multirole Fighter/Interceptor (MFI) requirement, struggled on into the 1990s, before it too was cancelled. The prototype, the 1.44, was flown for the first time in 2000, after the project had been abandoned by the Defence Ministry. The proposed successor to the MiG-31 Foxhound interceptor, MiG's ambitious Project 701 also fell by the wayside in the early 1990s.[63]

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[61] Cooper, *The Russian State,* 3.

[62] Dmitry Gorenburg, "Russia's Military Modernization Plans: 2018-2027," Policy Memo 495, PONARS Eurasia, November 2017, http://www.ponarseurasia.org/memo/russias-military-modernization-plans-2018-2027.

[63] Piotr Butowski, *Russia's Warplanes, Volume I: Russian-made Military Aircraft and Helicopters Today* (Houston, TX: Harpia Publishing, 2015); and Piotr Butowski, *Russia's Warplanes, Volume II: Russian-made Military Aircraft and Helicopters Today* (Houston, TX: Harpia Publishing, 2016).

Having been forced by economic reality to tear up the 1980s tactical combat aircraft route map, the air force was left having to try to find a way forward, with an ageing fighter fleet and limited funding. It was fortunate, however, that export sales had allowed Sukhoi, in particular, to survive the collapse in domestic orders. Doubly so, since a further update of the Flanker, initially intended for export only,[64] was to become the interim solution to the air force's need to modernize its single-seat fighter fleet. Rival fighter house MiG fared less well, failing to benefit from the export market to the same extent as Sukhoi.

Figure 7. Mikoyan MiG-31 BM (Foxhound). Photo: Mikhail Staodubov/ Shutterstock.

Following the cancellation of the MiG 1.42, Sukhoi prevailed over its traditional fighter rival in the successor competition. Selected in April 2002,[65] the project also came with an unrealistic schedule, which the manufacturer, and likely the air force, likely suspected from the outset was undeliverable. In 2001, the then head of the air force, General Anatoly Kornukov, claimed that the aircraft would enter service in 2010.[66] In fact, the first flight of the Sukhoi T-50 (Su-57 Felon) took place only in 2010. As of the second quarter of 2020, entry into service had yet to occur.

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[64] Butowski, *Russia's Warplanes, Vol I*, 90.
[65] Ibid., 98.
[66] *Jane's Defence Weekly*, "Russia Hopes to Have New Fighter by 2006," September 5, 2001, https://janes.ihs.com/Janes/Display/jdw02996-jdw-2001.

In parallel to pursuing a future multi-role fighter, the air force had the more immediate concern of eking out as much combat utility as it could from in-service types and existing designs. Both the single-seat Flanker and Fulcrum variants were fitted only for the air-to-air role, with the service lacking any real multi-role platform. The Su-27SM began to enter the inventory in small numbers from 2004. This introduced a hybrid cockpit, mixing three flat-panel displays and controls with analogue systems. The NIIP N001 casse-grain radar was upgraded to provide improved air-to-air detection range and to support the use of some air-to-surface missiles. The upgraded radar, sometimes referred to as the N001VEP, was also claimed to support the R-77 (AA-12a/b Adder). As of the end of 2019, around 67 Su-27SM/SM3[67] aircraft remained in the VKS inventory.

Figure 8. Sukhoi Su-27 (Flanker). Photo: Fasttailwind/ Shutterstock.

While the Su-27SM modification provided the air force with a stopgap in terms of a multi-role platform, it was also faced with further delay to the Sukhoi T-50 development. Suhkoi, however, had revisited the Su-35 concept, initially with the aim of developing an export product. In the event, its first customer was to be the Russian air force. Eventually, two batches of Su-35S (Flanker M), one of 48 and one of 50, were to be ordered, with deliveries falling within GPV 2020.

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[67] IISS, *Military Balance 2019*, 202.

While retaining the Su-35 designation of the T-10M/Su-27M (Flanker E), the latest iteration of the design was considerably different. Most visibly, it disposed of the canards, and sported shorter vertical fins. One of the criticisms of the Su-27M was said to be that the pilot could either fly or fight the aircraft, but not both, with the cockpit avionics found wanting when the aircraft was evaluated at the air force's test centre at Ahktubinsk. The Flanker M avionics would appear to have addressed this issue, and in doing so provides the VKS with its first aircraft to enter service designed to be multi-role from the outset. Three squadrons of the Su-35S were deployed in the Western Military district as of the end of 2019.

Figure 9. Sukhoi Su-35S (Flanker-M). Photo: JetKat/Shutterstock.

While the Flanker mid-life upgrade based on new-build airframes did eventually go ahead, if later than originally planned, the similar "deep modernisation" of the Foxhound, the MiG-31M, did not.[68] The MiG-31M programme was cancelled in the mid-1990s, after the construction of half a dozen prototypes. The extensive upgrade to the design included airframe modifications, radar, avionics, and weapons improvements. In the straightened circumstances of the 1990s, it was unaffordable. Instead, the air force was to pursue the MiG-31BM (Foxhound C)

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[68] Douglas Barrie, "Russia's Foxhound Finally Gets Its Bite Back," blog, *Military Balance*, April 30, 2019, https://www.iiss.org/blogs/military-balance/2019/05/russia-foxhound-upgrades.

programme to implement more modest improvements to its existing Foxhound inventory.

There have been sporadic reports in the past couple of years that exploratory work was again underway for a successor to the MiG-31 family. Sometimes referred to as the PAK DP[69] requirement, it is difficult to envisage its being progressed in the near-to-medium term. While the capability of the Foxhound is valued, there are likely other priorities with the funding that is likely to be available.

Air-to-air Missile Developments

At the same time as Soviet combat aircraft designers were working on the Su-27, the MiG-29, and the MiG-31, their air-to-air missile counterparts were working on new weapons as a complement. Work began on the Izdeliye 72 (R-73a Archer) infrared-guided dogfight missile in 1976, with the type entering service in 1983. Work on the medium-range Izdeliye 470 family (AA-10 Alamo) got underway in 1974, with service entry in the mid-1980s.

The West was to gain access to the AA-11a following German reunification, providing insight into the capability of the design.[70] The Archer was a high-manoeuvrability missile with a 7.4 kg warhead and in kinematic terms was a more capable missile than anything in the North Atlantic Treaty Organization's (NATO's) inventory of short-range air-to-air missiles (AAMs) at that time. This advantage was compounded when it was combined with a helmet-mounted sight, with the missile's Mayak-80 infrared seeker slaved to a monocular helmet-mounted reticle. Manoeuvrability was conferred through a mix of thrust-vector and aerodynamic controls. The missile was fitted with paired inceptors on the rocket motor nozzle, with four moving triangular fins mounted to the rear of the seeker. This combination gave the missile a high turn rate.

Originally designed by Molniya,[71] rival missile house Vympel inherited the Archer in the early 1980s, when the Soviet regime tasked the former to lead the Buran shuttle programme. Alongside working on upgrades to the basic R-73 at some point likely in the latter part of the 1980s, the design bureau also began to consider a successor. The Izdeliye 300, or K-30, are two designations associated with the project. A mock-up of the design is, if a photograph is correct, on display within Vympel's access-restricted museum in Moscow. The K-30 was a clean airframe design, doing away with the R-73 forward control surfaces and instead

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[69] Gareth Jennings, "Russia to Launch MiG-31 Replacement Programme Before End of Decade," *Jane's Defence Weekly*, August 13, 2015.

[70] See, for example, Tyler Rogway, "How to Win in a Dogfight: Stories from a Pilot Who Flew F-16s and MiGs," March 2, 2015, Jalopnik, https://foxtrotalpha.jalopnik.com/how-to-win-in-a-dogfight-stories-from-a-pilot-who-flew-1682723379.

[71] V. V. Vatolin et al., От ракеты «Биссектор» до ракеты РВВ-АЕ Полет [From the Bisector Missile to the RVV-AE missile], September 2006, http://www.aviation-gb7.ru/Bissektor.htm.

relying on thrust vector control. Most important, it was to replace the R-73 infrared seeker with an imaging IR system.[72] The latter provides greater counter-measures resistance, with a better capacity for flare rejection. Imaging infrared seekers also tend to provide greater target detection ranges, and allow for aim point selection in an engagement. The last provides for a higher probability of a kill.

If little progress was being made on an imaging infra-red (IIR) missile, Vympel continued to develop the basic R-73. The R-74M (AA-11b) is thought to have entered service in 2016, some thirty years after design work on an improved Archer was begun. The R-74M has a new IR seeker, providing a greater detection range and a greater off-boresight angle. A further project, the K-74M2, is now intended to be the first Russian dogfight missile featuring an IIR seeker.[73]

One problem for Russia, exacerbated considerably since its 2014 annexation of Crimea, is that the IR seeker technology during the Soviet era was the purview of Ukrainian institutes and manufacturing plants. This has required that Russia design and source replacement seekers domestically.[74] While work is ongoing on developing an IIR seeker, the status of this remains uncertain, as does when an entry into service might be expected. KTRV subsidiary Duks said, in mid-2019, that it was working on an IIR seeker aimed at upgrading the R-73. This, according to the company, was an internally funded project.[75]

Medium Range

As with the R-73, many of the components for the Soviet-era R-27 (AA-10) family were sourced in the Ukraine, as was all final assembly of all versions of the missile. The R-27 was developed in semi-active radar, IR, and passive radar-homing variants, combined with two motor configurations, the standard model and the so-called long-burn. The latter almost doubled the maximum fly-out range of the R-27R (AA-10a) to around 60 miles (100 km). The long-burn Alamo was considered a credible threat, although the engagement requirements of a semi-active seeker meant it had limitations. Similarly, the guidance-accuracy, or lack thereof, of the anti-radiation variant, designed to home on the emissions of US fighter radars, also had an impact on performance. Irrespective of this, however, there remained the potential deterrent effect on the opposition in knowing that illuminating a target might invite a "passive" response. The R-27R/ER was often carried in combination with the R-27T/ET infra-red variant of the missile. This provided the ability to

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[72] Piotr Butowski, *Russia's Air-launched Weapons: Russian-made Ordnance Today* (Houston, TX: Harpia Publishing, 2017), 47.

[73] Butowski, *Russia's Air-launched Weapons*, 47.

[74] Ibid., 46.

[75] Douglas Barrie and Piotr Butowski, "Russia's High-speed air-to-air Missile Upgrade," blog, *Military Balance*, July 25, 2019, https://www.iiss.org/blogs/military-balance/2019/07/russia-high-speed-air-to-air-missile-upgrade.

engage a target simultaneously with a semi-active IR-guided weapon, compounding the defender's countermeasures challenge.

The Vympel design bureau began work on a successor to the R-27 in the early 1980s.[76] Unlike the Alamo, the Vympel's Izdeliye 170 (AA-12a Adder) was to have an active, rather than semi-active, radar seeker. The missile design was also immediately recognisable by its lattice-grid cruciform tail fins. State trials of the medium-range missile were completed by 1993–94, but such was the parlous state of the air force's coffers that it was unable to buy the weapon. Instead, the export variant of the weapon, the Izdeliye 190, was to be widely sold as the RVV-AE: China and India bought relatively large numbers of the weapon as a part of broader combat aircraft packages. Along with the active-radar-guided variant of the R-77, Vympel had also considered alternative seeker and extended-range propulsion configurations. An IR variant of the missile was touted for export by some Vympel officials, while a rocket-ramjet variant was also ground-tested in the latter part of the 1990s.

Export of the R-73 and the R-77 (RVV-AE) provided a lifeline to Vympel in the 1990s and into the early 2000s, and likely provided at least some, however modest, investment in research and development. The design bureau, which became part of Russia's Tactical Missile Corporation in 2004,[77] benefited from the uptick in defence investment in the wake of the Novy Oblik. This allowed work to progress on an interim upgrade of the basic R-77. The R-77-1[78] tidied up the missile airframe, with its rear section boat-tailed, and the lattice fin mountings flush with the main body. The introduction of a lofted trajectory, combined with the reduced drag airframe, probably improved the missile's maximum engagement range to around 90 km against a closing target at around the same flight level. Test shots of the K-77-1 were carried out beginning in 2010 and the missile entered service with the air force in 2015. The first open source images of the missile on an operational aircraft, an Su-35S, emerged when the aircraft was deployed as part of the Russian air component in Syria. Since then, the missile has also been seen on aircraft intercepted as part of NATO's Baltic Air Policing.

Deployment of the 170-1 in the Syrian theatre changed the level of potential threat the US and its allies faced in the region. Prior to the arrival of the AA-12b, the Russian air force did not field a medium-range active radar-guided AAM and was reliant on the semi-active variant of the R-27.

The 170-1 has already been exported as part of the weapons package for the 24 Su-35s now in service with the People's Liberation Army Air Force (PLAAF). The

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[76] Rahul Udoshi, ed., *Jane's Weapons: Air-launched 2019–2020*, 61st ed. (London: IHS Jane's, 2019), 104.

[77] See KTRV, "About (the) Corporation," accessed May 5, 2020, http://eng.ktrv.ru/about/.

[78] Udoshi, *Jane's Weapons*, 104.

export variant of the missile is known as the RVV-SD (Raketa Vozdukh-Vozdukh, Sredeny Dalnosti) and open source images of the missile in China first appeared in 2018. While Russian air force 170-1 rounds have been seen with radar and laser fuses, the Chinese rounds seen appeared to be only the latter.

Vympel is also working on a further "upgrade" of the R-77, the R-77M (AA-X-12c?).[79] This is a more substantial development than the R-77-1, and has been associated with the Izdeliye 180 identifier. The most visible change reportedly is that the Adder's signature lattice fin has been replaced with a conventional blade. The missile is believed to be fitted with an improved motor, likely dual pulse, to extend the engagement range. This could offer around a further 30% range improvement in comparison to the R-77-1. The R-77M may be up to 10 kg heavier than the 170-1; much if not all of this increase could be solid propellant.[80]

While the R-77 and R-77-1 use variants of the same mechanically scanned array, the R-77M might be fitted with an active electronically scanned array (AESA). Russian radar seeker house Agat is known to have been working on AESA technology as an alternative to mechanically scanned arrays. This would offer improved detection range, and potentially better performance against low radar-cross section targets, as well as better countermeasures resistance.

As of the second-quarter of 2020, however, the Russian Defence Ministry had not approved information on the design to be made public. A production order for the R-77M, however, was reported to have been signed during the 2019 Army Defence Exhibition, held near Moscow from June 25–30, 2019. This would indicate the missile had completed company and initial state trials.

The Izdeliye 270 designation has been associated with a successor design to the R-77 family, although there is no further information available as to this project, and even the article designation is tentative.

Long range

Vympel's Izd.410/R-33 (AA-9a Amos) was fundamental to the MiG-31 Foxhound A's intercept capability. The draft requirement for what was to become the R-33 was created in 1968,[81] with the missile entering operational service in 1983 with the first Foxhound unit. The semi-active missile had a maximum engagement of 110 km. Work on a follow-on design, the Izd. 610/K-37 (AA-X-13), likely began in the latter part of the 1970s. This was intended to be the primary armament of the MiG-31M, a new-build mid-life modernization of the Foxhound. The MiG-

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[79] Barrie and Butowski, "Russia's high-speed air-to-air," 2019.
[80] Author conversations with Russian guided-weapons industry officials.
[81] Udoshi, ed., *Jane's Weapons: Air-launched*, 99.

31M programme was abandoned in the mid-1990s, as a result of the economic turmoil, and so it seemed also the K-37.

The Russian air force, however, was to pursue a modest upgrade to its in-service fleet of MiG-31s, and at the core of the capability improvement was a revised variant of the R-37, the R-37M (AA-13a Axehead). The R-37M entered service with the Russian air force in 2016,[82] providing the air force with an extended range intercept capacity against high-demand low-density targets such as tanker, airborne early warning, and intelligence surveillance and reconnaissance aircraft and cruise missiles. The R-37M is capable of engaging targets at ranges in excess of 150 km. While the R-33 was semi-active, and the original K-37 was active/semi-active, the R-37M uses only an active radar seeker for terminal guidance. The R-37M, in its export guise as the RVV-BD, is also being offered for export as part of the weapons package for the Su-35. A mock-up of the missile was displayed on Flanker M during the MAKS 2019 air show at Zhukovsky. The extent to which any actual integration work on the Flanker M may have been carried out as of late 2019 had not been made public. The Su-57 Felon may also carry the R-37M.

Figure 10. Vympel long-range air-to-air missile R-37M (AA-13a Axehead). Photo: Dmitry Eagle Orlov/Shutterstock.

The R-33 and the R-37M also likely have nuclear-armed variants. The R-33S (Izd.510; AA-9b Amos) was fitted with a small nuclear warhead to provide the ability to engage groups of targets such as cruise missiles, and the air force may also be adopting a similar approach with the R-37M.

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[82] Barrie, "Russia's Foxhound," 2019.

A follow-on project to the R-37M, possibly known as the Izd.810, was begun around 2010.[83] This was designed for carriage in the Felon's internal weapons bay. Performance improvements include longer range and the inclusion of a passive homing mode to complement the active seeker. Test items of the missile have reportedly been built, and it is conceivable that the weapon can be introduced into service by 2025. The missile probably has engagement range in excess of 250 km.

Forcing Factors

Obsolescence, deteriorating relations with the US and its NATO allies, export market drivers, and perhaps China have all acted to propel Russian AAM developments after near two decades of neglect. Given its age, the R-33 has been in need of replacement for some time, with the reliability of the weapon at least open to question. The breakdown in relations with the Ukraine may also have posed supportability issues for Russia's inventory of R-27s.

Certainly, for the 1990s, where Russian defence investment into conventional weapons research and development was negligible, and into the early years of this century, there was little urgency in revamping the air force's inventory of AAMs. The increasingly tense security environment and the Russian regime's threat perceptions have combined to refocus interest and funding on air-to-air weapons as a part of the wider and now more than decade-long effort to improve Moscow's conventional military.

The R-73 and the R-77, in its RVV-AE guise, have been exported widely as core elements of combat aircraft weapons packages. The latter system has been sold to at least 12 countries. Russia, however, currently lacks the ability to offer a successor to the Archer in the export arena, where an imaging infrared guidance is now required. Furthermore, the Chinese PL-10 IIR short-range missile could prove an attractive alternative to some previous R-73 operators.

The People's Liberation Army Air Force (PLAAF) has already integrated the PL-10 on a number of Su-27-based aircraft, including the J-11B and the J-16. As such, it could conceivably offer the PL-10 to other Flanker export customers as a successor to the R-73.

The VKS in the 2020s

As it enters the 2020s, the Russian air force poses a more credible air-to-air opponent than it did a decade ago. The introduction into service of upgraded combat types in operationally significant numbers, along with the belated introduction of improved short-, medium- and long-range AAMs is a marked improvement, if admittedly from a comparatively low baseline when judged against peer rivals

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[83] Butowski, *Russia's Air-launched Weapons*, 56.

The entry into service of the single-seat Su-35S Flanker M and the two-seat Su-30SM Flanker H has provided the VKS with capable multi-role combat aircraft. When combined with the improved R-77-1 and the R-74M missiles, this marks a notable change in the service's air-to-air combat capabilities. Furthermore, the MiG-31BM Foxhound C upgrade, including the fielding of the R-37M long-range AAM, provides the air force with an interceptor capable of extended range engagements against high-value targets, and with an improved counter-cruise-missile capacity. The potential for the Foxhound C to carry a nuclear-armed variant of the R-37M (AA-X-13b or AA-13b) also poses questions with regard to the nuclear threshold.

By the mid-2020s, the VKS should also be able, if the latest production schedule is met, to field its first operational regiments of the Su-57. The Felon will be the air force's first multi-role fighter with low-observable characteristics and will further improve the service's combat capabilities. When coupled with the R-77M mid-life update of the R-77, it will provide a credible threat to the latest generation of Western combat aircraft. The Su-57, and possibly the MiG-31BM, could by the latter half of the 2020s be capable of being armed with the Izd. 810, providing a very-long range AAM.

While unable by far to match the numerical strength of NATO combat aircraft, the VKS is still able to achieve local or regional numerical superiority. This would be particularly so were Moscow to initiate hostilities and benefit from being proactive. When combined with the belated modernisation that the air force has benefitted from in the past decade, it provides a capability that its northwestern neighbours would do well to take seriously.

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4. Adaptive and Dispersed Basing within an A2/AD Environment: Opportunities, Threats, and Concepts

Jamie Meighan, Wing Commander, RAF

In 2018, the US National Defense Strategy (NDS) was explicit in its assessment of the future operating environment and the urgent intellectual and physical investments needed to "compete more effectively below the level of armed conflict; delay, degrade, or deny adversary aggression; surge war-winning forces and manage conflict escalation; and defend the US homeland." It also specifically identified the need to modernise forces to be able to conduct adaptive basing (AB) as well as deliver a resilient and agile logistics enterprise.[84]

This strategy has given focus to and openly questioned the ability of US forces to operate effectively within a contested degraded environment. It has begun a significant examination of the USAF's ability to be comfortable with anti-access/area denial (A2/AD) threats and, when faced with such threats, having the robustness and agility to project power in A2/AD environments. In 2019 and into 2020 the conversation continues, with some progress being made to organise, train, and equip forces to be ready for this new reality. However, efforts broadly fail to consider that any strategy to compete, deter, and degrade a rising Russia must consider all the instruments of power at the macro level, combined with an effective strategy that can be enacted now at the operational level to enable manoeuvre and agility in all domains. Such an approach requires analysis and an agreed understanding of the concept of A2/AD that applies, not just to the traditionally accepted war fighting domains of air, sea, and land, but the more recent domains of space and cyber, in which manoeuvre is still massively misunderstood. It requires analysis of how to manoeuvre in the electromagnetic spectrum (EMS), which, whilst not officially a domain, has been referred to in the National Defense Authorization Act of fiscal year 2020 as a key area of assessment.[85]

EMS superiority will be vital to any strategy aiming to counter Russian aggression. It must build on the work already ongoing that considers the criticality of the joint functions; command, control and intelligence (combined into C4ISR); fires; movement and manoeuvre; sustainment; protection; and information. It must understand the balancing act that is resource-intensive Agile Combat Employment

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[84] US Department of Defense, "Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge," January 19, 2018, 7, https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.
[85] US Congress, "National Defense Authorization Act 2020," Public Law No. 116–92, December 20, 2019.

(ACE), Adaptive Basing (AB), or Dynamic Force Employment (DFE). Finally, it must consider balancing the risk of more comfortable passive activities with preparing for and executing a preclusion strategy against Russia in the Baltics. As the NDS states, in this new operating environment, if the strategy is correct, "we will challenge competitors by manoeuvring them into unfavourable positions, frustrating their efforts, precluding their options while expanding our own, and forcing them to confront conflict under adverse conditions."[86] The enemy does have a vote and will be persistent in its efforts to prevent this from happening; a central part of Russia's strategy to achieve this is through its A2/AD capabilities.

Anti-access and Area Denial

In facing any future operating environment in the Baltics, US and allied forces must reconcile the reality that current and future operational actions will be contested, and subject to persistent attack either physically, virtually, or cognitively. Russia's capabilities in all domains have grown dramatically, "the strongest it has been since the Cold War, fielding the most capable, modernized and well-funded force it is likely going to have for the foreseeable future."[87] As part of this reality, US and allied enablers that had previously been taken for granted to support force projection, such as in transportation and sustainment capability, are increasingly vulnerable. Some of this vulnerability in the Baltics is geographic. Latvia and Estonia border Russia; Lithuania borders Kaliningrad; all the options for US and allied agile basing, exercises, manoeuvre – all – are highly vulnerable to Russian force and influence. In the physical domains, the A2/AD environment is potent. Layers of short (400 km) and limited long range (1,600 km) ballistic and cruise missiles, such as the SS-26 Stone (Iskander) mobile system, the Kalbr ship-launched Tomahawk analogue, and the S-300, S-400 surface-to-air missile (SAM) systems, as well as the SU-24 Flanker and the newer SU-34 Fullback, all offer options combined with special forces from Russia proper and from Kaliningrad.

In considering the concept of A2/AD, definitions matter. In researching the environment, it becomes clear that both components that make up A2/AD are important to understand, yet the majority of effort is placed on the AD component, especially as capabilities traditionally employed in AD have expanded in range and effects. Anti-access could have a significant impact on the ability of forces to be projected as needed into an operational environment. In 2003, the Center for Strategic and Budgetary Assessments (CSBA) defined anti-access as "strategies (that) aim to prevent (US) forces entry into a theatre of operations."[88] In thinking

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[86] US Department of Defense, "Summary of the 2018 National Defense Strategy," 5.

[87] Michael Kofman, "Putin's Strategy is Far Better Than You Think," Commentary, War On The Rocks, September 7, 2015, http://warontherocks.com/2015/09/putin-is-a-far-better-strategist-than-you-think/.

[88] Andrew Krepinevich, Barry Watts, and Robert Work, *Meeting the Anti-access and Area-Denial Challenge* (Washington DC: Center for Strategic and Budgetary Assessments, 2003), ii.

about this in the context of multi-domain operations (MDO), this is in essence a proactive effort to limit the adversary's ability to manoeuvre in the physical domain, as well as in the virtual and cognitive domains. This does not have to be militarily physical in nature – i.e. standoff missiles, overt deployment of new capabilities, large-scale military build-up, or exercises – but can still be used to restrict adversary opportunities and exploit vulnerabilities. For example, likely adversary approaches could include limiting allied access to geographical locations in order to prevent allied build-up of forces and resources, the employment of proxies to plant misinformation in the homeland or manipulate the information environment, manoeuvre in cyberspace or in space to degrade power projection enablers. These are all moves focused on deterring or slowing allied access into the region, and on increasing the financial and psychological costs of operating there.

Area denial operations are defined as "activities that seek to deny freedom of action in the more narrow confines of the area under the enemy's direct control."[89] In the context of Russia and Kaliningrad, this manifests itself in the growth in missile technology and the capabilities brought into being, as well as the imposition of physical and psychological costs on the US and allies in order to limit manoeuvre inside prospective Russian operational areas. This is an activity ultimately to limit manoeuvre and includes such things as the selective geographic placement of forces, both fixed and mobile, in order to overstretch already stretched allied resources. It also includes the hardening of potential targets and the use of deception tactics to complicate targeting efforts and intelligence collections, the use of global positioning system (GPS) jamming and spoofing to deny access and manoeuvre in the EMS and space, and the degradation of C4ISR to limit communication, confuse decision-making, and degrade the effectiveness of US and allied forces.

When considering the A2/AD environment in the whole, manoeuvre and resiliency is at its core: either a willingness to limit it or the capability and resolve to project power in order to deter, coerce, and if needed survive and fight. The Russian employment of A2/AD capability is designed to deter US and allied activity in and around its geographic sphere of influence through every means possible in all domains. However, it is also a concept that is geared toward conflict, if needed. Russia holds the psychological and territorial advantage; so, close to home it holds the upper hand geographically, has escalation dominance, and can concentrate forces at will. It has mobility and dispersion already established through its mobile launch and advanced air defence systems, and low-observable cruise missiles. Moreover, it has the ability to collect and monitor US and allied activity using traditional intelligence as well as space and cyber capabilities, to manipulate social media, and to act in cyberspace and degrade critical infrastructure, all short of the

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[89] Krepinevich, Watts, and Work, "Meeting."

threshold of conflict. It seeks to undermine all of the key joint functions that successfully contribute to effective US and allied operations in all phases – with focus on disrupting intelligence collection, information, and C4ISR where it can.[90]

Multi-domain Strategy

Using a multi-domain asymmetric approach to the Russian A2/AD challenge requires an alternative mindset and strategic approach that marks a departure from current doctrine. A domain is defined as "critical macro maneuver space whose access or control is vital to the freedom of action and superiority required by the mission."[91] In this approach, an understanding of the macro-level strategic environment is the first point of departure for analysis. This analysis forms the foundation in seeking to undertake a holistic appreciation of the strategic environment, identifying opportunities, threats, and vulnerabilities that stretch the full range of instruments of power that identify asymmetric options that can be leveraged to deter, coerce, and compete with an adversary.

The concept of the Continuum of Domains focuses on MDO as the interdependency of 6 domains: the electromagnetic spectrum, space, air, land, maritime, and human; or the "continuum of integrated and interdependent domains."[92] The concept presents opportunities to decisionmakers, offering a flexible, adaptive, and responsive approach to adversary actions or likely actions, trends and decisions. Delivering the conceptual art of MDO requires the selection, development, and education of specialised personnel capable of using "combinations of domains to achieve access, control, or destruction of the adversary's interdependence between domains in order to accomplish operational goals."[93] Key to this is the ability to manoeuvre in the EMS.

The Electromagnetic Spectrum

The EMS as a domain, like air, maritime and land, has sub-elements within it, recently described as "electronic systems, subsystems, devices, and equipment that depend on the use of spectrum to properly accomplish their function." [94] Manoeuvre within the EMS is critical to the success of any strategy employed to counter Russia in the Baltics and critical to the success of adaptive basing. As Dr

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[90] Andrew Radin et al., *What Will Russian Military Capabilities Look Like in the Future?* Research Briefs (Santa Monica, CA: RAND Corporation, 2019), https://www.rand.org/pubs/research_briefs/RB10038.html.

[91] Jeffrey M. Reilly, "Multidomain Operations: A Subtle but Significant Transition in Military Thought," *Air & Space Power Journal (ASPJ)* 30, no. 1, Spring (2016): 61–73.

[92] Reilly, "Multidomain Operations."

[93] Ibid.

[94] Lauren C. Williams, "Navy Declares EMS a Full-fledged Warfighting Domain," Defense Systems, October 23, 2018, https://defensesystems.com/articles/2018/10/24/navy-electronic-warfare-williams.aspx?m=1.

Jeff Reilly points out, the EMS, "empowers space, allowing it to supply key enablers for the domains of air, land and sea, in turn facilitating the ability to influence the human domain."[95] Without US and allied EMS dominance, Russia is able to manoeuvre uncontested, with localised advantages, employing a range of capabilities such as sensing, jamming, spoofing, denial, passive and active defensive, and offensive capabilities all short of war.

A report published in September 2017 by the International Centre for Defence and Security, in Estonia, outlines the challenges members of the North Atlantic Treaty Organization (NATO) face as Russia builds on its capabilities in the EMS; a "total package" including capabilities to ensure Russia dominance in the EMS.[96] Just like China, Russia has embarked on a strategy of maximising the EMS, recognizing it as a distinct domain and building structures around it.[97] It has modernised 80-90% of its electronic warfare units and is employing capabilities that have been battle-hardened in Syria and the Ukraine and are fielded down to the company level. Russia's EMS operational strategy also encompasses the idea of information confrontation, which accounts for all methods of information gathering, transmission, and application, including the merging of electronic warfare (EW) and cyber units and capabilities.[98]

In order to compete and survive with the Russian approach, the US and allies have to invest in structures and capabilities that can "reduce the effectiveness of enemy surveillance and tracking, rapidly identify potential targets, and defeat large volumes of precision weapons at short notice."[99] Ultimately, the US and its allies must adopt concepts that facilitate manoeuvre in the EMS; dislocation and disruption – preventing Russia from achieving its objectives, and degradation of Russian forces. They should overtly demonstrate new capabilities as a means to deter Russian activities in a proactive and cost-effective manner. As former UK Chief of Defence Staff Sir Stuart Peach articulated, "to understand, manage and control the electromagnetic environment is a vital role in warfare at all levels of intensity. The outcome of future operations will be decided by the protagonist who does this to decisive advantage."[100]

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[95] Reilly, "Multidomain Operations," 67.

[96] Roger N. McDermott, "Russia's Electronic Warfare Capabilities to 2025: Challenging NATO in the Electromagnetic Spectrum," International Centre for Defence and Diplomacy, September 2017, icds.ee/russias-electronic-warfare-capabilities-to-2025-challenging-nato-in-theelectromagnetic-spectrum.

[97] McDermott, "Russia's Electronic Warfare," 10.

[98] Bryan Clark, Whitney M. McNamara, and Timothy A. Walton, "Winning the Invisible War; Gaining an Enduring Advantage in the Electromagnetic Spectrum," Center for Strategic and Budgetary Assessments, November 20, 2019, https://csbaonline.org/research/publications/winning-the-invisible-war-gaining-an-enduring-u.s-advantage-in-the-electromagnetic-spectrum/publication/1

[99] Clark, McNamara, and Walton, "Winning the Invisible War," 38.

[100] UK Ministry of Defence, "Cyber and Electromagnetic Activities," Joint Doctrine Note 1/18, Defence Concepts and Doctrine Centre, February 2018,

Adaptive Basing

Set to the context of the A2/AD environment and the challenges of manoeuvre within it, be that in the traditional domains or the EMS, the emerging concept of adaptive basing may provide an opportunity to erode advantages Russia may have in its A2/AD posture within the Baltics. AB is part of a broader strategy to operate within an A2/AD environment and maintain resilience complementary to active (Patriot, THAAD air defence and missile defence systems) and other passive defence measures (hardening, deception, and concealment). The concept is not new or original, executed during the Second World War by the US in the Pacific and by the British during the Battle of Britain. During the Cold War, US air forces in Europe (USAFE) practiced the dispersal of assets through regular deployments to the UK and Germany. There are many terms currently being used; adaptive basing, agile basing, agile combat employment, dynamic force employment, untethered operations. At the core of these concepts are some common aspects that if executed effectively make this a critical element of any anti-A2/AD strategy:

— dispersion/disaggregation of assets,
— dynamic logistic and sustainment support,
— C4ISR structures that if optimized for mission command enable speedy decisionmaking,
— the maintenance of situational awareness in a degraded communication network.

These concepts need to be underpinned by the acceptance of higher risk thresholds and the ability to operate when under attack. Furthermore, adaptive basing provides a quicker and cheaper alternative to attempting to field an effective long-range standoff force, combined with an effective fully enveloping air defence network, with robust communications to increase air base survivability. As Air Force doctrine states, "Few effective missions can be launched without a mission-capable aircraft; a fed and rested crew; fuel, weapons, command, control and communications; a usable runway; and a secure, uncontaminated base from which to operate."[101]

Dispersal

Ultimately, AB and ACE enable effective manoeuvre with a level of resiliency that places forces into an advantageous position in relation to the enemy, increasing survivability and responsiveness of allied capability within an A2/AD environment. A key component of AB/ACE is dispersion; US Doctrine refers to

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/682859/doctrine_uk_cyber_and_electromagnetic_activities_jdn_1_18.pdf 2.

[101] David Dammeier, Meka Toliver, and Logan Smith, "Overcoming a Power Projection Problem," CE Online, Spring 2016.

dispersion as "the spreading or separating of troops, materiel, establishments, or activities, which are usually concentrated in limited areas, to reduce vulnerability."[102] This concept encompasses both base-level dispersion and theatre-level dispersion. The concepts of dispersion and disaggregation are concepts that the US has forgotten about, until recently. Douhet had already warned in 1914 against the risks of relying on large Main Operating Bases for air assets, stating that it is more effective to "destroy the enemy's aerial power by destroying his nests and eggs on the ground than to hunt his flying birds in the air."[103] By dispersing assets, sustainment and logistics networks, and personnel, AB and ACE seek to improve the US and allied position while simultaneously complicating that of the adversary.

Using large main operating bases is generally very predictable; however, dispersion creates a degree of flexibility that has the potential (if executed correctly through manoeuvre) to maintain the element of surprise. Such bases also offer real potential for the development of agile C4ISR networks and logistics/sustainment practices, in addition to the execution of devolved command and control and execution of mission command. Much can be learnt from allies. The Finnish Air Force has utilized major exercises such as Exercise Arctic Challenge to demonstrate the ability to disperse the assets and supporting infrastructure that would be able to sustain and defend itself in an A2/AD environment. The US recently executed a series of exercises to begin proving AB concepts, including Exercise Agile Buzzard. As previously stated, these actions provide a visible deterrent to Russia, while enhancing US and allied credibility in showing capability to project power. AB/ACE complicates adversary collection and targeting during shaping operations and, if kinetic action were to ensue, increases the enemy collection requirements, seeking to over-stress the adversary system by increasing its intelligence needs, complicating its targeting, and raising the consumption of munitions and fuel, as well as raising the level of risk.

The execution of AB/ACE is not without its challenges and relies heavily on the identification of and access to suitable forward-basing options, an agile robust logistics and sustainment posture, and consideration of force protection requirements, all planned and executed in an environment in which Russia will compete, degrade, and harass. This is a very different environment from that which the US military and allies have been comfortable with over the last 20 years. Operating from well-established Main Operating Bases (MOBs) has afforded the luxury of fixed maintenance and logistics capability, fuel and munitions storage, hardened hangers and support buildings, and enduring operations, intelligence, and force protection personnel. In some instances, High Value Air assets such as tanker

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[102] US Joint Chiefs of Staff, *Air Mobility Operations*, Joint Publication 3–17, February 5, 2019, GL-8, www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_17.pdf.

[103] Giulio Douhet, *The Command of the Air* (Washington, DC: Office of Air Force History, 1983, originally published in 1921), 53–54.

aircraft and intelligence collection capabilities have also operated from MOBs, collocated with C4ISR capabilities. The employment of a hub and spoke concept has allowed the resupply and support of Forward Operating Bases (FOB). In the current A2/AD environment, access to MOBs and FOBs is limited by physical capacity at airfields. Other challenges to execute AB/ACE include increased personnel costs as basic functions often aggregated at MOBs such as airfield support and flight operations must be spread throughout more dispersed bases with a likely shortfall of staff. The same applies for maintenance staff, fuel and munition technicians, and intelligence and ISR (intelligence, surveillance and reconnaissance) support personnel. Limited or delayed food, accommodation, and general life support may also prove challenging, in addition to the potential effects of being more vulnerable to attack during the initial phases of establishment and maybe throughout if Force Protection assets are limited.

Austere and Dynamic Basing

A number of recent studies on AB and ACE have identified the need to seek out austere locations that push fighter aircraft capability deeper into an A2/AD environment. These can range in size and condition; however, a number of key criteria have been developed:

— They must have a runway or dual-use runway/highway to support fighter and, potentially, C-130/C-17 aircraft,
— they must have space to allow for prepositioned and/or supporting fuel, munitions, maintenance, and force protection capabilities,
— If prepositioning is not viable, they must have enough space to allow for capability to be airlifted in and airlifted out as needed, sometimes quickly and haphazard in nature.

RAND developed a basing model that the US military and allies may wish to analyse further; it truly examines the required material, capability, and personnel investment to support AB options. It has recognized the challenges of finding a balance between fixed and austere/temporary basing, strategic and diplomatic engagement challenges, as well as operational limitations. The study proposes three basing options beyond an MOB: Stay and Fight, "a fixed air base intended to sustain a squadron of fighters for about a month"; drop-in base, "used for shorter periods of time"; and Fighter Arming and Refueling Points (FARP), "used for hours."[104] One concept that is under continuing development and worthy of further examination is FARP.

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[104] Miranda Priebe, Alan Vick, Jacob Heim, and Megan L. Smith, *Distributed Operations in a Contested Environment: Implications for USAF Force Presentation*, Research Reports (Santa Monica, CA: RAND Corporation, 2019), 18,
https://www.rand.org/content/dam/rand/pubs/research_reports/RR2900/RR2959/RAND_RR2959.pdf.

Fighter Arming and Refueling Points

US doctrine defines FARP as "a temporary facility . . . to provide fuel and ammunition necessary for the employment of aviation manoeuvre units in combat."[105] The concept of FARP relies on the identification of FARP-capable airfields within the Baltic countries, as a means to operate proactively or reactively if MOBs or FOBs are no longer available temporarily or for an enduring period. A recent study identified that there were only three airfields in Estonia, five in Latvia, and five in Lithuania that could be used for FARP.[106] That, however, may not take into consideration the use of civilian airfields or the use of highways and suitable roads that can be used rapidly for operations. Nevertheless, the FARP concept has manoeuvre and agility at its core, with a focus on increasing the range and tempo of air operations by rearming and refuelling small packets of fighter aircraft using fuel stored in internal fuel tanks on aircraft such as C-130, C-17, or C-5, with an expected turnaround time for fighter aircraft of 90–120 minutes.[107] This concept also maintains a clear deterrence posture by displaying capability and intent that is proactive in nature, but enough to remain below the threshold of conflict. If the US and allied forces choose to deploy fifth- and, in the future, sixth-generation aircraft to FARP locations, the adversary will be faced with potent kinetic capability. If dispersed in sufficient quantities, although FARPs will not have the same force protection requirements of, maybe, an FOB, and may appear to be more vulnerable, by their very dynamic nature they are likely to be more survivable in an A2/AD environment. Given the potential for multiple FARPs, an adversary is likely to be unable to effectively collect and monitor all locations without assimilating huge additional intelligence collection costs and burdens on an already stretched C4ISR enterprise.

The FARP concept does not come without challenges. Meeting the sustainment and logistics requirements needed to operate is extremely challenging. Fuel needs may increase, as tanker and transport aircraft are required to operate further forward from rear locations. Manoeuvre forces may require resupply to maintain the initiative. Munitions requirements may increase; maintenance requirements forward will likely increase also. This also makes the sustainment network itself a key vulnerability and exploitable by Russia, who will undoubtedly seek to target it in multiple domains, comfortable in asymmetric action against enablers being deployed from the US mainland as part of a strategic A2 effort. Such methods may include attacking Sea Lines of Communication with anti-shipping missiles or

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[105] Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, November 8, 2010 (as amended through January 15, 2015), 95, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf

[106] Ralph S. Clem, "Geopolitics and Planning for a High-End Fight; NATO and the Baltic Region," *Air and Space Power Journal* 30, no. 1 (2016): 80.

[107] Robert D. Davis, "Forward Arming and Refueling Points for Fighter Aircraft; Power Projection in an Antiaccess [*sic*] Environment," *Air and Space Power Journal* 28, no. 5 (2014): 6.

using mines to prevent maritime manoeuvre. Activity against the US homeland to degrade power projection from airports and seaports of debarkation is highly likely. A cyberattack against a crane used to load and unload cargo could be as potent as a physical attack. Resiliency will be challenged, but US forces will seek to maintain logistics flow and continued projection of combat power. Russian actions may include attacks on transport and resupply nodes, and the employment of special operations forces (SOF) to disrupt and interdict and attrition of air lines of communication assets. Some of these challenges may be offset by the early forward positioning of munitions, fuel, and spare parts, or the continued development of alternative basing concepts, such as flexible basing (160 km from MOB or dispersed bases with a maximum of 5 days support) or cluster basing (one of 5–10 bases in which dispersed assets share logistics and defence resources).[108]

The use of roads that have been specially widened are also an effective alternative. These are not new concepts, as can be seen from the Swedish Base 90 concept, in which many of these concepts were explored, but many of these lessons have been lost in the organisational memory.[109] In delivering these concepts – of operating forward, and under time and resource pressure – resiliency becomes critical, through the employment of active and passive defence to mitigate any degrade in capability because of adversary action. Supporting this, there must be a robust and adaptable C4ISR structure and decisionmakers who will have to take more risk and accept greater losses that are pre-planned into redundancy.

In the A2/AD environment, C4ISR infrastructure becomes increasingly vulnerable, both inside the region and through network and communication dependencies that have external connections. Russia could easily target sea cables that carry data from the US and between allies, especially as they are documented on the internet. Operationally, the Command and Control of shaping, deterrence, or combat operations now or in the future should expect to operate through a severely degraded environment. As has already been mentioned, Russia has shown its capability to jam and spoof; Syria has provided a great example of this.[110] Military communications that rely on longer-range capabilities, including satellite communications, are highly susceptible to jamming. Shorter-range communications, such as fibre optics and line of site systems, are likely to be more reliable but still susceptible to attack. In dispersed operations with more adaptive basing, robust communication links become even more important. The size and scale of

[108] Jeff Hagen, Forrest E. Morgan, Jacob L. Heim, and Matthew Carroll, *The Foundations of Operational Resilience-Assessing the Ability to Operate in an Anti-access/Area Denial (A2/AD) Environment*, Research Report (Santa Monica, CA: RAND Corporation, 2016), 61.

[109] Harold C. Hutchison, "This is How the Swedish Air Force Planned to Survive World War III," We are the Mighty, June 12, 2017, https://www.wearethemighty.com/articles/this-is-how-the-swedish-air-force-planned-to-survive-world-war-iii.

[110] For a deeper understanding, see the report by C4ADS, "Above Us Only Stars: Exposing GPS Spoofing in Russia and Syria," 2019, https://www.c4reports.org/aboveusonlystars. It shows evidence that Russia used Syria as an experimental proving ground for jamming and spoofing capability.

these will vary depending on the role of the base; however, a greater reliance on deployable mobile communication systems is certain. This might see the use of mobile satellite communication terminals that are relocatable, the use of aerostat balloons and small unmanned air systems for rebroadcast, and the use of aircraft to rebroadcast and enable mesh networks to create and maintain communication links and enable the movement of ISR data. Yet even with effective communication networks, the cultural limitations of decisionmaking are also a huge challenge. Even if it were possible to build a both robust and capable C4ISR network for dispersed and dynamic operations, and do this in time and at a reasonable cost, this would hardly suffice against a peer adversary close to his home turf. In recent decades, the USAF has been able to operate with near impunity, with the initiative and the time, exquisite C4ISR capabilities and robust networks. Now, a major pruning of C4ISR requirements and command and control (C2) methods is needed to find more parsimonious methods better adapted to austere conditions and to a conflict where the enemy determines the tempo of operations.

The Need for Simplicity in C2

Chief of Staff of the Air Force, General David Goldfein, has said that the US Air Force is shifting its "doctrinal dependence on large vulnerable centralized command and control nodes to more agile, networked solutions . . . moving to distributed control and decentralized execution of multi-domain operations."[111] In an A2/AD environment, when executing AB/ACE concepts, it is unclear how decentralised execution will actually work in practice. It is highly likely that unless exercised frequently, new personnel structures, organizational structures, and an unfamiliarity with incomplete information and direction will create friction and fog that could be amplified by Russian disinformation and disruption.

The creation of pre-agreed sectors for air operations, not dissimilar to the sectors created during the Battle of Britain may offer one way to execute decentralised execution. Other ways to execute this concept include the delegation of decision authority down to individual bases, providing squadrons and sub-squadron levels with conditional authorities, delegating key actions and decisions being to commanders, based on pre-determined events, triggers or thresholds being met.

The USAF must become comfortable in the essence of true mission command and expect degraded access and communications and limited situational awareness and connectivity with higher echelons in order to make decisions. The use of Mission Type Orders, a mechanism for commanders to provide commanders intent and objectives alongside dedicated resources, is a well-known methodology that has been operationalised in previous conflicts. Overall, however, a shift is required

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[111] Dan DeCook, "Innovation, National Defense Strategy, the Future: CSAF at Air Force Association Air Warfare Symposium," *US Air Force News*, February 23, 2018, https://www.af.mil/News/Article-Display/Article/1449095/innovation-national-defense-strategy-the-future-csaf-at-air-force-association-/.

that moves decisionmaking into a truly decentralized model. As General Goldfein explains, "What's going to be essential to our success is that we have squadron commanders who feel empowered to make decisions and take appropriate risks, especially if they're cut off from the higher echelons of command."[112]

Strategic Partnerships are Key

Strategically, the establishment of agile bases, the dispersal of forces, and manoeuvre within an A2/AD environment symbolically reassures key allies showing deep commitment to regional partners. Freedom of movement, which is so vital to strategic messaging, relies heavily on access to allied basing and resources. At the macro level, access may be indirect in nature, with reliance on ports and logistics nodes outside of the operating environment. Within the region, the host nation support and resolve that enables access to military and civilian resources such as airfields may come with financial (additional infrastructure) and capability investments (defensive capabilities) that again strategically signal long-term commitment.

To plan and execute AB/ACE, the US will likely rely on and cultivate partnerships with host nations, surrounding nations, with the intent of ensuring access and support. The US will require a clear strategy that provides level of ambition, investment, and infrastructure expectations, including the preparation of dual-use airfields, co-located operations, storage and sustainment needs, and local contracts that support while generating revenue. Not all agreements will be quick or guaranteed and demands may exceed political, governmental, or leadership risk thresholds, given some of the uncertainty when facing an A2/AD environment. An MDO strategy may help in shaping a counter-A2/AD strategy against Russia in the Baltics.

Next Steps. . .

As has been outlined, through a better understanding of domain manoeuvre, a more comprehensive approach in the planning and execution of AB/ACE may yield some opportunities to identify friendly vulnerabilities to protect, as well as Russian vulnerabilities to exploit. AB/ACE as a deterrence mechanism, if executed across all domains and globally integrated, has the potential to present Russia with multiple dilemmas. Multi-domain manoeuvre has the potential to create doubt in the adversary's decisionmaking cycle, while increasing the potential for increased imposed costs over time. The use of a macro-level strategic design is a positive methodology in supporting early identification of potential converging and

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[112] David L. Goldfein, "Transcript, Air Force Association Air Warfare Symposium 2017," September 19, 2017,
https://www.af.mil/Portals/1/documents/csaf/CSAF_AFA_2017%20Air_Space_and_Cyber_Symposium.pdf.

diverging interests that may be utilized to support this. In a recent article, USAF General O'Shaughnessy suggests:

"[I]f, during a growing crisis, the United States executes concise whole-of-government actions targeted against varied vulnerabilities beyond the immediate issue – to include geopolitical weaknesses, internal political rivalries, national infrastructure challenges, economic dependencies, and geographic limitations – this may cause the adversary to reassess the risks of its approach. Faced with a significant deviation between expectations and reality, doubt and risk aversion increase, sense of control and confidence decreases – all delaying or even preventing the adversary from continuing along his planned course."[113]

The visible posturing and demonstrating of forces as well as manoeuvre at speed with agility, which may seek to purposely expose new technologies and techniques to the adversary, is a key military component of a proactive multi-domain strategy. This strategy seeks to limit Russian advantage. At every step, Russia will seek to outpace and deny domain manoeuvre. It will seek to deny access to the EMS using jamming and spoofing, manoeuvre in space with the employment of ASAT capability and maximise the use of its own GPS constellation and exploit partnership vulnerabilities, virtual vulnerabilities, and cognitive vulnerabilities to impact the human domain. Russia will ultimately seek to limit our speed and agility and if that fails use its kinetic and non-kinetic capabilities at will to impose physical and virtual costs on us.

In the A2/AD environment, there is a tendency to focus on the forces' ability to fight through the environment. A multi-domain approach focuses on fighting above, below, and around it. By robust red teaming, planners can truly understand the adversary and its likely strategic focus and national interests. It can recommend and create proactive actions that accelerate the decisionmaking cycle; it can introduce uncertainty into adversary decisionmaking and gain and maintain advantage.

Summary

This paper only really scratches the surface of some of the conceptual and execution challenges being faced when considering ACE/AB. National US direction is very clear: compete below the threshold and surge forces that can operate and be sustained in degraded and denied environments. In order to achieve this, AB/ACE must not be considered in isolation from the global strategic environment. Understanding multi-domain manoeuvre and the interaction between domains as well as the instruments of power provides an opportunity to understand US and allied vulnerabilities as well as seeks to identify adversary vulnerabilities to exploit. AB/ACE, whilst configured to enable combat operations, has a vital role to play in deterring Russian aspirations in the Baltics by displaying agility,

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[113] Terrence J. O'Shaughnessy, Matthew D. Strohmeyer, and Christopher D. Forrest, "Strategic Shaping, Expanding the Competitive Space," *Joint Force Quarterly* 90, 3rd Quarter (2018): 13.

capability, and strength of partnership. AB/ACE will rely on access/posture, manoeuvre, sustainment, protection, and C4ISR. New ways of delivering these functions must continue to be explored, both materially, conceptually, and culturally, to deliver within the Russian A2/AD environment, whilst old concepts and tactics must be reconstituted into the US and allied psyche in order to be prepared to deter, degrade, and, if required, destroy.

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5. Applying Historical Attributes of Anti-access Strategies to Current Analysis

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The goal is to "keep out" any force capable of overturning the results achieved. This was the primary strategy of Imperial Japan in the war with the US and her allies, 1941–1945, perhaps the clearest reliance on anti-access warfare (hereafter also referred to as "A2/AD") in the history of war. The goal of Imperial Japanese grand strategy was to create and retain a resource-rich empire ("co-prosperity sphere") in the Asia-Pacific region. Japanese planners (at least, those who were not blinded by racism) were well aware they could not prevail in a prolonged force-on-force contest with the United States, due to the superiority in US manufacturing productivity that could extend its reach on a global basis.[114] The strategic objective was, therefore, to expel US and allied forces from the region and prevent their return by building a barrier (or "network," in modern terminology) to prevent penetration, and by conducting operations – including diplomatic, economic, and political – that could convince the US that a return to the region would be just too costly.[115]

In the Pacific war, the attack on Pearl Harbor was designed to destroy as much of the US fleet as possible in order to instil the belief among US decisionmakers that any attempt to roll back the Japanese regional empire would cost more than they could bear.[116] At no time did Imperial Japan seriously contemplate an invasion of Hawaii, or any other US territory, except that within the region of conquest (Philippines and Guam) that could be defended by its "A2/AD network" of a

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[114] In fact, Yamamoto included a paragraph on superior US industrial power in the discussion notes on *Combined Fleet Secret Operations Order No. 1* that directed the Pearl Harbor attack. See US Congress, 69th Congress, First Session, *Pearl Harbor Attack: Hearings Before the Joint Committee on the Investigation of the Pearl Harbor Attack, Part XXXVI* (Washington, DC: GPO, 1946), 596 (Paragraph #7). Roberta Wohlstetter summarises the Imperial Japanese Cabinet War Liaison Conference of October 23, 1941, as asking, "6. *What are the US potential and ability for war?* The answer was about seven to eight times larger than Japan's." She quotes Imperial Japanese Foreign Minister Togo Shigenori as reporting, "There was no means, it was unanimously agreed, of directly vanquishing the United States in case of war against her." Roberta Wohlstetter, *Pearl Harbor: Warning and Decision* (Stanford, CA: Stanford University Press, 1962), 348.

[115] US Congress, *Pearl Harbor Attack, Part XXXVI*, 592. H.P. Willmott entitled his history of "Japanese and Allied Pacific Strategies February to June 1942" as *The Barrier and the Javelin,* to indicate that the basic Japanese strategy was "the barrier" with occasional "javelin" strikes, such as the Battle of Midway, in an attempt to attrite US forces. Meanwhile, the US strategy was to thrust an increasingly growing javelin. Hedley Paul Willmott, *The Barrier and the Javelin* (Annapolis, MD: Naval Institute Press, 1983).

[116] Yamamoto repeatedly stated such in his letters. See, for example, his January 7, 1941, letter to Navy Minister Oikawa, translated in Donald M. Goldstein and Katherine V. Dillon, *The Pearl Harbor Papers: Inside the Japanese Plans* (Washington, DC: Brassey's, US, 1993), 116.

powerful navy, land-based air power, and fortification of the mid-Pacific islands.[117]

Current Context of Anti-access

In a current context, the Imperial Japanese plan also appears – albeit as of yet without recourse to war – to be the strategy of the People's Republic of China (PRC) in its effective "conquest" of what was (and is still in a *de jure* sense) considered a global commons in the South China Sea. The PRC has built a formidable air and rocket force and a navy suitable for isolating Taiwan. It has built its own partial barrier in the medium of artificial islands in order to take away any manoeuvre space that US and allied forces (as well as its regional neighbours) could use in the South China Sea. Instead of being purely "defensive" in character, the A2/AD barrier, or reconnaissance-strike network, allows the PRC to physically isolate and convince Taiwan that it cannot rely on outside support to resist forcible annexation (or reclamation, from the PRC point of view). It also serves internal political purposes in ensuring that movements antithetical to Chinese Communist Party (CCP) internal control are well aware they cannot receive outside military support. Diplomatically, it encourages the neighbouring nations to seek accommodation with CCP/PRC policies and economic goals.

Of course, PRC strategy is certainly not an exact replica of that of Imperial Japan, and its economic strength and position in the global economy is vastly different than Imperial Japan's relative economic weakness. The problem of countering the PRC A2/AD posture is magnified by the PRC's economic position and its role as an originator of components in the global supply chain. Yet, the strategic logic of actual and potential PRC actions and development of an A2/AD posture mirrors that of the Imperial Japanese. This is not emulation – it simply conforms to the principles and experience of anti-access warfare in which a regional power seeks to keep a global power outside the region in order for it to expand and to consolidate its desired position. In this case, the A2/AD capabilities buttress the Chinese claim that the South China Sea is indeed their sovereign territory.

The desire of Vladimir Putin for Russia to act as a global power and compel a degree of Russian control over the politics of its neighbours in the "near abroad" and eastern Europe presents another situation in which an anti-access strategy is a logical adoption. Putin and other Russian decisionmakers are well aware it cannot contest the overall military strength of the North Atlantic Treaty Organization (NATO) and its partners. However, contesting that overall military strength is not

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[117] US Congress, *Pearl Harbor Attack, Part I*, 183; *Part VIII*, 3532; *Part XI*, 353–5354. Pearl Harbor attack planner Commander Minoru Genda claimed in later years that he advocated an invasion of Hawaii in conjunction with the attack, but was ignored. See Gordon W. Prange, *Pearl Harbor: The Verdict of History*, with Donald M. Goldstein and Katherine V. Dillon (New York: McGraw-Hill, 1986), 505–507.

necessary, since it is centred primarily in Western Europe and North America, regions that Russia might want to influence (by non-combat means such as social media), but has no objective to politically control. The military goal – if conflict were to occur with NATO or its partners – would be to swiftly achieve the regional objectives and convince the remaining NATO nations (as "outside" powers) that the cost of overturning the results would be too great, since they would be unable to successfully defeat the A2/AD barrier imposed. Thus, the A2/AD capabilities Russia continues to build – such as forward deployed naval power – are an inherent tool to ensure the success of any expansionist objective (or, perhaps, "reclamation" from a Soviet-era influenced Russian perspective).

Given Russia's economic dependence on the export of natural resources – a global market subject to great price volatility – it may be that their A2/AD capabilities cannot be maximised; the desired goal is made evident in their resumption of blue-water Atlantic Ocean operations and their pursuit of developing more capable naval strike weapons.

Reprise of Cold War Soviet Naval Strategy?

To some degree, this appears a reprise of Soviet strategy in any potential war with NATO as it appeared to the West in the 1970s and 1980s, at least in the naval realm. Since the countries of Eastern Europe were already under Soviet control (or, in its point of view, was comprised of its "allies"), the objective was indeed assumed to be military gains in Western Europe. Success depended on overwhelming the NATO forces emplaced in the central front. At the same time, however, it was widely assumed that a prototypical A2/AD barrier needed to be emplaced in the Atlantic region in order to prevent the flow of US and Canadian forces to the Western European theatre. A Soviet sea-denial navy, constructed around cruise missile-capable attack submarines and long-range naval bombers, was essential for such an effort.

In the later Cold War period, this became complicated. Once the US adopted the 1980s *Maritime Strategy*, with its more offensive orientation, the Soviet Navy needed to split the focus of its efforts, to include defence of its high northern and Pacific region and its nuclear ballistic missile submarine bastions. The result was that the potential battle space moved to the north of the Greenland-Iceland-United Kingdom (GIUK) gap, thereby reducing Soviet pressure on the trans-Atlantic flow. It also prevented absolute Soviet focus of resources on the central front battle, since they now faced NATO forces operating on multiple fronts.[118]

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[118] Norman Friedman, *The Fifty-Year War: Conflict and Strategy in the Cold War* (Annapolis, MD: Naval Institute Press, 2000), 461–463. It can be alternatively argued that the Maritime Strategy did not encourage the Soviets to cluster their SSBNs into bastions, but that the choice of bastions allowed for the potential success of the Maritime Strategy.

It should be noted, however, that a debate raged at that time (and still today) among Western analysts as to whether the Soviet Navy was actually "defensive" or "offensive" in nature, and whether it had the firm intent of attacking the trans-Atlantic flow. Given the large number of attack submarines procured by the Soviet Union, it is hard to see why it would not make such an attempt – based on strategic logic alone. Most naval platforms can conduct both "offensive" and "defensive" missions. Rather than reargue this debate, I would note the similarity between the nature of the Soviet Navy of the later Cold War and the concept of anti-access strategy itself: defensive in appearance, but necessarily offensive in combat operations.

Like the PRC, current Russian recreation of A2/AD barriers is not an exact emulation of the Soviet model. For one (very important) thing, Russia does not possess the total military power of the Soviet Union. For another, Russia is much more dependent on its position in the global economy as a resource exporter than was the Soviet Union, with its dysfunctional economy. However, strategic logic prevails. Russia cannot militarily challenge the United States and her allies – hence NATO – on a global or out-of-area basis. It needs, therefore, to keep a conflict regionally confined and prevent US/NATO from being able to bring its power to bear at the contested point.[119]

National Security Dilemma of Regional Neighbours

The current national security dilemma of Russia's regional neighbours revolves around how to defend their sovereignty while "covered" by a long-range Russian strike-reconnaissance network designed to support a wide spectrum of ballistic and cruise missiles and long- and short-range attack aviation. These systems can provide air cover for armoured forces, conventional infantry, warships, and special operations forces optimized for grey-zone conflict.

In but one example, the Russian ground-launched cruise missile (NATO designation SSC-8/Russian designation 9M729) that prompted the United States to suspend adherence to the Intermediate Nuclear Forces (INF) Treaty, can easily reach – with its well over 500-kilometre-range (310 miles) – Tallinn, Riga, Vilnius (from both east and southwest), Helsinki, and Polish and Swedish territory from the Kaliningrad Oblast.[120] The Russian government claims a 480-kilometre-range for the SSC-8, which still is enough to range the same cities and areas. Meanwhile,

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[119] One situation in which it would be of advantage for Russia to "expand" the conflict is if the PRC were conducting a near-simultaneous action in Asia-Pacific. This would potentially split US forces. In fact, this is what both Nazi Germany and Imperial Japan hoped to do through their improbable and dysfunctional alliance.

[120] For a concise discussion of the introduction of the SSC-8 and decisions to suspend the INF treaty, see Arms Control Association, "The Intermediate-Range Nuclear Forces (INF) Treaty at a Glance," *Arms Control Association Fact Sheets and Briefs*, August 2019, https://www.armscontrol.org/factsheets/INFtreaty.

the *Frankfurter Allgemeine Sonntagszeitung* has reported intelligence estimates that the SSC-8 could potentially reach to 2350 kilometres (1460 miles), covering much of Europe.[121] The newspaper has also reported that Russia has deployed at least 64 SSC-8 missiles on ground-mobile launchers.[122]

Defending these offensive batteries is an array of air defence systems, of which the SA-21 Growler (NATO missile designation)/S-400 Triumf is widely considered to be the most formidable.[123] The S-400, utilizing the Russian-designated 48N6 series surface-to-air missile, is rated at a maximum nominal range of 250 kilometres (155 miles) against aerial targets. It has yet to demonstrate anti-ballistic missile (ABM) capability but, reportedly, a comparable ABM missile is being tested.[124] An additional missile series, the 40N6, could potentially increase the air defence range to 400 kilometres (248 miles), although there are questions whether the S-400 radars could guide the missile to that distance.[125]

It is this combination of defensive *and* offensive systems – along with offensive operations as *fait accompli* – that characterises anti-access warfare and makes it a singular threat. The dilemma for Russia's neighbours is whether they can rely on the security guarantee of NATO or need to seek some sort of accommodation with "Putin-ized" Russia. Arguably, it is not that NATO would not honour its pledge to unite against aggression; it is a question of whether NATO could penetrate the anti-access barrier to reverse any Russian offensive gains at a cost that does not result in wholesale destruction within the contested region. From this perspective, Russian A2/AD capabilities act as a deterrent to a NATO response that has the potential to "destroy the village to save it," particularly if the mobile systems are brought forward into the territories of the neighbouring NATO members.

Again, this parallels the Imperial Japanese strategy of raising the costs of reversing its gains in Indonesia, the Philippines, and China. The fact that the Japanese miscalculated by directly attacking Hawaii, thereby rousing the "sleeping American giant," does not make the logic of anti-access warfare unsound.

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[121] "Report: Russia Has Deployed More Medium-Range Cruise Missiles Than Previously Thought," *Radio Free Europe/Radio Liberty*, February 10, 2019, https://www.rferl.org/a/report-russia-has-deployed-more-medium-range-cruise-missiles-than-previously-thought/29761868.html.

[122] For details on the SSC-8 and other Russian ground-based cruise and ballistic missiles, see Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region – Capabilities, Countermeasures, and Implications*, FOI-R--4651--SE (Stockholm: FOI, March 2019), 32–41, https://www.foi.se/ en/foi/reports/report-summary.html?reportNo=FOI-R--4651--SE. The authors point to SSC-8 as being a variant of the existing Kalibr family of cruise missiles.

[123] On some of the limitations of S-400, and a thorough assessment of *Triumf* in general, see Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 10, 27–31.

[124] Missile Defense Project, "S-400 Triumf," Missile Threat, Center for Strategic and International Studies, last modified June 15, 2018, https://missilethreat.csis.org/defsys/s-400-triumf/.

[125] Missile Defense Project, "S-400 Triumf."

Historical Lessons Encountered

Policymakers often view their security dilemmas as being unique, with characteristics that are more complex than the past. It became common wisdom that the post-Cold War era (or now the post-Post-Cold War era) presented threats – non-state terrorism, globally diffused advanced military technology, cybered conflict, an interdependent global economy, etc. – less clearly defined and thereby more challenging and more difficult to definitively resolve than in previous eras. This view can be debated, of course. However, this view has – to some extent – prompted policymakers to be reluctant to acknowledge the applicability of past experience, or what Richard Hooker and Joseph Collins of the US National Defense University call "lessons encountered" (as opposed to lessons learned).[126] In the case of anti-access warfare, this reluctance is a great mistake. The future is the past continued, and the history of past anti-access conflicts provides for the strategic logic of how to counter anti-access systems in the present day.

From this perspective, I have conducted analysis of the history of nine anti-access campaigns, spanning a period of 2500 years.[127] Of these, five proved to be anti-access "victories," in that the "militarily weaker" anti-access state was able (eventually) to prevail over an out-of-area strategically powerful force, forcing its departure from the region and dramatically reducing the level of continued threat. Four were examples of an anti-access "defeat," in which a strategically superior out-of-area force neutralised the regional power's anti-access network, thus retaining considerable influence on events in the region. There are undoubtedly other examples worthy of analysis from other cases of the many conflicts between unequal firsts. The following table summarizes these analyses.

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[126] Richard D. Hooker and Joseph J. Collins, eds., *Lessons Encountered: Learning from the Long War* (Washington, DC: National Defense University Press, 2015).

[127] I have not detailed the process of the selection of potential anti-access cases in my previous work, even though I have emphasised the criteria for their selection. In short, cases are initially identified through an examination of databases or datasets of conflicts commonly used in studies of international relations, such as Lewis Fry Richardson's *Statistics of Deadly Quarrels* (Chicago: Quadrangle Books, 1960), and the Correlates of War project initiated by J. David Singer and Melvin Small, in 1963, and now continued at Pennsylvania State University (see https://correlatesofwar.org/). My assessment of candidates is qualitative rather than quantitative, but such databases are a useful start and provide a degree of inclusivity. I do not, however, agree with the validity of some of the methodologies and variables used to build such datasets, which is why I avoid hypotheses created exclusively from quantitative results.

Years	Conflict Title	Regional anti-access force	Superior out-of-area force	Motivation for conflict	Anti-access methods[128]	Outcome
480–479 BC	Xerxes' invasion of Greece	Greek city-state alliance	Persian empire	Persian empire expansion; revenge for previous defeat; mainland Greek support of Asia Minor city-states	- Utilising geographic barriers - Securing control of sea lines of communication (SLOCs) and resupply routes. - Deception - Generating (/supporting) extrinsic events	Anti-access **victory:** Persian force withdraws from Greece, does not attempt return
1585–1588; 1598	Spanish Armada(s)	England	Spanish Hapsburg Empire	Dynastic claims; religious conflict and rebellion; irregular attacks on Spanish colonial empire in North America	- Utilising geographic barriers - Securing control of SLOCs - Deception - Generating (/ supporting) extrinsic events	Anti-access **victory:** Spanish forces withdraw; empire faces financial problems; cannot generate significant forces for renewed attempts
1756–1763	Seven Years' War/French and Indian War	France and allies in isolated regions: North America, India	Great Britain	Competition for commercial empire	- Extrinsic event in the form of allied land war in Europe - Utilising geographic barriers - Irregular warfare	Anti-access **defeat**: Unable to resupply its overseas forces, France's imperial enclaves are defeated in detail
1812–1815	War of 1812	United States	Great Britain	Impressment; economic embargo; security of Canada	- Existing extrinsic effect: Napoleonic wars	Anti-access **victory:** Despite consistent British military

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128 Anti-access methods are detailed in Tangredi, *Anti-access Warfare,* 13–22, 75–109, 234–252.

					- Utilising geographic barriers (distance) -Denying control of sea lines of communication (SLOCs) -Alliances	victories and reduction of US trade, Britain chooses to end conflict
1914–1915	Ottoman Defence of Turkish Straits (Dardanelles/ Gallipoli)	Ottoman Turkey (with German advisors)	Triple Entente led by Britain and Dominion forces	Establish resupply route to Russia; force Turkey out of World War I	- Existing extrinsic effect: war on the Western Front - Utilising geographic barriers - Denying control of SLOCs	Anti-access **victory:** Entente gives up campaign
1940–1941	Battle of Britain/ Operation Sea Lion	Great Britain	Nazi Germany and Axis	Germany sought a channel crossing and/or the imposition of heavy costs via air bombardment	- Utilising geographic barriers - Denying control of SLOCs - Combat in all possible domains - Diplomatic efforts at gaining ally (US)	Anti-access **victory:** Germany cannot achieve air superiority to support cross-channel assault; turns force on Soviet Union
1942–1945	World War II war in the Pacific	Imperial Japan	United States and Allies	Imperial Japan sought to prevent interference with conquests	- *Fait accompli* - Existing extrinsic effect: war on the Western Front between Germany and the Allies - Utilising geographic barriers - *Attempting to* deny control of SLOCs,	Anti-access **defeat**: Imperial Japan unable to maintain A2/AD barrier and sustain war; US willing to pay all costs of victory

					such as to and from Australia - Combat in all possible domains	
1943–1945	World War II in Europe post-Stalingrad	Nazi Germany	Allies	Nazi Germany attempts to prevent second front in Europe, maintain survival of the Reich	- Utilising geographic barriers and enhancement by construction (such as the "Atlantic Wall"). - Denying control of SLOCs - Combat in all possible domains - Diplomatic attempt to split Allies	Anti-access **defeat**: Germany unable to prevent second front or maintain an A2/AD barrier and sustain war; Allies willing to pay all costs of victory
1982	Falkland Islands (Islas Malvinas)	Argentina/ Argentine junta	United Kingdom	Argentine junta desire for national victory to retain internal control; prevent UK from regaining Falklands	- *Fait accompli* - Utilising geographic barriers (distance) - Denying control of SLOCs - Diplomatic efforts with US, UNITAS	Anti-access **defeat**: Argentines unable to form an A2/AD barrier; UK regains Falklands

Table 1: Historical anti-access/counter-anti-access campaigns.

It is not possible in this chapter to provide the details of these cases, and I have discussed most elsewhere.[129] Rather, we continue with an identification of five primary lessons encountered through the history of anti-access warfare. The ultimate objective is to provide insights of use to those analysts, military planners, and decisionmakers who face the dilemmas imposed by potential opponents' A2/AD strategies today.

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[129] Tangredi, *Anti-access Warfare*. I am preparing a sequel that will include additional cases.

1. **Rarely have A2/AD forces defeated a globally-capable out-of-area power. The strategically superior force gives up because it judges the cost as too high.**

Rarely has an anti-access force imposed a decisive defeat on its external opponent. The strategic logic of this outcome rests on the fact that states that elect to focus their resources on A2/AD barriers do so because they judge their own forces inferior to those of the global power in a force-on-force contest in an open manoeuvre space.[130] Their goal is to focus their military power to achieve regional, tactical advantage, with the ultimate objective being the neutralisation of the superior force until time, attrition, and extrinsic events shake the determination of the attacker.

In two cases, one could argue that the anti-access force did impose a "decisive" defeat on the out-of-area power. During the struggle with the Spanish Armada, the English fleet damaged half of the Spanish fleet off Gravelines (near Dunkirk). The Spanish fleet was forced into the North Sea and, given wind conditions, could not beat their way back into the Channel and had to sail back to Spain north of Scotland and Ireland with disastrous results. Yet, Spain's powerful army remained in northern France/Belgium in their war against the Dutch Protestants and Spain still could call on the wealth of its colonies in the Americas to rebuild its fleet. However, the imperial coffers were then bare – primarily due to English and French privateers and pirates swarming the Caribbean and interfering with the transit of treasure from the American mines – and Phillip II of Spain judged that the time was not ripe to renew his attack. (He did attempt to raise a second Armada a decade later.)

In the case of the Battle of Britain, the German Luftwaffe was never able to achieve air superiority over the English Channel in order to cover an amphibious invasion force. The Battle of Britain has often been portrayed as a decisive defeat of German expansionism. Yet, Germany retained powerful resources to potentially win a war of attrition. (The US had not yet entered the war.) However, Hitler's focus turned toward the east and the Soviet Union, and there is ample evidence that he preferred a negotiated armistice with Great Britain ("fellow Aryans") and extermination or enslavement of the Slavs. His cost-benefit analysis led him to suspend Operation Sea Lion (the Channel crossing).

Thus, I would argue that even in the cases when a major regional defeat of the counter-anti-access force occurred, the conflict was largely suspended by the superior power because it calculated the costs too high at that time, and because its attention was focused elsewhere (what I refer to as extrinsic events).

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[130] Ibid., 14-15.

Relating this to the current situation in northern and eastern Europe, there is no doubt that NATO is still a viable and powerful alliance, particularly when including potential (or apparent) partner states such as Sweden and Finland. The real current issue is not whether the Trump Administration is committed to NATO as a notional policy, since its public statements and final policy decisions often seem to diverge in favour of past commitments. The issue is how to prevent an early *fait accompli* (such as occupation of the Baltic allies) prior to the attrition battle that will inevitably occur as NATO-west or -north tries to break the Russian A2/AD barrier.

Additionally, there is the question of whether the PRC judges the time ripe (similar to Imperial Japan in its view of the war in Europe) to make aggressive moves on Taiwan or another neighbour. Can the US split its forces to deal with both contingencies, or does it need to deal with them sequentially? If so, what would/should it choose? Meanwhile, to reverse a question asked by De Gaulle fifty years ago, while charting France's then schizophrenic policy toward NATO: Is western Europe willing to trade Berlin and its access to oil and natural gas for Tallinn? One would hope so; but the effect of today's globalised economy on security decisionmaking is still largely untested.

These are questions that the national security planners of NATO and the front-line nations need to consider – at least privately. What is reassuring is that – as of the present – the record of history is ultimately on NATO's side, if its will remains intact. The issue is whether it can bear the initial destruction.

2. The first step of a counter-A2/AD campaign: blind the opponent's intelligence, surveillance, reconnaissance (ISR) network.

In the ancient Chinese text, *The 39 Strategems*, the first listed stratagem can be translated as, "cross the sea without heaven's knowledge." It is certainly ana-chronistic to interpret this as a recommendation – in today's context – to destroy the enemy's maritime (and land) reconnaissance satellites prior to attempting to move forces into the contested theatre. However, strategic logic dictates that this is indeed a requirement to successfully counter a modern, robust A2/AD network. Physical destruction of satellites and other ISR platforms may not be the optimal tactic – blinding via directed energy weapons, jamming, spoofing, cloaking, hacking, or otherwise deceiving, may be preferred. However, such counter-ISR actions are necessary if the outside, intervening force is to use the ocean, air, outer space, or other domain, as a manoeuvre space prior to theatre entry.

Destruction of satellites was considered a highly escalatory action during the Cold War period in which such satellites were perceived as being *primarily* national technical means (NTM) of detecting the possibility of a strategic nuclear strike. Under these circumstances, NTM would be a critical element of strategic nuclear

deterrence, and its destruction could indeed herald a nuclear attack or force the hand of the blinded nuclear power. Yet, it is difficult to determine whether this perception holds today, given the ubiquity of national and commercial satellites and their use for reconnaissance of much more than nuclear launch sites.

One might argue that the very ubiquity of commercial satellites prevents an intervening power from neutralising enough of them to blind the opposing A2/AD force. The argument is that there will always be a commercial source from which to purchase reconnaissance services. However, this argument is not realistic. Much commercial satellite surveillance is not time-sensitive and cannot deliver tactical-grade current intelligence on a timely basis. Despite claims trumpeted in popular media, one cannot utilise (for example) Google Earth to effectively attack moving ships at sea. One could utilise such a service to attack fixed targets; however, a military power in possession of a sophisticated missile arsenal does not need continuing surveillance to attack a known stationary target. Additionally, most commercial satellite firms are located in Western nations, and their operations can invariably be controlled by legislation (to say nothing of public pressure).

An intense "space war" of counter-ISR platforms versus ISR and counter-counter-ISR could indeed blind both opponents to a significant degree (and much of the space assets of other nations and companies as well). Under such circumstances, the advantage would go (assuming wise choices) to the forces that could best access, utilise, and manoeuvre in the global commons – under an anti-access scenario, most likely the outside, intervening force. This view has been contested by the idea that the US (assuming it acts as the outside, intervening force) has more to lose from a war in space from potential opponents.[131]

The struggle for ISR dominance in the counter-A2/AD campaign of the Pacific War was waged largely in the sphere of signals intelligence and cryptanalysis. Physical reconnaissance and detection by air, surface, and undersea assets also played a major role, but with primarily tactical rather than strategic effect.[132] At the battle of Midway, signals intelligence and the deciphering of Japanese code enabled Admiral Nimitz and his task force commanders to have great awareness of the Imperial Japanese Navy's objectives, battle plan, and probable location. American decisionmakers were well convinced that the thrust toward the Aleutian

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[131] For example, Thomas Gonzales Roberts, "Why We Should be Worried About a War in Space," *Atlantic*, December 15, 2017, https://www.theatlantic.com/science/archive/2017/12/why-we-should-be-worried-about-a-war-in-space/548507/. A contrary view is Kyle Mizokame, "Who Wins in a US-China Space War?" *Popular Mechanics*, September 7, 2016, https://www.popularmechanics.com/military/weapons/a22749/who-wins-in-a-us-china-space-war/.

[132] In regard to the result of tactical reconnaissance at Midway, one cannot forget the still-mysterious and embarrassing example of bad leadership known as Stanhope Ring's "flight to nowhere." Clearly, part of his force (LCDR John Waldron's Torpedo Squadron 8) had physically detected the enemy, a fact that the wing commander refused to acknowledge. See Craig L. Symonds, *The Battle of Midway* (New York: Oxford University Press, 2011), 245–65.

Islands was a feint that did not require the commitment of significant (or first-rate) resources, thereby negating part of the strategic effect that Admiral Yamamoto hoped to gain.[133] While technologically capable, the Imperial Japanese Navy did not achieve similar results from signals intelligence and cryptanalysis, although they expended much effort in signals deception and were indeed able to deceive the Allies, at least temporarily, of the assignment of specific ships and units.[134]

In the realm of physical reconnaissance, detection was very dependent on weather, air operations planning, and chance encounters. At Midway – although the US had made strides with radar – the weather, timing, and personnel dedication had dominant effects, hurting the Japanese air and submarine reconnaissance effort, and ultimately making US efforts more successful.[135]

All of this points to the need to blind "strategic" ISR systems in the initial stages of a counter-A2/AD campaign. Neutralisation of tactical ISR systems will also be a campaign objective, but unless positioned far forward, such systems would not be able to penetrate a vast manoeuvre space in any event. Strategic ISR, in the form of satellites, sky wave, and low-frequency ground wave over-the-horizon (OTH) radars; and long-range airborne early-warning systems (in whatever form, manned or unmanned); are the logical, prerequisite targets. Their neutralisation allows the out-of-area force to manoeuvre prior to entry into the range of the regional opponent's defences.

Blinding, or spoofing, ISR sensors is also the key to strategic and operational deception, a critical element of countering anti-access networks, as it is in all aspects of war.

Failure to blind the enemy's ISR inevitably results in a prolonged war of attrition. While this should seem evident to military planners, systems designed for this mission are not often prioritised in defence budgets, where large combat platforms soak up much of an inevitably constrained budget. Additionally, political decisionmakers may expect this phase to be much easier to accomplish than it is in reality.

3. **Strategic geography matters more than is popularly perceived. Flanking attacks are the key to overcoming geography-facilitated defence, but they may be impolitic.**

In the era of space systems, cybered communications, and a global economy, it is easy for many to believe that geography no longer presents a barrier to transit, transportation, and information flow. This notion may not affect military planners,

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[133] Symonds, *The Battle of Midway*, 198–205. Specialists will point out that Yamamoto's actual rank was that of Marshal General, but Admiral is the conventional equivalent.
[134] US Congress, *Pearl Harbor Attack, Part XI*, 5356.
[135] Symonds, *Battle of Midway*, 209–217.

who remain aware that there is quite a different problem between trying to defend Switzerland and trying to defend Poland. However, there are air power proponents who will still argue that geography is not a constraint if one can strike the opponent's centre of gravity from the air (or space).[136]

In any event, one can argue that concern for strategic geography is underrated in many defence policy arguments, under the assumption that a strategically superior force can inevitably overcome geographic obstacles. However, this fails to recognize that although these obstacles might *inevitably* be overcome, they always increase *costs* in a situation where the objective of the anti-access defender remains the neutralisation of the superior force until time, attrition, and extrinsic events shake the determination of the attacker. The operational use of geography facilitates that objective. In each of the cases examined, the anti-access force attempted to use geography to their benefit and the out-of-area force needed to overcome geography-based defences. In other words, most conflicts were not like Desert Storm.

That does not mean that the anti-access force is necessarily successful. The Spartans and allies were unable to hold Xerxes' Persian Empire forces at Thermopylae once a traitor had shown them a path through the mountains.[137] Athens was burned to the ground before the Battle of Salamis.[138] The French could not keep Wolfe's forces away from the walls of Quebec.[139] In 1812–1815, British forces could range at will throughout the young United States.[140] Imperial Japan failed to use the far distances of the Pacific to keep the Americans away. Nazi Germany could not stop the Allies in Normandy. Nevertheless, geography is a critical element in anchoring all anti-access networks.

Prior to the Second World War, France attempted to alter its geography to support an anti-access strategy through the creation of the Maginot Line.[141] As is well known, this was outflanked by mobile German forces, both through the Ardennes and the Low Countries – similar to Imperial Germany's strategy in the First World

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[136] The ultimate expressions of this remain John A. Warden, *The Air Campaign: Planning for Combat* (Washington, DC: National Defense University Press, 1988); and Warden, "The Enemy as a System," *Airpower Journal* 9, no. 2 (Spring 1995), 40–55.

[137] A concise discussion is Barry Strauss, *The Battle of Salamis* (New York: Simon & Schuster, 2004), 31–52.

[138] Strauss, *Battle of Salamis*, 61–72.

[139] A classic depiction of that campaign is Sir Julian S. Corbett, *England in the Seven Years' War: A Study in Combined Strategy*, in 2 vols., vol. I (London: Longmans, Green, 1918), 396–476. Another highly readable assessment is Tom Pocock, *Battle for Empire: The Very First World War, 1756–63* (London: Michael O'Mara Books, 1989).

[140] Although he focuses primarily on the naval war in an effort to deflate American views of the War of 1812, Andrew Lambert effectively depicts the apparent hopelessness of the American posture throughout *The Challenge: America, Britain and the War of 1812* (London: Faber & Faber, 2012).

[141] Arguably, this case does not fall within my definition of anti-access warfare concerning the requirement of preventing a strategically superior from entering the region. France appeared superior to the German Weimar Republic in all regards. However, it is a useful illustration of a strategic flanking attack.

War. In both wars, the German decisionmakers had few qualms about violating the neutrality of neighbouring states (and conquering them.) This is a more significant issue for a democratic alliance, such as NATO, if a flanking movement would necessitate accessing the territory of a non-belligerent. In a "grey zone" situation, there might be reluctance at taking such a political risk.

In the case of northeastern Europe, particularly in the Baltic region and Poland, geography is not as favourable for use in buttressing an anti-access strategy. This fact cuts two ways: it is relatively easier for Russian ground forces to move west than they could in more mountainous regions of Slovakia and Romania; but it is also easier for NATO forces to push back into the Baltics. The exclave of Kaliningrad oblast can be enveloped in the case of major war, although the current emplacement of nuclear weapons there can certainly act as a deterrent.[142]

In northern Europe, climate is the factor that makes the geography a more defensible feature, and therefore a facilitator of an anti-access strategy in a ground war scenario. Air warfare would not necessarily be tactically limited except as concerns the location of airbases and range of aircraft. In essence, the location of airbases does become a geographic feature that would have effects on a counter-anti-access campaign.

4. Counter-anti-access campaigns have a prerequisite maritime (and now aerospace) phase. Failure in this phase inevitably dooms the campaigns.

It does not take a navalist to recognize that naval operations – whether in the form of fleet combat and/or amphibious warfare – are a significant element in all of the above case studies. However, it is more accurate to view these maritime operations as a prerequisite (not just a significant element) for a complete anti-access campaign since, in most cases, the out-of-area power needs to transport its forces into the theatre via the sea. This is not a tautology but, rather, another fact of global geography.

Counter-anti-access campaigns have at least two phases that more often happen sequentially than simultaneously. In order for an out-of-area force to penetrate the

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[142] Charlie Gao, "NATO's Worst Nightmare: Russia's Kaliningrad Is Armed to the Teeth," blog, *The Buzz*, The National Interest, May 25, 2018, https://nationalinterest.org/blog/the-buzz/natos-worst-nightmare-russias-kaliningrad-armed-the-teeth-25958; Clark Mindock, "Satellite Images Appear to Show Russia Upgrading Nuclear Weapons Bunker at Kaliningrad," *Independent*, June 18, 2018, https://www.independent.co.uk/news/world/europe/russia-nuclear-weapons-kaliningrad-world-cup-vladimir-putin-a8405401.html; Mark Eckel, "Report: Russia Rebuilding Key Weapons Storage Bunker in Kaliningrad," *Radio Free Europe/Radio Liberty*, June 18, 2018, https://www.rferl.org/a/report-russia-rebuilding-key-weapons-storage-bunker-in-kaliningrad/29301928.html; Oren Liebermann, Frederik Pleitgen, and Vasco Cotovio, "New Satellite Images Suggest Military Buildup in Russia's Strategic Baltic Enclave," CNN, October 17, 2018, https://www.cnn.com/2018/10/17/europe/russia-kaliningrad-military-buildup-intl/index.html.

region, it initially has to establish sea control. The sea functions as a manoeuvre space for incoming forces, as do the aerospace dimensions. Both are fluid mediums, with the prime difference being the time dimension in the continuous operation of individual units – obviously, it is easier to sustain forces for lengthy periods at sea than in the air. Sea and air control into the region are part of the first or prerequisite stage for further operations on the land or tactical air operations within the theatre (second phase).[143] The second phase is usually the decisive phase since rarely is the war at sea in itself conclusive, even if it delivers the most critical effect (as did the closing of SLOCs in the ancient Greek-Persian conflict). Defeat of the Spanish Armada is one exception.

It is interesting to note that while the Russian armed forces do not have a doctrinal concept that exactly matches the NATO concept of A2/AD, its thinking appears to be more in accord with accepting the "two phase" approach than that of many Western militaries.[144]

NATO is in the unique situation of having forces not simply present in the overall theatre, but stationed within range of the Russian strike-reconnaissance network. Thus, the maritime dimension may not seem critical in the initial stages of any conflict. However, similarly to the Cold War posture, reinforcements would need to flow trans-Atlantic, which is one of the facts that prompts Russian naval investments even if these investments are modest and Russian naval forces would be required to carry out other missions as well. Western naval forces would need to defend this flow, but would also undertake direct attacks and flanking operations (as tactically appropriate) from the Baltic and Barents Seas and, possibly, the Pacific Ocean.

US Naval Forces Europe commander, Admiral James G. Foggo, USN, refers to the contesting of trans-Atlantic reinforcement as the "fourth battle of the Atlantic."[145] One can describe this part of the anti-access campaign in a similar fashion to the situation of the British forces at the Battle of Jutland in the First World War – victory for the West would not win the overall campaign, but defeat of the West could very well lose the overall campaign.

One of the elements of an A2/AD that has not been previously mentioned in this chapter is cybered conflict, which, concerning Russia's posture, deserves a lengthy treatment of its own.[146] Elsewhere, I have suggested that cyberspace qualifies as a

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[143] See discussion in Sam J. Tangredi, "Anti-access Strategies in the Pacific: The United States and China," *US Army War College Quarterly: Parameters* 49, nos. 1–2 (2019): 5–20.

[144] Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *US Army War College Quarterly: Parameters* 49, nos. 1–2 (Spring–Summer 2019): 23. Giles and Boulegue also argue that Russian A2/AD capabilities are overrated.

[145] James Foggo III, and Alarik Fritz, "The Fourth Battle of the Atlantic," *Proceedings Magazine* 142, no. 6 (2016): 18–23.

[146] An excellent overall treatment of the subject is Alison Lawlor Russell, *Strategic A2/AD in Cyberspace* (Cambridge: Cambridge University Press, 2017). The term "*cybered* conflict" is being used by scholars

"fluid dimension," which humans utilise for communications and trade, but cannot inhabit.[147] Like the maritime dimension, the struggle for cyberspace will take both sequential and simultaneous forms and can be part of an outflanking attack. This realization is one of the motives for the October 23, 2019, Russian test of its ability to cut off internet originating outside its borders.[148] Results of this test appear inconclusive, at least to Western observers.[149] However, control over cyberspace (of which internet is the dominant part) is an A2/AD technique in the domain of information.[150]

5. **Territory of the outside power traditionally retains sanctuary. Extrinsic events turn the focus**.

An anti-access strategy is appealing to aggressive powers that view themselves as militarily inferior, on a global basis, to a potential opponent. Though the anti-access power may possess relative superiority of forces within the contested region, as Imperial Japan did in the Western Pacific, its leadership retains doubts that it could defeat the enemy outside of the region. Thus, it does not seek a decisive engagement outside of the region, nor intend to threaten the sanctuary of the outside power's territory, except as a precarious attempt at blackmail as deterrence.

For example, Imperial Japanese naval strategy was to lure the US fleet into waters close to the Japanese homeland in order to be able to concentrate its naval and air assets in a decisive battle.[151] Since its territorial conquests remained in the Western

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at the Cyber and Innovation Policy Center of the US Naval War College – notably Dr. Chris C. Demchak – to delineate conflicts that occur in multiple domains that are facilitated by cyber tools. The distinction is meant to separate such "all domain" conflicts from conflict conducted in the cyber domain alone (i.e., *cyber* conflict). On this, see Peter Dombrowski and Chris C. Demchak, "Cyber War, Cybered Conflict, and the Maritime Domain," *Naval War College Review* 67, no. 2 (2014): 71–96.

[147] Sam J. Tangredi, "Beyond the Sea and Jointness," in *The US Naval Institute on Naval Strategy*, ed. Thomas J. Cutler (Annapolis, MD: Naval Institute Press, 2015), 143–146.

[148] Patrick Tucker, "Russia Plans to Cut Off Some Internet Access Next Week," *Defense One*, December 19, 2019, https://www.defenseone.com/technology/2019/12/russia-plans-cut-some-internet-access-next-week/162028/?oref=defense_one_breaking_nl.

[149] Jane Wakefield, "Russia 'Successfully Tests' Its Unplugged Internet," *BBC*, December 24, 2019, https://www.bbc.com/news/technology-50902496; Emma Woollacott, "Russia Cuts Off Its Internet, With Mixed Results," *Forbes*, December 24, 2019, https://www.forbes.com/sites/emmawoollacott/2019/12/24/russia-cuts-off-its-internet-with-mixed-results/#15113dcf619d.

[150] This is developed in greater detail, concerning North Korea, in Tangredi, *Anti-access Warfare*, 203–209.

[151] Discussions of the Imperial Japanese Navy's "Kantai Kessen" (translated "naval fleet decisive battle") strategy include David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics and Technology in the Imperial Japanese Navy, 1887–1941* (Annapolis, MD: Naval Institute Press, 1997); Edward S. Miller, *War Plan Orange: The US Strategy to Defeat Japan, 1897–1945* (Annapolis, MD: United States Naval Institute Press, 1991); Jonathan Parshall and Anthony Tully, *Shattered Sword: The Untold Story of the*

Pacific region, it did not need to contest the outside powers (US, U.K. and its independent dominions, and, initially, France and the Netherlands) on a global basis.[152] It did not have the strength or reach to do so, although its improbable alliance with Germany was intended to make the US face a global conflict.

In each of the cases examined, the anti-access opponent never significantly threatened the home territories of the out-of-area forces. Commerce wars were conducted at sea as part of the anti-access strategies. Raids and coastal operations were conducted. However, due to limited resources (and usually a defensive mindset), the anti-access forces *generally* did not attempt counterattacks onto the out-of-area land territory.[153]

Of course, the cases examined were not between two nuclear weapons-capable states; thus, it can be argued that nuclear weapons in combination with ballistic missiles ensure that home territories can never be truly considered sanctuaries. Nuclear weapons can also be viewed as the ultimate A2/AD weapons. Nevertheless, the point is that given an inequality in forces that motivates the adoption of an anti-access strategy, potential threats to the homeland of the power projection force rarely have an effect on its decisionmaking. Rather, the occurrence of extrinsic events that affect other elements of its national interests causes it to shift attention and resources elsewhere.

In fact, violations of the perception of sanctuary – such as the miscalculated attack on Pearl Harbor – are more likely to cause the out-of-area power to pursue its intervention with a degree of emotional fervour so high as to ignore extrinsic events. Such emotional fervour may propel the out-of-area power to make rash decisions; however, history indicates that it has often led to victories that could be achieved only by total commitment.

In applying this to a future confrontation between Russia and NATO, it would seem that the strategic situation would encourage Russian actions to be fast and *limited*. Actions that threaten the sanctuary of the US and Canadian homelands

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Battle of Midway (Dulles, VA: Potomac Books, 2005); Asada Sadao, *From Mahan to Pearl Harbor: The Imperial Japanese Navy and the United States* (Annapolis, MD: Naval Institute Press, 2006).

[152] Prange, *Pearl Harbour*, 166–168. Nevertheless, as with other parts of the Japanese strategy, the Tripartite Alliance had negative effects on Japan – it was the proximate justification for the US's ending the supply of scrap iron and steel to Japan (502).

[153] In this case, I am not considering the Aleutian islands of Attu and Kiska as "home territory." They are nearly 1,700 km from the Alaskan mainland. At the time of the Japanese invasion, Attu had approximately 600 inhabitants and Kiska, 10. Today they have none. There is, however, a possible example of World War II attacks against home territory by an A2/AD force that facilitated a successful A2/AD defence. If one concurs that an RAF bombing raid on Berlin in 1940 provoked Hitler and Goering to focus Luftwaffe attacks on British cities rather than military bases, it can be said that that RAF Berlin attack was a key factor in winning the Battle of Britain. The change of focus to London and other cities reduced the prioritisation of German attacks on RAF radar installations critical to British air defences. See, for example, John T. Correll, "How the Luftwaffe Lost the Battle of Britain," *Air Force Magazine*, July 30, 2008, https://www.airforcemag.com/article/0808battle/.

would appear to have counter-productive effect on any Russian anti-access strategy. Whether such should be concluded about the sovereign territories of the United Kingdom, France, or Germany, is a different question, which deserves investigation.

Nevertheless, the scenarios that should be prioritized for detailed examination by military planners should be the extrinsic events that may develop in the overall global environment – such as simultaneous military action in the Middle or Far East – rather than threats against the homelands of the out-of-area powers.

Conclusion and a Reversal?

This chapter concentrates on defining the strategic logic behind anti-access warfare and A2/AD networks and identifying historical lessons encountered. In discussing the lessons encountered, it also identifies problems and dilemmas of the current day with which military planners – particularly those of NATO and its partners – must wrestle. It suggests several prerequisites that need to be accomplished at the beginning of any counter-anti-access campaign: (1) blinding of the anti-access ISR; (2) retaining control of the global commons, particularly the maritime commons and the airspace above it; and (3) anticipating extrinsic events and maintaining focus on the counter-anti-access campaign despite these events.[154]

What can be done about military *fait accompli*, the bolts from the blue, the results of which can be defended by anti-access networks? In developing a plan, it may be possible for neighbouring states facing aggression from a regional hegemon *to adopt, themselves,* some of the techniques that the aggressive regional power would use against interference by a strategically superior outside force.

This is an area for fruitful analysis and, if sound, its implementation may call for changes in the military acquisition priorities of the nations involved.[155] As concerns the situation in east Asia, analysts have suggested that Taiwan reprioritise its defence expenditures in order to optimise its own anti-access strategy.[156] Should certain NATO members focus exclusively on developing an anti-access network, while others focus on how to break any anti-access network that is activated against the Alliance? If such a combined defence policy is adopted, it would only be effective if agreed to by the entire Alliance (rather than adopted solely by individual members), lest the efforts to either employ mini-A2/AD are defeated in detail before a Russian A2/AD network can be broken in order to

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[154] The phases and required steps and actions of a counter-anti-access campaign are described in detail in Tangredi, *Anti-access Warfare*, 88–96. This is applied to Russia on pages 222–230.

[155] Recommendations for US Army resources in the Pacific appear in Tangredi, "Anti-access Strategies in the Pacific," 16–20.

[156] For example, William S. Murray, "Revisiting Taiwan's Defense Strategy," *Naval War College Review* 61, no. 3 (2008): 13–40.

reverse any aggressive gains.[157] Conceptually, an A2/AD network – with reliance on ISR, air defence, and cybered warfare as well as offensive military hardware – can be conceived as almost a military "electronic curtain." No one wants to see another curtain fall on eastern (or northern) Europe.

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[157] Critics might argue that NATO has never actually achieved such "divine" all-member agreement, and many members have "hedged their bets" in the past by agreeing to NATO-wide principles, yet procuring weapons systems designed to provide some degree of strategic independence. Examining this critique is outside the scope of this study and a worthy effort. It should be noted, however, that costs of systems are always a constraint on strategic independence, and for smaller states it may be easier to procure common NATO systems. There is logic to "going with the flow."

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6. Defeating the A2/AD Umbrella – Concepts for Exploitation of Russia's Operational Weaknesses

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Introduction

The concept of A2/AD, anti-access/area denial, has received much attention in recent years. The general idea is that the proliferation of long-range precision-strike missile technology allows adversaries to compete for access or area denial in large areas.[158] Unfortunately, the detail that A2/AD is a competition has been largely forgotten in much popular debate, and instead the discourse has indicated that countries such as China and Russia have the ability to practically shut down large areas for any access by other forces. This has created a notion of impenetrable fortresses around missile batteries that have translated into angry looking threat rings on a map.

Fortunately, a more level-headed analysis has started to emerge. Dalsjö et al.[159] have shown that the practical capabilities of Russia's missiles are nowhere near the advertised ranges, and that the West would be able to apply countermeasures to further decrease their effectiveness. This has introduced what can be described as a tactical argument against A2/AD. Other analysts, such as Kofman[160] and myself,[161] have addressed the question from a more operational angle by pointing out that the establishment of A2/AD bubbles might be counterproductive to many political goals that Russia could have with military aggression against the West. In the wake of such a conflict, Russia would want the West to accept whatever changed geopolitical order as quickly as possible, so normal relations could be resumed from a new baseline. Establishing semi-permanent A2/AD zones would make it hard for the West to accept Russia's claim of a new normal.

In this paper, I explore how the West can exploit the insights from these two lines of argument in a confrontation with Russia. The tactical objection to A2/AD stipulates that Russia will face technical obstacles that can be exploited, and the

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[158] Luis Simon, "Demystifying the A2/AD Buzz," War on the Rocks, January 4, 2017, https://warontherocks.com/2017/01/demystifying-the-a2ad-buzz/.

[159] Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region – Capabilities, Countermeasures, and Implications,* report, FOI-R--4651--SE (Stockholm: FOI, March 2019), https://www.foi.se/rapportsammanfattning?reportNo=FOI-R--4651--SE.

[160] Michael Kofman, "It's Time to Talk About A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge/.

[161] Anders Puck Nielsen, "Russia's A2/AD Strategy Is a Myth," blog, *Romeo Squared*, September 9, 2019, https://romeosquared.eu/2019/09/09/russias-a2-ad-strategy-is-a-myth/.

operational objection indicates that the West can find ways to make A2/AD a politically unpalatable option for Russia.

The goal of this discussion is not to discard the quality of Russian missile techno-logy or to deny the fact that the long ranges of modern high-precision missiles have changed the character of warfare.[162] Rather, the aim is to bring attention to the fact that A2/AD is a dynamic competition between belligerents, and that Russia's missiles will not guarantee that they gain control of the contested region. In fact, there are several reasons to believe that the West will have the upper hand in a competition over access to many areas, e.g., when looking at a Baltic scenario.

The first part of the paper is about the tactical weaknesses of Russia's A2/AD capabilities. I account for some technical challenges for Russia's missile systems, and I derive some conclusions about how that can be turned into tactical concepts that the West can utilize. To a large extent this is a discussion about how the West can confuse the process of target acquisition, so Russia would be unable to bring their missiles into play.

In the second part of the paper I turn to the operational dilemmas related to A2/AD. At its core, A2/AD is a concept related to the operational level of war.[163] It is supposed to unite the techniques and physical possibilities at the tactical level with the political goals and constraints at the strategic level. I show that this connection would be deeply problematic for Russia, and that there are ample opportunities for the West to exploit Russia's political constraints.

Finally, I will combine the tactical and operational perspectives in a discussion that identifies concepts that the West can apply in a conflict with Russia. The concepts are divided into groups of measures to be taken before and after outbreak of armed confrontation respectively.

Tactical Weaknesses for Russia's A2/AD Capabilities

The tactical level of war deals with techniques. It is at this level "at which battles and engagements are planned and executed to achieve military objectives assigned to tactical units or task forces."[164] Tactical questions are therefore related to the technical application of weapons and the relative strengths between military forces.

The tactical aspects of Russia's A2/AD capabilities have been extensively covered in FOI's much acclaimed report, *Bursting the Bubble*.[165] Here, Dalsjö et. al. show

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[162] Roger N. McDermott and Tor Bukkvoll, "Tools of Future Wars – Russia Is Entering the Precision-Strike Regime," *Journal of Slavic Military Studies* 31, no. 2 (2018): 191–213.

[163] Edward N. Luttwak, "The Operational Level of War," *International Security* 5, no. 3 (1980): 61.

[164] US Department of Defense, "Department of Defense Dictionary of Military and Associated Terms," February 15, 2016, 520, https://fas.org/irp/doddir/dod/jp1_02.pdf.

[165] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, passim.

how Russia's missile capabilities are widely overrated. Some of the reasons for this are related to the missiles themselves. Too often the Russian claims of missile performance are taken at face value, and usually analysts have not distinguished between the nominal range of the missile and the effective range. Also, the problems related to hitting a moving target at great distance are underestimated. By factoring in these challenges, Dalsjö et. al. find that the effective range of the S-400 air defence missile system may be as low as 20–35 kilometres against manoeuvring targets at low altitude.[166]

Other reasons are related to the possible countermeasures that an opponent can apply.[167] These can be divided into indirect, passive and active countermeasures. Indirect measures are those where the threat is mitigated without direct interaction with the weapon. Rather than facing the threat, it is avoided by staying out of the danger zone or by applying some form of deterrent that makes it improbable that Russia will dare to use the A2/AD weapon. Passive and active countermeasures both seek to defeat the threat by attacking the opponent's kill chain directly. Passive measures aim to prevent the enemy from launching an attack by making it hard to find, fix or track a target. Passive measures include camouflage, stealth technology, limiting electronic emissions, dispersal of forces, mobility, and flying at low altitudes. Active measures seek to beat the weapon once it is employed. This can be done through soft-kill measures such as jamming, decoys or evasive action, or it can be done with hard-kill measures where you employ weapons against the enemy's weapons. Often hard kills are envisioned as shooting down the incoming missile, which can be difficult if the missile is sophisticated. More commonly, however, hard kill measures involve disabling some other part of the kill chain such as the fire control radar or the communication links. For example, an S-400 air defence battery may have 64 medium-range missiles ready to fire, but it only has one engagement radar which is vulnerable to anti-radiation missiles or long-range precision-strike attacks.

Conceptually, the notion of impenetrable A2/AD bubbles rests on the assumption that Russia's missile technology is so good that only indirect countermeasures will work: Once the A2/AD zone has been established, there is no other option than to stay outside the threat ring. Proponents of this discouraging interpretation effectively dodge any discussion of A2/AD as a competition, because entrance into the bubble is assumed to be impossible or too costly. When that is combined with an exaggerated estimate of missile ranges, you get some really big threat rings that can give a wrong impression of Russian capabilities.[168]

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[166] Ibid., 29.
[167] Ibid., 45–64.
[168] For example, Richard Scott, "Face Off: Russia's Improving A2/AD and Hybrid Warfare Capabilities Are Asking New Questions of NATO's Maritime Forces," *IHS Jane's Defence Weekly* 53, no. 39

Obviously, there is good reason to believe that direct countermeasures would in fact be effective against Russian missile systems. The West will soon have sophisticated technology such as the F-35 or the JAS 39E/F Gripen fighters, and Russia would have to establish their A2/AD bubbles from vulnerable positions. Even if Russia's missiles are assumed to be state-of-the-art technology, it is meaningless to imagine that they would dominate the battlefield to the extent that much A2/AD discourse suggests. The important insight is that A2/AD is supposed to be a long-term concept. As Tangredi reminds us, anti-access and area denial strategies imply that you can prevent the enemy from striking at your centre of gravity for so long that he can never achieve victory, and "the ultimate measure of its accomplishment is the continued exclusion of a superior opposing force from the contested region until time, attrition, and/or extrinsic events shake the determination of the superior force."[169] Sometimes the discussion about A2/AD gets confused with considerations about casualties in case of a Western counter-offensive. This is a mistake. Russia will obviously be able to cause substantial losses for Western forces in a head-on battle, but that is common in combat and does not make it A2/AD. It follows logically from Tangredi's definition that the timeframe of A2/AD is supposed to be measured in weeks or months rather than hours.

Therefore, A2/AD is also not a concept to be confused with the fact that the West may be unable to defend the Baltic states in case of a Russian surprise attack.[170] The A2/AD stage of the conflict comes after the initial outbreak of hostilities, and it is the environment in which the West will have to organize a counter-offensive. In these circumstances, the West could benefit from larger quantities of weapons, a higher degree of technical sophistication, the benefit of geographical depth, and the advantage of choosing the pace of operations. I am not implying that the West will inevitably win such a war, and that Russia does not have any countermoves, but I am making the argument that long-range precision missiles will probably not do it alone. Over time, the West might be able to defeat Russia's missile systems in a competition for access and area denial, applying a combination of different direct and indirect countermeasures to degrade the effectiveness and strength of Russia's weapons. It is easy to imagine the damage that a prolonged Western air campaign could do to military capabilities in vulnerable locations such as Kaliningrad.

For Russia to have any chance of success at A2/AD in the Baltic region would require a simple operating environment and a crude approach. A narrow focus on

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(September 28, 2016): 28–30; Stephan Frühling and Guillaume Lasconjarias, "NATO, A2/AD and the Kaliningrad Challenge," *Survival* 58, no. 2 (2016): 106.

[169] Sam J. Tangredi, *Anti-access Warfare: Countering A2/AD Strategies* (Annapolis, Maryland: Naval Institute Press, 2013), 2, 75.

[170] David Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics*, Research Reports (Santa Monica, CA: RAND Corporation, 2016).

the missiles themselves may overlook the fact that the hard part about missile engagements is the target acquisitioning. Locating and identifying targets and communicating necessary information to the shooting unit is difficult and requires target reporting units to move into vulnerable positions in order to get reliable information. If Russia tries to do this with sophisticated discrimination between possible targets, they will likely suffer from severe attrition as their target reporting assets are destroyed. Bearing Tangredi's point in mind that A2/AD by design involves attrition, it would be unsustainable for Russia to use their assets carelessly.

Therefore, from a tactical point of view, Russia's most viable approach to A2/AD would be to do target acquisitioning at large distances, which in practical terms means that it would be hard to distinguish between different kinds of targets. Russia does have HF radar equipment for over-the-horizon targeting such as the Podsolnukh-E system,[171] but it is a land-based system that requires large and immobile infrastructure, and the technology is not mature enough for independent target identification.[172] Russia also has airborne warning & control system (AWACS) aircraft, such as the Beriev A-50 "Mainstay," which can detect targets at long ranges, but it cannot reliably identify and categorise ships and aircraft at these distances. Therefore, if the operating environment is complex and requires distinction between, e.g., hostile and neutral targets, Russia might not be able to engage. In other words, it is a tactical requirement for effective A2/AD that Russia has a clean and predictable operating environment, so they can shoot down any target that is not positively identified as their own.

Operational Obstacles to Russian A2/AD

While the tactical perspective examines whether it would be possible for Russia to establish A2/AD bubbles, the operational perspective looks at whether it would make political sense. It all comes down to Clausewitz's theorem that, "War is merely the continuation of policy by other means."[173] If it is not politically attractive to establish A2/AD zones, then Russia is not going to do it. This creates a new dimension of possible countermeasures that the West can apply in a conflict with Russia, namely measures that make it politically unattractive to enforce the clean operational environment that is required in order to make A2/AD feasible from a tactical point of view.

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[171] Michael Kofman, "Russian Maritime 'A2/AD': Strengths and Weaknesses," blog, *Russia Military Analysis*, January 29, 2020, https://russianmilitaryanalysis.wordpress.com/2020/01/29/russian-maritime-a2-ad-strengths-and-weaknesses/.

[172] Dimov Stojce Ilcev, "Introduction to Coastal HF Maritime Surveillance Radars," *Polish Maritime Research* 26, no. 3 (2019): 153–62.

[173] Carl von Clausewitz, *On War*, Indexed Edition, trans. Michael Eliot Howard and Peter Paret (reprint edition, Princeton, NJ: Princeton University Press, 1989).

The operational level of war – or arguably more accurately "operational art"[174] – is about the process of connecting tactical actions to strategic goals. Too often the strategic and the tactical discussions of military issues are siloed off from one another, and that can lead to disparate understandings of the situation. Something may make perfect sense on one level but be unrealistic on the other, and this discrepancy has derailed much of the discussion about A2/AD. From a tactical perspective it might make sense to create huge anti-access zones, while from a strategic perspective the same A2/AD zones could be counterproductive to the political goals that Russia aims to achieve. It is the job of operational art to connect the strategic and the tactical worlds so there is better congruence.

Michael Kofman has suggested an operational interpretation of A2/AD which dramatically changes the perspective from veritable no-go zones to a more nuanced discussion of the contributions of different weapon systems. [175] He suggests that air defence, precision strike, and maritime defences should be seen as separate cases with their own logic. In the air domain, Russia is building a variety of different weapons with the goal of creating a comprehensive integrated air defence system. The different weapons supplement each other to create defensive mass rather than bubbles, and the goal is to match an opponent (i.e. the United States) in a war of attrition. Regarding precision strike land attack missiles, Kofman reminds us that Russia's primary area-denial weapon on land is old-fashioned artillery, and that the new missiles will likely be reserved for strategic targets. The area where Kofman sees most credibility in the notion of A2/AD bubbles is in the field of maritime operations. The role of Russia's long-range anti-ship missiles is to keep Western adversaries at a distance so critical infrastructure can be protected against attacks from the sea. It is far from certain that this would work given the tactical difficulties of establishing an effective kill chain, but the missiles are intended as an answer to Western long-range sea-launched missiles. However, Kofman also warns us not to confuse the notion of A2/AD bubbles with the normal level of initial front-line attrition that must be expected in areas such as the Baltic Sea or the Black Sea.

While Kofman provides a more nuanced interpretation of Russia's weapon systems and their operational purposes, his framework is not necessarily practical as a guideline for discussions among Western military observers. Kofman's errand is to explain the Russian perspective on war and the logic behind their weapon systems, but that kind of empathizing with the enemy isn't always helpful for the military planner. For example, Kofman explains that, "Russia expects that the United States will be the aggressor and build up its forces in peacetime as tensions

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[174] Aaron Jackson, "Surrogate: Why Operational Art Adopted Strategy," *Military Operations* 2, no. 2 (2014): 8–11.

[175] Kofman, "It's Time"; see, also, Sergey Sukhankin, "From 'Bridge of Cooperation' to A2/AD 'Bubble': The Dangerous Transformation of Kaliningrad Oblast," *The Journal of Slavic Military Studies* 31, no. 1 (2018): 15–36.

escalate."[176] That is perhaps an accurate description of the Russian expectations, but it is not a meaningful point of departure for the Western analyst who is given the task of preparing a military response to Russian aggression.

It lies in the nature of defence planning that you prepare to be attacked, and therefore it is sometimes necessary to assume that the other side will be aggressive. That is why Western military planners expect a war to take place on Western territory, and Russian military planners assume that it will play out on Russian soil. It is therefore meaningful to work with scenarios such as a Russian invasion of the Baltic States, even if one believes – as Kofman does – that Russia doesn't see it that way.

The traditional notion of A2/AD bubbles suggests that Russia will pursue area denial aggressively. They will do this by keeping the operating environment mostly clean of any kind of traffic, because that is the tactical requirement that I have described above. From a tactical point of view this is a smart thing to do because it keeps threats at a distance, so they reduce the risks of taking their own losses. However, the operational benefits are dubious. A strict enforcement of A2/AD will have a range of political effects, and most of them will be undesired.

The typical argument for the notion of a Russian A2/AD strategy is that it will create a *fait accompli*. The idea is that the military costs to bursting the Russian missile bubble will be so great that the West will be forced to accept an unfavourable diplomatic solution.[177] However, this logic puts too much emphasis on the importance of the military instrument of power. There is validity to the argument of a *fait accompli* from a purely military perspective, especially if one includes the risk of escalation to nuclear war.[178] But the perspective is too narrow if one does not include considerations about other aspects of international relations than only military confrontation.

Instead, there are many instruments of national power, and an armed conflict between Russia and the West would have consequences in all spheres. A classical framework for analysis is the DIME model, which looks at diplomatic, informational, military, and economic instruments of power.[179] In the following, I use the DIME model on a classical scenario[180] of an invasion of the Baltic States to illustrate why A2/AD may be a double-edged sword for Russia. Before I

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[176] Kofman, "It's Time."

[177] Ben Hodges, Tony Lawrence, and Ray Wojcik, "Until Something Moves: Reinforcing the Baltic Region in Crisis and War," Center for European Policy Analysis, April 2020, 7, https://www.cepa.org/until-something-moves.

[178] Kristin Ven Bruusgaard, "Russian Strategic Deterrence," *Survival* 58, no. 4 (2016): 11–12.

[179] US Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1 (N.p.: US Joint Chiefs of Staff, July 12, 2017), www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp1_ch1.pdf.

[180] Anders Puck Nielsen, "How Would a War between Russia and the West Play Out?" blog, *Romeo Squared*, January 1, 2018, https://romeosquared.eu/2018/01/01/the-military-scenario/.

continue, it is important to note this important caveat: the scenario is used to make a point about A2/AD, and the argument should not be taken too far. It is possible to identify a variety of other things that Russia could do in the same area, e.g., in the fields of hybrid warfare or nuclear coercion, and my only errand in this article is to demonstrate why A2/AD bubbles are unlikely to be a part of the package.

Therefore, it also only makes sense to look at a fairly aggressive scenario in this article. A2/AD bubbles by nature cannot be applied in a limited border skirmish or in a hybrid action, because that would immediately turn them into much larger conflicts. One common misunderstanding in military debates is that A2/AD is a calm process. It is assumed that everyone recognizes the existence of a bubble, so opposing forces simply stay outside, and the number of casualties remains low. This assumption can lead to the idea that Russia could use A2/AD for escalation control in limited scenarios. However, that is an unlikely schedule of events. There is no reason to believe that the mere existence of Russian missiles would deter Western forces from entering a contested area. Russia would have to demonstrate their ability and determination to use these weapons in a given conflict. In other words, A2/AD is not a flexible tool for escalation control, but an extremely aggressive move that would involve real engagements of Western aircraft and warships far away from the actual area of ground operations.

So I will use a scenario where Russia performs a quick landgrab of Estonia, Latvia, and Lithuania, and the application of overwhelming military power is intended to deter the North Atlantic Treaty Organization (NATO) from trying to liberate its allies. The political goal for Russia would be a long-term alteration of the geopolitical landscape in the Baltic region. This would require that other states accept Russia's claims of a "new normal" so that relations can be resumed from a new baseline where the Baltic States are under Russian hegemony. The traditional view on A2/AD is that Russia will achieve these political goals by closing down the Baltic Sea for all air and marine traffic, whereby the West will be coerced into a deal. However, if the West does not immediately capitulate and accept Russia's claims of a "new normal," this application of A2/AD will result in a range of negative effects for Russia itself.

- **Diplomatic:** There is nothing normal about a strict regime of area denial in the Baltic Sea where Russia shoots down Western aircraft and ships in order to demonstrate resolve. It would be a blatant violation of inter- national law, and it would suppress the sovereign rights of other Baltic countries such as Finland, Sweden, and Poland to operate in their own territories. Great powers such as the United States would be unwilling to accept any notion of a "new normal" in such an environment where they have lost the right to operate in a part of the ocean. The longer the A2/AD regime is upheld, the greater the pressure will be on neutral countries such as China, India, or Japan to take sides against Russia. Often, in warfare,

powerful neutrals have proven an important limiting factor to the ability of belligerents to employ certain military means, and the same may be true in the case of A2/AD bubbles.[181] Therefore, A2/AD could create an enormous diplomatic problem for Russia, if it were to unite the world community in condemnation.

- **Informational:** A2/AD would be a public relations disaster for Russia. It would be hard to frame a violent shutdown of maritime and aerial communications over the Baltic as anything but an aggressive move, and Western information operations would pound on the matter. Public opinion could be galvanized against Russia, and even domestically it would be hard for the Russian leadership to maintain a narrative of Western aggression.

- **Military:** A2/AD would strengthen the Western alliance and lead to horizontal escalation. Any hopes that Russia could have about a quick and limited military action in Estonia, Latvia, and Lithuania would be quashed if they broaden the battlespace to the entire Baltic Sea. Finland and Sweden would have to respond militarily to engagements of their military forces inside the A2/AD zone, and over time it would increase the likelihood that the non-aligned countries would aid – directly or indirectly – in a NATO counteroffensive to retake lost territory.

- **Economic:** Russia is deeply dependent on the maritime economy and the trade flows in the Baltic Sea. In 2018, Russia's Baltic ports handled more than 246 million tons of cargo including 133 tons of oil products.[182] This activity would stop if merchant traffic in the Baltic Sea were closed down. In addition, the World community would levy harsh economic sanctions on Russia for the violations of international law related to A2/AD. This is not necessarily something that would convince Russia to change their course in the short term once a conflict has erupted, but economic self-damage surely also doesn't contribute to the political calculus that this line of action is worthwhile.

In other words, if Russia were to make an aggressive military move against the West involving the establishment of A2/AD bubbles, there could be tremendous negative impacts for Russia itself if the West successfully applied other instruments of national power. Russia might be able to absorb such consequences for a few days or possibly some weeks, but in the long run it would be unsustainable. The tactic of A2/AD would be counterproductive to the political goals that

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[181] Ian Speller, *Understanding Naval Warfare*, second edition (London/New York, NY: Routledge/Taylor & Francis Group, 2019), 23.
[182] Nielsen, "Russia's A2/AD Strategy."

Russia could have following a limited military action against the West, and therefore it would not make operational sense.

Concepts for Operational Countermeasures against A2/AD

In addition to the above mentioned indirect and direct tactical countermeasures against A2/AD, it may also be useful to discuss the concept of operational countermeasures. The purpose of such a category of operational countermeasures would be to identify measures to make A2/AD as politically inconvenient as possible for Russia. This would introduce obstacles to Russia's tactical application of weapons and reduce the likelihood that they would attempt to create A2/AD bubbles.

Operational countermeasures can logically be divided into two subgroups: those applied before outbreak of war and those applied during war. In either case, the point is to make the operating environment as confusing as possible.

Operational Countermeasures before Outbreak of War

The most important obstacle to A2/AD before outbreak of war is to make it inconvenient for Russia to get started. A sometimes-forgotten nuance in discussions about A2/AD is that until war actually begins, it is technically speaking still peacetime. This means that until the last minute, Western warships, aircraft, merchant shipping, and civilian airliners still have unlimited access to the area that Russia would want to turn into a no-go zone.

One way to counter A2/AD at an early stage is therefore to make sure that Russia has a lot of clutter to deal with. The more civilian and military traffic the better, and preferably from as many different countries as possible. This would give Russia the ungrateful task of having to persuade everyone to leave without causing a diplomatic stir.

Another approach is to preposition military units that Russia cannot intimidate into leaving voluntarily. Soldiers on the ground such as NATO's Enhanced Forward Presence in the Baltic States can function as a tripwire, but so can ships at sea or aircraft in the sky.[183] If Russia's ambition is to get away with a limited landgrab, it would be utmost inconvenient to have to sink a couple of American warships in the process of establishing an A2/AD zone. This way A2/AD loses its function as a method that Russia can use to deter the West from escalation, because they would have to escalate to a level of certain retaliation to even get started.

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[183] Sascha H. Rackwitz, "Clausewitz, Corbett, and Corvettes," Center for International Maritime Security, April 17, 2020, http://cimsec.org/clausewitz-corbett-and-corvettes/43475.

Operational Countermeasures during War

If war is already a reality, a simple operational countermeasure is to just wait for the negative consequences of A2/AD to manifest themselves. In the long run, it will be hard for Russia to uphold a strict area denial regime, and they will discover that they get ever farther away from achieving their desired political goals.

A more active approach would aim to speed up the process of turning A2/AD into a self-inflicted headache. This could involve severe economic sanctions, repeated calls for adherence to international law, information campaigns, and military countermoves like a blockade of the Danish straits. Countries like Sweden and Finland could utilize their position by insisting on access to the closed areas for both warships and commercial vessels. Especially Finland is dependent on maritime and airborne supplies, and a strict Russian enforcement of area denial in the Baltic Sea would essentially constitute a trade embargo. If Russia denies the possibility of Sweden and Finland to receive supplies, it could escalate the conflict. Actions could also be taken to clutter the operating environment with fishing vessels, small boats, or unmanned vehicles.

Russia will have to bend to meet the concerns of other parties if they wish to maintain any hope of international recognition of a new geopolitical reality. If they do not relax the area denial regime, they will never achieve their political goals. Therefore, at some point Russia will have to accept a more cluttered A2/AD operating environment. In this sense, operational countermeasures can be seen as a kind of shaping operation, because their application will ensure that tactical countermeasures become more effective if and when the West finally decides to fight inside the so-called A2/AD zone.

Conclusion

The argument in this article is a simple one: if A2/AD is counterproductive to the achievement of Russia's political goals, they are not going to do it. It is regrettable that much Western debate on the topic takes place within a narrow tactical context, where such political considerations are forgotten. From a tactical point of view, it may sound attractive to shut down all traffic in and above the Baltic Sea, but from a political perspective it is evident that there could be negative ramifications.

I suggest the concept of operational countermeasures to describe the things that the West can do to make A2/AD less attractive from a political point of view. This ties the discussion of A2/AD to the literature about operational art, which deals with the application of tactical actions to achieve strategic goals. It is my hope that this framework can provide a new lens into discussions about A2/AD, so technical aspects about what can be done are checked against political considerations about what it makes sense to do.

The immediate consequence of this perspective is that A2/AD becomes less scary. Dalsjö et al. already demonstrated that Russia's tactical capabilities may be overrated. The operational perspective expands on this argument by suggesting that there are numerous ways the West could make an aggressive anti-access strategy work against Russia's political interests. [184] In other words, A2/AD bubbles may not work very well, and they could hurt yourself more than the adversary. It doesn't sound like something Russia would do as a preferred option.

This conclusion should not lead to complacency. All it says is that A2/AD bubbles probably aren't a tool that Russia expects to use in connection with offensive actions in a complicated environment like the Baltic Sea. It does not say that Russia will not use other tools such as hybrid measures, or that the idea of a *fait accompli* could not be pursued by other means, including nuclear coercion. Also, the concept of operational countermeasures to A2/AD does not change the strategic calculus in more simple geopolitical environments like the Arctic, where Russia's Bastion defence concept is a well-established application of A2/AD.[185] Finally, it is also clear that Russia still has some impressive long-range missiles that a Western military planner would have to take into account, even if Russia doesn't establish enormous A2/AD bubbles. The missiles just play a different role on the battlefield.

Essentially, this article claims two things: (1) if Russia tries to establish A2/AD bubbles in a complex environment such as the Baltic region, there are some quite simple things the West can do to make it counterproductive for Russia. And (2) for that reason it is unlikely that Russia will even try to go down this route. But that does not make the military analysis less complicated. On the contrary, it means that we have to put more effort into understanding the Russian military capabilities and operational thinking. A concept of impenetrable A2/AD bubbles is inherently simple to understand, and it requires a lot more insight to make a sound analysis of the fluid complexity that arises when we have thrown it into the virtual garbage can where it belongs.

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[184] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, passim.
[185] Mathieu Boulègue, *Russia's Military Posture in the Arctic: Managing Hard Power in a 'Low Tension' Environment*, Research Papers (London: Chatham House, June 2019), 6–8, https://www.chathamhouse.org/sites/default/files/2019-06-28-Russia-Military-Arctic_0.pdf.

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7. Thoughts on Fighting inside an Enemy A2/AD Bubble

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Introduction

The purpose of this contribution to the debate of future battlespace is to shed light on the practicalities of potential warfare in the contemporary European theatre, with an emphasis on the Baltic area. There is a discrepancy amongst and within military and political leadership on what war against a peer adversary looks like today and in the immediate future. Furthermore, too much focus has been on individual problem sets, such as anti-access, area denial – A2/AD – without holistically addressing the entirety of the challenge. Contemporary conflict spans multiple domains and addresses different conditions in separate phases and levels. By addressing only one part, it is easy to overlook the bigger picture and how matters at different levels and in different domains are interconnected and interdependent.

This essay focuses on current challenges, the need to at least anticipate the complexities of change, and then offers some thoughts on conducting land battle against an overwhelming force within an A2/AD bubble. The A2/AD construct is valuable in that it serves as a vehicle for describing contemporary challenges in modern warfare and provides clarity on potential ways to deal with the concept, while also highlighting some of the requirements stemming from these challenges. Arguably, A2/AD is not the primary challenge; it is an enabler. The focus of this article is the problems facing the three Baltic states, but anchored in well-established contemporary challenges of the intertwined and connected modern battlefield. If contesting the A2/AD bubble is important, so is the ability to fight alone, inside the bubble, fighting together with Allies to burst the bubble, and then fighting after the bubble bursts.

Initially, a short description of the larger military problem sets the scene; following that, three considerations focus our attention, and thereafter, some perspectives on the conduct of land warfare are entertained. A short conclusion summarises some fundamental considerations for the future land warrior within an A2/AD-enabled area.

Preparing for the Next War

> The art of war is simple enough. Find out where your enemy is. Get at him as soon as you can. Strike him as hard as you can, and keep moving on.

<div align="right">

Ulysses S. Grant

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For the past three decades, Western military thinking (to include affiliated academia) focused on counterinsurgencies (to include stability operations and peacekeeping). This has resulted in significant discrepancies in understanding the modern challenges of warfare. Post-Cold War Western military thought arguably relies on three decades of counterinsurgency, or stability operations characterised by small unit operations with uncontested air superiority and instant close air support. Operations Desert Storm and Iraqi Freedom provided a reference for larger unit operations, but again with no contested air superiority. Both leverage a vague memory template of the Cold War period. The result is a very distorted view and opinion of future land battles.

The challenge across the spectrum is that we lack the masses of the past and rely too much on the assumption that we will enjoy all the technological advantages over the entire span and duration of any future conflict. This is very optimistic wishful thinking. There is a lack of comprehensive knowledge of the holistic effects of competition between innovative technologies. Additionally, we have more or less outsourced many of the services that used to be governmental prerogatives (telecommunications, transportation infrastructure, and electricity, as well as logistic services for military hardware, etc.). We unconsciously assume that technological advantages will have the same effect in fighting a peer adversary of today as an inferior one, and we seem to think that all services (technological and commercial) will be available regardless of the direction the conflict takes. But the reality is that we simply do not know what future war will look like. The only certainty is that any modern battle, or war if you prefer, on the continent of Europe between peers will be messy, brutal, and full of surprises – for all of the belligerents.

An example of the changing character of war, and more importantly, our understanding of it, is the so-called A2/AD phenomenon. In essence, the aim of A2/AD is that land-based systems can finally impact sea and air platforms, reducing their freedom to fight each other, and then shape the land domain at will (something Allied air forces have taken for granted for a very long time). Additionally, A2/AD invalidates the legacy of massed rear area logistics solutions we have relied on since World War II. In regards to the A2/AD debate, it is not primarily the systems themselves that are important, but what they enable. By potentially denying freedom of action for Allied forces, they achieve strategic effect. The focus has been too technical and perhaps too tactical, overlooking the grand utility of such capabilities. A2/AD is best studied as a vehicle for Russian enablement and for

denial of the North Atlantic Treaty Organization's (NATO's) actions. A2/AD serves best as Lord Torrington's "fleet in being" idea of the past, wherein its actual use has too many possible non-calculable consequences for both sides. Once committed, it departs from its strategic importance and enters the tactical level. Easily forgotten is the notion that A2/AD cuts both ways and is merely a contest of systems. It has, though, different effects and serves different purposes at different stages of a conflict. A2/AD systems enable other activities of one's own side to go unhindered if not contested, and denies certain options to the enemy. This is important because in focusing on the A2/AD bubble, one loses sight of what is going on elsewhere – and that is the grand utility of it. The objective being to achieve strategic paralysis and enable the conduct of covert and overt tactical and operational effects of strategic importance. Simply put, it combines strategic offense with tactical defence superbly.

This enablement of land-based systems changes the conduct of land battle. Using General Grant's quote from the beginning of this article, the dictum of "get at him" and "strike him" has changed order nowadays. If adversaries can hit each other before getting close, tactical fighting becomes more like submarine warfare – once detected, you are out. Russia's development of its reconnaissance-strike complex is the Russian answer to decades of Western conventional standoff supremacy. Now, with the perceived A2/AD bubble, it enables them, together with strategic (nuclear) escalation dominance, to thoroughly exploit the combination of these capabilities and traditionally massed ground forces in regions adjacent to Russia. This is simply an evolution of reach. Historically, the reach of weapons systems and thus the depth of the immediate danger zone of the battlefield has increased, from musket range in the old days, via machine-gun range of 300 metres in World War I, the tank and optics range of 1–3 kilometres in World War II, to the 30-kilometre-range of modern unmanned aerial vehicles (UAVs), sensors, and artillery. Moreover, the safe rear area no longer starts from 10 km behind the lines, but 200–500 km, because of the range of sensors and theatre missiles. So, on top of the inhibiting effects of A2/AD on combat operations, they also impede rear operations, and thus could induce operational paralysis.

In combination with low force-to-space ratios, the result might be a highly dispersed battlefield where formations are challenged to come to grips with each other. The quest for a mid-twentieth-century style decisive close battle has become hard to achieve, as suggested by events in Ukraine. Are we returning to World War I, where painfully achieved local victories fail to achieve the broader success that, in turn, is almost impossible to exploit operationally? In order to leverage the perceived advantage of A2/AD, one must strike at the heart of its utility. The two obvious courses of action for the defender are to either "ignore" Russian opaque special measures, compel him to escalate prematurely, denying him the under-the-threshold moment, or strike first. Advocating both could enhance deterrence, but touches some fundamental challenges. The first strike option presents NATO with

a difficult dilemma, in that Russia could consider its A2/AD systems a strategic asset. By engaging those, NATO risks triggering further escalation; but, on the other hand, by not doing so (or at least not planning for it), NATO would give in to blackmail and also let the enemy decide the terms of the way the conflict is fought. NATO would then run the risk of losing the war, its credibility, and its reason to exist.

In addition to the kinetic challenges described above, non-kinetic means are equally important in the contemporary environment. Russia highly prefers the art of operating with ambiguity, and deniability, leading to a *threshold paradox*. The Russian ability – and preference – to operate under the so-called threshold for national as well as for allied treaty-bound military response was well observed in 2014, during the initial efforts in Ukraine. The possibility of denial of culpability and responsibility presented to the West by the Kremlin left Ukraine isolated, and one should assume that similar techniques of ambiguity in action and of blaming the victim might be used in any future scenario against a NATO member. However, the Kremlin's preference for ambiguity would become harder to maintain as time progresses, making time a critical factor.

To complete the paradox, this preference for ambiguity is, of course, directly opposite to the interest of the target of aggression. The latter's direct and vital interest is to be able, firstly, to respond accordingly, with all means available and, secondly, to be confident that nothing hinders nor stalls the fulfilment of the treaty obligations of allies. Russian contemporary modus operandi, with strategic enablers such as A2/AD (with means for nuclear escalation), will almost certainly direct all their efforts to keeping everything under the threshold for direct and unified response, by a combination of ambiguity and intimidation. The objective is to achieve a creeping but full *fait accompli* against the West. In contrast, the defendant has to maximise its effort to escalate the covert conflict to a level above the threshold and facilitate the transition of a "local problem to a global problem." This paradox, together with Russia's emphasis on the importance of the decisiveness of the initial phase of war, puts both sides under time pressure. Once the conflict comes out into the open, Russia cannot militarily afford a protracted initial phase that grows into a unified kinetic allied response, while the defending side cannot sustain battles of attrition. Both activities, however, could potentially lead to nuclear escalation if too successful. In any circumstance, the defendant has no choice but to go kinetic, as the risks of appeasement empirically lead to defeat by default, especially when considering the geographical situation of certain countries, such as the Baltic states vis-à-vis Russia. These two antagonistic objectives or requirements of the belligerents create different playing fields, but one factor is of equal importance for both sides: time.

Considerations

> Although our intellect always longs for clarity and certainty, our Nature often finds uncertainty fascinating.
>
> Carl von Clausewitz

Understand

Understanding the contemporary battlefield environment is hard enough as nowadays technologies are changing faster than ever before and those available today are not fully understood, particularly in their military utility. The armies of 1914 all had machine guns and the belligerent armies favoured the offense. They attacked with their infantry in formation and suffered enormous casualties as a result. Note that the belligerents knew about the machine gun, but did not, or did not want to, anticipate the consequences it would have on the battlefield. Current emerging multi-domain thinking addresses far more complex interactions. However, few remedies are offered. We do not need to dwell on how a machine gun operates, but, instead, on understanding or at least anticipating the emergent interactions between modern technologies, domains, and platforms. During 1914–1918, the machine gun's unforeseen interactions with culture, doctrine, training, massed mobilisation, barbed wire, the weight of artillery fire, defensive trench tactics, and partly mechanised logistics were what made it such a killer. In this respect, we need to be able to out-think our opponent with regard to the possibilities of emerging technologies. Needless to point out is the fact that organisations and leaders need to be prepared for radical change once hostilities break out, as most likely we are all going to be in for a surprise.

To further complicate things, we need to fully comprehend that in an ever more interconnected world – big data, artificial intelligence (AI), 5G, etc.) – where everything is linked, the military must accept that tactical successes or failures will have immediate strategic consequences. The so-called strategic corporal is evolving as "the tactical minister" arguably joins him[186]. This brings complexity to a higher level as the attention span and reachback now reaches the entire world instantly, and even when manipulated, is an integral part of the game. As a result, the dividing lines of the peace-crisis-war paradigm, as well as tactical-operational-strategic lines, blur and interconnect even more. Note the discrepancy between the outlooks of military and civilian leaders concerning what those lines are. To cope with this, leaders must accept the notion that action in one area results in decisive outcomes elsewhere, across all domains and levels of confrontation, as in the poetic metaphor, the "butterfly effect," used by Edward Lorenz in describing chaos

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[186] Wavell Room, "Mission command: The Fall of the Strategic Corporal and Rise of the Tactical Minister," April 23, 2017, https://wavellroom.com/2017/04/23/mission-command-the-fall-of-the-strategic-corporal-rise-of-the-tactical-minister/.

theory. Unexpected exploits, such as the positional advance of a small unit, can decisively cancel potential manoeuvre response both militarily and politically, as the famous Russian airborne battalion proved with their audacious run to Pristina airfield in 1999. Tactical units can make a strategic impact. The trick is, however, to determine what is and is not relevant in an ever-compressed time interval. With this in mind, we need leaders and units who can outpace our opponents. The risk of outpacing Russia is that any confrontation near Russia risks escalating very quickly because of the short and simple command lines between the military and the regime. Understanding the balance is critical for leaders and governments as a whole, but the challenge is that this is itself dynamic, and the Russian regime is deliberately deceptive, obsessively secretive, and opaque.

Adapt

To survive and be relevant on the future battlefields, military units have to be able to adapt as the nature of conflict changes. Pace is important, but mastering adaptation is as important. The peace-crisis-war paradigm is blurred and unfortunately so is our current thinking. As the chameleon adapts with the environment, so must units during conflict, and leaders with them. Military capabilities and effects will have different meanings during different phases of the conflict. Mental and physical agility over time will be vital as it enables leaders to adapt and thus outfight their opponent cross-domain as the situation develops. Manoeuvring and positioning, and more importantly, hiding one's intent, keeping the enemy guessing your next move, has been an integral part of the art of war for millennia. Nowadays, militaries must be able to do so in plain sight. Overt manoeuvre can dislocate adversary planning as well as covert. Modern sensors and AI technologies enable everyone to "see" much more than any have before, in previous wars. The trick is to understand what is happening and what is important. AI will assist, but it will only be as good as the algorithm will allow. The defender can and will either saturate the enemy's systems or cloak himself and his intentions – in other words, camouflage across the domains.

As electromagnetic emissions and signatures are traceable (like tracers, they work both ways), this becomes even more important. One thing is to hide your own formations; the other is to limit emissions to a minimum – but still ensure command and control (C2). Here, we would have to be able to outlast our adversary. Future battlefield participants will have to work with parsimonious C2 formats and fluctuating C2 availability and be prepared to switch their communications systems off and on. This necessitates that future junior leaders are authorised to make appropriate decisions. Additionally, multi-domain functions will have to be decentralised, with delegated authority. Senior leaders must let go of having full control and accept not knowing what is going on in real time. Mission command will be paramount. This would represent a very major cultural and leadership change compared to how Western military operations have been run in recent decades.

Focus

The military leader will have to prioritise and focus actions more than ever as the possibilities provided by emerging technologies will be immense. Massing fires or troops in time and space will be difficult, not because of target acquisition or lack of objectives, but because of the risk of exposure to retaliation. There is a significant discrepancy between what one would want to do, what one should do, and what one can do, especially fighting Russia from a Baltic perspective, where mastering very limited resources is paramount. The constant interaction of the want-should-can trinity is, of course, constantly changing. Whereas the US can plan for multi-domain operations from the relative safety of North America, even with the risks to its expeditionary warfare, small countries with big aggressive neighbours have to focus on what is achievable. *Multi-domain operations* describes contemporary contest. [187] Whereas more-resourced nations strive to "command and control" multi-domain operations, I would argue that it would be more beneficial for many nations to take aim at multi-domain *anticipation*, so to say: strive for multi-domain awareness and understanding and focus on mission command, not on central control of the domains. In determining what is achievable, asymmetric advantages can be found and exploited.

To outlast and sustain relevance on the battlefield, dispersal of one's forces becomes essential. The dispersed battlefield will create opportunities, but also distractions – one of them is the perceived need for decisive action. Fighting Russia; many have yearned for that decisive battle, but have been denied. For Baltic forces, engaging in decisive battles is even more challenging, as attrition over time will only favour Russia. This does not mean that there should not be any contest. On the contrary, the dispersed battlefield creates many opportunities to contest the aggressor on more favourable terms. Contesting the aggressor is vital, especially when it comes to his *fait accompli* objective. Focusing on speed of decision and speed of execution is paramount. Time is of the essence. Particularly in the Baltic scenario, as the first 24 hours and the subsequent three days would be the generic timeframe to focus on, keeping in mind that this could quickly turn into a marathon, as the war in Ukraine has proven.

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[187] "Operations conducted across multiple domains and contested spaces to overcome an adversary's (or enemy's) strengths by presenting them with several operational and/or tactical dilemmas through the combined application of calibrated force posture; employment of multi-domain formations; and convergence of capabilities across domains, environments, and functions in time and spaces to achieve operational and tactical objectives," US Joint Chiefs of Staff, *Joint Planning,* Joint Publication 5-0 (Washington, DC: US Government Printing Office, June 16, 2017).

Contesting Time and Ambiguity

> Never do the same thing twice. Even if something works well for you once, by the second time the enemy will have adapted. So, you have to think up something new.
>
> General Hermann Balck

This rest of this article focuses on the inside of the bubble and the consequences, or rather considerations, for leaders. Geography dictates that in addressing a volatile Russian military aggression, anyone in close proximity will have to fight immediately for national survival. Estonia, Latvia, and Lithuania (the Baltic states) chose not to do so in 1939/1940, and suffered the consequences.[188] As a general consideration, fighting inside the A2/AD bubble, the defender must assume the worst-case scenario, which is to be completely cut off. Again, the paradox of having one objective prior to, but another after, the breakout of hostilities comes into play. Units and leaders have to be ready to multi-task, or multi-think for several contingencies. As important as it is to be able to fight alone inside the bubble, it is equally important to fight together with Allies to burst the bubble and continue fighting after the bubble bursts.

From a Baltic states perspective, recognising the proximity to Russia and the time-distance-forces gap for any allied reinforcement, as well as the A2/AD challenge to it, one would suggest an inevitability of finding alternative ways of managing the scarce means available. In regards to the battle within the bubble (before, during, and after bursting it), one of the most difficult things is to determine what Russia would engage with. No one knows for sure; as deception is a Russian speciality, suffice it to assume that Moscow would not use the entire western military district to strike the Baltic peninsula, as it would not be the strategic objective. Instead, a simplified order of battle would be as follows. Namely, the three-army approach: one to provoke NATO, one to counter NATO, and the third as reserve for exploitation and or consequence management. By forgetting the larger play at stake, which is obviously great power competition, many overrate the importance of the three Baltic states in themselves. Arguably, Russia considers Estonia, Latvia, and Lithuania as means to achieve something greater. In their eyes, they are pawns in a bigger game; therefore, the second army in the simplified order of battle, the one to counter any NATO/US response, should be considered as the main effort. This is good news for the Baltic states and the forward-deployed NATO forces, as it would imply that there was a lesser, albeit more rapid, force to counter.

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[188] As a direct consequence of the secret protocol of the Nazi German-Soviet Nonaggression Pact of August 23, 1939, Latvia was coerced into signing a dictated treaty of mutual assistance, by which the USSR obtained military, naval, and air bases on Latvian territory, with up to 250,000 troops. On June 17, 1940, Latvia was subsequentially invaded and occupied – at the same time that German tanks rolled in to Paris.

Geography matters when trying to address emerging and existing challenges – the closer you are to the threat, the less of a safety net you have, as well as fewer options for engagement. The Baltic states arguably have approached these challenges from an underdog perspective. The *universal* principles of maintaining freedom of action (manoeuvre), the establishment of concentration of effort, and ensuring the economy of one's forces are, of course, applicable for the Baltic theatre, but with different angles and scale. The predicament of the Baltic geography and available resources make it inevitable that the strategy is not to win a war against an aggressive Russia, but rather not to lose one. Again, what one would like to do, or should do, is not always the same as what one actually can do. Bearing this in mind, any action from the Baltic states' point of view has to count. Every action has to have maximum utility, even if it does not cover the whole necessity and even if complete success is not achievable. Violence has to be an integral part of this action, as it is the shortest and most effective path to rendering the ambiguity pointless. This idea, together with an ability to manoeuvre through multiple domains – "judo" across the tactical-operational and strategic levels – and finding achievable multi-domain effects are essential requirements in designing defence stratagems.

Making it Count

In case of a Russian strategic surprise attack, obviously preceded by failed Allied deterrence, one has to accept that the aggressor's immediate objectives will be met/taken (in multiple domains). This will require nerves of steel and constraint by all levels of command and leadership on the defending side, as the intent of the enemy is probably to provoke ill-coordinated responses. Exercising restraint and not expending scarce resources on lost opportunities/causes will be a severe mental and moral challenge. By not engaging on the aggressors' terms, time becomes our ally (i.e. *fait accompli* denied). By anticipating and synchronising multi-domain efforts and by leveraging the ambition levels with the available resources, one can deliver unexpected problem sets to the enemy, thus staggering his decision cycles. If this state of affairs can be sustained over time, the defending forces will remain relevant. On the tactical field, this corresponds to the establishment of non-linear combined-arms defence-in-depth systems, with supporting joint fires (multi-domain effects), together with an aggressive hunter-killer mindset for all units involved that engages on its own terms rather than on the enemy's.

As the strategic surprise attack scenario suggests, an automatic disruption of the defenders' C2 (technical means as well as decisionmaking across all levels of government) will occur. What one cannot prevent, one must protect against – or eliminate as a critical factor. On the command side, that would require the delegation of authority and pre-planned actions ready to be executed: in other words, mission command and contingency plans. Some nations are already rediscovering these forgotten principles. Headquarters (HQ) organisations will be

what one can afford to make survivable, not the staff functions one wanted to have before the HQ was obliterated. Either staffs should be made as light as possible, or as cloaked as possible. If the necessary C2 arrangements of a fighting force require an HQ that is too big to move with speed and agility, it has to be able to "disappear in plain sight" by dispersal and camouflage blending into a particular background. An alternative is to go "clouding," with services provided from afar. This, however, requires guaranteed connectivity or organisational agility to "switch off, and switch on," and to be content with this. In regards to communications, there is a growing argument against having separate military communications networks. Fighting dispersed comes to mean not being detected. Perhaps encrypted cell phones or other software-based solutions could trump current military-grade very high frequency/high frequency (VHF/HF) systems as well as other high-bandwidth-dependent networks, especially with the power source challenge of military-specific batteries and the equipment that demands them.

As force ratios are not and cannot be favourable, forces need to engage, but not decisively. This is analogous to the cavalry of bygone times conducting covering-force battle, always contesting but not engaging decisively. Being light forces, they can neither afford attrition, nor hold ground. Units need to master the meeting-engagement tactics and learn when to disengage. The defender must contest the enemy selectively across a wide area, where it is achievable, with sensor-enabled forces for reachback kinetic and non-kinetic effects. The aim is to force the enemy to commit more resources than initially set aside. Direct fires should be limited to high pay-off opportunities. The whole point of a prepared, non-linear, combined-arms, defence-in-depth is that units can perform independently but, more importantly, orchestrate combined effects with fires. As Russia can hope to employ overwhelming amounts of indirect fires on a battlefield within the protection of their A2/AD bubbles, the defender must explore alternative approaches for directing and massing fires. Arguably, classic fires direction C2 architecture overexposes itself through its electro-magnetic signature and therefore would be vulnerable to counter-battery fires. Innovative sensor-to-shooter systems should be considered, using new approaches such as an "artillery Uber app" directing fires independently, for the good of its "anonymous" clients.

Terrain matters, and favours, the defender, if adequately prepared. A non-linear combined-arms defence-in-depth, where units can perform independently but also orchestrate combined effects, would be challenging for any attacking force over time. Terrain, nowadays, also includes the population directly affected in the target nation, or indirectly in allied troop-contributing nations. Focusing on the military aspect, then, by preparing and equipping the force to operate independently and dispersed – marching separated but fighting together, as Moltke would have said – the defender can limit the enemy's freedom of movement, or freedom of choice. The challenge is to reach the necessary mass to achieve an effect. This requires agility. Tactical mobility suited to the terrain is indispensable. The defender tries

to channel the enemy advances. The enemy is compelled to maintain speed. It is paramount that the defender employs platforms that can negotiate every terrain in order to maintain the greatest freedom of action.

With the Russian preference to mass fires on objectives and troops, defending obvious enemy terrain objectives must be considered carefully. However, when opting for holding ground, it is necessary to prepare properly, with the intent to weather the assault and exploit this to its maximum utility. Holding contested ground fixes enemy actions and can be used or exploited by counterattacking with massing fires in time and space with maximum violence at our disposal. Timing is critical, as the available resources are limited. Ideally, counterattacks should be undertaken immediately after a tactical enemy success, i.e. when he has relaxed momentarily, but before he has regained his balance or been able to exploit success. In tactical terms, this would be a spoiling attack, with the purpose of inflicting disturbances on enemy timelines and redirecting resources, as well as allowing friendly troops to disengage. Rather than taking or holding terrain in itself, the objective should be to inflict physical destruction of enemy forces, especially in the early stages of hostilities. To add the equally important informational space contest, kinetic actions must be supported by non-kinetic (or the other way around!) effects, across the spectrum, to bring the fight to other arenas simultaneously, the objective being to contest Russia's ability, or rather endurance, to support simultaneous overt and covert activities, in addition to main and secondary efforts across the domains and time. Force her to exhaust pre-hostilities-formulated battle plans (scenarios or so-called playbooks). This is to compel the Kremlin to be reactive rather than proactive. This will require an agile mindset and the acceptance of risk, with the requirement of excellent mobility not only across terrain, but also across the domains and levels of command.

Summary

As always, we are all captives of our own experiences. Current Western military thought is shaped by events over the past three decades, with a vague recollection of the Cold War as the baseline. During this time, Russia and others evolved their military thinking and some in the West are left mesmerised, but some are slowly realising and dealing with the consequences. The A2/AD construct is an example of this and can be used as a vehicle for describing contemporary challenges in modern warfare. The focus is either on the systems themselves, or on what they enable. For the Baltic states defence forces, the focus has to be on what they enable over time and through different stages of a future conflict. Denying the aggressor's objective of achieving strategic paralysis and the enablement of his covert and overt effects must be our outmost goal. Military organisations have to be adaptable to be able to fight alone, inside the bubble, and fight together with allies to burst the bubble and then continue fighting after the bubble bursts.

Predicting the future has always been a major challenge, especially anticipating battlefield effects of emerging new technologies. Rather than trying to understand technologies independently, the focus should be on anticipating interactions between them, as well as preparing leaders and organisations for adapting to change at a faster pace. Contesting the interaction between what one wants, should, and can do will be important, as the opportunities from technologies will only grow.

Preparations for the defence of the Baltic states must recognise the proximity to Russia and the time-distance-forces gap for any Allied reinforcement to it, as well as the inevitability of finding alternative ways of managing the scarce means available. The advantage of Russia's considering Estonia, Latvia, and Lithuania as the means to achieving something greater, and not as an objective in itself, can and must be exploited. If a strategic surprise attack is launched, then on those three lines of effort the defence must be designed, not forgetting the array of possibilities of multi-domain effects available.

The strategic objective must be to counter the Russian preference and ability to operate under the so-called threshold for national as well as for Allied-Treaty-bound military response. As this preference for ambiguity gets harder to maintain as time progresses, time becomes a critical factor and an ally. Baltic strategy is not to win a war against an aggressive Russia, but rather not to lose one. Surprise comes with automatic disruption, especially on the defenders' C2 (decisionmaking at large). As this cannot be prevented, it must be mitigated by mission command and contingency plans and planning. As Baltic forces cannot engage in decisive battles where attrition will only favour Russia, alternative, dispersed battlefield designs can be employed as they create more opportunities to contest the aggressor on more favourable terms. Every Baltic action has to have maximum utility, even if it does not cover the whole necessity and even if complete success is not achievable. Note that the main purpose/task for the forces of the Russian Western Military District is not to strike the Baltic peninsula, but to fight NATO at large. To understand this means having a better intellectual foundation when devising opportunities for sustained defence. As long as the Baltic defence remains relevant longer than anticipated, we are winning. The fight is for time.

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8. Different Approaches to Managing the Long-Range Ballistic and Cruise Missile Threat

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The first combined offensive use of cruise missiles and long-range ballistic missiles is more or less as old as these weapon systems themselves. The German strategic bombing offensive against British cities, mainly London, kicked off in June 1944 with the launch of the first V-1 cruise missiles. This was followed three months later by the first V-2 attacks.

The "Baby Blitz"[189] was in effect a pure terror bombing campaign, but as the war progressed the weapons saw use in a role closer to the anti-access/area denial (A2/AD) strategy often envisioned for their descendants today. The most important target was the port of Antwerp, which was a significant port of entry for Allied shipments into the northwestern European theatre of operations. After the US capture of the Ludendorff Bridge, at Remagen, Germany also used the V-2 to try and knock out the strategic crossing. The poor accuracy of the weapon, however, meant that none of the rockets fired hit closer than 180 metres from the target.[190]

During the early years of the Cold War, the main mission of both ballistic and cruise missiles was seen as carrying nuclear warheads to targets where free-fall bombing had little to no possibility of success, either due to the long ranges involved or due to the airspace's being heavily defended. However, as technological improvements meant that the accuracy of individual systems increased, the possibility of using conventional warheads to strike individual targets became more alluring. This development came first to the cruise missiles, since the first non-US ballistic missiles showing pinpoint accuracy had become operational only after the turn of the millennium. With the development of these modern systems, a new threat scenario emerged, one where very long-range systems could be used to take out individual pinpoint targets. As the threshold for when ballistic missiles and cruise missiles would be used in times of war moved down below the realms of nuclear warfare and deterrence theory, the question of how to defend against these weapon systems received renewed interest.

To understand the different approaches to managing the cruise missile and long-range ballistic threat, it is important to recognise the areas where the threats from the two weapon systems are similar in their nature and where they diverge. In essence, what both systems do is allow an attacker to land a warhead at a faraway

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[189] Helen Cleary, "World Wars: V-Weapons Attack Britain," *BBC – History*, February 17, 2011, http://www.bbc.co.uk/history/worldwars/wwtwo/ff7_vweapons.shtml.

[190] Ken Hansen, "What Finished the Bridge at Remagen?" *Stars and Stripes*, March 17, 1962.

target. This allows an attacker to destroy targets without putting their own platforms or personnel at risk. The crucial difference is in the way they do this, as the cruise missile flies towards the target in the same way as an unmanned aircraft, getting lift from its wings and propulsion from an engine which in most cases is air-breathing. The ballistic missile on the other hand flies towards the target following a ballistic flight path, i.e., the shape you would get if you threw the missile towards the target. This requires immensely more power in the early parts of flight, but also gives the missile extremely high speeds when falling back towards earth. The ballistic missiles rely on rocket engines, either solid- or liquid-propellant engines, which allows a higher thrust-to-weight ratio of the engine compared to air-breathing ones.[191]

The single most important benefit of the cruise missile compared to the ballistic missile is its relative simplicity. The lower speed makes the requirements placed on the manufacturing of parts and subsystems significantly lower than those placed on ballistic missiles, and the similarity to ordinary aircraft makes it possible to draw from the significant amount of knowledge, off-the-shelf parts, and manufacturing technologies from the aeronautical industry.[192] The lower speed makes manoeuvring as well as the installation of seeker heads and navigational systems easier. These combinations make the cruise missile more effective against moving targets and small, fixed, or semi-fixed targets whose general location is known. On the other hand, some modern ballistic missiles, such as the Chinese DF-26 system, are reportedly capable of intercepting moving targets based on a combination of data-linked targeting information and an active radar-seeker on the missile itself.[193] However, this capability further adds to the complexity and cost of the already complex and expensive system that is the ballistic missile, and while the future will likely see more ballistic missiles able to intercept moving targets, their most significant benefit will remain their extremely high terminal speed, which makes countering ballistic missile attacks technically difficult. The Russian Iskander-M missile has a reported speed at burnout of 2.1 km/s at a height of 12 to 15 km (approximately Mach 7).[194]

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[191] Some thought has been given to whether the use of air-breathing boosters is possible, but these were deemed to be unnecessarily complex and heavy compared to traditional rockets; see Select Committee on Astronautics and Space Exploration, "Propulsion Systems," sections L and M, in *Space Handbook: Astronautics and Its Applications* (Washington: United States Government Printing Office, 1959), https://history.nasa.gov/conghand/propulsn.htm.

[192] An obvious example of the relation between cruise missiles and aircraft is the original V-1 cruise missile, which was available in both unmanned and manned versions, the latter known as the Fieseler Fi 103R, with the Fi 103 sans R being the formal designation of the V-1.

[193] Andrew Tate, "China Touts Capabilities of DF-26 as ASBM," *Jane's 360*, January 28, 2019, https://www.janes.com/article/86013/china-touts-capabilities-of-df-26-as-asbm.

[194] Stefan Forss, *The Russian Operational-Tactical Iskander Missile System,* working paper, Department of Strategic and Defence Studies Series 4 (Helsinki: National Defence University, 2012).

These important differences on the principal level make the question of how to manage the threat from cruise missiles and long-range ballistic missiles fork into two different sub-questions, with partly differing answers.

The "Baby Blitz" is interesting in this regard as most of the methods used today for managing the threat from cruise and ballistic missiles were already found in the British attempts at managing the V-1 and V-2 threat, anti-ballistic missile systems being the only new major aspect introduced since 1944. As noted above, the cruise missile can be countered with the same systems used to counter enemy aircraft. In the case of the British campaign, the air defences of the country were divided into three geographical areas, or "bands," altering between ground-based systems and specialised, V-1 hunting, fighter units patrolling the southern parts of England. These fighter units were equipped with some of the finest fighters available to the RAF at the time.[195] In the end, these defensive efforts were described as "reasonably effective."[196] The amount of resources allocated to the air defence of the British homeland, at this late stage of the war, to reach this level of effectiveness, is, however, notable. For the V-2, no such defensive measures were available, and the sole answer lay in offensive efforts against launching sites and other targets related to the V-1 and V-2 programmes, as well as deception, by feeding false information and denying the enemy accurate targeting data.

The basic premise that fighters and ground-based systems are a key part in countering cruise missiles still remains valid, although contemporary cruise missiles can hug the ground and can be programmed to follow specific flight paths. Most countries today employ some form of air defence. However, countering cruise missiles requires modern systems optimised for air surveillance and defences against small targets at low level. Similarly, denying the enemy accurate targeting data is still a key feature of modern concepts of striving to deny the enemy the ability to use long-range missiles effectively. Dispersion, camouflage, and being mobile are the most important methods, and are often used in conjunction with each other. However, it is important to remember that a modern "reasonably effective" defence might well require, in the same way as in 1944, a significant amount of a country's total air defence capabilities to be allocated to countering the cruise missile threat. Here, it should also be noted that ground-based air defences have largely been neglected amongst Western countries for the last few decades.[197]

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[195] This included, e.g., all three squadrons equipped with the fastest version of the Spitfire available, the Griffon-engined Mk XIV, as well as the first squadron of jet fighters, the No. 616 Squadron equipped with the brand new Gloster Meteor F.Mk I; see Alfred Price, "Supermarine Spitfire: Part 2," in vol. 16 of *Wings of Fame* (London: Aerospace Publishing, 1999); Jon Lake "Gloster Meteor Variants Part 1," in vol. 14 of *Wings of Fame*.

[196] Price, "Supermarine Spitfire," 44.

[197] Krister Pallin, ed., *Västlig militär förmåga – En analys av Nordeuropa 2017* (Stockholm: FOI, January 2018), https://www.foi.se/rapportsammanfattning?reportNo=FOI-R--4563--SE, 205.

Ballistic missiles are a different kind of beast, and are generally only targetable with dedicated missile defences or specially configured high-end air defence systems. Depending on the nature of the ballistic missile (i.e., range and flight profile), different anti-ballistic missile systems are used. Against systems such as the venerable SCUD-series and the modern Iskander, adapted versions of medium-to long-range air defence missiles, such as the Patriot family, can be used. Specialised systems, such as THAAD (Terminal High Altitude Area Defense) provide additional missile defence capabilities, making them more effective against longer-range missiles and saturation attacks that include a larger number of missiles in a single salvo.[198] What is notable is that while for a long time the technical issue in engaging ballistic missiles has been solely about their high speed, modern systems such as the Iskander can make course corrections and take evasive action during the final stages of flight, further complicating the issue of success-fully intercepting them.[199] When discussing the engagement ranges of modern air defence systems it is important to remember that, while a modern mid- to long-range system such as the MIM-103 Patriot or SAMP/T has a stated maximum range of around 70 to 100+ km,[200] these ranges are usually given for non-manoeuvring targets at height. Against ballistic targets, the effective ranges are in the order of 15 to 22 km, due to the speed and steep flight trajectory of the incoming missiles.[201]

A key question is also at what point the intercepting missile can be launched. It is not unusual to have a mismatch between the range of the organic sensor (i.e., the radar tied to an air-defence battery or ship) and the interceptor. In the ideal situation, the threat is detected enough in advance that when the interceptor is fired it will intercept the incoming missile close to the interceptor's maximum effective range. As the incoming missile approaches at extremely high speed, during the time it takes for the interceptor to reach its maximum range the incoming missile will have moved a significant distance from the initial point of detection. In practice, the detection range of the organic sensor and the maximum effective range of an interceptor are often quite close to each other in absolute terms, leading

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[198] Amanda Macias, "Why America's Missile Defense Systems Are the Best in the World," *Business Insider*, August 23, 2016, https://www.businessinsider.com/top-missile-defense-systems-2016-8.

[199] These missiles are sometimes described as "semi-ballistic," to distinguish them from missiles that follow strict ballistic tracks once the rocket engine cuts out.

[200] Jyrki Sulasalmi, "Patriot PAC-3 ja S-300PMU-2 ballististen ohjusten torjuntajärjestelminä," Pro gradu (Master's) thesis (Maanpuolustuskorkeakoulu, 2007), 40, https://www.doria.fi/bitstream/handle/10024/74429/SM380.pdf?sequence=1&isAllowed=y and MBDA Inc., "ASTER 30-SAMP/T," company product page, MBDA, accessed September 5, 2019, https://www.mbda-systems.com/product/aster-30-sampt/.

[201] Puolustusvoimat, "Ohjusjärjestelmät ja -puolustus," November 29, 2017, https://puolustusvoimat.fi/artikkeli/-/asset_publisher/ohjusjarjestelmat-ja-puolust-1.

to a mismatch, since, for the interceptor to be able to use its maximum performance, a sensor with significantly longer range than the interceptor is needed.[202] This means that the inclusion of an early warning sensor is of great importance, as it allows the interceptor to be launched based on the detection of the incoming target by the remote sensor, so-called Launch on Remote (LoR).[203] LoR significantly increases the area it is possible to defend by a battery, as well as increasing the area where multiple engagements are possible.[204]

In short, when it comes to kinetic defences against missile strikes, defence against cruise missiles is interlinked with the general air defence capability, while defence against ballistic missiles is largely a stand-alone capability, sometimes taken care of by air defence batteries adapted for the role.

In practice, countries usually employ a multifaceted approach to the combined threat. Which measures are prioritised rests on a number of different factors, including the assessed threat levels, air defence doctrine, defence budget, and national security considerations. Even for countries that are found in the same operational theatre, the approaches used can differ widely. The Baltic Sea region – Finland and Sweden in particular – is a good example of this.

Finland – Good Enough to Allow for Quantity

For Finland, the key threat systems include land- and sea-based[205] cruise missiles and air-launched cruise missiles (Kh-555 and Kh-101), as well as the land-based and air-launched versions[206] of the Iskander ballistic missile. To a certain extent, the measures taken to mitigate these are launch-platform agnostic, in that countering a missile doesn't depend on whether it is air-, ground-, or sea-launched as much as on the specifications of the missile itself. The one aspect that does differ is that sea-launched and especially air-launched missiles can be launched from surprising angles due to the mobility of the launching platforms. In particular the Kinzhal opens up directions of attack that aren't available to the ground-launched Iskander. For cruise missiles the difference is smaller; provided they

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[202] This is a situation that can be desirable when intercepting slower targets such as aircraft and cruise missiles. There is also the inherent physics-based difficulty in building and operating very-long-ranged radars.

[203] There is also the associated and more complex concept of Engage on Remote (EoR), where the remote sensor not only provides early warning but handles fire control as well.

[204] Simon Petersen (@SimonHoegbjerg), "I always say that planning is 85% of BMD [ballistic missile defence] and I've been meaning to do a thread on BMD planning, Sensor cueing and Launch on Remote for some time now. I finally got around to generate the visual aids needed, so here we go. This is going to be a long thread!" Twitter, June 14, 2019, https://twitter.com/SimonHoejbjerg/status/1139631877554409473.

[205] Both from the Baltic and Northern Fleets.

[206] The latter being the Kh-47M2 Kinzhal.

have the range, they can be routed through a series of waypoints on their way to their target.

Finland has a well-developed doctrine concerning how to manage the long-range ballistic and cruise missile threat, based on a variety of measures. For the benefit of the general public, in late 2017 the Finnish Defence Forces issued an eight-page press release, entitled "Missile Systems and Defences," to explain its views on defences against cruise and ballistic missiles. The text notes that missile defences are made up of several layers (in bold, in accordance with the original text):

> The first objective is to prevent the proliferation of missile technology and the missile threat in one's own home region. The second objective is to prevent the use of missiles against one's critical resources. The third objective is to prevent the missiles from hitting. The fourth is to minimise the effect of a possible hit, and recover as quickly as possible. **It is important to understand that missile defences are made up of a wide range of measures, of which the military ones are just one part of the whole.**[207]

The text also notes that the military measures comprise both active and passive measures and the creation of a powerful enough deterrent to achieve a threshold effect. The aggressor needs to understand that any missile attack will cause an immediate answer of such a scope that the aggressor decides that the cost is too high compared to the achieved effect.[208] No details regarding the deterrent are provided, but former Finnish Chief of Defence, Admiral (ret.) Juhani Kaskeala, who was closely involved in the Finnish acquisition of the AGM-158 JASSM, has stated in interviews that both the Finnish deal as well as the Polish deal for the AGM-158B JASSM-ER have been made to "eliminate the threat from the [Iskander] ballistic missiles and to create a deterrent."[209] No public discussion has taken place regarding the nature of the targets held at risk by the Finnish JASSM arsenal, though the very nature of the weapon means that a credible deterrence by denial is impossible to achieve with a limited number of conventional warheads. Senior Research Fellow Charly Salonius-Pasternak, at the Finnish Institute of International Affairs, also noted that the targets used in the Finnish live test-firings bore a striking resemblance to large missile launchers, such as those used by the Iskander and the S-400 Triumph long-range surface-to-air missile. Salonius-Pasternak further commented that, "If you want to enhance deterrence it is useful to publicly suggest what you might use a capability for."[210] However, considering

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[207] Puolustusvoimat, "Ohjusjärjestelmät ja -puolustus"; author's translation.

[208] Ibid.

[209] Olli Ainola, "Amiraali Kaskeala: USA:n poliittinen voima ja sotilaallinen suorituskyky on Suomen viimeinen turva," *Iltalehti*, March 2, 2018, https://www.iltalehti.fi/politiikka/a/201802022200717039.

[210] C. Salonius-Pasternak, on Deterrence and Stratcom, "If you want to enhance #deterrence it is useful to publicly suggest what you might use a capability for. On the left I present targets used in @FinnishAirForce #JASSM test, on the right S-400 and Iskander," Twitter, March 20, 2018, https://twitter.com/charlyjsp/status/976089724988411911.

the limited number of JASSM operated by Finland and that it is highly question-able whether Finland would be able to maintain the kind of targeting cycle required to attack mobile targets such as Iskander transporter erector launchers (TELs),[211] it seems unlikely that the Finnish Air Force would target individual TELs with the JASSM. Another question is whether JASSM really would be the weapon of choice for the TEL-hunting mission.[212] While a counter-value mission is equally unlikely, based on Finnish doctrine and the nature of the weapon, targeted strikes against military and political leadership remain a possibility due to the deliberate ambiguity employed by the Finnish Defence Forces with regard to the intended use.[213] Notably, Finland in general has been known to employ ambiguity as a means of increasing deterrence and thereby stability.[214]

With regard to the passive measures, these include "dispersion, movement, concealment, entrenchment, and deception."[215] As opposed to anti-ballistic missile systems that only are able to cover a limited area and rely on early warning from other sensors, these passive measures are easily scalable to offer protection throughout the country as well as for the protection of the general population. It should be noted that Soviet and later Russian use of military means, including long-range missiles, to create an anti-access/area denial (A2/AD) capability in the Baltic Sea region is something Finland – in a manner – has been adapting to since the Cold War. As then Lt. Col. Aki Heikkinen described the situation in an article published in *Sotilasaikakauslehti* (The Military Periodical) in 2016:

> Throughout the period following the wars [1939–1945] we have determinedly planned our national defence and security of supply according to the demands of A2AD [...] I am not arguing that the situation would be perfect when it comes to, e.g., security of supply, but above all we have continuously taken it into account.[216]

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[211] Transporter-erector-launcher; the same vehicle is able to transport the missiles to their area of operation and, once there, independently raise the missiles into a ready state, before eventually launching them against potential targets.

[212] For example, a key part of Finnish intelligence-gathering capabilities in time of war would still be long-range infantry patrols. Their ability to instantly ambush targets of opportunity might make them better suited to missile-hunting compared to a hunter-killer team of reconnaissance assets and JASSM-equipped Hornets. The JASSM would on the other hand be clearly superior when faced with stationary "hard" targets, such as bridges and fortified command posts.

[213] It should be noted that it is likely that Russia also sees their high-precision long-range weapons as having a deterrence value, providing credibility to the idea of JASSM as a non-nuclear deterrent. See Oscar Jonsson, *The Russian Understanding of War: Blurring the Lines between War and Peace* (Washington DC: Georgetown University Press, 2019), 87.

[214] Charly Salonius-Pasternak, *Ambiguity and Stability in the Baltic Sea Region – Defence Cooperation between Finland and Sweden increases both*, FIIA Briefing Paper (Helsinki: FIIA, June 2018). https://www.fiia.fi/wp-content/uploads/2018/06/bp241_ambiguity-and-stability-in-the-baltic-sea-region.pdf, 7. The effectiveness of the approach is not uncontroversial and a feature of some academic debate (ibid.).

[215] Puolustusvoimat, "Ohjusjärjestelmät ja -puolustus."

[216] Aki Heikkinen, "A2AD, mitä se on?" *Sotilasaikakauslehti* 956, no. 8/2016 (2016): 4, 45–46, author's translation. The view is supported by Marku Palokangas, who notes that an internal memo created by

In essence, Finnish planning takes into account that the enemy can direct fire towards all Finnish targets from the outset of the crisis. The Finnish national defence system is based on small and highly mobile units operating independently under mission command, making it hard for relatively short-range anti-ballistic missile systems to find their place in it. The Finnish Defence Forces lists the cost of a generic short-range ABM system, such as the Patriot, as approximately EUR 1 bn,[217] while the need for early warning sensors further increases the cost of this already expensive system. In the end, the Finnish view is that when considering the limited area covered by anti-ballistic missile systems relative to their cost as well as sensor and manpower needs, relying on active measures for missile defences is not an option. For a small country with limited resources, the defence against ballistic missiles will instead rely on deterrence and passive measures such as dispersion and constant movement.[218] This view was further cemented by General Timo Kivinen in an interview given shortly after he had taken up the position of Chief of Defence, where he stated that, "No minor country has the resources to develop and maintain an active missile defence system. […] Finland has a passive missile defence system, based on an analysed and identified threat. The concept is based on protection, movement, and decentralized operations."[219] The Finnish involvement in the French-led TWISTER project, announced in November 2019, should be seen against this backdrop; as Minister of Defence Antti Kaikkonen stressed, in an interview, Finland is not going to acquire the endo-atmospheric interceptor that is part of the project, but is interested in the potential for improved early warning of incoming long-range weapons.[220] Movement is not only relevant when troops are deployed out in the field, but also within individual bases and garrisons.[221] However, there is also a requirement for robustness that allows for losses to be accepted without undue damage to the combat capability of the defence forces or the warfighting ability of society as a whole.[222] It should also be noted that, "munitions for these developed weapons systems [Iskander, Kalibr,

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the Operations Division of the Defence Command, in 1956, found that the enemy always had "numerical and material superiority throughout the battlespace as well as fire superiority on land, in the air, and at sea"; author's translation; Marku Palokangas, *Hankitun tiedon varassa: yhtymätason tiedustelutoiminnan kehitys Suomessa itsenäisyytemme aikana* (Helsinki: Edita Publishing Oy, 2018).

[217] Puolustusvoimat, "Ohjusjärjestelmät ja -puolustus."

[218] Ibid.

[219] Joonas Kuikka, "Suomi puolustautuu ohjushyökkäystä vastaan eri filosofialla kuin suurvallat – Puolustusvoimain uusi komentaja avaa myös, miksi korvettien mitat kasvoivat," *Kaleva*, October 26, 2019, author's translation.

[220] Jenni Virtanen, "Suomi valmistautuu puolustautumaan avaruudessa – EU:n uudessa puolustusprojektissa varoitetaan hypersoonisista ohjuksia," *Helsingin Sanomat*, November 12, 2019.

[221] Heikkinen, "A2AD," 46.

[222] Some glaring issues are found with regard to this approach, such as the concentration of all self-propelled guns and NASAMS II air-defence units to a single unit (the Armoured Brigade in Parola). Steps have, however, been taken to mitigate some of them, such as the peacetime dispersal of tanks. Maavoimat, "Panssarikaluston käyttö laajenee Maavoimissa," Maavoimat.fi, September 6, 2016, https://maavoimat.fi/artikkeli/-/asset_publisher/panssarikaluston-kaytto-laajenee-maavoimissa.

and Triumph] are expensive and not available in large numbers," meaning that the total number of strikes made by long-range ballistic and cruise missiles will be comparatively low,[223] and finally that based on historical data the number of ballistic missile strikes can be expected to be significantly lower than the number of cruise missile strikes in any single conflict.[224]

However, some targets are fixed or semi-stationary by their very nature. The Finnish total defence concept aims at ensuring that the creation of nodes that constitute critical vulnerabilities is minimised and that the amount of redundant nodes is high enough that the disruption or destruction of no single node will cause a critical system or function to shut down.[225] This can be seen as a direct counter to the presumed Russian doctrine of large-scale strikes against critical objectives, to paralyze the enemy system through attacking the nodes of their key subsystems. Depending on the effect the attacker wishes to achieve, this can include key military structures such as air or naval bases, but also civilian infrastructure such as bridge or water/power supply nodes, or systems holding importance for decisionmaking, such as political or military leadership or the communications network they use.[226]

The current high-end system in the Finnish ground-based air defences is the NASAMS II short/medium-range surface-to-air missile system. The system is capable of countering both enemy aircraft and cruise missiles. The semi-stationary nature of the system means that it is suited for protection of fixed and semi-fixed areas rather than moving ground units. The capital, Helsinki, is frequently mentioned with regard to the wartime mission of the missile system.[227] The choice of system has been controversial, as the NASAMS is shorter-ranged and has a significantly lower ceiling than the Buk-M1 (SA-11 Gadfly) it replaced.[228] However, the flexibility of the system, the larger number of launchers and missiles, and the synergies with the Finnish Air Force all carried a higher weight, in the final

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[223] Heikkinen, "A2AD," 45.

[224] Tommi Jääskeläinen, "Ballististen ja risteilyohjusten muodostama uhka nyt ja tulevaisuudessa," *Ilmatorjunta*, no. 2/2017 (2017): 14.

[225] Heikkinen, "A2AD," 46.

[226] Michael Kofman, "It's Time to Talk about A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge/. The most well-known example of the creation of redundant nodes is the Finnish use of road bases as secondary airfields during wartime; see Paavo Airo, "Poikkeusoloissa maantietukikohtia käytettäessä pitäisi olla aina vihollista askeleen edellä," *Reserviläinen*, September 29, 2016. Whether Russia would in practice be able to hit a large enough number of targets is somewhat controversial, as some note that in reality the number of weapons available will likely limit their use in countering key capabilities, such as hostile air power; see Susanne Oxenstierna and Fredrik Westerlund, eds., *Russian Military Capability in a Ten-Year Perspective – 2019,* report (Stockholm: FOI, December 2019).

[227] Tero Tuominen, "NASAMS suojaa Helsingin," *Reserviläinen*, May 2010.

[228] Touminen, "NASAMS"; Ahti Lappi, "Buk-M1 ensimmäisenä Suomeen, ensimmäisenä museoon," *Ilmatorjunta,* no. 2/2017 (2017): 27.

evaluation, compared to range and ceiling. As then Chief of Defence, Admiral Kaskeala, described the deciding factor, "Do we buy one Cadillac or four Volvos?"[229] This is in line with how the Finnish Defence Forces have looked at their top-range air defences throughout the missile-era, having always prioritised flexibility and cost-effectiveness over outright performance. This is visible in not only the choice of the Buk-M1, but also the S-125 Neva/Pechora (SA-3 Goa)[230] that preceded it.[231] The S-125 was a system particularly tailored towards better coverage at lower altitude compared to its longer-ranged predecessor in Soviet service, the S-75 Dvina (SA-2 Guideline) of Vietnam War fame.[232]

However, the step back in altitude coverage from the Buk-M1 to the NASAMS II does open up for a scenario where if the Finnish Air Force suffers serious losses amongst its fighters, the enemy would be able to operate with impunity at medium to high altitude. In part because of these shortcomings, and in part as a general modernisation drive, the Finnish Defence Forces is currently in the midst of a major upgrade of its air defence capabilities, including a serious step-up in capability against cruise missiles. The three main components of this package are the HX multipurpose fighter programme aimed at replacing the current fleet of F/A-18C/D Hornets; the Pohjanmaa-class[233] multipurpose corvettes; and a new ground-based air defence system with higher reach, approximately 8 to 15 kilometres, and longer range compared to the NASAMS II.[234] The new system will have defence against enemy strike aircraft and bombers as its main purpose, with capabilities against cruise missiles coming along as a "freebie."[235] The upcoming Pohjanmaa-class corvettes will be fitted with quad-packed ESSM missiles as their primary anti-aircraft weapon. The missiles will provide a potent defence against weapons such as the anti-ship version of the Kalibr cruise missile, the 3M54, and allow the vessels to participate in the air defence of the coastal regions; but, they are not able to target ballistic missiles.[236] The current Chief of Staff of the Finnish

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[229] Olli Kemppainen, "Ohjusjärjestelmä Norjasta, ohjukset Yhdysvalloista, tutkat Ranskasta," *Reserviläinen*, March 2009.

[230] The NATO reporting name is SA-3 Goa.

[231] Ilkka Enkenberg, *Asekirja – Suomen aseet vuodesta 1917* (Helsinki: Readme.fi, 2015), 140–141.

[232] Chaim Herzog, *The Arab-Israeli Wars* (New York: Vintage Books, 1984), 215.

[233] Also known as Squadron 2020, or Laivue 2020, in Finnish.

[234] Niilo Simojoki, "Suomi haluaa korkeammalle yltävää ilmatorjuntaa Hornetien tueksi," *Turun Sanomat*, January 18, 2018, https://www.ts.fi/uutiset/kotimaa/3805360/Suomi+haluaa+korkeammalle+yltavaa+ilmatorjuntaa+Horn etien+tueksi.

[235] Simojoki, "Suomi haluaa korkeammalle yltävää ilmatorjuntaa."

[236] Ministry of Defence, "Surface-to-Air Missile System for Pohjanmaa-Class Corvettes," Valtioneuvosto (Council of State), Finnish Government, accessed August 22, 2019, https://valtioneuvosto.fi/en/article/- /asset_publisher/pohjanmaa-luokan-korvetteihin-ilmatorjuntaohjusjarjestelma; Lentoposti.fi, "Merivoimien Pohjanmaa-korvetteihin siilolaukaistavat Evolved SeaSparrow –ilmatorjuntaohjukset," February 21, 2019, https://www.lentoposti.fi/uutiset/merivoimien_pohjanmaa_korvetteihin_siilolaukaistavat_evolved_seas parrow_ilmatorjuntaohjukset_video.

Navy, Commodore Tuomas Tiilikainen, notes that, "credible BMD [ballistic missile defence] requires vast and specialized resources and global commitment. That would drain the required and critical national defence assets from a rather small project, and still be uncertain [in value],"[237] or as Captain (N.) Veli-Petteri Valkamo described the decision: "Capability requirements for SQ2020 [Pohjanmaa-class] are based on […] national defence demands. BMD is not part of that."[238]

Sweden – A Patchwork of Capabilities

The aforementioned Finnish Defence Forces text on doctrine notes, in several places, the similarities to Sweden's, albeit with some exceptions.

The key similarities include the view that a "single solution, method or system cannot protect against a diverse air threat";[239] the importance of "integrated air defence systems able to meet different threats";[240] the fact that an air defence system such as the Patriot can (after significant investments in sensors and other associated technologies) defend individual targets against short-range[241] ballistic missiles;[242] and that these systems will need to be defended against air strikes by short-range air defence systems and by counter-special operations force (counter-SOF) units against enemy special forces raids.[243]

However, as opposed to Finland, Sweden has taken the decision to invest in the Patriot air defence system with PAC-2 missiles, for use against aircraft and cruise missiles, as well as PAC-3 missiles for point-defence[244] against short-range

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[237] Tuomas Tiilikainen (@TuxuTiilikainen), "I believe not. As you well know, credible BMD requires vast and specialized resources and global commitment. That would drain the required and critical national defence assets from a rather small project, and still be uncertain. A known unknown I should say," reply to Robin Häggblom (Corporal Frisk, @CorporalFrisk) on BMD for SQ2020, Twitter, August 22, 2019, https://twitter.com/TuxuTiilikainen/status/1164616975668142083.

[238] Veli-Petteri Valkamo (Veli-Petteri Valkamo [anchor symbol] officer with joint twist, @VpValk), "Capability requirements for #SQ2020 are based on only for national defence demands. #BMD is not part of that," reply to Robin Häggblom (Corporal Frisk, @CorporalFrisk) and Tuomas Tiilikainen (@TuxuTiilikainen) on topic of SQ2020 BMD, Twitter, August 22, 2019, https://twitter.com/VpValk/status/1164587709513515008?s=20.

[239] Puolustusvoimat, "Ohjusjärjestelmät ja -puolustus."

[240] Fredrik Berefelt, Björn Larsson, and Ove Steinvall, *Framtidstrender för luftvärnssystem,* report, FOI-R--4140--SE (Stockholm: FOI, November 2015), 28, https://www.foi.se/rest-api/report/FOI-R--4140--SE.

[241] Ranges less than 1,000 km.

[242] Regeringen, *Försvarsmaktens långsiktiga materielbehov: Betänkande av utredningen om Försvarsmaktens långsiktiga materielbehov*, Statens offentliga utredningar SOU 2018:7 (Stockholm: Sveriges Riksdag, February 2018), 98, https://www.regeringen.se/492372/globalassets/regeringen/dokument/forsvarsdepartementet/sou/sou-7-2018.pdf.

[243] Regeringen, *Försvarsmaktens långsiktiga materielbehov*, 98.

[244] Götz Neuneck, Tommi Koivula, and Katariina Simonen, eds., *Arms Control in Europe: Regimes, Trends and Threats*, vol. 16, Research Publications 1 (Tampere: MPKK, 2017), https://www.doria.fi/bitstream/handle/10024/144087/Arms%20control%20in%20Europe_netti.pdf?sequence=1, 43.

ballistic missiles.[245] The plan for the early warning sensor network is unclear at the moment, though new sensors will be introduced before 2025. [246] The introduction of Patriot into Swedish service is described as comparable in complexity to the combined systems of the JAS 39 Gripen multirole fighter, the Swedish national radar network, and the national fighter command and control system.[247]

Tracing the requirement for ballistic missile defence capability shows that in 2011 the main Swedish study regarding ground-based air defences listed a requirement for a system with "limited capability against ballistic missiles."[248] However, as recently as 2013, the Swedish Armed Forces Headquarters did not list capability against ballistic missiles as a requirement for the replacement of the MIM-23 HAWK[249] in the Army's development plan (AUP 2014).[250] It is notable that this was five years after the Georgian War 2008 saw Russian forces fire tens of ballistic missiles, including Iskanders, against Georgian targets.[251] This did not last long, and later in 2013 the capability to operate against ballistic missiles with ranges below 600 km (re)appears in the study of the air defence system 2020.[252] Whether this shows lingering reservations within the Swedish defence establishment regarding the importance of the requirement is unclear. It should also be noted that the planned order of battle of the Swedish air defence battalions following the introduction of the "new medium range system"/Patriot has shifted in open documents, going down from four to two batteries per battalion between 2016[253] and the eventual offer in 2018. [254] The decision to acquire Patriot has been

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[245] Regeringen, "Anskaffning av medelräckviddigt luftvärn," Pub. L. No. Skr. 2017/18:290 (2018), https://www.regeringen.se/4a4958/globalassets/regeringen/dokument/forsvarsdepartementet/skrivelser/anskaffning-av-medelrackviddigt-luftvarn-skr.-2017-18-290.pdf; Jonas Olsson, "USA:s regering godkänner att Sverige köper Patriot luftvärn för 25 miljarder," SVT Nyheter, *SVT*, February 22, 2018, https://www.svt.se/nyheter/inrikes/usa-godkanner-att-sverige-koper-patriot-luftvarn-for-25-miljarder.

[246] Fredrik Zetterberg, "Arbetar med anskaffning av medelräckviddigt luftvärn," *Artilleri & Luftvärn* 2/2018, 2018, https://issuu.com/whdesign.se/docs/artilleri_och_luftv_rn_nr_2_2018luftvärn, 6-7.

[247] Hans Ivansson, "Kunskaper om Patriot," FMV, November 16, 2018, http://www.fmv.se/sv/Nyheter-och-press/Nyheter-fran-FMV/Kunskaper-om-Patriot/.

[248] Stefan Jönsson, "Luftvärnet – tillbaka till framtiden," *KKrVA:s Handlingar och Tidskrift*, no. 3 (March 16, 2016): 13, https://kkrva.se/hot/2016:3/jonsson_luftfvarnet.pdf.

[249] Försvarsmakten, "Robotsystem 97," n.d., https://www.forsvarsmakten.se/sv/information-och-fakta/materiel-och-teknik/vapen/robotsystem-97/.

[250] Försvarsmakten, "Arméns utvecklingsplan (AUP) 2014–2023," Högkvarteret, August 28, 2013, https://www.forsvarsmakten.se/siteassets/2-var-verksamhet/armen/armens-utvecklingsplan-2014.pdf.

[251] The exact number is unclear; Michael Kofman writes 17 to 22 missiles, while Tommi Jääskeläinen claims the total number of ballistic missiles was approximately 60. See Michael Kofman, "Russian Performance in the Russo-Georgian War Revisited," War on the Rocks, September 4, 2018, https://warontherocks.com/2018/09/russian-performance-in-the-russo-georgian-war-revisited/; Jääskeläinen, "Ballististen," 17.

[252] Jönsson, "Luftvärnet," 13, referencing Luftvärnsregementet, *Luftvärnssystem 2020 – MARK 121301S*, study, September 13, 2013.

[253] Ibid., 19.

[254] Toni Eriksson, "Patriot-offerten har kommit," FMV, May 7, 2018, http://www.fmv.se/sv/Nyheter-och-press/Nyheter-fran-FMV/Patriot-offerten-har-kommit/.

controversial, both with regard to whether the ability to perform the point-defence mission against ballistic missiles should be a defining requirement,[255] and whether the competing SAMP/T system should have been chosen instead.[256]

As for the reason behind the different outcome in both Finland and Sweden, regarding the acquisition of ground-based air defences capable of intercepting ballistic missiles, a key difference is the number of potential targets of an Iskander strike launched from Russian territory. The common land border that Russia and Finland share means that the vast majority of Finnish targets are within striking range of the system's 500–700 km range. Sweden on the other hand is not within range of systems based on the Russian mainland, though Iskanders of the 152nd Guards Missile Brigade, based in the Kaliningrad exclave, are able to reach parts of southeastern Sweden.[257] The small area and limited number of missiles available[258] means that the number of potential targets is limited, making the use of point-defence systems against enemy ballistic missiles more feasible compared to the Finnish situation. In a wider crisis, the vulnerability of Kaliningrad might also mean that it is possible to deter the Russian forces from utilising their long-range A2/AD assets based in the exclave.[259] However, it should be noted that a very different threat scenario exists in the form of the Kalibr cruise missiles that are found on Russian naval ships in both the Russian Baltic Fleet and the Northern Fleet, as well as against air-launched missiles. The latter can also operate with impunity against Swedish targets, unless the Swedish Air Force (SwAF) can operate in Finnish and/or Norwegian airspace.[260] Observers have noted that long-range cruise missiles constitute the most important threat to Swedish defence-associated infrastructure, and especially if they employ surprising ingress routes.[261]

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[255] Carl Bergqvist (Wiseman @wisemanswisdoms), "Bild från FOI som väl illustrerar varför det är tämligen meningslöst att ha ballistisk robot som dimensionerande hot för nytt svenskt luftvärn. Vad ska skyddas? Vad får man göra avkall på?" Twitter, February 25, 2018, https://twitter.com/wisemanswisdoms/status/967672133877985280.

[256] Gustaf Tapper, "Patriot står försvaret dyrt," *Dagens Industri*, December 20, 2017.

[257] Jägarchefen, "Nytt läge – Del 2 'Korridoren till Baltikum,'" blog, *Jägarchefen*, February 14, 2016, http://jagarchefen.blogspot.com/2016/02/nytt-lage-del-2-korridoren-till-baltikum.html.

[258] Reported as 16+16 reloads available for non-nuclear strike missions. See Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region – Capabilities, Countermeasures, and Implications*, report, FOI-R--4651--SE (Stockholm: FOI, March 2019), 58, https://www.foi.se › rest-api › report › FOI-R--4651--SE.

[259] Dalsjö et al., *Bursting the Bubble*, 62–63.

[260] The same would naturally be true for the cruise missiles travelling from the Russian Arctic Ocean to targets in Sweden. However, strikes during the last few decades, especially in the Middle East, have shown that overflights by weapons are generally treated as less serious compared to overflights by combat aircraft. It is also highly unlikely that the Russian government would be bothered to ask for permission from Finland or Norway for cruise missile strikes on Swedish territory, while the opposite is true for Swedish air strikes passing through Finnish or Norwegian airspace.

[261] Johan Wiktorin (@forsvarsakerhet), "Ett par läxor för Sverige. Angriparen har initiativet och det är kryssningsrobotar, ffa från oväntad riktning, som är det stora hotet mot vår försvarsinfrastruktur," on

In general, it should also be noted that air and sea combat have traditionally taken a more important role in Swedish defence planning compared to the traditionally army-centred Finnish Defence Forces. Sweden has operated a long-range air defence system, able to target enemies beyond the reach of fighters, in the form of Bloodhound II, which became operational in 1967. The system was mainly meant to target high-value assets such as jammer and reconnaissance aircraft operating at high altitude.[262] While the Bloodhound was rather short-lived in Swedish service, it does provide the country with a historic precedent, not found in Finland, of operating ground-based systems as strategic assets.

The acquisition of the Patriot system is only one part of the current modernisation programme of the Swedish air defences. Beginning in 2019, the country's two air defence battalions have started to exchange the venerable RBS 70 for the new IRIS-T SLS.[263] The system will provide point-defence and close-defence of the Patriot batteries. Eight TEL, each with four missiles, are included in each battalion.[264] The IRIS-T offers Sweden its first credible ground-based defence against modern cruise missiles.[265] The quoted cost for the Swedish Patriot acquisition is about SEK 10 bn (approximately EUR 930 million),[266] which can be compared to the introduction of the short-ranged IRIS-T, and which is budgeted to cost approximately SEK 1.5 bn (approximately EUR 140 million).[267] The costs are not directly comparable,[268] but this does reflect the significant difference in cost between short- and medium-/long-range systems.

Under Swedish doctrine, each battalion will defend a single target.[269] While two Patriot battalions can be argued as making a significant difference against enemy Iskanders, given the small number of potential targets, it is immediately clear that for general air defence this is woefully inadequate. The simple fact is that not even all five of Sweden's air force bases can be protected against cruise-missile attacks

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topic of cruise missiles, Twitter, September 16, 2019, https://twitter.com/forsvarsakerhet/status/1173473129055903745.

[262] Lennart Andersson, *Fienden i öster!: Svenskt jaktflyg under kalla kriget*, Försvaret och det kalla kriget 53 (Svenskt militärhistoriskt biblioteks förlag, 2012), 143.

[263] An adaptation of the Iris-T air-to-air missile as a ground-launched air-defence system; internationally, the designation IRIS-T SLS is sometimes used.

[264] Henrik Hedberg, audio-visual presentation on procurement of a new air-defence system, FMV, 2016, https://fmv.se/sv/Press/Filmer/.

[265] Michael Reberg, "Anskaffning av Patriot beslutad," *Vårt Luftvärn*, no. 3/2018, 2018, luftvarn.se/vlv/1803.pdf.

[266] Tapper, "Patriot."

[267] Fredrik Magnusson, "Robot 98 levereras till Halmstad," SVT Nyheter, *SVT*, August 23, 2019, https://www.svt.se/nyheter/lokalt/halland/robot-98-levereras-till-halmstad.

[268] Some general integration costs are included in the price tag of the Patriot, despite being of equal importance to both systems. See Jonas Svensson, "En svensk Patriot," *Försvarets forum*, no. 4/2018, September 12, 2018.

[269] Though there is also "some possibility of acting with half a battalion" (author's translation); Gustav Sjöholm, "Sverige förbereder jätteköp av nytt luftvärn," P4 Norrbotten, *Sveriges Radio*, June 24, 2017. https://sverigesradio.se/sida/artikel.aspx?programid=98&artikel=6723989.

at the same time, not to mention other key strategic locations such as army and navy bases, cities, and civilian infrastructure. This leads back to the need for passive protection measures such as dispersion, movement, and staying hidden. It is also notable that of the three units capable of intercepting cruise missiles, two are the Patriot battalions and their IRIS-T TELs, with the sole remaining unit being the BAMSE-equipped unit stood up in Gotland last summer.[270] As such, while the sets of potential targets for ballistic missile and cruise missile strikes in Sweden differ, the main air defence units might well be tied up in the defence of potential ballistic missile targets, leaving the rest of the country wide open for cruise missile strikes, with the exception of the ability of the Swedish Air Force to counter those strikes.

The introduction of the Meteor very long-range air-to-air missile in Swedish service as the main weapon of the JAS 39C Gripen has added significantly to the SwAF's ability to counter cruise missiles, something which will be further enhanced with the introduction of the JAS 39E Gripen, with its more powerful sensor suite that was destined to replace the current fleet of "legacy" Gripens within the current decade. However, the drop in numbers (as of today, only 60 Gripen E are on order)[271] means that the fleet will be very busy when spread out over the air superiority, reconnaissance, and potential air-to-ground and maritime strike missions. What is also notable is that while widely expected, no decision has been made on replacing the current Swedish AEW&C assets in the form of the ASC 890. These kinds of airborne sensors would play a key role in detecting low-flying cruise missiles early enough that the Gripen flights would have time to react.

NATO Countries in the Baltic Sea Region

How the North Atlantic Treaty Organization (NATO) views the threat from long-range ballistic and cruise missiles has generally been better covered and in-depth by English-language open sources, compared to the Finnish and Swedish approaches, and hence will not be described in as great detail here.

A key observation is that NATO places a higher importance on active measures compared to the two smaller countries. Crucially, concepts such as NATO Integrated Air and Missile Defence (NATO IAMD) and its implementation through the NATO Integrated Air and Missile Defence System (NATINAMNDS) ensure that limited national and NATO systems and resources are coordinated to ensure the highest level of efficiency. What is notable is that full-scale exercises of the complete chain have not taken place in recent years, making the

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[270] Högkvarteret, "Fast luftvärn på Gotland," Försvarsmakten, July 1, 2019, https://forsvarsmakten.se/sv/aktuellt/2019/07/fast-luftvarn-pa-gotland/.

[271] Whether the drawdown will take place as originally planned is uncertain, as both Försvarsdepartementet (2019) and Försvarsmakten (2019) argue for retaining the current number of aircraft.

effectiveness of the system as it is set up today somewhat open for discussion. An example of how this can play out is Denmark, which currently lacks interceptors capable of targeting ballistic missiles, but still plans on equipping the frigates of the Royal Danish Navy with radars capable of providing early warning.[272] While the USA naturally provides the brunt of both sensors and interceptors, in quality as well as quantity, other countries also possess systems capable of intercepting cruise missiles. There are some limited number of specific programmes aimed at countering the kind of low-flying targets that cruise missiles present, such as the recently announced Polish plan to base an aerostat-mounted radar system in Kisielice, in northern Poland;[273] while a small number of countries are acquiring the capability of targeting ballistic missiles through programmes such as the German TLVS[274] and the Polish Wisła,[275] both based on the US Patriot system.

Voices are also being raised questioning the survivability of rear units, including key nodes such as command points. The size of, e.g., brigade command posts make these difficult to move, making them vulnerable to indirect fire from long-range systems.[276] A renewed emphasis on mobility is seen as both increasing the survivability as well as the efficiency of the staff work, thanks to smaller and leaner structures.[277] However, these efforts, as well as a renewed emphasis on the kind of short-range systems that provide the massed air defences necessary to defeat incoming cruise missile strikes, are currently implemented to a varying degree, and in many cases are still in their infancy.[278]

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[272] Pallin, ed., *Västlig militär förmåga*, 56.

[273] Marcin Niedbała (@MarcinNiedbala), "Polish Armed Forces are probably going to procure the aerostat mounted radar system. Kisielice (in northern Poland) were chosen as a place where the radar base should be founded. I wonder, if it could be networked with IBCS ;)," Twitter, September 17, 2019, https://twitter.com/MarcinNiedbala/status/1173706415539707905.

[274] Based on the MEADS system.

[275] Based on the Patriot PAC-3+.

[276] Recent historical examples include the strike on the tactical operations centre of the US Army's 3rd Infantry Division's 2nd Brigade, outside Baghdad on April 7, 2003, putting it out of operation for approximately an hour, until a "serviceable alternative" TOC could be set up. The weapon likely used was either the 70-km-range 9K52 Luna-M artillery rocket with a 550 kg high-explosive warhead, or the indigenous longer-ranged but lighter Ababil-100; see David Zucchino, *Thunder Run: The Armored Strike to Capture Baghdad*, Kindle (New York: Grove Press, 2004), 162. More recently, during the latest high-visibility NATO exercise, Exercise Trident Juncture 2018, a joint fire support team from Sweden's A9 Artillery Regiment was inserted by helicopter behind "enemy" lines, from where it directed fire that destroyed a brigade command post as well as a Patriot battery; see (Artilleriregementet (@artilleriregementet), shows A9 at TRJE18, Instagram, November 8, 2018, https://www.instagram.com/p/Bp6VXlohR-f/).

[277] Brad Spiel, "Less Is More: The Enabled Combat Brigade Headquarters," blog, *Grounded Curiosity*, January 5, 2018, https://groundedcuriosity.com/less-is-more-the-enabled-combat-brigade-headquarters/; Combat Boot (@combat_boot), Nicholas Drummond (@nicholadrummond), and Think Defence (@thinkdefence), Tweet dialogue on UK Brigade HQs, Twitter, October 31, 2018, https://twitter.com/combat_boot/status/1057421866636324870.

[278] Angry Staff Officer (@pptsapper), "I'm consistently amazed at how poorly we train at survivability. Granted, it's a lost art, but overhead cover for fighting positions cannot be a single piece of plywood, as

Managing Missiles Today and Tomorrow

There is no single method or approach that currently can be described as the gold standard of managing the threat of long-range ballistic and cruise missiles. Instead, most countries employ a mix of active and passive measures, with the form these approaches take and the balance between active and passive being governed by a number of factors such as available funds, doctrine, size and role of the ground-based air defences, and civil-military relations, as well as the historical role of ground-based air defences relative to fighters. As the active measures available to counter ballistic missiles are of a qualitatively different kind than those needed to counter enemy aircraft and cruise missiles, and as these ballistic missile defences place significant demands on the sensor network and are expensive to procure and operate, any kind of comprehensive coverage remains largely unachievable. As such, passive measures will continue to play a key role whenever faced with the threat of enemy ballistic missiles.

Achieving reasonable protection against cruise missiles by using active systems seems plausible. However, that would require a significant number of modern short- and medium-range air defence batteries. As Major General (Engineering) Kari Renko of the Finnish Defence Forces Logistics Command explained when asked whether increased territorial coverage could be achieved solely by increasing the range, "Increased territorial coverage means that we have more batteries operational."[279] Currently, none of the countries around the Baltic Sea, nor NATO allies such as the USA or United Kingdom – that is, those that are expected to become involved in a crisis in the area – have the necessary number of systems to provide a comprehensive cover against long-range cruise missiles.

Based on open sources, it appears that most countries, with the exception of a few (such as Finland) that strongly make the case for passive measures as the most effective approach to managing the threat of long-range missiles, seem to dedicate the brunt of their efforts in the area towards active measures, including the acquisition of high-end air defence systems capable of operating as missile defences. However, it is difficult to assess to what extent this reflects current doctrine, and to what extent the procurement of these high-end systems simply gets more visibility on account of being more media-sexy, compared to more mundane issues, such as achieving redundancy in system nodes, or questions regarding conventional deterrence, which can be difficult to accurately explain to the general public in newspaper articles. The open-source material does, however, indicate that many countries have not fully investigated the opportunities that protection, mobility, concealment, and conventional deterrent provide. This is regrettable, as these skillsets will not only provide cost-effective ways of managing

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it often is. (giving [*sic*] the photo the benefit of the doubt that they later harden it)," Twitter, September 12, 2019, https://twitter.com/pptsapper/status/1172232141045936128?s=20.

[279] Simojoki, "Suomi haluaa korkeammalle."

the long-range ballistic and cruise missile threat, but also generally increase the survivability of troops and infrastructure on an increasingly lethal battlefield.[280]

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[280] Other current trends – beyond the scope of this text – that increase the lethality include, e.g., increased tactical use of drones for reconnaissance and small-scale strikes, ballistic computers on individual and crew-served weapons, and loitering munitions.

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9. The Case for NATO Theatre-range Missiles in Europe[281]

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Much ink has been spilled on Russia's alleged anti-access/area denial (A2/AD) strategy in the Baltic region.[282] According to many observers of Baltic security, Russia has acquired in the last two decades a sophisticated suite of missile capabilities that it now deploys in the exclave of Kaliningrad and its Western Military District. These missiles are aimed not only at strengthening its defences, but also at improving its wherewithal to perform offensive functions. More specifically, by being in possession of various missiles that could be delivered from the ground, at sea, or in the air, Russia could significantly complicate efforts by the United States and other North Atlantic Treaty Organization (NATO) members to enter and to move around in the Baltic region should they try to defend their Baltic allies in case of Russian attack. The high price that NATO would have to pay to overcome this so-called A2/AD bubble thus means that the security guarantees that benefit the Baltic countries of Estonia, Latvia, and Lithuania become much less believable. To be sure, some critics are sceptical whether Russia has an A2/AD strategy. Regardless, the evolving missile balance benefits Russia and creates fears of European allies' being decoupled from one another, and from the United States. This problem was further compounded by the termination of the Intermediate Nuclear Forces (INF) Treaty in 2019.

In this essay, we argue in favour of ground-based, land-attack, theatre-range missiles in Europe. This has several benefits. First, so long as these missiles were not nuclear-armed, such deployments would help produce stability by dampening fears about decoupling in the European context. Second, they would help strengthen conventional deterrence in NATO's northeastern flank – that is, Poland and the three Baltic countries – by holding at risk Russian military assets in Kaliningrad and elsewhere. Third, they could encourage Russia to make costly

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[281] A longer version of this contribution has previously appeared with the *Texas National Security Review*: https://tnsr.org/2020/05/the-post-inf-european-missile-balance-thinking-about-natos-deterrence-strategy/

[282] Stephan Frühling and Guillaume Lasconjarias, "NATO, A2/AD, and the Kaliningrad Challenge," *Survival* 58, no. 2 (2016): 96; Luis Simón, "The 'Third' US Offset Strategy and Europe's 'Anti-access' Challenge," *Journal of Strategic Studies* 39, no. 3 (2016): 417–45; Fabrice Pothier, "An Area-Access Strategy for NATO," *Survival* 59, no. 3 (2017): 73–80; Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region: Capabilities, Countermeasures, and Implications*, report, FOI-R--4651--SE (Stockholm: Swedish Defence Research Agency – FOI, 2019); Alexander Lanoszka and Michael A. Hunzeker, *Conventional Deterrence and Landpower in Northeastern Europe* (Carlisle, PA: Strategic Studies Institute, 2019); and Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *Parameters* 49, no. 1–2 (2019): 21–36.

investments aimed at improving its own capabilities. At the moment, economic sanctions notwithstanding, NATO countries have not been putting strategic pressure on Russia, opting instead to adopt a reactive posture. Finally, and relatedly, new theatre-range missile deployments would create a new source of leverage that the United States and NATO could use in order to bring Russia back to arms control. Just as NATO has not been putting strategic pressure on Russia, it has no leverage to use, nor even tolerable concessions it can make, in the spirit of arms control.

We make our argument in several steps. We begin by talking about the evolving missile balance in Europe. We then outline the potential role that theatre-range missile deployments could play in NATO strategy. Note that by theatre range, we mean all missiles that could be used within the European theatre so as to encompass short, medium, and intermediate ranges. Finally, we rebut potential criticisms of our proposal before offering concluding remarks.

The Evolving Missile Balance in Northeastern Europe

The missile balance figured prominently in discussions of the military balance during the Cold War. Yet the successful negotiation of the INF Treaty in 1987 made the missile balance much less important for European security. Signed by the Soviet Union and the United States, this bilateral agreement prohibited the deployment and testing of all ground-based missiles and launchers with ranges between 500 and 5,500 kilometres. Still, the missile balance was not entirely absent during the INF era. As relations worsened between the United States and Russia in the 2000s, the missile balance became a source of controversy. On the one side, the Bush administration withdrew from the Anti-Ballistic Missile Treaty in 2002, on the argument that countries like Iran posed new missile threats to its and its European allies' interests – an argument that Russia flatly rejected. On the other side, Russia converted its newfound wealth from high oil and gas prices to reconstitute its military, with special attention to precision-guided missiles such as the 9K720 Iskander and the Kalibr cruise missile family. These military acquisitions took place when European countries maintained their defence spending at historic lows. The Iskander and Kalibr missiles were particularly unnerving for NATO's newest members. The ground-based Iskander has ranges that can envelope each of the Baltic states in their entirety as well as large parts of Polish territory. Ground, air, and sea platforms could launch Kalibr missiles to ranges up to 1,500 km.[283] More recently, Russia developed the 9M729 missile (NATO codename: SSC-8 "Screwdriver") – a ground-based missile forbidden by the now defunct INF Treaty because it was tested at prohibited ranges. Indeed, this

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[283] Roger N. McDermott and Tor Bukkvol, *Russia in the Precision Strike Regime: Military Theory, Procurement, and Operational Impact*, FFI-Rapport 17/00979 (Oslo: Norwegian Defence Research Agency – FFI, 2017): 11–14.

missile led the Obama and Trump administrations to accuse Russia of violating the INF Treaty and ultimately gave impetus to its demise.[284]

According to many observers, these missile capabilities give rigour to the view that Russia has an A2/AD strategy that it is pursuing in the Baltic region. Stephan Frühling and Guillaume Lasconjarias write that, "[b]y emplacing highly capable and long-range anti-air, anti-shipping and surface-to-surface missiles in … the Kaliningrad exclave, … Russia can deny NATO forces the use of large areas of the sea and air surrounding, and even within, the Alliance's territory."[285] More precisely, Russia could isolate the Baltic countries in a military confrontation, whereby it used its missile capabilities to make any effort to rescue them extremely expensive for the United States and the rest of NATO to undertake. *Faits accomplis* – not unlike what took place with Russia's annexation of Crimea – could become likelier as far as the Baltic countries are concerned.

The United States and its NATO allies are not toothless against Russia's maturing missile capabilities and the threat they pose. First, since 2009, the United States has tried to implement the European Phased Adaptive Approach (EPAA), a plan designed to protect Europe against short-, medium-, and intermediate-range ballistic missiles by using sea- and land-based configurations of the Aegis missile defence system. Second, local allies and partners are developing their own missile defence capabilities. In addition to its planned purchase of eight Patriot batteries by 2025, Poland will acquire interceptors like the Skyceptor missile.[286] Non-NATO countries Sweden and Finland are also investing in missile defence and surface-to-air missiles, respectively. Finally, NATO also relies on long-range missile capabilities and air power based in the United States and Western Europe in order to deter Russia from using its theatre-range missiles in northeastern Europe. Still, the local missile balance – and the larger military balance, for that matter – grossly favours Russia.

That the missile balance favours Russia is not in dispute. Nevertheless, some observers are sceptical as to whether Russia's capabilities are as significant as implied by talk of "A2/AD bubbles." An FOI report shows that Russian air defence systems are limited in their ability to detect, track, and shoot down aircraft at long ranges.[287] Alexander Lanoszka and Michael Hunzeker as well as Keir Giles and

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[284] See Alexander Lanoszka, "The INF Treaty: Pulling Out in Time," *Strategic Studies Quarterly* 13, no. 2 (2019): 54. See also Jacob Cohn, Timothy A. Walton, Adam Lemon, and Toshi Yoshihara, *Leveling the Playing Field: Reintroducing US Theater-range Missiles in a Post-INF World* (Washington, DC: Center for Strategic and Budgetary Assessments, 2019); and Evan Braden Montgomery, *Extended Deterrence in the Second Nuclear Age* (Washington, DC: Center for Strategic and Budgetary Assessments, 2016).

[285] Frühling and Lasconjarias, "NATO, A2/AD," 96.

[286] Matthew Kroenig, "Poland's Missile Defenses are Critical for the Defense of Europe," *Defence24*, September 19, 2019, https://www.defence24.com/polands-missile-defenses-are-critical-for-the-defense-of-europe-opinion.

[287] Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 31.

Mathieu Boulegue argue that Kaliningrad is more of a liability for Russia than an asset precisely because the exclave can be isolated.[288] NATO could develop its own A2/AD capabilities to complicate Russia's ability to reinforce Kaliningrad. Michael Kofman directly challenges the notion that the development of A2/AD capabilities is even central to Russian military planning.[289]

Nevertheless, just because NATO can burst the A2/AD bubble does not mean that the price for doing so is low. Giles and Boulegue acknowledge that Russian A2/AD systems are vulnerable to saturation, but add that "casualty-averse Western forces must expose themselves to risk and the likelihood of losses."[290] Even so, this scenario assumes that escalation will remain under control despite the possibility of nuclear exchange. Kofman admits that "the [A2/AD] concept has utility when looking at a *maritime* theatre involving Russia or China," but argues that Russia faces a deeper naval challenge than NATO.[291] Still, if Kofman is right that Russia's war plans involve theatre-strike weapons that could destroy critical nodes in an adversary's command and control structures, then war over the Baltics would still be ugly, however unlikely. The concept of A2/AD certainly should not imply impenetrability and immobility. Rather, it denotes that costs must be paid in order to operate in a particular theatre.[292] For the state implementing an A2/AD strategy, these costs serve to deter external aggression. Alternatively, if that state has offensive motives, systems that take on A2/AD characteristics raise the costs for those states that are otherwise expected to defend those allies that fall within their range.

From a force planning perspective, our revised understanding of Russia's capabilities and approach to war do not fundamentally alter the strategic needs and problems facing NATO and the Baltic countries. NATO countries might still not tolerate the costs associated with sending reinforcements to the Baltic region, even if Russia's purported A2/AD systems suffer from key limitations. NATO countries could be too averse to casualties and to escalation with a nuclear-armed power such as Russia. Indeed, if those states believe that Russia has an escalate-to-de-escalate strategy, whereby it would threaten limited nuclear use in order to deter military intervention, then those very states might prefer to stand pat.[293] For their

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[288] Lanoszka and Hunzeker, *Conventional Deterrence*; Giles and Boulegue, "Russia's A2/AD Capabilities," 26.

[289] Michael Kofman, "It's Time to Talk about A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge/.

[290] Giles and Boulegue, "Russia's A2/AD Capabilities," 25–26.

[291] Kofman, "It's Time to Talk"; see also Robin Häggblom, "The True Face of the Baltic Fleet," Corporal Frisk – Analysis and Consulting, October 12, 2019, https://corporalfrisk.com/2019/10/12/the-true-face-of-the-baltic-fleet/.

[292] Luis Simón, "Demystifying the A2/AD Buzz," War on the Rocks, January 4, 2017, https://warontherocks.com/2017/01/demystifying-the-a2ad-buzz/.

[293] Analysts are divided as to whether Russia really has such a strategy. See Kristin Ven Bruusgaard, "The Myth of Russia's Lowered Nuclear Threshold," War on the Rocks, September 22, 2017, retrieved from

part, the Baltic countries cannot rationally entrust their security to NATO. They thus still need to develop deterrence-by-denial capabilities in case they are isolated in a military confrontation.[294] Whatever the state of Russia's missile or A2/AD capabilities, the bottom line is that NATO may have global escalation dominance, but Russia still has local escalation dominance such that it can "decouple" the local and global levels of deterrence.

The Potential Role for Missiles in Current NATO Strategy

We argue that new theatre-range missile deployments can enhance NATO strategy in the Baltic region in several ways. First, these missiles can give NATO defence planners more flexible options in addressing the military threat posed by Russia. At present, aside from sea-based cruise missiles, NATO can really only bring to bear long-range missiles based in the continental United States, or airpower based in the United States or Western Europe. Other than that, the Alliance has relatively few conventional military options available within the Baltic theatre. Beyond what local militaries can provide, NATO has four multinational battalions spread out across the three Baltic countries and Poland, in addition to an embryonic missile defence architecture. Thus, a major gap exists in NATO's military options, so that it cannot respond appropriately and commensurably to Russian aggression. Second, drawing on airpower to help relieve the Baltic countries in case of attack assumes that air reinforcements based in Western Europe could get into theatre. They may, but at potentially significant cost or delay, due to the need to first suppress air defences to an acceptable level. And at least Western European militaries may hesitate to use airpower under such circumstances.

Second, current deterrence measures have largely been premised on "contact warfare" with Russia. Shortly after Crimea, the United States began to pre-position military hardware in the region for possible use by ground forces in some future contingency. Following the 2016 Warsaw Summit, NATO countries agreed to create the enhanced Forward Presence (eFP), deploying – as mentioned above – a multinational battalion-sized battlegroup to each of the Baltic countries and Poland. The United States also rotates an armoured brigade combat team and additional forces in Poland while pouring money into various infrastructural projects aimed at improving logistical links between local allies. Yet some critics argue that such measures are too tethered to land. As Michael Kofman writes, "proposing to engage Russian forces in contact warfare, a metal-on-metal ground fight, is not a good strategy. Russia holds a lot of advantages in land warfare near its borders. This plan does not hold at risk what Russia values, and misses

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https://warontherocks.com/2017/09/the-myth-of-russias-lowered-nuclear-threshold/; and Katarzyna Zysk, "Escalation and Nuclear Weapons in Russia's Military Strategy," *RUSI Journal* 163, no. 2 (2018): 4–15.

[294] Alexander Lanoszka and Michael A. Hunzeker, "Confronting the Anti-access/Area Denial and Precision Strike Challenge in the Baltic Region," *RUSI Journal* 161, no. 5 (2016): 12–18.

important changes in how Moscow sees the character of modern warfare."[295] Though Kofman misses the assurance value that ground forces can have for allies that host them, in the way that they can provide skin in the game, his critique highlights more key gaps in NATO's deterrence posture.[296]

Conventional theatre-range missiles can complement the NATO ground presence in northeastern Europe in several ways. To begin with, in the words of a recent report, "ground-launched theatre-range missiles could hold high-value enemy targets at risk while helping US air and naval forces obtain access to hotly contested battlefields, thereby contributing to military operations in challenging warfighting scenarios."[297] The operational implications are twofold in the Baltic region. One is that, in the opening phases of a military confrontation, theatre-range missiles can strike at air defence systems located in Kaliningrad and other such missile hubs in Russia's Western Military District. Doing so would allow reinforcements to have more freedom of manoeuvre. Another is that local allies – especially the Baltic states – will not be forced to exhaust their combat power quickly by trying to burst A2/AD bubbles from within. Surface-to-ship missiles, for example, can also punch a hole in any blockade that Russia might try to impose on a Baltic city from the sea. To be sure, we do not advocate that NATO should replicate the Western Military District on the shores of the Baltic Sea, whether with regard to the missile balance or otherwise. Rather, we believe that NATO should deploy just enough missiles that can hold at risk those Russian military assets that could complicate NATO operations and its reinforcement strategy.[298]

Theatre-range missiles also have a useful role to play for the strategic competition presently unfolding between the United States and Russia. The biggest worry revolving around the eFP battlegroups is their impermanent nature. Russia will always be in west of the Urals and so may be biding its time for complacency to develop with NATO's ranks. It could simply wait out the eFP deployments at low cost. However, NATO's deployment of theatre range, ground-launched missiles in northeastern Europe could pressure Russia to invest in costly missile defence and targeting systems, rather than power projection capabilities.[299] This would both help redress the current strategic balance (i.e., by forcing Russia to rebalance from an offensive-dominant strategy towards a more defensive one) and also impose financial costs on Moscow; thus increasing US-NATO bargaining leverage

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[295] Michael Kofman, "Permanently Stationing US Forces in Poland is a Bad Idea But One Worth Debating," War on the Rocks, October 12, 2018, https://warontherocks.com/2018/10/permanently-stationing-u-s-forces-in-poland-is-a-bad-idea-but-one-worth-debating/.

[296] See Michael A. Hunzeker and Alexander Lanoszka, "Landpower and American Credibility," *Parameters* 45, no. 4 (2015–16), 17–26.

[297] Cohn et al., *Leveling the Playing Field*, ii.

[298] In this very vein, Finland has already been thinking about how long-range precision munitions may complicate Russian planning and decisionmaking. See Robin Häggblom's contribution to this volume.

[299] Cohn et al., *Leveling the Playing Field*, p. 21.

in future arms control talks. Indeed, at present, NATO cannot make any concession in the Baltic space with Russia, and so needs to create leverage.

Rebutting Arguments Against New Theatre-Range Missile Deployments

We anticipate several criticisms of our argument. One is that missiles undermine strategic stability and will only worsen relations with Russia, thereby intensifying an arms race that will further jeopardise European security. The second is that new missile deployments will damage NATO cohesion, when it is already under much duress.

Consider, first, the view that missiles would undermine strategic stability.[300] We argue that this concern is misplaced. According to Thomas Schelling and Morton Halperin's formulation, strategic stability is a situation in which neither side has the ability to launch a disarming first strike against the other.[301] This fear of attack can be especially dangerous if war seems likely. However, many analysts worry about Russian intentions precisely because Russia might have the ability to launch such an attack on those NATO members located on the Alliance's northeastern flank. Even if Russia may not go so far as launching such an attack, its suite of missile capabilities could give a sanctuary for mischief and give it the confidence to behave aggressively at levels that would not trigger Article 5.[302] Far from granting NATO the ability to launch a bolt-out-of-the-blue strike, missiles would complicate Russia's ability to undertake *faits accomplis* by creating new sources of risks and expanding the set of liabilities that Russia would have. Indeed, conventional missiles will not dramatically affect the nuclear balance, if at all. One 2019 estimate holds that, "Russia has a stockpile of roughly 4,490 nuclear warheads assigned for use by long-range strategic launchers and shorter-range tactical nuclear forces," in addition to having over 1,800 warheads assigned to non-strategic and defensive forces.[303] Theatre-range missiles could even enhance strategic stability because the latter ensures mutual vulnerability – something that arms control advocates endorse. Russian missiles are already enveloping large swaths of NATO territory within their ranges, whereas theatre-range missiles would simply level the playing field.

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[300] See, for example, Tom Countryman and Kingston Reif, "Intermediate-Range Missiles are the Wrong Weapons for Today's Security Challenges," War on the Rocks, August 13, 2019, https://warontherocks.com/2019/08/intermediate-range-missiles-are-the-wrong-weapon-for-todays-security-challenges/.

[301] Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (New York: The Twentieth Century Fund, 1961): 9.

[302] See Alexander Lanoszka, "Russian Hybrid Warfare and Extended Deterrence in Eastern Europe," *International Affairs* 92, no. 1 (2016): 175-195.

[303] Hans M. Kristensen and Matt Korda, "Russian Nuclear Forces, 2019," *Bulletin of the Atomic Scientists* 75, no. 2 (2019): 73-74.

Some critics may similarly worry that an arms race would be destabilising. Yet Russia is already building up its military. It may be largely for defensive purposes, but NATO defence planners cannot be certain of Russia's having good intentions in light of its recent behaviour. Still, arms races are an inherent feature of strategic competition, in that one party's refusal to counter a move gives the other party an edge, thereby endangering strategic stability.[304] Accordingly, NATO's failure to respond to Russia's INF violation could lead to instability in the European system, and endanger the security of Eastern European states. Moreover, a decisive – and still proportional – response on the part of NATO could in fact help get us to an arms control agreement, because of the added pressure on Russia. As indicated, one reason why the Soviet Union agreed to the INF Treaty was because the United States and its NATO allies had leverage over it. Accepting an unfavourable missile balance deprives NATO of even attempting to recover that lost leverage, while making arms control agreements tantamount to unilateral disarmament.

The second objection that critics raise is that new missile deployments would damage NATO cohesion at a time when it is already under major duress from within. With President Donald Trump exhibiting an aversion to NATO amid an intense dispute over collective burden-sharing, NATO can ill afford another controversy. The reasoning here is that new missile deployments will be controversial, because even front-line allies will not want them and might in fact resist them, while those less concerned by Russia would fear being dragged into a war that they do not want to fight. Even though some front-line allies like Poland might be reluctant to accept missile deployments initially, they might also feel that they need to accept missiles in order to enhance deterrence of Russia. Missiles could bolster US security commitments. After all, an ally cannot complain of being vulnerable to Russian attack while rejecting measures that would help reduce that very vulnerability. To do so may lead the United States to doubt the sincerity of the threat assessments that the ally claims to have. Still, threat perceptions within NATO do vary. Not every member considers Russia to be its main threat. Some might even value its cooperation and so would reject measures that could be seen as provocative. But blaming missiles for any intra-alliance discord would put the cart before the horse since divergent threat perceptions already exist. Alliance cohesion would still unravel if certain members felt that they were unable to get strong security guarantees and must remain vulnerable because the sensibilities of other allies would be otherwise offended. Simply put, Russian missiles – and more broadly, different attitudes to Russia – are what drive disagreements within NATO, rather than US missiles.

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[304] See, e.g., Bradford Lee, "Strategic Interaction: Theory and History for Practitioners,'" in *Competitive Strategies for the 21st Century: Theory, History and Practice*, ed. Thomas G. Mahnken, 28–46 (Stanford: Stanford University Press, 2012).

Conclusion

The demise of the INF Treaty and Russia's ongoing investment in theatre-range missiles represent a threat to deterrence in Europe. More specifically, theatre-range missiles strengthen Russia's A2/AD strategy, and can help convene the perception that Moscow enjoys local escalation dominance in northeastern Europe. In order to redress that situation, we argue that NATO should deploy theatre-range, ground-based conventional missiles in the Baltic region. This would set the foundations for achieving strategic stability between NATO and Russia in a post-INF context. Moreover, and given Russia's violation of INF, the deployment of theatre-range missiles in Europe would give the Alliance the security and leverage to drive Moscow back into arms control talks.

The deployment of theatre-range missiles in the Baltic region should be limited and proportional. Further research should focus on questions related to what kind of posture would provide an adequate balance between restoring stability and avoiding an escalation spiral; the specific mix of defensive and offensive missile capabilities; and transatlantic burden sharing, including what is the appropriate contribution of the European allies when it comes to redressing the missile imbalance in the Baltic region.

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10. Missiles Are Not the Only Threat

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It is normal for discussions about anti-access/area denial, A2/AD, to focus on the threat of missiles, their ranges and capabilities, and how to counter them. But this is only part of the challenge posed to military mobility by states like Russia; and in fact, launching missiles is the least likely means of preventing movement that Russia could employ.

Russia has a wide range of other means of preventing movement into or within an area of potential or current conflict. Whether referred to by any of their current names – political warfare, or sub- threshold operations, grey zone or hybrid – any of the methods that Russia could employ that do not involve open and undeniable hostilities will be encountered well before the first missile is fired. Russia will use these measures first because they are less costly, less risky, and certainly less escalatory than any of the more high-profile methods normally considered under the heading of A2/AD; up to and including the laying of mines at sea, another area of threat at present entirely eclipsed by the intense focus on missile capabilities.

This chapter therefore considers the range of measures that Russia could employ against plans for national and operational military movement, reception, staging, onward movement, and integration that do *not* involve missiles, mines, or other munitions.[305]

A Pervasive Challenge

Russia is still investing heavily in developing its military capabilities with the aim of prevailing in high-end high-intensity warfare when confronted with the overall conventional superiority of the West as a whole – ideally in a conflict that is limited in time and scope in order that the full force of that superiority is not brought to bear. Nevertheless, this does not mean that Russia has abandoned the search for asymmetric measures that would make that Western conventional superiority, and the exquisite technologies on which it is partly based, irrelevant. When compared with direct military action, these asymmetric approaches have a number of distinguishing features. They present a threat that spans all levels, from strategic through operational to tactical. They are by their nature deniable, whether plausibly or implausibly – a distinction that is of demonstrably little importance to

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[305] In this context, "national military movement" refers to the movement of forces on home territory from their home base to the point of embarkation, and "operational" to movement through host nations from the point of debarkation to the area of operations. See discussion in Eva Hagström Frisell, Robert Dalsjö, Jakob Gustafsson, and John Rydqvist, *Deterrence by Reinforcement: The Strengths and Weaknesses of NATO's Evolving Defence Strategy*, ed. Eva Hagström Frisell, report, FOI-R--4843--SE (Stockholm: FOI, November 2019), 11.

Russia. And they can be deployed at any time, including pre-emptively, without waiting for the commencement of open hostilities.

At the time of writing, the challenges at the strategic level have recently been clearly illustrated by statements and actions by North Atlantic Treaty Organization (NATO) leaders in the period preceding the London NATO "non-summit," in December 2019. While the danger to NATO of impetuous decisions by US President Donald Trump had long been recognised, in late 2019 competitors emerged, in the form of French President Emmanuel Macron and Turkish President Recep Tayyip Erdoğan, for the title of who could make the most alarming statement calling NATO unity, and unity of purpose, into doubt. In addition, the danger was more pronounced and specific than previously. Instead of mere threats of upheaval to NATO by President Trump based on insistence that the United States should contribute less to European security in relative terms, late 2019 saw an alarming demonstration of the danger posed to friends and allies by actual Trump decisions. The US withdrawal from northeast Syria, implemented at zero notice, with no consultation, and in direct contradiction of the stated plans and priorities of the US Department of Defense and armed forces, set a highly alarming precedent for allies that might rely on American support in time of crisis. It demonstrated that while the good intentions and value placed on alliance solidarity by the US defence and foreign policy establishment as a whole remain strong, they are nevertheless hostage to snap decisions by the commander-in-chief. Meanwhile, Turkey was developing a policy line of opposing the ratification of plans by NATO to defend frontline states in the Baltic. At the last minute, Turkey was dissuaded from doing so, in return for incentives to do so that at the time of writing remain undisclosed.[306]

In each of these cases, as with the disturbing spectacle of President Macron repeating lines on NATO that perfectly match Russian state narratives, it may not necessarily be that this results from Russian influence. Nevertheless, each case serves the interests of Russia far more than it does those of each national leader's notional allies, and demonstrates the potential that could be achieved by Russia's exerting influence or pressure on key leaders, including through techniques of reflexive control.[307] *If national leaders can be induced to issue legitimate orders to stop military movement, this is a far more effective means of doing so than carrying out missile attacks*.

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[306] "Turkey Drops Block on Defence Plan for Baltics – NATO Chief," *Reuters*, December 4, 2019, https://www.reuters.com/article/nato-summit-turkey/turkey-drops-block-on-defence-plan-for-baltics-nato-chief-idUSL9N26V03R.

[307] Keir Giles, Anthony Seaboyer, and James Sherr, "Russian Reflexive Control," Defence Research and Development Canada, October 2018, https://www.researchgate.net/publication/328562833_Russian_Reflexive_Control.

At the other end of the spectrum, potential adversaries of Russia need to consider the range of levers available to Moscow at the tactical level to interfere with the movements of men and materiel. These levers include not just organised state agencies, including the intelligence services and Spetsnaz of varying flavours and degrees of sophistication that could carry out active measures or sabotage, or even private military companies and proxies.[308] They also include a range of arm's-length and non-governmental organisations whose links with the Russian state are fully or partially deniable, such as:

- oligarchs funding and sponsoring political subversion operations and providing both a duplicate chain of command and direct economic leverage;
- cyber-criminal organisations, enjoying a symbiotic relationship with Russian security agencies and acting as proxies and contractors, which could turn their hostile attention to critical logistics functions;
- state-controlled commercial entities, such as the Night Wolves (a multinational corporation masquerading as a motorcycle gang), which was observed carrying out a blockading function before and during the Russian military intervention in Crimea;[309]
- a variety of organisations promoting the rights of "compatriots" and ethnic Russians living abroad, and which seek to co-opt their efforts on behalf of the Russian state – which could potentially extend to attempting to mobilise them for demonstrations, protests, or blockades;
- legitimate means of exerting economic or logistical pressure on adversaries, including ownership of private sector logistics chains, via willing proxies in the target nation;
- infiltration of private sector logistics entities by Russian or Russian-sympathising employees, with instructions to carry out specific actions in time of crisis;
- organised crime, with its transnational reach into various sectors of the economy;
- agents of influence in the target country, supporting Moscow and seeking to influence and carry out policy in Russia's favour, either because they are paid or induced to do so, or out of their own convictions (the "useful idiots").

Taken together, challenges of this nature point to a gap in the joint defence of Europe. This gap arises because, while the joint military defence of Europe is the purview of NATO (or, for non-member states, surrogate organisations and

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[308] Keir Giles and Valeriy Akimenko, "Use and Utility of Russia's Private Military Companies," *Journal of Future Conflict*, Issue 01 (2019), https://www.queensu.ca/psychology/research/journal-future-conflict/journal-future-conflict-issue-01-fall-2019.

[309] Matthew A. Lauder, "'Wolves of the Russian Spring': An Examination of the Night Wolves as a Proxy for the Russian Government," *Canadian Military Journal* 18, no. 3 (2018): 5–16.

coalitions of the willing such as the Joint Expeditionary Force, JEF), non-military defensive functions – such as good governance, financial integrity, counter-subversion activities, counter-intelligence in critical national infrastructure and logistics, and the integrity and resilience of civil society – remain the task of individual states, with no effective supranational mechanism for pooling and coordinating efforts. In theory, these functions should be in the purview of the European Union (EU). But resistance to Russian political warfare at present consists of national measures of widely varying effectiveness and commitment, undertaken in some cases despite, not because of, Brussels; while the consensus nature of the EU leads to the lowest common denominator response, which can effectively equate to no response at all.[310]

Non-kinetic actions against civilian targets may not be a military responsibility, but they are certainly a military problem, because they entail direct military consequences. In the case of A2/AD, dealing with missiles is the task of national militaries, which especially in the Nordic-Baltic region are already alert to the challenge. But dealing with non-kinetic A2/AD means defence against everything else; against the full range of means that would be either plausibly or implausibly deniable by Russia and hence do not automatically and unarguably signify open hostilities.

The remainder of this chapter therefore considers specific examples of ways in which Russia could interfere with military movement in Europe without necessarily triggering a military response from the target country or its allies. Each of these distinct options could be applied either in isolation, or (more likely) in combination, to present severe challenges for timely force projection. It should be remembered in each case that while not all Russian covert actions against its adversaries are successful, for Moscow to achieve its aims the measures it undertakes need not be elegant or efficient to be effective.

Subversion

As noted above, the most effective way of preventing movement by the armed forces of a given country is through causing a legitimate order to be given by the country's own chain of command or political leadership. It follows that political influence through subversion should be considered a key vulnerability to Russian activities. In fact, viewed through the prism of non-kinetic A2/AD, Russia's entire foreign policy could be seen as devised in large measure to hamper freedom of manoeuvre or even deny access to whole countries or even regions for powers or blocs deemed hostile to the Kremlin. The apparent power and reach of Russian information warfare techniques presents a substantial risk at crisis points,

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[310] Mark Galeotti, "Living in Different Worlds: The European Union and Russian Political War," MC Series: Security Insights no. 39, September 2019, https://www.marshallcenter.org/mcpublicweb/en/nav-fix-sec-insights/2790-art-pubs-sec-insights-39-full-en.html.

especially if Russia chooses to deploy capabilities known to be held in reserve in order to foment opposition and obstruction to troop movements among local populations and governments.

Russia could affect reinforcement efforts in northern Europe by targeting states even outside the immediate locality for political subversion; indirect effect can be achieved by subverting political processes in countries far from the target area. Delivery of reinforcements to the scene of a crisis in the Baltic Sea region depends on mitigating a long chain of vulnerabilities stretching back through multiple countries.[311] Among these, some states (such as the front-line states and the Nordic nations) may have a well-developed perception of the threat and be taking steps to reduce it; but certainly not all.

In the United States, although the most visible and alarming risk to commitments to the defence of Europe is that of impetuous decisions by President Donald Trump (whether under Russian influence or not), this is not the only challenge. Russia could seek other means of inducing the US to constrain its response in the European theatre and undercut US domestic support for vigorous American participation. Through traditional media outlets and a broad-based social media campaign, Russia can reach out to anti-war or isolationist elements inside the United States. Subversive messaging could emphasise the narrative that European countries are shirking their own defence responsibilities, further develop support for US politicians who share ideological sympathies (for instance transnational isolationist and nativist agendas) with Moscow, and suggest that Europe's security is not worth American blood. Russia might hope that these low-cost, plausibly deniable efforts could be sufficient for the US to place caveats on the movements or actions of its forces in Europe.

In most scenarios of confrontation in northeastern Europe, Germany plays a key role as a transit country and logistics enabler. Russia could seek to neutralise Germany in this role through a combination of diplomatic and economic measures, targeting of influential individuals, and a propaganda campaign aimed at government and public opinion. Friends of Russia would be employed to propagate a narrative supportive of Russia's actions in a crisis, together with assurances that Germany itself is under no military threat. The result could be civil society or even elements of the German state or federal governments raising questions about the movement of US personnel and defence materiel across its territory. These questions might not even be political or ethical in nature: if German national authorities could be induced to enforce with diligence the rules and regulations regarding customs clearance, transport of hazardous materials, protection of the environment, safety in the workplace, and all other considerations that are inimical to rapid movement of combat power, this in itself could severely

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[311] Frisell, Dalsjö, Gustafsson, and Rydqvist, *Deterrence by Reinforcement*.

compromise reinforcement efforts. Russia could further boost this effect by using disinformation channels to encourage mass demonstrations across the country, work stoppages, protests that block rail lines, and other actions.

The EU as a whole also presents a target. The confused delineation of responsibility between the EU and NATO in regard to security policy still risks being blurred further by the EU's determination to create armed forces under its command from already overstretched European military resources. At the same time, Russia can combine aggressive action in its neighbourhood with continued engagement with Russia-friendly elements within the EU's leadership. In time of crisis, these Russia-friendly elements could well be induced to demand restraint from NATO and the US, including holding back from delivering reinforcements to the front-line states.

Russian political interference, assisted by information warfare campaigns, can have aims as ambitious as a change in government or as modest as simple disruption and destabilisation. Action anywhere along this spectrum could be conducive to hindering the arrival or integration of reinforcements in a front-line state in time of crisis. An extreme case would be the political neutralisation of the host country. But other options, particularly in the case of countries with a direct border with Russia, include terrorist actions and insurgency campaigns, for political exploitation with the aim of keeping NATO, the United States, and other allies at arm's length.

In the Baltic states themselves, Russia could seek to replicate the tactics used in the early stages of the conflict in Ukraine, and stage protests by "activists" in order to prevent movement of local or foreign troops, with or without cooperation from the local Russian-speaking population.[312] Covert actions to discourage or impede friendly reinforcement could include staging protests and provocations organised near foreign forces' bases and transportation nodes, and efforts to engineer direct violent confrontation between visiting troops and protesting ethnic Russians. Sabotage, corruption, and instigation of civil protest to block railway lines could compel use of road transit, with consequent potential delays, increased dispersion and far greater vulnerability to further enemy action.

More assertive steps could include terrorist attacks against public gatherings (e.g., Estonians, Latvians, and Lithuanians welcoming the arrival of foreign forces), the NATO Force Integration Units (NFIUs), and bases where visiting forces would be deployed. The aim would be to constrain the activities of foreign troops and in particular their interaction with the local population, create the impression that they are unwelcome in the country, and directly interfere with the infrastructure and personnel needed to carry out reinforcement. All of the above would be accompanied by a disinformation campaign intended to create and exploit

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[312] Andrew Roth, "From Russia, 'Tourists' Stir the Protests," *New York Times*, March 3, 2014.

divisions between visiting troops, the local civilian population, the host government, and overseas allies, with the aim of persuading other states against deploying additional forces to the region on the grounds that sending reinforcements into the region would "inflame the situation" and "provoke Russia." Additional elements of disinformation for foreign consumption would, as seen in the case of Ukraine, seek to persuade Western Europeans that conflict in the Baltic states was civil or internal in nature, as opposed to the result of Russian intervention; and therefore NATO allies should not be involved. Further afield, anti-war demonstrations or blockades at key transport nodes or outside military storage facilities could compel friendly forces or local law enforcement agencies to use force in order to proceed, which would constitute a substantial propaganda opportunity for Russia and a potential domestic political crisis.[313]

Russia could be expected to combine information activities with direct action in other domains, such as economic pressure or in particular energy blockades, raising the prospect of what one senior European politician speaking under the Chatham House rule described as "the lights going off across Europe and all the spineless Europoliticians denying America access to the continent to save their positions of power and their heating." The long contest between the United States and Russia over the status of the Manas transit centre in Kyrgyzstan provides a case study of Russia's eventually successful mutually reinforcing use of a variety of levers in this manner to impede US logistical capability.[314]

In fact, Russia has a wide range of options for slowing, disrupting, or sabotaging the movement of reinforcements across Europe through economic and commercial means before resorting to hostilities. Road and rail transportation networks and hubs and the commercial entities that operate them can all be targeted through economic leverage, market manipulation or insider threat. This could include intervention to deny access to transportation or routes by for instance reducing the amount of rail rolling stock or port space available, or causing chokepoints in transportation networks through coordinated efforts to saturate key points with commercial cargo. Exploitation of the open nature of commercial logistics entities in Europe could include infiltration, recruitment or coercion of individuals in transport and logistics corporations to report on movements of personnel and materiel and disrupt this movement on demand,[315] or triggering or manufacturing

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[313] Precedents include the "peace camps" set up in the United Kingdom to protest against the deployment of ground-launched cruise missiles in the 1980s; and movements for conventional and nuclear disarmament that urged their members to collect and report information on military facilities and movements in their own country.

[314] "US Transit Center at Manas," NATO Stratcom CoE, June 6, 2019, https://www.stratcomcoe.org/hybrid-threats-us-transit-center-manas.

[315] "Russian spy is judged in Latvia," Baltvideo.com, June 12, 2017, http://baltvideo.com/en/latvia/russian-spy-is-judged-in-latvia.

labour unrest to shut down critical facilities or networks serving land, sea or air transport.

However, logistical challenges will not solely be the result of Russian intervention. Commercial developments in European rail transport since the end of the Cold War mean that there is no longer the guarantee of capacity to move reinforcements that was previously ensured by national governments. In addition, in a pre-crisis situation, reinforcements will not at present be afforded either priority access to rail transport or exemption from restrictive EU road regulations. Overall, one expert assessment holds that "a working hypothesis is that civilian capabilities would face substantial disruption in times of crisis and war. This would further restrict effective military mobility, and increase reinforcement times."[316]

Sabotage

Direct action in the form of physical sabotage is also likely both before and during open conflict, both on land and at sea through the entire depth of friendly territory, and whether carried out by special forces inserted covertly for the purpose or by long-term sleeper agents already in position.

On land, targets would include storage and transit locations, road and rail routes, and transport assets. Attacks on prepositioned military stocks intended to facilitate rapid reinforcement would seek to damage or destroy them in place, or prevent their movement. At sea, Russia could use a number of covert or deniable techniques to hamper navigation and impede and delay the arrival by sea of reinforcements and/or their heavy equipment.

- Key navigational aids such as lighthouses, buoys, and markers can be removed or put out of use.
- Port and harbour facilities, where military movements will already face severe capacity issues, can be sabotaged to complicate operations and movements.
- Short of an overt campaign of mining, stray sea mines can be covertly placed in shipping lanes. Russia could use a small number of mines of obsolete or foreign type to interdict traffic if deniability needs to be maintained.

These actions would meet several Russian strategic objectives:

- Discourage and delay the arrival of reinforcements by sea.
- Impede freedom of movement at sea overall.
- Cause NATO and partner nations to expend extra resources and time to secure shipping lanes and freedom of shipping.

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[316] Frisell, Dalsjö, Gustafsson, and Rydqvist, *Deterrence by Reinforcement*, 47.

- Gain time for Russia's own dispositions in the region.
- Block access to Baltic seaports of debarkation (SPODs).
- Create a more favourable maritime environment for Russian operations in the event of a transition to hostilities.

All of these methods would have the secondary effect of heightening the perceptions of vulnerability of the front-line states, while at the same time diminishing the impression of allied military capability and – crucially – *maximising the leverage of a key Russian advantage, namely Western aversion to risk.*

Sabotage can also be carried out remotely, in the form of cyberattacks on port, rail, logistics, or transit facilities.[317] The attacks can be against individual facilities or locations (as in 2013, when a group of hackers was able to close a major tunnel in Haifa, Israel)[318] or they can be against corporations and networks. The widespread disruption caused by the NotPetya virus to Maersk, the world's largest cargo-shipping company, in 2017, demonstrates the vulnerability of logistics chains to targeted cyberattack.[319] With shipments delayed by weeks, and cargo handlers temporarily resorting to pen and paper to log movements, the implications for urgent reinforcement measures are clear.

Furthermore, cyberattacks are unlikely to be conducted in isolation, but will more probably present just one of a number of simultaneous threats. The socio-cyberattacks on Estonia in May 2007 provide a case study of demonstrative cyber operations that cause more disruption than actual damage, but can be combined with instigation of social unrest to present more complex challenges to the target country.[320]

A related topic is A2/AD in cyberspace itself, where Russia has been intensively probing vulnerabilities in civilian telecommunications infrastructure in order to be able to interdict or impede communications, including over the internet, in time of crisis.[321] Denial of access to cyberspace for a targeted nation could include physical operations to inflict damage to vital information technology infrastructure, such as fibre-optic cables, servers, terrestrial communication lines,

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[317] Alison Lawlor Russell, "Strategic Anti-access/Area Denial in Cyberspace," NATO CCD CoE, 2015, 153–160, https://ccdcoe.org/uploads/2018/10/Art-11-Strategic-Anti-Access-Area-Denial-in-Cyberspace.pdf.

[318] Abby Ohlheiser, "Hackers Shut Down a Tunnel Road in Israel," *Atlantic*, October 2013.

[319] Andy Greenberg, "The Untold Story of NotPetya, the Most Devastating Cyberattack in History," *Wired*, August 22, 2018.

[320] Rain Ottis, "Analysis of the 2007 Cyber Attacks Against Estonia from the Information Warfare Perspective," NATO CCD CoE, 2018, 1–6, https://ccdcoe.org/uploads/2018/10/Ottis2008_AnalysisOf2007FromTheInformationWarfarePerspective.pdf.

[321] Keir Giles, "The Next Phase of Russian Information Warfare," NATO Strategic Communications Centre of Excellence, November 2015, https://www.academia.edu/31014519/The_Next_Phase_of_Russian_Information_Warfare.

wireless communication systems, antennas, telecommunication towers, and space infrastructure. The effect of communications failures on reinforcement efforts would be inability to coordinate movements with commercial logistics organisations or the host nation, and in some cases inability to navigate.

Counter-space Capabilities

This latter vulnerability is even more pronounced given the reliance of Western forces on overhead capabilities. As entire military land, aerospace, and maritime capabilities are heavily dependent on space-based communications, navigation, reconnaissance, and intelligence systems, they are vulnerable to a determined adversary that wishes to target those systems.[322]

Russia is pursuing a diverse suite of counter-space capabilities to damage or destroy satellites in all orbital regimes. Methods under development include ground-based kinetic attack, in-orbit rendezvous and proximity operations, and directed-energy applications (such as laser or jamming).[323] Non-physical counter-space capabilities include the use of laser, microwave, and electromagnetic pulse energy against space systems. Relevant electronic warfare (EW) capabilities involve interference, denial, and manipulation of radio frequencies operations against satellite and ground support systems.[324] At the juncture of the domains of space and cyber, cyber counter-space operations include capture, disruption, and denial operations against satellite systems through the utilisation of cyber capabilities and the exploitation of digital vulnerabilities.[325]

Satellite communications systems (SATCOM) are exposed to cyber intrusion and sabotage operations in a variety of threat scenarios.[326] SATCOM data links are a fundamental part of C5ISR (command, control, computers, communications, cyber, intelligence, surveillance and reconnaissance) military transportation, and especially aviation technology, where these data link systems are indispensable.

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[322] Northrop Grumman, "Assured Position, Navigation and Timing: The Future Challenge," 2019, 1, https://www.northropgrumman.com/Capabilities/AssuredPNT/Documents/NorthropGrumman-APNT.pdf.

[323] Leonard David, "China, Russia Advancing Anti-Satellite Technology, US Intelligence Chief Says," Space.com, May 18, 2017, https://www.space.com/36891-space-war-anti-satellite-weapon-development.html.

[324] Todd Harrison, Kaitlyn Johnson, and Thomas G. Roberts, "Space Threat Assessment 2018," Center for Strategic and International Studies, April 2018, 13, https://csis-prod.s3.amazonaws.com/s3fspublic/publication/180823_Harrison_ SpaceThreatAssessment_FULL _WEB. pdf.

[325] Rajeswari Pillai Rajagopalan, "Electronic and Cyber Warfare in Outer Space," UNIDIR, May 2019, 1–11, https://www.unidir.org/files/publications/pdfs/electronic-and-cyber-warfare-in-outer-space-en-784.pdf. See also Beyza Unal, "Cybersecurity of NATO's Space-based Strategic Assets," Chatham House, July 2019, https://www.chathamhouse.org/sites/default/files/2019-06-27-Space-Cybersecurity-2.pdf.

[326] Ruben Santamarta, "SATCOM Terminals: Hacking by Air, Sea, and Land," IOActive, 2014, https://www.blackhat. com/docs/us-14/materials/us-14-Santamarta-SATCOM-Terminals-Hacking-By-Air-Sea-And-Land-WP.pdf

Cyber vulnerabilities in satellite receiving stations also pose a risk to military transportation, as many operational services including weather data are distributed via ground station links.[327] Russia is known to have the capability to execute cyber operations against satellite systems, as was the case in 2015 when a Russia-linked cyber unit was able to successfully issue instructions, which appeared to come from its control server, to a commercial satellite.[328]

In the worst-case scenario, Russia would use both land- and space-based anti-satellite (ASAT) weapons systems to launch a mass attack on satellites, targeting the situational awareness of governments and military forces in Europe and elsewhere, potentially globally, and their ability to communicate, navigate, and target opposing forces.

- This process could begin with non-kinetic attacks on space systems. Jamming attacks on ISR and communication satellites may be difficult to attribute and are unlikely to provoke military escalation. These low-level attacks are reversible yet effective at degrading decision-quality information to leaders and their ability to command fielded forces.
- The next level of escalation in the battle of space systems would include regional jamming of global positioning system (GPS) and navigation systems. Disrupting commercial air and sea transportation, especially in critical choke points, is more likely to be attributable and lead to a public response, but not necessarily a military one.
- Escalating further would include more advanced attacks targeting military systems. This might include spoofing GPS in order to control remotely piloted aircraft or defeat precision-guided munitions. Direct attacks on targeting radars would also occur. Injecting false information favouring Russian objectives into audio and video transmissions could also be done at this point.
- The final stage would be to openly attack and permanently degrade space systems, beginning with directed energy attacks to degrade or destroy surveillance satellites. Kinetic attacks on the space segment could come from ground-based interceptors or co-orbital ASAT satellites. Destroying ground stations would also deliver the desired effects.

There are clear advantages for Russia in attacks on space systems; not only is Russia less reliant on them, but also degradation or destruction of space assets puts expeditionary forces at a severe disadvantage relative to forces who are already present in theatre and can use terrestrial systems.

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[327] Mike Gruss, "Report Cites Vulnerability in NOAA's Satellite Ground Stations," *Space News*, August 2014, https://spacenews.com/41685report-cites-vulnerability-in-noaas-satellite-ground-stations/.
[328] Sam Jones, "Russian Group Accused of Hacking Satellites," *Financial Times*, September 9, 2015.

Information Attacks

For Russia, both cyberattacks and physical attacks on information nodes such as satellites and their ground stations come under the broad heading of information warfare. This holistic concept is often subdivided into two categories: "information-technical" activities, including what Western militaries would refer to as computer network operations, but also other activities targeting data and its processing; and "information-psychological" activities that target the human cognitive domain, for example psychological operations, malign influence campaigns, deception, and propaganda. Each of these categories has A2/AD applications.

Information-technical

In addition to the cyber operations and attacks on space- or land-based navigation and telecommunications systems discussed above, information warfare activities launched by Russia could include EW operations designed to hamper communications, navigation (military and civilian), and targeting. This would create problems with military command, control, communications, and intelligence (C3I); sea and air transportation; troop movements; and military reinforcements. Whether brought about through counter-space capabilities or other means, information outages could be just as damaging as cyberattacks on infrastructure, if troops and equipment are moving blind, deaf, and unable to communicate.

Russia has shown the ability to jam radio and telecommunication frequencies with two distinct effects:

1. to deny access to cyberspace for wireless cellular receivers; and
2. to disable semi-autonomous weapon systems reliant on remote digital connection, such as drones, from operating within the effective distance of the jammer.[329]

In doing so, it is meeting its ambition to extend the scope of cyberspace information denial capabilities from closed internal systems to national level, affecting broad-scale geographic areas and entities.[330] Closing down internet and mobile communications would create severe challenges for the economy and day to day

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[329] Kelsey D. Atherton, "Russian Drones Can Jam Cellphones 60 Miles Away," C4ISRNET, November 2018, https://www.c4isrnet.com/newsletters/unmanned-systems/2018/11/16/russian-drones-can-jam-cell-phones-60-miles-away/.

[330] Martti J. Kari, *Russian Strategic Culture in Cyberspace: Theory of Strategic Culture – A Tool to Explain Russia's Cyber Threat Perception and Response to Cyber Threats*, JYU Dissertations 122 (Jyväskylä, Finland: Faculty of Information Technology, University of Jyväskylä, October 2019), 61–63, https://jyx. jyu.fi/bitstream/handle/123456789/65402/978-951-39-7837-2_vaitos_2019_10_11_jyx.pdf?sequence=4&isAllowed=y.

activity in a region where e-governance, and reliance on connectivity more generally, has greatly expanded.

Navigational systems, in particular GPS, are distinctly vulnerable to sub-threshold and partially deniable attack. Persistent and enduring shutdown of GPS across large areas of Europe before overt hostilities begin would meet several objectives. It would, for instance, complicate road movements and every other type of activity that depends on GPS. Navigation systems without multiple redundancies and fallback systems would be affected, as would millions of embedded systems. Military movements would be affected even if military navigational systems themselves were resilient; with civilian traffic reliant on GPS, chaos on road networks would be likely. Similarly in the air, while commercial air traffic would continue to be able to navigate due to redundancy of systems, general aviation with greater reliance on GPS would cause severe ATC and traffic management challenges, for instance by blundering into busy controlled airspace. In addition to the civilian chaos that would result, target nations would be presented with the challenge of how to respond to a form of attack with no evident countermeasures, either in a technical or legal sense.

Russia's capability to interfere in the operation of the global navigation satellite system has been demonstrated repeatedly. In October–November 2018, during NATO's Trident Juncture exercise in Norway, the Baltic Sea, and the North Atlantic, Norway's Ministry of Defence blamed Russia for the disruption of GPS systems, which, it said, endangered all air traffic in the region. Later, the Finnish Foreign Ministry announced that there was evidence of Russian interference, and demanded that Moscow cease all further such actions, which could lead to "undesirable incidents."[331] Russian efforts to protect its Khmeimim air base in Syria through GPS jamming and spoofing have also been blamed for GPS disruptions in Israel and as far away as Cyprus. Pilots flying throughout the Middle East first began to report GPS problems in the spring of 2018. The problem was initially limited to high-flying aircraft. In mid-2019, however, the signal began to affect take-offs and landings as far away as Tel Aviv's Ben Gurion International Airport. GPS disruptions have also been reported at Larnaca International Airport, in Cyprus, approximately 225 kilometres away, and the signal was so strong that it could even be picked up by sensors on the International Space Station.[332] One study logged nearly 10,000 instances of Russian interference with GPS services, and found that a total of 1,311 ships in Russian waters had had to correct their

[331] Aleksandr Gostev, "'Мишки' на Севере. Был ли российский спецназ на Шпицбергене" ['Little Bears' in the North: Was there a Russian Spetsnaz force on Spitsbergen?], Radio Svoboda (Radio Liberty), October 2, 2019, https://www.svoboda.org/a/30195704.html.

[332] Kyle Mizokami, "Russia Is Disrupting GPS Signals and It's Spilling into Israel," *Popular Mechanics*, July 1, 2019, https://www.popularmechanics.com/military/weapons/a28250133/russia-gps-signals-israel/.

course because GPS signals were being spoofed and were unreliable.[333] Russia would be able to extend the already substantial range of its EW capabilities in peacetime by, for example, placing EW systems on vessels on scheduled transits between St Petersburg and Kaliningrad.

Use by Russia of EW assets to interdict navigation and communications services would have the following effects:

- to hamper movement of military units and cargo;
- to impede air and sea navigation on the approaches to ports of debarkation;
- to hamper communications and therefore joint operations between Allies.

To date, Russia's interference with navigational aids has been relatively overt. However, if Russia wished to create even greater confusion through frustration of attribution, far more deniable options for disrupting civilian traffic are available, as demonstrated by experiments spoofing traffic bottlenecks in navigation software via use of a collection of slow-moving smartphones.[334]

Information-psychological

The paralysis thus induced would be capitalised on by other measures, including, for example, information warfare strategies to emphasise the helplessness of NATO and the defencelessness of the Baltic States. The aim of such an information warfare campaign would be to reduce public and government support in the United States for sending further reinforcements to the region, and among European NATO members for allowing their transit.

At a more localised level, Russia could undertake targeted information attacks intended to slow or prevent movement – for instance, triggering shutdowns or evacuations of transit points through terror scares, blocking traffic with refugees, stirring labour unrest through social media efforts, or reducing transit capacity through real or fictitious contamination of cargo and handling facilities. Any credible threat of hazardous contamination of a port or airport, up to and including the reported presence of a "dirty bomb," could significantly slow or disrupt normal operations by forcing port and transport authorities to verify reports and put additional security measures in place.

On an even more personalised scale, Russia has practised and refined its techniques for undertaking information activities against individuals, including delivering disinformation to the mobile devices of military personnel as well as

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[333] BBC News, "Study Maps 'Extensive Russian GPS Spoofing,'" April 2, 2019, https://www.bbc.co.uk/news/technology-47786248.

[334] Brian Barrett, "An Artist Used 99 Phones to Fake a Google Maps Traffic Jam," *Wired*, February 3, 2020, https://www.wired.com/story/99-phones-fake-google-maps-traffic-jam/.

targeting them through their families.[335] While the effectiveness of these measures remains undetermined, Russia claims that they have had substantial effect in Syria, and they have since been used against frontline military personnel in Ukraine.[336] Individual information exposure of individuals on social media has been demonstrated to be a key enabler for tracking military movements, and consequently for interdicting them;[337] there is at least one instance, from Israel in 2010, of an injudicious social media post causing the cancellation of an entire military operation.[338]

Intimidation

A campaign intended to deter and intimidate Western political leaders and populations could include military movements, activities, and threats short of actual use of force. Provocative behaviours from the staging of deliberately reckless close encounters across the domains, including in the air, at sea, on the ground, and in other environments such as cyber and electromagnetic, all the way up to nuclear threats, could substantially augment Russia's current broad-based campaign to persuade Western leaders that sending reinforcements into a given region is dangerous and provocative, with potential consequences including widespread and uncontrollable escalation.

One means by which Russia could attempt to intimidate Western powers into inaction in a period of escalating tensions and prior to the commencement of overt hostilities would be to declare an "Air and Sea Self-Protection Zone" covering areas of the eastern Baltic from Kaliningrad north to the Gulf of Finland, and state that movements by US and NATO naval and air assets into this zone would be considered hostile acts and constitute grounds for use of force. Russia could deploy a broad diplomatic and information warfare campaign targeting public opinion and policymakers across NATO members and partners, highlighting that challenging this exclusion zone would be an escalatory move by the US. At the same time, it could demonstratively deploy or put on high alert a range of interdiction capabilities intended to convince politicians that an attempt to force the issue would be costly and potentially fruitless. A key part of this effort would be leveraging Western misconceptions about Russian A2/AD capabilities, and using the plethora of infographics available from previous studies on A2/AD, including from official Western government sources, showing neat circles on maps to

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[335] "Time to Shed More Light on Russian Harassment of NATO Forces' Families," Chatham House, August 14, 2019, https://www.chathamhouse.org/expert/comment/time-shed-more-light-russian-harassment-nato-forces-families.

[336] Keir Giles, "Assessing Russia's Reorganised and Rearmed Military," Carnegie, 2017, 7, https://carnegieendowment.org/files/5.4.2017_Keir_Giles_RussiaMilitary.pdf.

[337] Issie Lapowsky, "NATO Group Catfished Soldiers to Prove a Point About Privacy," *Wired*, February 18, 2019, https://www.wired.com/story/nato-stratcom-catfished-soldiers-social-media/.

[338] BBC News, "Israeli Military 'Unfriends' Soldier After Facebook Leak," March 4, 2010, http://news.bbc.co.uk/ 2/hi/8549099.stm.

suggest that areas within Russian missile coverage are impregnable.[339] Russia could not only declare the area "out of bounds," but also make navigation there challenging through use of electronic warfare systems targeting communications and navigational aids across the region. While NATO pondered its options and attempted to prompt national governments into making a decision, Russia could use the window of opportunity to take any one of a range of actions in the region without the immediate risk of NATO intervention.

Alternative means of preventing movement into an area of the Baltic Sea could include the declaration of temporary exclusion zones for military exercises, including live firing, as has been repeatedly practised in the Black Sea; or an ultimatum to an individual national government to allow short-term freedom of movement or transit to Russian forces, especially by air, without opposing them. The latter approach would take advantage of the massive disparity in locally available air power between the Baltic states and Russia, and could attempt to frame the ultimatum in a manner politically palatable to the target nation's friends and allies, in order to buy the few hours necessary to present the world with a *fait accompli*.[340]

NATO partners Sweden and Finland present a special case for Russian attempts at intimidation, given their role both as non-members, but also as critically important to effective measures by NATO to defend the Baltic states. Russia can be expected to combine diplomatic and soft power efforts with military intimidation to convince Sweden and Finland not to provide logistical support to NATO or grant access to their territory, airspace, or waters. This would involve diplomatic approaches, military-to-military communications, and broader messaging targeting the publics in both countries, warning that any material support to NATO or the United States would make Sweden and Finland a party to the crisis and bring major risks. While pursuing diplomatic options, Russia would also emphasise the possibility of a pre-emptive military strike.

In addition to the tactical and operational levels of A2/AD activities against the movement of NATO assets and information outlined above, strategic-political influence also has A2/AD potential if it causes the decisionmaking systems of NATO member states and partner nations to be affected. One potential example is opposition to the Host Nation Support Memorandum of Understanding, signed by both Sweden and Finland, to provide a legal framework for the enhancement of

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[339] As discussed in Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *Parameters* 49, nos. 1–2 (2019): 21–36. See, also, Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble: Russian A2/AD in the Baltic Sea Region – Capabilities, Countermeasures, and Implications*, report, FOI-R--4651--SE (Stockholm: FOI, March 2019).

[340] This would follow a pattern set by Operation GATLING, in 1978, where Rhodesia utilised all of these elements for a highly successful operation on Zambian territory. Audio recording of the polite conversation between the Rhodesian Air Force delivering the ultimatum and Zambian air traffic control is available at https://www.youtube.com/watch?v=z0ft w4bQq6g.

logistical efforts and deployment of forces of a third-party nation in the event of a military conflict.[341] The Host Nation Support agreement has been under constant indirect information pressure on Russia's behalf via its political proxy groups in Finland, which support "alternative" ideologies, anti-immigration themes, and the strategic isolation policies for Finland,[342] and this pressure can be expected to intensify radically in time of crisis. Russia could also use leaks of documents (real or fabricated) related to US military cooperation with Helsinki and Stockholm in order to generate public debate about whether the governments have been honest about such cooperation, and distract attention from Russia's own actions.

Diplomatic approaches could be coordinated with military moves to demonstrate Russia's intent while attempting – not necessarily successfully – to stop short of measures that would swing Sweden and Finland to anti-Russian positions. In public messaging, Russia would step up attempts to exploit local sympathetic figures and agents of influence ready to argue in favour of positions that ultimately benefit Russia's interests.

It should be noted that previous intensive campaigns to sway public opinion in Sweden and Finland – most notably on the topic of potential or possible NATO membership – have as a rule been counter-productive, serving only to highlight the nature of the threat from Moscow. Successful campaigning would therefore require an increase in sophistication, and in particular in awareness and understanding of the target audience. Meanwhile, however, Russia could also seek to leverage potentially sympathetic voices in other EU member states in order to prevent a strong EU position in support of NATO's and the United States' actions. By thwarting EU consensus, Russia could negate the possibility of the Lisbon Treaty's solidarity clause being invoked, thus eliminating a mechanism of support for Sweden and Finland.

Detection

If Russia were to undertake any of these forms of hostile action, it is to be expected that it would deny doing so. These denials might well be implausible, but positive attribution by Western nations to a standard that will satisfy their domestic populations takes time; and in almost all cases where Russia is carrying out this kind of activity, its primary purpose is precisely to buy time for Russia to achieve

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[341] Juha Pyykönen, *Nordic Partners of NATO: How Similar Are Finland and Sweden within NATO Cooperation?* FIIA Report 48 (Helsinki: Finnish Institute of International Affairs, 2016), 93–95, https://www.fiia.fi/wp-content/uploads/ 2017/04/report48_finland_sweden_nato.pdf.

[342] Daniel Sallamaa, *Ulkoparlamentaarinen äärioikeistoliikehdintä ja maahanmuuttovastaisuus 2010-luvun Suomessa*, report, Publications of the Faculty of Social Sciences 97 (Helsinki: Centre for European Studies, University of Helsinki, 2018), 27–28, https://helda.helsinki.fi/bitstream/handle/10138/253474/Raportti-Sallamaa.pdf?sequence=1&isAllowed=y.

its objectives with minimal opposition. Thus, even temporary obfuscation by Moscow may be effective in meeting Russia's overall goals.

It follows that early detection, and methods for clear attribution, of the kinds of measures described above are a key capability. Target nations need an appropriate level of vigilance to intercept preparations for active measures like sabotage, as well as robust physical, commercial, cyber, and personnel security. There is a parallel with early detection of attempts at radical Islamic terrorism: Western police and security agencies have some successes as well as some failures at pre-empting attacks through effective intelligence work. However, the challenge from Russia is far more profound. Domestic terrorists may be determined and unscrupulous, but they are not as a rule professional and highly-trained intelligence or special forces personnel fully supported by the resources of a nation state, as would be the case with attacks from Russia.

The experience of confirmed or possible sub-threshold attacks in northern Europe suggests that a key question is how a victim can identify for sure what is happening. Especially if there is an effort to maintain deniability and frustrate attribution, at a low intensity of activity it might even be difficult for the victim to know that it is under attack.[343] A key task is to determine what combination of unexplained incidents – "things going wrong" – would indicate a coordinated assault; to take an example from late November 2019, whether a major outage of e-government services is the result of a cyberattack by a hostile power, or of rats chewing through cables.[344] An additional complication is that socio-political threats, such as successful subversion, could develop from the convergence of a number of already existing social, technical, or economic problems. Such threats are then exploited by an adversary – without having been necessarily planned, masterminded, or coordinated ab initio.

Key indicators would probably comprise a mixture of the traditional and the novel. Traditional warning signs would include the arrival in the country, or in a specific region, of meaningful numbers of a specific type of visitor from an adversary country; or civil discontent or protest turning into a staged confrontation; or a sudden or escalating pattern of sabotage. More novel indicators would include promotion of a specific narrative by Russia's disinformation media and channels, preparing the ground for a specific campaign of subversion or destabilisation. In either case, there is no substitute for well-developed situational awareness by the target nation across all domains.

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[343] Patrick J. Cullen and Erik Reichborn-Kjennerud, "MCDC Countering Hybrid Warfare Project: Understanding Hybrid Warfare," MCDC, January 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647776/dar_mcdc_hybrid_warfare.pdf.

[344] "E-services Inaccessible After Rats Chew Through Wires," ERR, November 21, 2019, https://news.err.ee/1005241/e-services-inaccessible-after-rats-chew-through-wires.

Recommendations

As noted earlier in this paper, it should not be assumed that if Russia attempts any or all of these measures they will necessarily be successful. But in addition to the key advantage that Russian interventions need not be elegant to be effective, Moscow also benefits from two important force multipliers: the ability to take and implement decisions rapidly when required; and lack of restraint or compunction in causing collateral damage. These three considerations together substantially broaden the range of possible actions that are available to Russia. In a time of confrontation, therefore, the Baltic Sea region and its approaches could be subjected to a mess of coordinated and uncoordinated Russian actions in the physical, informational, political, and economic domains and more: some would be ineffective, while others would be in conflict with or impede each other, but all would be intended to buy time for Russia to achieve its overarching strategic aims.

The key lesson from the vulnerabilities described above is that approaches to mitigating Russian A2/AD should not be limited to military posture and conventional defence capabilities, but also extend to bolstering whole-of-government resilience in relevant fields, including improving situational awareness and hardening logistics chains. The challenge extends beyond purely military implications such as impeding freedom of movement and reinforcement of friends and allies in time of conflict, and into the foreign policy domain, with the necessity of close cooperation on politically challenging issues with partners and allies, not all of whom are fully cognisant of the threat. But the current focus on only conventional capabilities risks leaving Western armed forces blind-sided by the spectrum of unconventional means that Russia could use to impede or prevent their freedom of movement.

In addition, it has been persistently demonstrated through the experience of the frontline states that a critically important element in bolstering national and societal resilience to sub-threshold threats is raising the awareness of the civilian population, and ensuring an appropriate level of threat perception. This is a key enabler in avoiding the vacuums that these kinds of actions can exploit – vacuums of knowledge or situational awareness, of attention, of physical presence of military and law enforcement agencies, and above all, of political will to accept risk and responsibilities.

International cooperation in countering the threats is essential. But despite their military implications, the role of military cooperation organisations in doing so is strictly limited. Defence against campaigns of this kind is largely societal, not military, and assistance to civil society is tangential to NATO's or JEF's core functions. Instead, coalitions of the willing are needed to provide a currently missing coordinating function between allies and partners, pooling and sharing experience and efforts to ensure resilience of freedom of movement, fostering awareness, and sharing best practice at national level.

In practical terms, the EU's Permanent Structured Cooperation (PESCO) initiative also presents opportunities for enhancing the efficiency and security of cross-Europe logistics. PESCO's "Military Mobility" subsection aimed to simplify and standardise cross-border military transport procedures in order to guarantee unhindered movement of military personnel and assets within the borders of the EU[345] – in effect, the "military Schengen" consistently called for by co-author Lt. Gen Ben Hodges and others. Measures under PESCO that deliver real and tangible improvements in logistical resilience and capability should be encouraged and implemented briskly; for example, to address the challenge of EU requirements for vehicles, drivers, and loads that restrict military movements, PESCO should be leveraged to ease EU road regulations in the pre-crisis phase, when speed of reinforcement could be critical but open hostilities have not yet begun.[346] But this must be only part of much broader efforts to reconstitute the ability swiftly and efficiently to move reinforcements across Europe, remedying the situation where "many years of post-Cold War out-of-area operations [have] left European military transport infrastructure, logistics, and bureaucracy to wither." [347] In particular, military mobility initiatives must not be allowed to be hazarded – or potentially left unfunded – as a result of EU politicking.[348]

Until cancelled due to coronavirus, the Defender 2020 exercise scheduled for May–June 2020 was set to be a major test of the capability of the United States and its NATO allies to move reinforcements across Europe as intended. The exercise was to be as much a test of ability to overcome legal and bureaucratic obstacles as it is of logistical capacity and competence.[349] But while exercises such as this are in effect held under peacetime conditions, it is to be hoped that if and when they resume they will also take account of hostile actors who wish to impede the movements they are practising, and plan to test resilience accordingly. In any case, it can safely be assumed that Russia will be observing these exercises closely, not only to assess NATO military capability but also to search for critical vulnerabilities of the entire reinforcement process at all stages and across all domains. NATO too needs to carry out a similar search in order to identify and mitigate the same non-military vulnerabilities.

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[345] European Council, "Permanent Structured Cooperation (PESCO) First Collaborative PESCO Projects – Overview," December 11, 2017, http://www.consilium.europa.eu/media/32079/pesco-overview-of-first-collaborative-of-projects-for-press.pdf.

[346] See United Nations Economic Commission for Europe, Inland Transport Committee, *European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)*, in 2 vols, vol I – ECE/TRANS/275 (New York/Geneva: United Nations, 2018), https://www.unece.org/index.php?id=50858&no_cache=1.

[347] Frisell, Dalsjö, Gustafsson, and Rydqvist, *Deterrence by Reinforcement*, 25.

[348] Alexandra Brzozowski, "Europe's Military Mobility: Latest Casualty of EU Budget Battle," EurActiv, February 25, 2020, https://www.euractiv.com/section/global-europe/news/europes-military-mobility-latest-casualty-of-eu-budget-battle/.

[349] Jen Judson, "Fighting the Bureaucracy: For NATO, the Defender 2020 Exercise in Europe Will Test Interoperability," DefenseNews, October 14, 2019, https://www.defensenews.com/digital-show-dailies/ausa/2019/10/11/fighting-the-bureaucracy-for-nato-the-defender-2020-exercise-in-europe-will-test-interoperability/.

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11. Deterring Russia on NATO's Eastern Flank

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Deterrence

Following Russia's invasion of Ukraine, in 2014, and its illegal annexation of Crimea, the North Atlantic Treaty Organization (NATO) responded quickly. Successive NATO Summits in Wales (2014), Warsaw (2016), and Brussels (2018) have empowered the Alliance to transition from assurance to deterrence in support of its members along NATO's Eastern Flank, from the Baltic Sea to the Black Sea.[350] But deterrence is inherently hard to measure, as it aims to influence a potential adversary's cost/benefit calculus with regard to undertaking a certain action. This is done by demonstrating the capability and the will to resist and/or punish said action.[351] Capabilities can easily be demonstrated, but how does one prove will? The upcoming US exercise Defender 2020 constitutes a prime example.[352] It demonstrates US will to defend its European allies and partners. 20,000 US troops and equipment will move across the Atlantic to join 17,000 American and European troops in exercising the defence of Europe, the largest deployment of US troops to Europe in 25 years.[353] The exercise contributes to building capabilities and is not done on the cheap. It proves that the US, despite popular claims to the contrary, is not disengaging from Europe. It also comes on the heels of a sharp increase in the number, scale, and complexity of NATO exercises in 2014–2019, a disproportionate share of which have focused on the Baltic Sea Region.[354]

Undeniably, NATO's light footprint on the Eastern Flank has created vulnerabilities that Russia can exploit, and Russia's 2014 annexation of Crimea and increasingly aggressive behaviour call for more robust NATO deterrence in the east.[355] The two most effective means of deterring Russian aggression are

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[350] This chapter is based on and is a further expansion of findings from an earlier CEPA report, Ben Hodges, Janusz Bugajski, and Peter B. Doran, *Strengthening NATO's Eastern Flank: A Strategy for Baltic-Black Sea Coherence* (Washington, DC: Center for European Policy Analysis, 2019).

[351] If the US goes through with the troop reductions in Germany announced by the White House in June 2020, this would seriously reduce the capability of the US military in Europe, including the capacity to receive reinforcements and to support operations elsewhere, as well as cast doubts on the will of the US and the cohesion of the alliance. Cf. Karl Doemens, "Ex-General : Trumps Abzugsplan 'schadet uns nur selbst'", *Augsburger Allgeimene*, June 16, 2020.

[352] Defender 2020 has since been reduced from three brigades to one, due to the force majeure of the corona virus pandemic, but the planning and the practical steps taken have still demonstrated the US commitment to NATO and to the defence of Europe.

[353] NATO SHAPE, "Exercise Defender-Europe 20 Underway," press release, February 4, 2020.

[354] Albin Aronsson and Björn Ottosson, *Västlig militär övningsverksamhet 2014–2019: Anpassning, utveckling och framsteg*, report, FOI-R--4875--SE (Stockholm: FOI, 2020).

[355] Cf. David A. Shlapak and Michael W. Johnson, *Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defence of the Baltics*, Research Reports (Santa Monica, CA: RAND, 2016);

cohesion and coherence across the entire Eastern Flank, from the Baltic to the Black Seas.

Cohesion and Coherence Underpins Deterrence

Cohesion entails the political solidarity between allies. Russia seeks to undermine Alliance cohesion with all available means, while carefully staying below the threshold of Article 5. Preserving alliance cohesion is NATO's most important task, as a united alliance of 29 nations committed to defending each other is the best possible deterrent. While Russia can establish local superiority in the correlation of forces, as long as NATO maintains its cohesion, Russia has no prospects of winning any drawn out, high-intensity confrontation with NATO over wide geographical areas.

Coherence is equally important. As Russia looks for capability gaps along the entire flank and acts where it finds them, NATO must adopt a coherent approach to the defence of the entire Eastern Flank in all domains. There are three core geographic theatres: the Baltic Sea region, Poland and the Suwalki corridor, and the greater Black Sea region. While the Suwalki corridor has received much-needed attention over the last few years,[356] there is room for improvement and increased coherence in NATO's approach to the Baltic Sea region and, in particular, to the greater Black Sea region.

The establishment of the enhanced Forward Presence (eFP) battlegroups in the Baltics and Poland is a success story. In Russia's view, however, NATO's tailored Forward Presence in the Black Sea region is most probably a weaker deterrent than the eFP. To achieve coherence, the tailored Forward Presence should be upgraded and a concept of Forward Presence adopted for the entire Eastern Flank. But it has to be more than just increasing capability in the Black Sea region. The geography, challenges, and alliance structures, as well as the competing strategic priorities, are quite different from the Baltic region. The increased deterrent capability for the Black Sea region should be the result of developing a strategy for this critical area, where Europe, Russia, and the Middle East all come together. The approach should be "one threat, one flank, one presence." In addition, NATO should investigate and identify gaps and vulnerabilities on the Eastern Flank in an annual regional risk report, in order to gradually address them.[357]

Alexander Vershbow and Philip Breedlove, *Permanent Deterrence: Enhancements to the US Military Presence in North Central Europe* (Washington, DC: Atlantic Council, 2018).

[356] Cf. Ben Hodges, Janusz Bugajski, and Peter B. Doran, *Securing the Suwalki Corridor: Strategy, Statecraft, Deterrence and Defence*" (Washington DC: CEPA, 2018); Hodges, Bugajski and Doran, *Strengthening NATO's Eastern Flank*.

[357] Hodges, Bugajski, and Doran, *Strengthening NATO's Eastern Flank*, 4–5.

The Need for Speed – Speed of Recognition, of Decision, and of Assembly

Speed is essential in achieving a coherent approach. This includes speed of recognition, speed of decision, and speed of assembly, in order to be able to identify, agree on, and respond to threats, no matter where they emanate. Firstly, speed of recognition is required to understand what Russia is doing and planning. This makes more efficient intelligence-sharing vital, as allies in Russia's vicinity in the Baltic or Black Sea regions often have a better understanding of the day-to-day situation than the US. Here, there is a need to overcome unnecessary obstacles, such as overdependence on "Five-Eyes" intelligence-sharing, instead of sharing intelligence and information with all allies and non-NATO partners, such as Sweden, Finland, Ukraine, and Georgia. Such procedures could contribute to quicker recognition (if not early warning) of a looming or potential crisis, giving political leaders the opportunity to make decisions on troop movements to prevent a crisis. Secondly, speed of decision is needed for timely preparations and mobilisation. Here, a commonly agreed definition of aggression and what constitutes a violation of Article 5 is necessary.[358]

Lastly, speed of force assembly is required to arrive at the critical point or area in time to prevent or respond to a potential crisis. Military mobility is a crucial function in order to secure the movement of troops across Europe and the timely arrival of the reinforcements needed to achieve deterrence. Currently, however, such vital movement of troops and equipment is hampered by, e.g., deficient transport infrastructure, such as tunnels or bridges, complicated and bureaucratic border-crossing procedures, and the scarcity of rail wagons suitable for tanks.[359] A number of good efforts to address some of these issues are currently underway in the European Union (EU) including in the European Defence Agency (EDA), but a higher sense of urgency and increased cooperation between the EU and NATO are required at the decisionmaking level. To incentivise allies to address these issues, spending on dual-use infrastructure and transport capacities, as well as cyber protection for these capacities, should count towards their two percent of GDP as defence expenditures.

Further Initiatives Needed

NATO should consider further steps to gain the initiative in the Baltic Sea region and the greater Black Sea region. The US and Western Europe do not fully appreciate the greater Black Sea region's strategic importance. Currently, the Naples-based US Navy Europe and NATO Joint Force Command Naples are

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[358] Ibid., 5.

[359] Eva Hagström Frisell, Robert Dalsjö, Jakob Gustafsson, and John Rydqvist, *Deterrence by Reinforcement: The Strengths and Weaknesses of NATO's Evolving Defence Strategy,* report, FOI-R--4843--SE (Stockholm: FOI, 2019); Hodges, Bugajski and Doran, *Securing the Suwalki Corrido*r, 6.

overwhelmingly oriented towards the Atlantic, the High North, the Baltic, and the Western Mediterranean. However, the Black Sea is where Europe, Caucasus, and the Middle East meet. The Black Sea is arguably of greater strategic importance to Russia than the Baltic Sea. It serves as a staging ground and a springboard for all of Russia's power projection and operations in Georgia, the Eastern Mediterranean and the Middle East. Whereas allies and partners surround the Baltic Sea, the situation is not the same in the Black Sea.[360] Russia is using its strong position on the Black Sea to gradually choke off Ukraine's maritime trade and access to the sea, via illegal restrictions on the use of the Kerch Strait and by the live firing of missiles in the waters off Odessa. The greater Black Sea region should take on greater prominence in NATO's strategic mindset, including through the development of defence plans. In the event of a crisis in the Baltic Sea region, NATO and partners should be able to achieve sea control in the Baltic Sea in a relatively short period of time (cf. Anders Puck Nielsen's chapter in this volume). This is not the case in the Black Sea. Therefore, the operational aim should be sea denial, in order to prevent the Russian Navy, in time of conflict, from being able to operate from the Black Sea or its illegal bases in Crimea.

Furthermore, NATO's Multinational Division Southeast should be upgraded to a three-star joint headquarters, focusing exclusively on the maritime, air, and land domain of the Black Sea region. The Black Sea Air Policing mission should be converted into Air Defence. NATO presence in the Black Sea should be enhanced to maintain a year-round rotational presence by non-littoral states. Given the restrictions of the Montreux Convention, NATO needs to strengthen its strategic relationship with member state Turkey to ensure its support to such initiatives**.

Capabilities in the Baltic Sea region can be enhanced in a similar manner. A joint command responsible for the Baltic Sea is needed; among its tasks would be to collate, maintain, and distribute, including to formally non-aligned partners such as Finland and Sweden, a Recognised Air Picture and a Recognised Maritime Picture. The Baltic Air Policing mission should be converted into Air Defence, and the Baltic States' air and missile defence capabilities should be strengthened, including the development of mid-range capabilities.

Collective Defence Leads to New Challenges

NATO's return to territorial and collective defence comes with a new set of challenges. The European theatre today is far more complex than the Afghan theatre ever was, and makes demands very different from those in NATO's layered-cake structure on the Central Front during the Cold War. In Afghanistan, allies were given responsibility for a sector/district each and generally stayed

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[360] Hodges, Bugajski and Doran, *Strengthening NATO's Eastern Flan*k, 4–5.

within that patch. In Germany during the Cold War, allies were assigned responsibility for one or two corps sectors, which meant that most interactions below that level were purely national. Defending Europe today, in a theatre with much lower force-to-space ratios and where forces from different nations are intermingled, requires a higher degree of interoperability and cooperation under demanding circumstances. There are many vulnerabilities to address. For example, interoperable and secure tactical communication equipment within multinational formations is paramount but still lacking. Digital counter-fire is necessary to hold mobile Russian units at risk, but there are question marks regarding the capability of a unit from country X to provide target data for a unit from country Y. Furthermore, the theatre-wide Integrated Air and Missile Defence has not been exercised in at least the last seven years, meaning that potential shortcomings and improvements to command and control may not have been identified. Annual and theatre-wide exercises of this function are urgently needed.

On the same note, exercises should primarily serve as a test of operational principles. There is a worrying trend in which most of the effort is spent on the Distinguished Visitors' Day and symbolic gestures of unity. Exercises should be as realistic as possible and aim to identify mistakes and areas for improvement. Commanders should not worry about failing, as exercises are there to learn from mistakes.

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Where to, Beyond the Bubbles?

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In this chapter, we draw preliminary conclusions about what can be learned from the conference. Crucially, we argue that the scope of disagreement can be narrowed considerably, as significant areas of agreement have been identified. As importantly, however, genuine insecurity or disagreement remains on a limited number of topics, which in and by themselves can yield very different outcomes in system-versus-systems scenarios. Having pinpointed those topics allows us to zoom in on them.

Narrowing the Scope of Disagreement

It appears clear that considerable areas of agreement can be found amongst leading analysts and practitioners when approaching Russian anti-access/area denial – A2/AD – capabilities from a variety of viewpoints. We are thus arriving at a more nuanced and sober assessment of the challenges posed by those capabilities. Although few experts in this field contend that Russia can create impenetrable bubbles (or that they would be as large as originally conceived), no one seriously argues that breaking through Russian A2/AD layers would be simple or risk-free.

From the contributions in this report, it is clear that in addition to the systems that were primarily examined in *Bursting the Bubble*, additional subsystems, as well as complementary domains, need to be included in any full-spectrum analysis of the Russian A2/AD threat. Firstly, the aircraft part of Russia's Aerospace Forces (VKS) would probably play a significant role in operations by the Western Military District. The service has significantly improved its capabilities in recent years, even though starting from a relatively low base. Even if small in comparison to total North Atlantic Treaty Organization (NATO) air forces, in a short, sharp, and regional conflict, they might potentially achieve temporary air superiority, especially if NATO is slow out of the starting blocks.[361] That said, it seems implausible that Moscow would subject a majority of its air assets to potentially very high attrition rates early on.[362]

Likewise, complementary systems beyond the main A2/AD systems supplement the capabilities of such long-range systems as the S-400, which are part of the

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[361] See Chapter 3, by Douglas Barrie, for further elaboration. Beyond this, also see Jonas Kjellén and Nils Dahlqvist, "Russia's Armed Forces in 2019," 31–34, in Fredrik Westerlund and Susanne Oxenstierna, eds., *Russian Military Capability in a Ten-Year Perspective* – 2019," report, FOI-R--4758--SE (Stockholm: FOI, 2019).

[362] However, this is dependent on the scenario envisioned. See, for instance, Johan Norberg and Martin Goliath, "The Fighting Power of Russia's Armed Forces in 2019," 61–67, in *Russian Military Capability,* ed. Westerlund and Oxenstierna. If Russian stand-off strikes against air power targets are used successfully early on in a conflict, this would naturally alter the strategic calculations involved.

VKS. This includes medium- and short-range army air defences, such as Tor, Buk, and Pantsir, as well as Spetsnaz special operations forces (SOF). Last, but not least, long-range precision strikes pose a major threat against critical nodes, such as Main Operating Bases (MOB), for Western air forces.[363] In addition, there are several indications that Russian non-military means could be used to augment its military A2/AD capabilities. These range from persuading Western decisionmakers to abstain from sending forces to the East or lifting constraints on military mobility, to less subtle but still plausibly deniable measures, such as cyberattacks and outright sabotage.[364]

Lest it was not sufficiently explicit in *Bursting the Bubble*, it should hence be clear that Russia's potential A2/AD capabilities, taken as a whole, constitute a significant, multi-domain threat, which is far beyond reliance on only its most well-known components (such as the S-400, Bastion-P, and Iskander). Furthermore, any response would by necessity have to be multifaceted, as responsibilities and capabilities for countermeasures are spread out over multiple multilateral organisations, countries, services, and domestic agencies. Thus, predicting outcomes in any systems-versus-systems contest is inevitably fraught with large uncertainties. But one should be wary of accepting at face value official Russian statements of maximum nominal capabilities, or of assuming that there is only one, predetermined, "Russian way of warfare," as if the General Staff would forego its ability to achieve strategic gains or surprise for the purposes of doctrinaire dogmatism.[365]

Whilst the threat is significant and merits serious consideration, the range of existing and possible future countermeasures – at the tactical and the operational levels – is also very broad. Air force agile basing (AB), currently a work in progress within the USAF, while already practiced within Sweden's and Finland's armed forces, could mitigate the threat from long-range precision strikes against major Western airbases. Implementing this is a demanding task, however, both in terms of logistics and increasing the level of mission command, and would require significant effort to become fully operational.[366] Historical precedent also suggests that the first move in counter-A2/AD operations involves blinding the opponent's ISR network. Radars and networking seem to be the most vulnerable link in the

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[363] See Chapter 2, by Justin Bronk, for further elaboration; also, see Norberg and Goliath, "Fighting Power," 61–67.

[364] See Chapter 10, by Keir Giles, for further elaboration; also, see Jakob Hedenskog and Gudrun Persson, "Russian Security Policy," 83–86, in *Russian Military Capability*, ed. Westerlund and Oxenstierna, for further examples.

[365] Cf. Michael Kofman, who dismisses the risk of a local war as "some contrived pinky fight in the Baltics"; Michael Kofman, "Russian A2/AD: It Is Not Overrated, Just Poorly Understood," blog, *Russia Military Analysis*, January 25, 2020, https://russianmilitaryanalysis.wordpress.com/2020/01/25/russian-a2-ad-it-is-not-overrated-just-poorly-understood/.

[366] See Chapter 4, by Jamie Meighan, for further elaboration.

Russian A2/AD kill chain, suggesting significant resources could usefully be invested in electronic warfare, decoys, and other measures to disintegrate the Russian Integrated Air Defence Systems (IADS) into its individual components.[367]

Measures to counter the long-range precision strike threat include creating redundancy of nodes and other passive measures, as well as defence against cruise missiles combining ground-based and combat aircraft systems. Military geography might also dictate that different solutions – i.e., the mix between passive and active measures, and, for the latter, also between high-end ballistic missile defence capability and broad coverage of defences against cruise missiles – are better suited to protecting different countries, since ranges and target sets vary significantly.[368] A complementary approach could also be to improve the "missile balance" by stationing ground-based medium-range conventional missiles in for instance the Baltics or Poland, enhancing the capability for deterrence by punishment or for striking critical nodes, and thus forcing Russia to invest in protection against precision strikes inside its own territory.[369]

Even "inside" an enemy "A2/AD-bubble," several countermeasures are available. In the maritime domain, the ability to neutralise Russian target reporting units, and leveraging the cluttered operational environment, would complicate accurate Russian targeting in the crucial initial stages of a conflict. On the operational level, non-military measures directed at making any attempts at A2/AD dissuasively unattractive could also have a deterrent effect.[370] In the land domain, army units already in place could adopt various measures (dispersal, limiting emissions, using parsimonious C2 protocols, and avoiding decisive engagements) to remain relevant as a defensive force, depriving a would-be aggressor of the desired operational goal, that is, a swiftly established decisive defeat of NATO forces in place and, thus, a *fait accompli*.[371]

Last but not least, devising a viable strategy for dissuading Russian A2/AD ultimately hinges on alliance cohesion and coherence across the entire "front" with Russia. Likewise, it is ultimately dependent on speed – of recognition, decision, and assembly.[372]

Assuming, as most scenarios published to date do, that the Kremlin would strive for a short, sharp, geographically limited conflict, followed by attempts at quick de-escalation, a Western response should arguably focus on having a well-rehearsed, coordinated response in store, a response that could both deny Russia a quick and clean victory, and increase the prospects that any aggression might lead

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[367] See Chapter 5, by Sam Tangredi, for further elaboration.
[368] See Chapter 8, by Robin Häggblom, for further elaboration.
[369] See Chapter 9, by Alexander Lanozska and Luis Simón, for further elaboration.
[370] See Chapter 6, by Anders Puck Nielsen, for further elaboration.
[371] See Chapter 7, by Ilmars Lejins, for further elaboration.
[372] See Chapter 11, by Ben Hodges, for further elaboration.

to a drawn-out and costly conflict that Russia might lose. And to achieve this, significant room for improvement certainly remains.

On these overarching points, it appears that many if not most scholars and practitioners in this field see eye to eye, although perfect consensus should never be expected, nor is it desirable. That said, there are still important topics about which genuine disagreement or uncertainty remains, indicating areas that are in urgent need of further analysis.

Key Areas for Future Research

Those differing assessments could have huge implications for the perception of the military balance between Russia and the West in various regional conflicts, not only in the Baltic region. If, for example, we assume that the Russian IADS in Kaliningrad would be a tough nut to crack, taking up to a month to attrite to acceptable levels, this might give Russia plenty of time to achieve a *fait accompli* on the ground with its locally superior ground forces. Then, the conclusion would be that the military balance in the region is unstable and tilted in Russia's favour. If, on the other hand, we assume that S-400 or S-300V4 systems in the exclave can be suppressed sufficiently in only a number of days, then there might be scope for NATO to apply its formidable airpower against attacking Russian ground units before they have secured their objectives.[373] In that case, we should conclude that the military balance is more stable and even. Each of these alternatives demonstrates the peril of succumbing to self-fulfilling expectations, which is itself just one example of how differing assessments can play psychological havoc with our perceptions, and outcomes.

Thus the remaining points of disagreement or uncertainty among analysts are doubly important: both as indications of topics that need further analysis, and in their implications for the regional military balance. Below, we have outlined some of the more salient of the still outstanding issues:

- the capability of the Russian air defence system as a whole and of its components – especially to what degree different components can deliver effects approximating their nominally claimed capabilities or not, and the extent to which the individual components are truly integrated into a single IADS;
- the reasons for the recent poor performance of Russian air defence systems in the Middle East;
- whether Russia really does have an A2/AD doctrine or strategy, or whether this has been ascribed to them by the West after Crimea, based on what China is perceived to be doing;

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[373] Krister Pallin and Eva Hagström-Frisell, eds., *Western Military Capabilities 2020*, report (Stockholm: FOI, forthcoming).

- the logic or rationality behind developing, building, and fielding anti-ship missiles that can fly 300 km if one doesn't have targeting assets that can see that far;
- whether Russia is deliberately – for both political and commercial reasons – overstating its capability and the performance of its A2/AD systems, and if so, the implications this has for analysis based primarily on open sources;
- the potential effects of the introduction of F-35s and other cutting-edge systems on Western capabilities to operate within and against Russian "A2/AD bubbles."

The State of Russian Air Defences

On the issue of the current state of the Russian air defences there is a measure of disagreement among analysts on three specific points. The first is whether Russia has currently, actually, fielded the 40N6 and 9M96 active air-defence missiles with its S-400 batteries, or whether these batteries are still only equipped with the older semi-active 48N6 missile. Some think that we should err on the side of caution when assessing Russian air defence capabilities, thus coming down in favour of including the new missiles. Others pay more attention to reports of problems with deliveries, leading to the conclusion that they have not yet been deployed.[374]

The second point of contention is whether it would be operationally feasible to use the 40N6 missile for a "hunter-killer" launch in a lofted trajectory against air targets below the radar horizon, based on limited target data. Some argue that we need to take seriously the possibility that Russia could launch 40N6 missiles in this manner in order to hit distant but low-flying targets, such as in a strike package. Others think that while this might be theoretically possible and could have some value as "nuisance shots," it would be unfeasible, because of the large volume of airspace that would have to be scanned by a comparatively simple and low-powered seeker, and because it is difficult for a rapidly plunging missile to find, manoeuvre, and hit the right target among other echoes.[375] Moreover, as the launch of a huge missile like the 40N6 is visible from space, it might be possible to warn the target aircraft of the missile launch, allowing it to take evasive action. Finally, as long as 40N6 missiles remain scarce, and primarily intended for use

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[374] Bronk, Chapter 2, in this volume; IISS, "Turkey, the S-400 and the F-35," *Strategic Comments* 25, no. 22 (August 2019); Kevin Rothrock, "Russian Newspaper Deletes Article by Defense Analyst Who Accused Moscow of Sabotaging Long-range Missile Shipment to China," Meduza, February 25, 2019, https://meduza.io/en/feature/2019/02/25/russian-newspaper-deletes-article-by-defense-analyst-who-accused-moscow-of-sabotaging-long-range-missile-shipment-to-china; Jeremy Chin, "Russia to Replace Damaged S-400 Missile Shipment to China," Missile Threat, CSIS, February 20, 2019, https://missilethreat.csis.org/russia-to-replace-damaged-s-400-missile-shipment-to-china/.

[375] Cf. Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 91; authors' interviews with Andreas Hörnedal and Erik Berglund, missile specialists at FOI.

against high-value aircraft or ballistic missiles (see below), it might be a waste to use them in this way.

The third point of contention concerning Russian air defences is whether Russia has one IADS, or two, or even three (air force, army, and navy), and to what degree different Russian air defence systems are integrated. Many, if not most, of those who have written on Russian A2/AD capabilities seem to assume, often implicitly, that Russia has a single integrated air and missile defence system in which all assets – sensors, C2, and effectors – are or could be connected. Others keep an open mind on this issue, recognising the limitations of the Russian defence electronics industry and the challenges of building such a capability, but think that we should err on the side of caution, as the Russians are clearly working on such capabilities.[376] If there is a single and highly integrated Russian IADS, this would be much more formidable, as forward-deployed army air defence units or airborne radars could provide target data for long-range systems deployed further back, thus alleviating the problem of the radar horizon. The system would also be much more resilient, as sensors and shooters could be networked and could thus continue to function even if key nodes were taken out.[377]

However, some specialists on the Russian armed forces or its air operations do not consider the Russian armed forces as a monolith; instead they highlight the differences between the services and their different tasks. According to this camp, the ground-based air defence of the air force (VKS), to which the S-300, S-400, S-350, and air defence fighter aircraft belong, is organisationally and doctrinally separate from air defence units in the army and navy, and these different units are not integrated across service barriers.[378] The VKS ground-based air defence units have longer range,[379] are less mobile, or even semi-fixed, territorially organised, and primarily tasked with protecting the homeland and its strategic assets.[380] Some analysts also contend that VKS systems, such as S-400, tend to use prepared deployment sites, and are not configured or organised for shoot-and-scoot

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[376] See Chapter 2, by Justin Bronk.

[377] Justin Bronk, *Modern Russian and Chinese Integrated Air Defence Systems: The Nature of the Threat, Growth Trajectory and Western Options,* RUSI Occasional Paper (London: RUSI, January 2020), 9–12, https://rusi.org/sites/default/files/20191118_iads_bronk_web_final.pdf.

[378] Cf. Asymmetric Warfare Group, US Army, *Russian New Generation Warfare Handbook,* Version 1 (Ft. Meade, MD: Asymmetric Warfare Group, December 2016), 8, https://info.publicintelligence.net/AWG-RussianNewWarfareHandbook.pdf; the following publication was earlier available, but no longer, through a link in Sebastien Roblin, "The US Army Has a Handbook on Russian Hybrid Warfare," Asymmetric Warfare Group, US Army, April 9, 2019, https://www.awg.army.mil/AWG-Contributions/AWG-Recruiting/Article-View/Article/1809255/the-us-army-has-a-handbook-on-russian-hybrid-warfare/.

[379] VKS also has close-range systems such as Pantsir for the defence of some S-400 units against precision-guided munitions.

[380] Kofman, "Russian A2/AD"; Fredrik Lindvall, "Luftoperationer och väpnad konflikt i Nordeuropa," *Kungl Krigsvetenkapsakademiens Handlingar och Tidskrift* no. 2 (2019); authors' interview with Fredrik Westerlund, Russian military specialist at FOI.

operations or for operations in contested or occupied territory. This would invalidate scenarios of quick land-grabs (e.g., Gotland or Bornholm) followed by forward-deployment of long-range air-defence systems.[381] The VKS batteries also have only one engagement radar, which supports several launchers (TELs), making them more vulnerable.[382]

In contrast, the army's air-defence assets, which include short- and medium-range systems, such as SA-11/17 Buk, SA-13 Strela 10, SA-15 Tor, and SA 19 Tunguska, primarily exist to protect army units wherever they are against air attack.[383] They thus are much more mobile (often tracked) and are capable of engaging targets autonomously, as each transporter-erector launcher and radar (TELAR) has its own engagement radar. However, as army air defence is to be capable of following mechanised units on marches and in the attack onto enemy territory, they cannot depend on communicating orders, reports, or target data, by landline, but have to depend on air links (essentially radio), which have lower capacity, are less dependable, and more vulnerable to interference. Thus, even though the Russian army has special components (Kupol, Polyana) for the networking, integration, and control of different air defence units in an operations area (recognised air picture, target recognition and allocation, etc.), this might not always work.[384]

The same reasoning, *mutatis mutandis*, can be applied to the navy, which primarily commands short- and medium-range systems for the protection of their ships and bases.

Of these issues of contention and uncertainty, the final one would seem to be the most important one for the analytic community. The eventual deployment of the 40N6 may just be a matter of time, and the use of the same missile as hunter-killer might literally be a long shot, only of value in specific circumstances. However, both the contentious issue of whether Russia has one single IADS or three structured along service lines, and the issue of uncertainty about the degree of integration and character of links within and between these networks (including their susceptibility to jamming), have potentially huge implications for the

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[381] Lindvall, "Luftoperationer"; authors' interview with Fredrik Westerlund.

[382] Dalsjö, Berglund, and Jonsson, *Bursting the Bubbl*e, 53. If the S-400 batteries in a battalion or a regiment are connected by networks, which they most probably are, the TELs from battery A could still fire with the help of an engagement radar from battery B, C, or D. However, the number of targets an engagement radar can engage simultaneously is limited to six. Thus, while this capability could be useful in hide-and-seek tactics, it would be less useful in the case of a saturation attack. Carlo Kopp, *Almaz-Antey 40R6/S-400 Triumf Self Propelled Air Defence System/SA-21,* Technical Report APA-TR-2009-0503, Air Power Australia, 2009-2012, https://www.ausairpower.net/APA-S-400-Triumf.html.

[383] However, the army has one long-range system, comparable to the S-400, in the S-300V4, mainly intended for the protection of higher-level headquarters.

[384] In this context, one should consider that a number of Russian high-tech projects have failed, fizzled, or suffered substantial delays in recent years, among them the Armata tank, the Su-57 stealth fighter, the 40N6 missile, and the Burevestnik missile.

assessment of the strength and resilience of Russian air defences, and thus also for the overall military balance in Europe's east. While it might be reasonable to assume that basic target data can be shared within and perhaps also between networks, and that handover of targets can take place, it is by no means certain that this would be automatic or fail-safe. Nor does it seem wise to simply assume that different systems from different manufacturers and different technical generations could automatically cross-feed high-quality target data, nor that one type of system could illuminate targets for another.[385] The former presupposes that the Russian electronics and IT industries – which are far from world class[386] – have mastered the demanding problems of creating a capability for network-centric warfare, the latter that it has been even more successful and achieved a capability for cooperative engagement.[387]

It seems that this set of issues merits serious attention in coming years. That eventual analysis would need to consider not only technical factors (such as the nature and status of systems and data links, etc.) and operational factors (it would obviously be of great operational advantage to Russia if it were to network and integrate its air defence assets), but also cultural and bureaucratic factors and service rivalries. During the Cold War, we often assumed that if a certain capability was technically feasible and operationally advantageous, the Soviet armed forces would have connected the dots and gained the capability. However, the collapse of the Warsaw Pact revealed that this was a misconception.[388]

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[385] Integrating systems from different services brings up sticky issues of turfs and budgets, such as which service is going pay for the integration, which service's standards are to be used, and who will "own" or manage the capability and be responsible for the upkeep.

[386] As the domestic Russian IT sector is not up to date and non-competitive, Russia has been heavily dependent on importing electronic components and software, also for defence purposes. A programme of import substitution instituted after 2014 has not been so successful. See Igor Sutyagin, *Russia's New Ground Forces: Capabilities, Limitations and Implications for International Security*, with Justin Bronk, Whitehall Paper 89 (London: RUSI, 2017), 85–88; Richard Connolly and Philip Hanson, *Import Substitution and Economic Sovereignty in Russia* (London: Chatham House, 2016), 16f; Oleg Lypko, "Import Substitution in the Russian Defence Industry: Issues and Achievements," Meta-Defense, August 22 2019, https://www.meta-defense.fr/en/2019/08/22/import-substitution-in-the-Russian-defense-industry-issues-and-achievements/.

[387] Network-centric warfare was a military fad around the turn of the millennium, which failed to deliver expected capabilities, despite heavy spending. Now, a new attempt to develop such capabilities is being made under the rubric "any shooter, any sensor," but it is only in the early stages, with discussions and simulations. Lauren Williams, "Services Grapple with 'Any Sensor, Any Shooter' Network Concept," *FCW,* March 6, 2020, https://fcw.com/articles/2020/03/06/jadc2-shooter-sensor-williams.aspx; "Northrop Grumman, MBDA and Saab Demonstrate the Integration of Disparate Missile and Radar Systems into Integrated Air and Missile Defense Battle Manager," *Air Recognition,* November 26, 2019, https://www.airrecognition.com/index.php/news/defense-aviation-news/2019-news/november/5661-northrop-grumman-mbda-and-saab-demonstrate-the-integration-of-disparate-missile-and-radar-systems-into-integrated-air-and-missile-defense-battle-manager.html; on cooperative engagement, see Dalsjö, Berglund, and Jonsson, *Bursting the Bubble*, 74f.

[388] For example, during the Cold War it was widely assumed that Soviet frontal aviation could strike ships at sea, which would make larger ships vulnerable in the Baltic. After the collapse, it turned out that they were not trained, equipped, and tasked to do this, and that this was a task solely for naval aviation.

The Poor Performance of Russian Systems in the Middle East

The poor performance in recent years of modern Russian-made air defence systems, most notably the Pantsir-S1 (SA-22), but also other systems such as Buk-M2 (SA-17) and S-300, during the conflicts in Syria and in Libya – often accompanied by embarrassing video clips – have raised questions concerning their performance.[389] The heart of the matter is whether the weak performance of Russian air defence systems – due not only to the equipment but training and doctrine – in the Middle East is due to local factors, or whether the failures are also indicative of how the systems might eventually perform when in Russian service. If the Pantsir, widely touted before operations in Syria as a very capable close-in defence system, can be taken out fairly easily – as appears from Israeli and Turkish videos – this reflects badly not only on the system itself, but potentially on other Russian air defence systems and technologies.[390]

Five explanations have been offered (or are conceivable) for the weak performance in the Middle East, four of which ascribe the failures to local factors. The *first* explanation is that the systems that have come up short are export variants that have been intentionally hobbled, if compared to systems in Russian service.[391] As is evident from their designations, they are indeed export variants, but Russian spokesmen indignantly reject that they have been handicapped, claiming that incompetent local operators are at fault.

Russian dismissal of such claims in turn leads to the *second* explanation offered for the failures.[392] Much of the track record of Middle Eastern air-defence

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Likewise, Russian pilots are still rigidly controlled from the ground, despite the fact that a transition to a system where the pilot has greater leeway – as in the West – would have great advantages.

[389] Turkish president Erdogan has claimed that Turkey destroyed 8 Pantsir systems in Idlib province in a short space of time, using indigenously developed, armed Anka and TB2 drones; see *Daily Sabah*, "Russia Denies Destruction of Pantsir System Despite Footage," blog, March 11, 2020, https://www.dailysabah.com/politics/russia-denies-destruction-of-pantsir-system-despite-footage/news. Other sources claim that during the same period Turkish drones caused massive losses to Syrian forces: "3,000 soldiers, 151 tanks, eight helicopters, three drones, three fighter jets (including two Russian-made Sukhoi Su-24s), around 100 armored military vehicles and trucks, eight aerial defense systems, 86 cannons and howitzers, ammunition trucks and dumps, and one headquarters, among other military equipment and facilities"; see Ali Bakeer, "The Fight for Syria's Skies: Turkey Challenges Russia with New Drone Doctrine," Middle East Institute, March 26, 2020, https://www.mei.edu/publications/fight-syrias-skies-turkey-challenges-russia-new-drone-doctrine; Stephen Bryant, "Russian Pantsir Systems Neutralized in Libya," *Asia Times,* May 23, 2020; H.I. Sutton, "One of Russia's Most Advanced Missile Systems Captured in Libya," *Forbes,* May 19, 2020.

[390] Mandeep Singh, "Saturation of Air Defences: Observations on Failure of Air Defence Systems in Syria," *Indian Defence Review*, March 27, 2019, http://www.indiandefencereview.com/news/saturation-of-air-defences-observations-on-failure-of-air-defence-systems-in-syria/; Robin Häggblom, "Another Pantsir lost," blog, *Corporal Frisk*, January 21, 2019, https://corporalfrisk.com/2019/01/21/another-syrian-pantsir-lost/.

[391] Pesach Malovany, "What Stands Behind the Failure of the Syrian Air-Defense Systems?" *Israel Defense Newsletter*, July 30, 2018, https://www.israeldefense.co.il/en/node/35119.

[392] Malovany, "What Stands Behind." In a later article, Malovany says that the poor performance of Russian-made air defences (missiles going astray or exploding in mid-air) during an Israeli attack on

operators can indeed be called miserable – the Egyptian surface-to-air missiles (SAMs) in the early phase of the Yom Kippur War being a notable exception – from the Golan Heights in 1982, through Libya in 1986,[393] to last year's failure of Saudi units to protect a key oil installation, and this year's spectacular failures in Libya. However, that Russia now blames the operators does not dovetail with earlier statements by its spokesmen that Syrian missile operators are trained to the same high standards as their counterparts in Russia.[394]

A *third* possible explanation for the failures is that the unlucky Pantsirs featured in video clips have been moving or for another reason not been hooked up to an IADS that could have cued them to the presence of enemy aircraft or drones.[395]

The *fourth* reason proffered is that, rather than deficiencies in the Pantsirs or in their crews the results are due to the resourcefulness and cunning of the opposing side, the US, Israel, and Turkey.[396]

The *fifth* potential explanation is simply that the results from the Middle East are more or less true indicators of the performance and military worth of these Russian-made air defence systems, and perhaps of others too, at least when used against a competent adversary with good equipment.[397]

The above explanations are not mutually exclusive: it is possible that several apply simultaneously, and that the causes vary between the conflicts and parties. To obtain greater certainty, it is thus important to improve the granularity of the

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Syria in November 2019 may have been due to another Syrian unit's switching on an electronic jammer provided by Iran. Pesach Malovany, "Report: This Was the Reason for the Failure of the Syrian Air-Defense," *Israel Defense Newsletter*, December 17, 2019, https://www.israeldefense.co.il/en/node/41299.

[393] A candid Soviet after-action report from the US raid on Libya is available on the website of the Parallel History Project on Collective Security, "Information from Air Force Marshall Koldunov on Issues Related to 'US Aggression against Libya,'" translation from original Warsaw Pact document, in German, April 1986, Parallel History Project on NATO and the Warsaw Pact (PHP), www.isn.ethz.ch/php, by permission of the Center for Security Studies at ETH Zurich and the National Security Archive at the George Washington University on behalf of the PHP network, http://www.php.isn.ethz.ch/kms2.isn.ethz.ch/serviceengine/Files/PHP/16231/ipublicationdocument_singledocument/0cbff145-1f5a-453f-952b-d58e73e0269b/en/8604_information_eng.pdf.

[394] Russia said that its advisers had spent the previous 18 months completely rebuilding the Syrian air defence system, and that the high number of intercepted rockets spoke to "the high effectiveness of the weaponry in Syria and the excellent training of Syrian servicemen prepared by our specialists"; see Peter Beaumont and Andrew Roth, "Russia Claims Syria Air Defences Shot down 71 of 103 Missiles," *Guardian,* April 14, 2018, https://www.theguardian.com/world/2018/apr/14/russia-claims-syria-air-defences-shot-down-majority-missiles.

[395] Two drawbacks of shoot-and-scoot tactics are increased vulnerability during movements and a reduction in the number of units that can fire simultaneously.

[396] Bakeer, "The Fight for Syria's Skies." Reports that Israel has turned to saturation attacks against Pantsirs indicate that jamming may not always suffice; cf. Bronk, Chapter 2 in this volume; Singh, "Saturation of Air Defences."

[397] It can be noted that of the five manned aircraft that Russian-made air defence systems have shot down in the past decade, two were civilian airliners, one was a Russian signals intelligence plane, and only two were adversary aircraft: an Israeli F-16 and a Turkish F-4.

analysis of what has occurred and why, as this sheds light on their true capabilities and the countermeasures that will prove effective.

Does Russia Really Have an A2/AD Doctrine or Strategy?

Many of those who have written on Russian A2/AD capabilities after Crimea have implied that Russia has a strategy or doctrine built around A2/AD, as China most probably does.[398] While the discussion of Russian A2/AD has not reached the depths of the frenzy stirred by "Russian hybrid warfare" and the "Gerasimov doctrine" a few years ago,[399] there have been some similarities, primarily in believing that there has to be a major cause behind a major effect, and in ascribing an almost superhuman deviousness to the Russian general staff. Michael Kofman has done us all a service by questioning whether this really is so; examining one's own and others' assumptions is a critical cornerstone of all forms of analysis.[400] As he points out, Russia − unlike China − currently does not really have a geographic environment conducive to creating large no-go zones outside its coasts and borders.[401] One could also add that Russian A2/AD capabilities are not at all as multifaceted and mutually reinforcing as the Chinese capabilities are, nor − as of yet − accompanied by official claims that the neighbourhood really belongs to them.

It may very well be that Russia does not have an A2/AD strategy or doctrine, but simply stumbled on this capability as they replaced old missile systems with new, and as they tried to recreate a perimeter shield after their loss of the outer and inner glacis in 1990/1991. The double shocks of the US airpower demonstrated in the first Gulf War, and the collapse of the Soviet Union, must have badly rattled the General Staff in Moscow.[402]

That said, the capability to deter adversaries from operating off Russia's borders, and thus to dominate the hinterland militarily, meshes very well with Russia's openly declared desire to tear up the present security order and replace it with a version of Yalta Europe, where the strong powers call the shots in their own

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[398] Robert Dalsjö, "Air-Sea Battle: Ett amerikanskt koncept för att hantera A2/AD-hotet," in *Örnen, Björnen och Draken: Militärt tänkande i tre stormakter*, ed. Robert Dalsjö, report, FOI-R--4103--SE (Stockholm: FOI, 2015).

[399] Mark Galeotti, "I am Sorry for Creating the 'Gerasimov doctrine,'" *Foreign Policy*, March 5, 2018, https://foreignpolicy.com/2018/03/05/im-sorry-for-creating-the-gerasimov-doctrine/.

[400] Michael Kofman, "It's Time to Talk about A2/AD: Rethinking the Russian Military Challenge," War on the Rocks, September 5, 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge/.

[401] Ibid. One might argue that the geography of the High North and of the Black Sea Region might be somewhat more favourable for this than that of the Baltic. Svein Efjestad and Rolf Tamnes, "NATO's Enduring Relevance," in *Future NATO: Adapting to New Realities*, ed. John Andreas Olsen, Whitehall Papers 95:1 (London: RUSI, 2019); Ben Hodges, Janusz Bugajski, and Carsten Schmiedl, *One Flank, One Threat, One Presence: A Strategy for NATO's Eastern Flank* (Washington DC: CEPA, 2020).

[402] The current Russian military doctrine, for instance, still describes the US Prompt Global Strike concept − launched in 2003 − as a military threat. Hedenskog and Persson, "Russian security policy," 81.

spheres of influence.[403] Moreover, after several years of open publications in the West on the possible great advantages for Russia of having A2/AD capabilities, Moscow should be well-acquainted with the idea. And, finally, military doctrine is constituted not only by what is written down and published, but also by what one does and how. Action speaks louder than words and new doctrine is sometimes made on the fly by grabbing an opportunity, or dealing with an urgent problem, as in Crimea.[404]

The Logic behind Long-range Missiles Sans Matched Targeting Assets

Some readers have questioned our finding in *Bursting the Bubble* that Russia is developing, producing, and fielding long-range missiles without having matching assets for long-range target detection, or identification, firmly in place, making the long range of the missiles operationally useless. The best example of this is perhaps the Bastion-P coastal anti-ship missile, which is reported to have a 300–350 km range, but whose organic target acquisition radar cannot see beyond the radar horizon at sea level, which is 40–50 km.[405] In this configuration, the Bastion-P would be reduced from an A2/AD asset capable of shutting off the southern Baltic Sea, to a coastal defence asset for Kaliningrad. Similar arguments can be made about very long-range air defence missiles, such as the 40N6 and the 9M82MD for the S-300V4-system, although they might hit distant targets at high altitude.[406]

There are two types of counterarguments to the view we presented in our original report. The first is that the missiles can still be launched against distant targets on low-grade indication and then find the targets using their own active seekers. The second is that it simply does not make sense for Russia to field missiles with a very long range without the commensurate target acquisition capabilities. Thus, there must be some other Russian targeting assets – spies, satellites, ships, submarines – that can feed target data to the battery. The first counterargument has already been discussed in Justin Bronk's and Anders Puck Nielsen's chapters in this volume and in the above section on the status of Russian air defences. On the

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[403] Ibid., 80–84; Vladimir Putin, "Speech and the Following Discussion at the Munich Conference on Security Policy," President of Russia website, February 10, 2007, http://en.kremlin.ru/events/president/transcripts/24034; President of Russia, "The Draft of the European Security Treaty," President of Russia website, November 29, 2009, http://en.kremlin.ru/events/president/news/6152.

[404] For a similar argument on Russia's intervention in Syria, see Anna Borshchevskaya, "Shifting Landscape: Russia's Military Role in the Middle East," *Policy Notes* (The Washington Institute for Near East Policy) 68 (September 2019): 6. https://www.washingtoninstitute.org/ policy-analysis/view/shifting-landscape-russias-military-role-in-the-middle-east.

[405] With the help of a radar mounted on a Ka-32 helicopter from naval aviation, the potential target detection range could increase. At a helicopter altitude of 900 m, the radar horizon would be about 140 km for ships. Cf, Nielsen, Chapter 6.

[406] Tass, "Russia's New S-300V4 Air Defense System to Get Three Types of Hypersonic Missiles," Russian Aviation, September 9, 2016, https://www.ruaviation.com/news/2016/9/9/6820/?h.

second counterargument, we note that many of us ascribe near-perfect rationality to the military and procurement systems of other countries, when watched from a distance, while we are very much aware of the imperfections, glitches, and capability gaps produced by our own systems.

Another explanation for the very long-range air-defence missiles is possible. In the West, we tend to see the S-400 and S-300V4 systems as air-defence systems intended for use against distant high-value aircraft, but Russian statements often also tend to stress the systems' capability to intercept ballistic missiles.[407] Building missiles with extreme ranges and speeds makes sense if the primary task is intercepting ballistic missiles. While NATO has not had any ballistic missiles in Europe for three decades, the development of the forerunners of the S-300V4 and the S-400 systems began during the Cold War, with the intention of defending against Pershing-II and SRAM.[408]

Is Russia Deliberately Overstating the Capability of Its A2/AD Systems?

It should be obvious by now that the extent of Russia's fielding of A2/AD systems and its estimates of their performance have been overstated by its spokespersons and sources as an element of strategic communications (stratcom) designed to attain political and commercial effects. The political stratcom narrative is that Russia is strong and has a long arm in powerful weapons that can hold at bay Western forces that dare approach Russia's borders, and be used to counter developments that Moscow dislikes. This political messaging was very much evident in the deployment of the Iskander-M and S-400 systems to the Kaliningrad exclave. Although it was really a matter of a planned and orderly replacement of older systems (SS-21 Tochka and S-300), at a fairly leisurely pace, on several occasions Moscow garnered much attention in the West from this rearmament, since Russia had at first dropped hints that it might deploy if NATO acted "threateningly," which it then followed with exercises of temporary deployments, and then, finally, deployment. This is just one example of how Moscow is able to maximise its stratcom mileage from a single deployment.

Russia's commercial messaging is to offer what it claims are highly capable high-tech systems at a fraction of the price for comparable Western systems. An

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[407] Tass, "Russia's New S-300V4"; "Russia Demonstrates S-400's Hypersonic Ballistic Missile Interception Capability at Full 400km Range," Military Watch, May 1, 2020, https://militarywatchmagazine.com/ article/russia-demonstrate-s-s-400-s-ability-for-hypersonic-ballistic-missile-interceptions-at-full-400km-range.

[408] Carlo Kopp, *NIEMI/Antey S-300V 9K81/9K81–1/9K81M/MK Self Propelled Air Defence System/SA-12/SA-23 Giant/Gladiator*, Technical Report APA-TR-2006-1202, Air Power Australia, 2003–2012, https://www.ausairpower.net/APA-Giant-Gladiator.html; Kopp, "Almaz-Antey 40R6/S-400 Triumf." Many of the "new" Russian systems that have been fielded in the last 10–15 years are really the fruits of 1980s research and development projects that were in the freezer during the frugal years. Jonas Kjellén, *Russian Electronic Warfare: The Role of Electronic Warfare in the Russian Armed Forces*, report, FOI-R--4625--SE (Stockholm: FOI, 2018), 62, 81, 84f.

example is Turkey's snub of the US Patriot and its purchase of the S-400, instead. In such messaging, Russia clearly overstates the capabilities of the S-400 system when it markets it as having a 400-km range, despite the fact that the 40N6 was for many years plagued by problems and not in production. Similarly, when the dust settles on the Pantsir engagements in Syria, we will likely know more about the extent to which the system's capabilities have been exaggerated.

With the collapse of the Soviet Union, Russia went from being a closed society to a much more open one in only a few years. The concomitant arrival of the internet and the dependence of the Russian arms industry on exports meant that the volume of available data in different weapons systems and other military matters exploded. Consequently, open source analysis of the Russian military has become something of a cottage industry, ranging from high-end think-tanks and institutes to basement bloggers. In our minds, the obvious overestimations of Russian A2/AD capabilities that appeared in the West during the years 2014–2019 should be a call of caution for the analytic community, and lead to better methods and routines for assessing open source information from the East.

The Effects of the Introduction of F-35s on Russian A2/AD "Bubbles"

That the widespread fielding within NATO of the stealthy and sensor-packed fifth generation F-35, as well as stealthy bombers, drones, and cruise missiles, should have a significant impact on the operational balance between Russian A2/AD systems and Western countermeasures seems clear. But uncertainty surrounds two issues: first, just how much of an advantage will the F-35 have over Russian air-defence systems, and in which dimensions will those advantages manifest themselves? Will the F-35s be able to manoeuvre inside the "bubbles" with near impunity and easily take out air-defence systems and other high-value targets, or will the aircraft just scrape past search radars and the missions remain dangerous? Second, how do we assess the capabilities of other assets, including fourth-generation aircraft such as the Growler, F-16 CJ, or the Typhoon, as well as electronic warfare (EW) drones like the miniature air-launched decoy (MALD) in such a duel? Of course, these two questions are related – if the F-35 just scrapes in to the inside the bubble, fourth-generation aircraft will become less vital.

The capabilities of the F-35 and of Russian search- and targets-acquisition radars are shrouded in secrecy, just as the outcome of any duel between them is cloaked in genuine uncertainty: that was one of the reasons why, once Turkey had acquired the S-400, its purchase of F-35s was blocked by the US.[409]

Some think that the F-35 is a must for conducting suppression of enemy air defence (SEAD) missions against a high-grade IADS.[410] The next position would be that

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[409] IISS, "Turkey, the S-400 and the F-35."
[410] Bronk, *Modern Russian and Chinese*, 28–29; interviews.

either F-35s or stealthy drones are needed inside the bubbles, albeit as ISR assets, primarily, for determining the position and status of targets, which can then be prosecuted with long-range weapons carried by fourth-generation aircraft outside the bubbles. American military sources reportedly talk about systems being able to operate "inside" or "outside" A2/AD bubbles. It is also possible to hold the view that, since the S-400 tends to operate from prepared positions and the US has good overhead intelligence, it would suffice to hit likely deployment positions with numerous stand-off missiles, and then send in F-35s, Growlers, and Wild Weasels shrouded by electronic warfare assets for the clean-up. Finally, one might consider electronic warfare capabilities and the tactics, techniques, and procedures (TTPs) employed in the SEAD missions as more important than the platforms used.

We cannot know from open sources, if at all, how the balance stands in these duels, but more information may become available in coming years, as the S-400 and F-35 become more widely used. It is also notable that a source within the Israeli Air Force describes the F-35 as desirable, but not strictly necessary, for penetrating Iranian airspace protected by the S-300, while for years the IAF has been striking targets in Syria with F-16s and F-15s, with only one loss.[411] Perhaps this is a testimony to the importance of electronic warfare and TTPs.

Facts and Estimates

Some things are facts and practically immutable – the world is round, the laws of physics apply, and Putin is the president of Russia. Other things are facts, but changeable, or hard to ascertain from the outside, making us dependent on patchy data or on estimates. Still other things, such as how a conflict might play out, are the realm of more or less complex models, professional judgement, or even gut feeling. As analysts, we collectively try to fill the blanks between facts with estimates. Hence, exposure to critical scrutiny is vital in order to keep an open mind and the analysis reasonably clean. In this, we are grateful to each of the conference participants, without whose lively discussions and invaluable written contributions – in a compact and concentrated format – this edited volume would not have been possible. We hope the contributions herein will set the stage for further discussions.

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[411] Mitch Ginsburg, "Could Israeli F-35s Turn the Tables on Iranian S-300 Missiles?" *Times of Israel*, April 19, 2015, https://www.timesofisrael.com/could-israeli-f-35s-turn-the-tables-on-iranian-s-300-missiles.

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States with the ability to use a combination of sensors and long-range missiles to prevent adversaries from operating and thus creating an exclusion zone, are said to possess anti-access/area denial (A2/AD) capabilities. This collection of essays uses our previous FOI report on Russian A2/AD capabilities (Bursting the Bubble) as a point of departure. Ten experts analyse five themes: Russian A2/AD capabilities today and in the future; options for counter-A2/AD operations in Europe; concepts for defending or reconquering territory under a hostile A2/AD umbrella; different approaches to managing the long-range precision strike threat; and the impact of A2/AD on the balance of power in Europe.

The study does not arrive at any single, overarching conclusion, but there is significant convergence of views amongst a majority of the authors. On the one hand, Russia cannot create impenetrable "bubbles" where NATO forces cannot operate. On the other hand, counter-A2/AD operations are complex, requiring significant assets and capabilities, and carry significant risk of high attrition rates. The critical factors are the assets required, expected attrition rates, the time frames needed – and political will to shoulder costs and risks. A majority of the authors also argue that Russian A2/AD would be at its most troublesome during a short, sharp war, making well-rehearsed countermeasures essential.

Compared to Bursting the Bubble, the multi-domain character of counter-A2/AD operations, including i.a. electronic warfare and non-military means, is emphasised, thus deepening the granularity of the analyses. Considerable uncertainty or disagreement remains on topics such as the level of integration within Russian air defences, the impact of stealth, and electronic warfare.