



REPORT

AIR DEFENCE OF THE BALTIC STATES

| SIR CHRISTOPHER HARPER | TONY LAWRENCE | SVEN SAKKOV |

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63/4 Narva Rd., 10152 Tallinn, Estonia
info@icds.ee, www.icds.ee

FOREWORD

Europe currently faces the greatest set of external risks to its security since the end of the Cold War. Instability to our south requires our constant engagement and brings the challenges of migration and terrorism to our borders. Chapters that we had thought closed – such as Afghanistan and the Western Balkans – demand our renewed attention. To our east, a resurgent Russia is testing us on a range of fronts, and has reminded us once again that we need to be steadfast if we are to deter aggression and armed conflict on our continent.

NATO, the cornerstone of our defence, has reacted rapidly and effectively to the military threat posed by Russia. The enhanced Forward Presence, agreed by the Allies at the Warsaw Summit in 2016, is a considered response that demonstrates the Alliance's collective determination to secure its north-eastern flank. The four battalions it places in Estonia, Latvia, Lithuania and Poland substantially enhance deterrence, and bring additional defence capability to the territories of NATO's more vulnerable Allies.

If, however, deterrence fails, the Allies will need to reinforce the Baltic region by land, sea and air, and should expect to face Russia's attempts to use its increasingly sophisticated air power to frustrate their reinforcement and defence operations. But Baltic air defence capability is thin. With its crucial role of creating a permissive environment for defence, it is perhaps the most serious military capability shortfall in the region. It is in the interests of both the Baltic states and the wider Alliance that this shortfall is urgently addressed.

Filling the air defence gap will be challenging but, as this report demonstrates, a significant improvement in today's situation is achievable. Cooperation will be essential. Substantial effort will be required from the Baltic states to build a basic air defence capability, but a far more effective posture can be created with additional support from the rest of NATO. The three Baltic states themselves will also need to work together if they are to make best use of scarce resources and attract this extra support from NATO. Furthermore, regional air situational awareness would greatly benefit from cooperation with NATO's partners, Finland and Sweden.

I commend the Estonian Ministry of Defence for its determination to address this problem and its commissioning of this important and timely report from the International Centre for Defence and Security. I very much welcome the authors' exploration of the deficiencies in Baltic air defence and their proposal of a sensible and realistic set of solutions.

Anders Fogh Rasmussen

Secretary General of NATO, 2009 to 2014

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Our thanks are also due to General Philip Breedlove for his unpaid expert advice, to personnel of the Estonian Air Force for their answers to many technical questions, and to Gabriel White, our intern at ICDS, who assisted greatly in gathering background information for this report.

While we have received much valuable help from others, the conclusions and recommendations of this study, as well as any errors of fact or judgement, are ours alone.

ABOUT THE AUTHORS

AIR MARSHAL SIR CHRISTOPHER HARPER

Air Marshal Sir Chris Harper joined the Royal Air Force as a fighter pilot in 1976. He flew numerous aircraft including the Jaguar, the CF-18 and, more recently, the Eurofighter Typhoon. He was involved in active operations over Iraq and in the Balkans, and has commanded at all levels of the RAF including – as a 2-star – as the Air Officer Commanding all the RAF's combat air power.

Sir Chris has also held important staff appointments in the UK MoD and at the RAF's Air Command headquarters. His last seven years in the RAF saw him working in NATO. From 2009 to 2011, he was Deputy Commander of NATO's Joint Force Command at Brunssum in the Netherlands; following that, he was the UK's Military Representative to NATO and the EU in Brussels. Most recently, from 2013 to 2016, he was the Director General of the NATO International Military Staff. From this high-level military-diplomatic position in NATO HQ in Brussels, he managed the Alliance's political-military seam and was responsible for developing, negotiating and gaining consensus amongst NATO's 28 Allies for innumerable major NATO strategic policy decisions.

Sir Chris left the RAF in January 2017. Determined not to let his experience in international defence and security go to waste, he started a small, independent consultancy company, CH4C Global Ltd. Sir Chris regularly speaks at key events such as the Munich and Berlin Security Conferences and at Wilton Park. He is the Honorary Air Commodore of No. 2620 'County of Norfolk' Squadron of the Royal Auxiliary Air Force and is the President of the RAF Flying Clubs Association. He is a Trustee of the Air League and a Non-resident Senior Fellow of the Atlantic Council.

TONY LAWRENCE

Tony Lawrence is the Head of the Defence Policy and Strategy Programme at the International Centre for Defence and Security. He worked at ICDS from its establishment in 2006 until 2013, returning to the Centre in 2016 after a career break. His major projects have included chairing a multidisciplinary study of options for the future of NATO's Baltic Air Policing mission, leading studies evaluating alternatives for organising strategic-level defence institutions in Estonia and developing policy positions on defence issues for Estonia's presidency of the Council of the EU, and directing the 2013 Annual Baltic Conference on Defence.

Between 2005 and 2013, Tony was also an Assistant Professor at the Baltic Defence College, responsible for the design and delivery of around 50% of the annual Higher Command Studies Course. Tony spent the first half of his career as a civil servant in the UK Ministry of Defence, including appointments in scientific research and procurement, and policy positions dealing with NATO issues, operational policy in the Balkans, the European Union's security and defence dimension – now CSDP – and ballistic missile defence.

SVEN SAKKOV

Sven Sakkov has been the Director of the International Centre for Defence and Security since September 2017.

For the prior two years he was the Director of the NATO Cooperative Cyber Defence Centre of Excellence, an international knowledge hub specialising in research, training and exercises in the areas of technology, strategy, operations and law. As the director of CCDCOE, Sven led an international staff from 20 countries and various specialities.

Between 2008 and 2015 he served as the Undersecretary for Defence Policy (policy director) of the Estonian Ministry of Defence. During his tenure, he was responsible for policy planning, threat assessments, NATO and EU policy, and international cooperation and arms control. He was also the Estonian representative to the NATO Senior Officials' Group. Previously, Sven has served at the Estonian Embassy in Washington and the Estonian Mission to NATO, as national security and defence advisor to the President of Estonia, and as the Director of Policy Planning of the MoD.

EXECUTIVE SUMMARY

This report concerns air defence capabilities for the Baltic states. The armed forces of Estonia, Latvia and Lithuania are relatively small and light and NATO's local presence – enhanced Forward Presence – is sized as a tripwire. NATO's defence of the region is thus heavily reliant on its ability to quickly deploy reinforcements. Land, air and sea movements, however, are vulnerable to the substantial air power Russia has built in the Western Military District and to its long-range Anti-Access/Area Denial capabilities. Air defence is the biggest military capability gap in the region, and while the three states have taken steps to address this, the full range of systems required for comprehensive, layered air defence is prohibitively expensive. This is a concern for the Baltic states, but a vulnerable north-eastern flank should also be a concern for NATO as a whole.

The key air defence shortfalls in the Baltic states are:

- **in C4ISR**, including gaps in low-level radar coverage, vulnerabilities in the communications network for air command and control, insufficient trained personnel to command and control air defence operations in times of crisis, inadequate interoperability with deployed NATO air defence assets, a lack of situational awareness of Finnish and Swedish airspace, and the lack of a standing NATO Joint Force Air Component for air command and control in times of crisis; and
- **in weapon systems**, including the lack of integration of existing Ground-Based Air Defence systems with Baltic air command and control arrangements, limited missile stockpiles, the non-availability (in some cases) of Ground-Based Air Defence from the start of a crisis, and the lack of anything other than short-range Ground-Based Air Defence systems.

The three states alone will not be able to address these shortfalls and must look to NATO and the Allies for assistance. Together, the Baltic states and the rest of NATO can take a shared, coherent approach to enhance deterrence and air defence in the Baltic region. We thus recommend measures that the Baltic states should take to mitigate air defence shortfalls, most of which should be implemented through a common Baltic approach and will require substantial investment and reprioritisation. We also recommend actions for NATO to complement these measures.

LIST OF ABBREVIATIONS

A2AD	Anti-Access/Area-Denial
ACCS	Air Command and Control System
AFSC	Alliance Future Surveillance and Control
AMRAAM	Advanced Medium-Range Air-to-Air Missile (also known as AIM-120)
APOD	Air Port of Debarkation
ASBE	ACCS Software Based Element
ASDE	Air Situation Data Exchange
ASW	Anti-Submarine Warfare
AWACS	Airborne Warning and Control System
BALTNET	Baltic Air Surveillance Network
BFC	BALTNET Future Configuration
BMD	Ballistic Missile Defence
CAOC	Combined Air Operations Centre
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CMD	Central Military District (Russia)
CRC	Control and Reporting Centre
CRP	Control and Reporting Post
DACCC	Deployable Air Command and Control Centre
EDI	European Deterrence Initiative
eFP	enhanced Forward Presence
EPAA	European Phased Adaptive Approach
GBAD	Ground-Based Air Defence
HQ AIRCOM	HQ Air Command
ISR	Intelligence, Surveillance and Reconnaissance
IAMDS	Integrated Air and Missile Defence System
IFF	Identification Friend or Foe
JASSM	Joint Air-to-Surface Standoff Missile
JFAC	Joint Force Air Component
JREAP	Joint Range Extension Applications Protocol
LVC	Live, Virtual, and Constructive
MANPADS	Man-Portable Air Defence System
MRAD	Medium-Range Air Defence
NAEW&C	NATO Airborne Early Warning and Control
NASAMS	Norwegian Advanced Surface to Air Missile System
NATINAMDS	NATO Integrated Air and Missile Defence System
NB8	Nordic-Baltic 8
NIAMD	NATO Integrated Air and Missile Defence
NORDEFCO	Nordic Defence Cooperation
NSIP	NATO Security Investment Programme
PESCO	Permanent Structured Cooperation
QRA	Quick Reaction Alert
RAP	Recognised Air Picture
SAM	Surface-to-Air Missile
SLAMRAAM	Surface-Launched Advanced Medium-Range Air-to-Air Missile
SMD	Southern Military District (Russia)
SPOD	Sea Port of Debarkation
TDL	Tactical Data Link
UAS	Unmanned Aerial System
VDV	Vozdushno-desantnye Voyska Rossii (Russian Airborne Forces)
VSHORAD	Very Short-Range Air Defence
WMD	Western Military District (Russia)



INTRODUCTION

This report, commissioned from the International Centre for Defence and Security by the Estonian Ministry of Defence, concerns air defence capabilities for the Baltic states. It describes the Russian air threat to the Baltic region; outlines existing and planned Baltic air defence capabilities; identifies shortfalls; and proposes options for addressing these shortfalls.

The report has been written following extensive discussions with officials and military personnel in Estonia, Finland, Latvia, Lithuania, Poland and Sweden, and in NATO headquarters and the Joint Air Power Competence Centre. Regrettably, we were able to hold only limited discussions with senior representatives of the NATO military authorities, hence their perspectives are not comprehensively represented in what follows. In order to ensure frank discussions, all interlocutors were guaranteed anonymity and, while our report draws extensively on the information and views they provided, their comments are not individually attributed.

Our report makes the following assumptions:

- because of the small size of the three Baltic states and the high speed of air operations, we consider the three states to be a single block of airspace within a single area of operations. It follows that we look, where feasible, for common solutions to address capability shortfalls;
- a key security concern in the Baltic region is Russia's Anti-Access/Area-Denial (A2AD) capability, which has the potential to deny Allies entry to the region for reinforcement, and to limit freedom of manoeuvre there. We consider A2AD only so far as it pertains to air defence; we have not examined solutions to the wider Baltic A2AD problem; and
- our report is intended to provide an overview and high-level assessment of possible solutions to air defence shortfalls in the Baltic states. More detailed work on technical aspects will need to be conducted before its recommendations may be implemented.

In generating recommendations, we have been

guided by the following considerations. First, the existing Baltic air defence architecture has critical deficiencies which are obstacles to NATO's efficient and effective air defence of the region in times of crisis – for example, if local control of the airspace is (as is currently the case) inadequate, NATO can take full advantage of long-range air defence assets only if it also deploys command and control capability to the region. These deficiencies must be addressed by the three states as a

The existing Baltic air defence architecture has critical deficiencies which are obstacles to NATO's efficient and effective air defence of the region

matter of urgency, although this alone will not result in comprehensive air defence in the region. For this, further steps are required.

Second, these further steps will be expensive. The three states will not be able to do all that is necessary to provide adequate levels of air defence for their territories unaided. They must look to NATO and the Allies for assistance. Together, the Baltic states and the rest of NATO can provide a coherent package of measures to enhance deterrence and air defence in the Baltic region. The Baltic states must be ready to make joint efforts, including fresh investment and/or reprioritisation, to enhance their air defences, or there will be little motivation for NATO or the Allies to step in to solve the problem for them. The impetus to address Baltic air defence shortfalls should thus come primarily from the three Baltic states. Only where shortfalls cannot reasonably be addressed here do we recommend solutions that will require actions from NATO collectively, or from the Allies individually or in groups.

It is, however, important to stress that a more credible deterrence and air defence posture on its north-eastern flank is vital for NATO too. Robust air defence is essential: to protect the mobilisation of the reserve forces critical to the initial stages of the defence of the Baltic states; to protect NATO forces deployed to the Baltic states under enhanced Forward Presence (eFP) and other deployments or exercises; to protect the Sea and Air Ports of Debarkation (SPOD

and APOD) necessary to reinforce the Baltic region; and to complicate the calculus of an adversary who will be unable to assume local air superiority.

Third, we intend that our proposed solutions should be realistic and able to be implemented in the short- to medium-term. For this reason, we have discarded options that we judge to be too ambitious in the present economic and political climate. These include ideas such as an immediate move to a standing, peacetime Baltic Air Defence mission, permanent deployment of long-range Allied Ground-Based Air Defence (GBAD) systems to the Baltic region, or a NATO programme to develop a commonly owned long-range, GBAD capability.¹

Fourth, where possible we have looked for common Baltic solutions for air defence. This will:

- offer opportunities for saving resources through economies of scale;
- improve interoperability between the three states and ensure easier integration into wider NATO architectures. At present a regional approach to air defence is made difficult by the operation of different systems, lack of commonality in operating procedures, and disjointed training;
- ensure that air defence is continuous over the territories of the three states, both technically and in policy terms – an essential requirement given the size of the Baltic states and the high speed of air operations. Progress towards seamless air defence will offer opportunities to review and fill gaps in other operating domains; and
- accord with NATO/EU concepts that promote defence cooperation (e.g. smart defence, PESCO) thus earning greater support from other Allies.

Finally, we recognise that, although for reasons of brevity and clarity and because we consider them to be a single block of airspace within a single area of operations we discuss the three Baltic states as a whole in this report, so far they have tackled their air defence shortages at different rates, as finances and other priorities allow. Some are further ahead than others. The shortfalls we identify in this report, and the recommendations we make for addressing them, do not apply equally to all three states.

This report contains five substantive sections. Section 1 outlines the strategic context in the Baltic states and describes the Russian air threat to the region. Section 2 provides a brief primer on air defence and introduces concepts that will be discussed later in the report. Section 3 describes the existing and planned air defence capabilities of the three Baltic states, as well as those of Finland, Poland and Sweden. Section 4 describes key air defence shortfalls, and Section 5 offers a number of potential solutions. We close our report by drawing brief conclusions and summarising our recommendations.

1. THE STRATEGIC CONTEXT

The Russian Federation is behaving as a revisionist power, with an apparent wish to overturn the existing European security architecture and, more widely, the entire global order. In pursuit of that goal Russia has, amongst other things, invaded Georgia and occupied one fifth of its territory (2008-present), annexed Crimea and waged war in Donbas

Russia's challenge to the West has taken many different forms, from cyber-attacks and information warfare to subversion and corruption

¹ Luke Coffey and Dan Kochis, "Time for the Baltic Air Policing Mission to Become the Baltic Air Defense Mission," Heritage Foundation Issue Brief, No. 4679, 2 October 2017, 3; Breedlove, Philip M, Towards Effective Air Defense in Northern Europe (Washington DC: Atlantic Council, 2018), 5, Andrius Sytas, "Baltics need anti-aircraft protection against Russia, Lithuania says," Reuters, 20 July 2017, <https://www.reuters.com/article/us-usa-baltics-patriot/baltics-need-anti-aircraft-protection-against-russia-lithuania-says-idUSKBN1A51VC>

(2014-present), inserted itself into the Syrian civil war (2015-present), interfered in the US presidential elections (2016), instigated a coup attempt in Montenegro (2016), and used chemical nerve agents on the territory of the UK (2018). Russia's challenge to the West has taken many different forms, from cyber-attacks

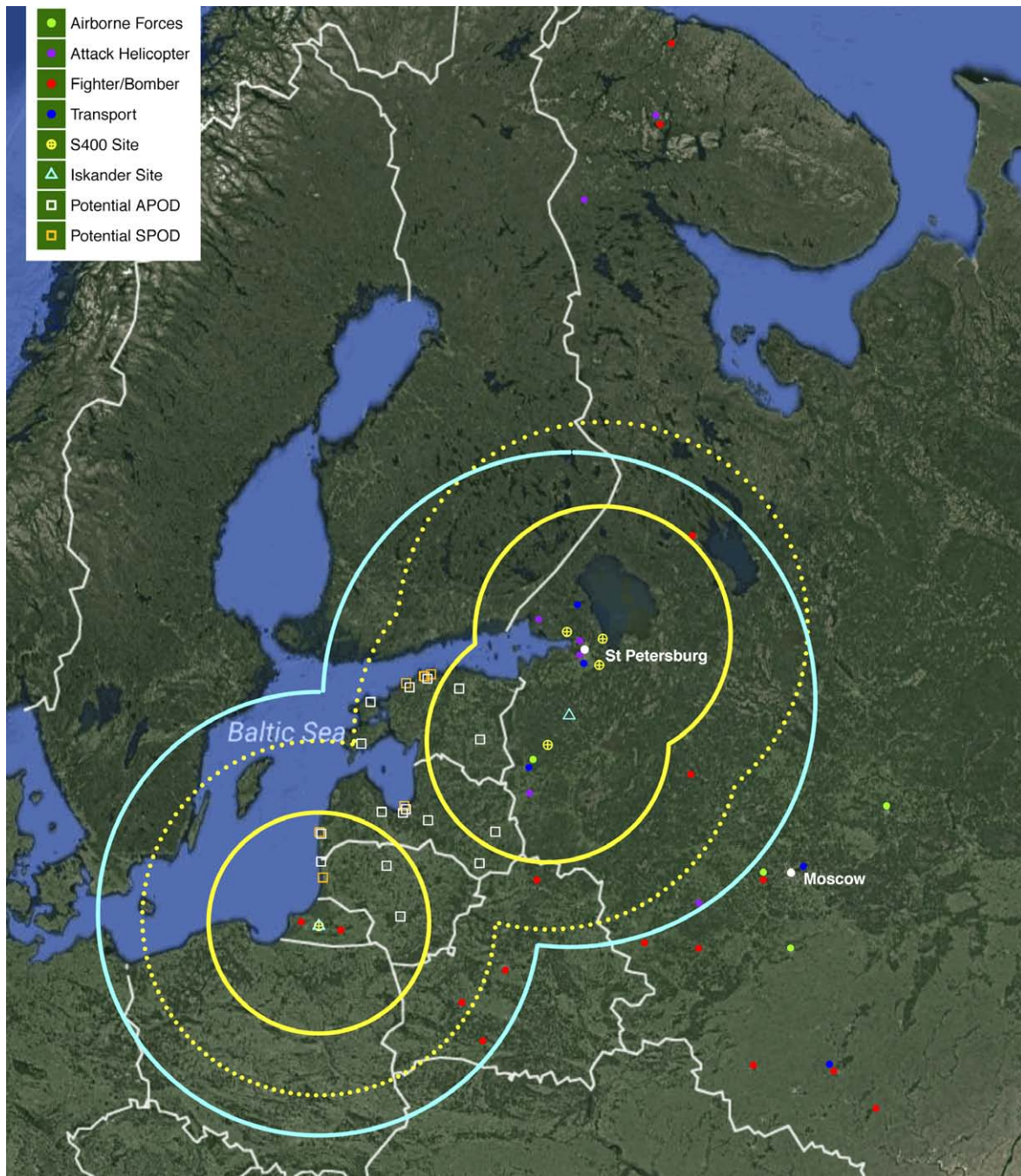


Figure 1. Selected Russian Air and A2AD Capability near the Baltic Region.²

and information warfare to subversion and corruption. The collection of different tools used by Russia in its quest to undermine the current European security architecture is usually referred to as hybrid warfare. While this report concentrates on conventional military capability, we should not lose sight of this wider effort.

Building on the lessons it learned from its war against Georgia, Russia has put considerable effort into the modernisation of its Armed Forces. New weapon systems have usually been first fielded in Russia's Western Military District (WMD), the strategic command that adjoins the territories of NATO and EU member

² Missile ranges: Iskander – 500km, upper range estimate, MISSILETHREAT: CSIS Missile Defense Project, "SS-26 (Iskander)," <https://missilethreat.csis.org/missile/ss-26/>; S400 – 250km (manufacturer's claim) and 400km (estimated, although likely exaggerated range of the 40N6 missile), Maciej Kowalski, "Restoring the balance on NATO's eastern flank," DefenseNews, 17 May 2017, <https://www.defensenews.com/land/2017/05/17/restoring-the-balance-on-natos-eastern-flank-commentary/>.

states. In the air domain, this effort has included the replacement of the SS-21

New weapon systems have usually been first fielded in Russia's Western Military District

(Tochka/Scarab) ballistic missile with the SS-26 (Iskander/Stone) and the deployment of S-400 (Triumf/SA-21 Growler) GBAD units.³ In 2018, the Baltic Fleet will acquire two Karakurt class missile corvettes armed with 2500km-range Kalibr cruise missiles, a capability that Russia has previously exercised in Kaliningrad.⁴ These modernisation efforts have already led to a significant increase in Russia's A2AD capability around the Kaliningrad Oblast and St Petersburg (see Figure 1). The WMD has also benefitted from a substantial increase in its overall force posture – two Army commands (the 1st Guards Tank Army and 6th Army) and four new divisions have been added to its order of battle during the last decade, bringing the total number of troops there to around 300 000.⁵

Furthermore, the Russian Armed Forces have frequently conducted no-notice battle readiness exercises which, along with factors such as the geographical proximity of Russia to its targets, its small, closed decision-making circle, and the decline in the West's capacity for Russia analysis, have complicated NATO's ability to identify and assess warnings.⁷

Zapad 2017 was much wider in geographical scope, much larger in the number of forces involved, and much broader in the capabilities rehearsed than Russia announced in advance

Both Russia's invasion of Ukraine and its move into Syria, for example, were preceded and clouded by large-scale snap exercises. The massive exercise Zapad 2017 was conducted along the whole stretch of Russia's western border, from the Arctic Sea to the Black Sea. Estimates of the numbers of personnel involved vary widely, but certainly exceeded the declared figure of 12 700; all told, more

	2017				2018	
	Defence expenditure (€million)	Defence expenditure as %age of GDP	Equipment expenditure as %age of defence expenditure	Equipment expenditure (€million)	Defence expenditure (€million)	Defence expenditure as %age of GDP
Estonia	479	2,08	19,2	92	524	2,14
Latvia	470	1,75	17,2	81	576	>2,0
Lithuania	724	1,73	31,1	225	873	>2,0

Table 1. Baltic States' Defence Expenditure, 2017-8 Estimates.⁶

than 100 000 likely took part. In any event, Zapad 2017 was much wider in geographical scope, much larger in the number of forces involved, and much broader in the capabilities rehearsed than Russia announced in advance.⁸

³ Roger McDermott, "Russia's Military Precision Strike Capability Prioritizes Iskander-M," Eurasia Daily Monitor 14(82), <https://jamestown.org/program/russias-military-precision-strike-capability-prioritizes-iskander-m/>; "Russia's Western Military District to get four S-400 missile systems this year," TASS, 13 January 2017. <http://tass.com/defense/924840>.

⁴ Välisluureamet (Estonian Foreign Intelligence Service), *International Security and Estonia 2018*, (Tallinn: Välisluureamet, 2018), 19; Fredrik Westerlund, "Russia's Military Strategy and Force Structure in Kaliningrad," *RUFBS Briefing*, no. 40, May 2017, 1.

⁵ Comprising the Baltic Fleet, the 6th Red Banner Leningrad Army of Air and Air Defence Forces, the 6th and 20th Armies, the 1st Guards Tank Army, three divisions and one brigade of airborne forces, marines and coastal defence forces, and intelligence, support and specialised units and formations. Anna Maria Dyer, "Russia Beefs Up Military Potential in the Country's Western Areas," *PISM Bulletin*, no 35 (885), 13 June 2016, 1.

⁶ For 2017: NATO, "Defence Expenditure of NATO Countries (2010-2017)," Communiqué PR/CP(2018)16, 15 March 2018, 6, 8, 12. For 2018: Ministry of Defence (Estonia), "Defence Budget," Ministry of Defence, 12 February 2018, <http://www.kaitseministeerium.ee/en/objectives-activities/defence-budget>; Beth Stevenson, "Latvia's defence spending to reach 2% of GDP in 2018," IHS Jane's Defence Weekly, 27 November 2017, <http://www.janes.com/article/75972/latvia-s-defence-spending-to-reach-2-of-gdp-in-2018>; "Lithuania's defence budget: expanded and expanding," The Baltic Times, 28 February 2018, https://www.baltictimes.com/lithuania_s_defence_budget_expanded_and_expanding/.

⁷ Mark Cozak, *Strategic Warning on NATO's Eastern Flank. Pitfalls, Prospects and Limits* (Santa Monica: Rand, 2018), 30-33.

⁸ Välisluureamet, *International Security and Estonia 2018*, 18-19.

NATO's reorientation, meanwhile, has been different. Following the 2001 terrorist attacks on the US, the Alliance focused on fighting insurgencies far from its home territory, requiring a very different set of capabilities from those needed to face a military challenge from a near-peer state adversary. After the Russian annexation of Crimea and invasion of Donbas, NATO has once more put greater emphasis on its core mission of collective defence. However, inadequate levels of defence investment in most European NATO states suggest that there is still some lingering hope that Russia's challenge to the West will somehow dissipate.

The Alliance's most notable response to the Russian challenge has been the deployment of four multinational battalions to its eastern flank, one to each of the Baltic states and one to Poland, under the eFP programme. While welcome, these deployments are limited and do not yet constitute the jointly enabled military capability along NATO's eastern flank decided at the Warsaw Summit.⁹ The Baltic states themselves are small and have limited resources (see Table 1 for an overview of current Baltic defence spending). They are able to field only small, light armed forces. While NATO may enjoy conventional military predominance over Russia in general, in the Baltic region – the only

eFP is sized as a tripwire. NATO's defence is thus heavily reliant on its ability to quickly reinforce the region. Reinforcement by land is difficult as the narrow land corridor around Suwalki in Poland, which connects the rest of NATO territory to Lithuania, is sandwiched between Kaliningrad and Russia's ally Belarus. Air and sea movements, meanwhile, are vulnerable to Russia's A2AD capabilities. In addition, Sweden and Finland's status as militarily non-aligned nations further complicates the logistic and operational situation facing the Alliance in the Baltic region.

The biggest gap in military capabilities in the region is in air defence

Unfortunately, the West has not yet been successful in reining in Russia's malign activities. The funding of NATO nations' defence forces remains challenging, the EU is distracted by matters such as Brexit, populism is on the rise on both sides of the Atlantic, and Donald Trump's presidency is not traditional. The current lack of a credible Western military response to the Russian challenge brings the risk that the Kremlin may miscalculate the cohesion and resolve of the Allies to defend their eastern members. One way of reducing the likelihood of such a miscalculation is for NATO and the Allies to further bolster their defence efforts in the Baltic states. The biggest gap in military capabilities in the region is in air defence.¹¹ Reducing that gap is not only critical for the security of the region, but also for the security of NATO as a whole.

In the Baltic region Russia enjoys a time and space advantage over NATO

NATO region with a significant land border with Russia – it is Russia that enjoys a time and space advantage over NATO. A number of recent studies and war games have illustrated the vulnerability of the Baltic states to Russia's local advantage.¹⁰

Moreover, the Baltic states' geostrategic position does not favour NATO's defence efforts. The armed forces of Estonia, Latvia and Lithuania are relatively small and light and the

1.1. THE RUSSIAN AIR THREAT

In this section, we outline Russia's military doctrine and capabilities in the air domain, in particular those located in the Western Military District adjoining NATO's borders.

⁹ "Joint Statement. Prime Ministers' Council of the Baltic Council of Ministers," Tallinn, 18 December 2017, 1.

¹⁰ Most notably, David A. Shlapak and Michael Johnson, *Reinforcing Deterrence on NATO's Eastern Flank. Wargaming the Defense of the Baltics* (Santa Monica: Rand, 2016). See also, for example, Heather Conley, Jeffrey Rathke and Matthew Melino, *Enhanced Deterrence in the North. A 21st Century European Engagement Strategy* (Washington DC and Lanham MD: CSIS and Rowman & Littlefield, 2018); Wesley Clark, Jüri Luik, Egon Ramms, and Richard Shirreff, *Closing NATO's Baltic Gap* (Tallinn: ICDS, 2016).

¹¹ Air defence was the only military capability specifically referenced in the joint statement issued by the three Baltic and US Presidents following their 3 April 2018 meeting: "We continue to explore new ideas and opportunities, including air defense, bilaterally and in NATO, to enhance deterrence across the region." The White House, Office of the Press Secretary, "A Declaration to Celebrate 100 Years of Independence of Estonia, Latvia and Lithuania and Renewed Partnership," 3 April 2018.

1.1.1. RUSSIAN DOCTRINE

In the post-Cold War period, Russia has seen its aerospace forces as a primary means of achieving its political objectives and potentially as a means of circumventing the need to capture and hold territory.¹² Russia's latest general military doctrine, released in 2014, recognises the key role of air and space forces in wartime, and directs the strengthening of air defence capabilities as a priority for military development.¹³ Russian air superiority in a conflict would also make possible the deployment of its airborne infantry forces (VDV), which analysts suggest would be used promptly to seize strategically important locations and infrastructure or to disrupt ground-based defensive operations. Overall, Russian VDV forces amount to four manoeuvre divisions, including the 76th Guards Air Assault Division based in Pskov, and an additional five brigades.¹⁴

Against this background, the three Baltic states share a common view of the priorities for their air defence. These are, in general terms, mobilisation facilities, manoeuvre units, and air and sea ports of debarkation.

1.1.2. RUSSIAN AIR CAPABILITY

Figure 1, compiled from public sources and an examination of publicly available satellite imagery, provides an overview of Russian fixed and rotary wing capability in its WMD, as well as airborne infantry forces and selected ballistic and surface to air missile capability.

Russian air power in the Western Military District is substantial

Russian air power in the WMD is substantial. In total, there are 27 air squadrons and an additional six battalions of attack helicopters.¹⁵

¹² Defense Intelligence Agency (USA), *Russia. Military Power* (Defense Intelligence Agency, 2017), 33.

¹³ The Embassy of the Russian Federation to the United Kingdom of Great Britain and Northern Ireland, "The Military Doctrine of the Russian Federation," press release, 29 June 2015, 32f, 35c.

¹⁴ Defense Intelligence Agency, *Russia*, 55.

¹⁵ Richard Sokolsky, "The New NATO-Russia Military Balance: Implications for European Security," Carnegie Endowment for International Peace, March 13, 2017, <http://carnegieendowment.org/2017/03/13/new-nato-russia-military-balance-implications-for-european-security-pub-68222>.

Russia's attack helicopter units are principally equipped with Mi-24 Hind gunships. The fixed wing fighter and bomber squadrons comprise:

- North Sea Naval Aviation (38 fighters, 23 mixed role, 18 ground attack):
 - 1 squadron of Su-33 Flanker; Su-25 Frogfoot, (fighter)
 - 1 regiment of MiG-31 Foxhound (interceptor)
 - 1 regiment of MiG-31 Foxhound; Su-24 Fencer (interceptor/ground attack)
- Baltic Sea Naval Aviation (18 fighters, 10 ground attack, 4 ISR/ASW):
 - 1 squadron of Su-27 Flanker (fighter)
 - 1 squadron of Su-24M Fencer (anti-submarine)
- 6th Air Force and Air Defence Army (61 fighters, 74 mixed role):
 - 1 regiment of MiG-29 Fulcrum (fighter)
 - 1 regiment of MiG-31BM Foxhound; Su-27 Flanker (fighter)
 - 1 regiment of Su-27 Flanker; Su-35S Flanker (fighter)
 - 1 regiment of Su-34 Fullback (ground attack)
- Four Squadrons of Tu22M3 Backfires (long range strategic bomber).¹⁶

In the event of conflict, air assets could also be rapidly introduced from Russian air squadrons ordinarily located in the Central and Southern Military Districts (fighter and bomber complements: CMD – 40 MiG-31 Foxhound, 26 Su-24M Fencer, 11 Su-25SM Frogfoot; SMD – 12 MiG-29 Fulcrum, 34 Su-27 Flanker, 12 Su-27SM Flanker, 12 Su-27SM3 Flanker, 4 Su-30M2, 22 Su-30SM, 36 Su-34 Fullback).¹⁷

Russia's 5th generation fighter, the Su-57 is intended to replace the 1980s-vintage MiG-29 and Su-27. Prototype aircraft have been deployed to Syria, but it remains unclear how quickly Russia will be able to introduce this aircraft into its air forces.¹⁸ Meanwhile,

¹⁶ International Institute for Strategic Studies, "Russia and Eurasia," in *The Military Balance* 2017, ed. James Hackett (London: Routledge for the IISS, 2017), 218-219.

¹⁷ Ibid, 220-221.

¹⁸ Fergus Kelly, "Russia to Order 12 fifth generation Su-57 stealth fighters to 'test combat use'," The Defense Post, 8 February 2018, <https://thedefensepost.com/2018/02/08/russia-order-su-57-stealth-fighter-test-combat-use/>.

analysts have noted that the failure of past acquisition projects to produce credible successors to Russia's aging fleet of ground attack and fighter aircraft will place a growing strain on the fighting capability of its current aerospace forces as maintenance and logistics challenges will be sharply compounded.¹⁹

Russia is also actively seeking to integrate Unmanned Aerial Systems (UAS) companies into each of its manoeuvre brigades for intelligence collection, targeting and electronic warfare (cellular network jamming capability, for example, has already been demonstrated).²⁰ As an aside to this report, we note that NATO is apparently inadequately prepared, both in policy terms and technologically, to deal with the growing threat from UAS.

1.1.3. RUSSIAN AIR DEFENCE AND A2AD

Russia's Air Defence and Air Force were merged in 2015 to form the Russian Federation Aerospace Forces, effectively linking both aspects of the air domain and emphasising the increased importance of air operations in conjunction with A2AD systems.²¹ In the event of conflict, Russia could be expected to

Russia could be expected to employ offensive air power while denying air superiority to Allied forces

seek a major advantage, at least in the short-term, by employing offensive air power while denying air superiority to Allied forces through its sophisticated GBAD systems. It has been suggested that Allied 4th generation and older aircraft would face challenges operating in the vicinity of Russian air defence systems and it is not yet known how effective American-made 5th generation aircraft will be in combatting both Russian air defence positions and modern Russian aircraft in the sky.²²

¹⁹ Pavel Baev, "Russian Air Power is too Brittle for Brinkmanship," PONARS Policy Memo 398, November 2015, <http://www.ponarseurasia.org/memo/russian-air-power-too-brittle-brinkmanship>.

²⁰ Keir Giles, "Assessing Russia's Reorganized and Rearmed Military," Carnegie Endowment for International Peace, May 3, 2017, <http://carnegieendowment.org/2017/05/03/assessing-russia-s-reorganized-and-rearmed-military-pub-69853>.

²¹ Defense Intelligence Agency, *Russia. Military Power*, 36-7.

²² Giles, "Assessing Russia's Military".

Russia formed a joint air defence system with Belarus in 2016 and has also attempted, without success, to secure an agreement for permanent basing of military aircraft in the country.²³ Russia sees Belarus as a crucial component in any military conflict with NATO. There are some indications that Belarus might be reluctant to be part of such hostilities, but it is prudent to include their participation in defence planning.²⁴ The Belarussian air force is made up of four squadrons of fighter/ground attack aircraft: two MiG-29S/UB Fulcrum and two Su-25K/UBK Frogfoot, roughly 40 combat capable aircraft in total.²⁵ A Belarussian order for Su-30 Flanker-C is still ongoing, with 12 fighters expected to be delivered in 2019.²⁶

2. AN INTRODUCTION TO AIR DEFENCE

In this section, we provide a brief introduction to air defence for the reader who may be less familiar with some of the concepts and terminology involved.

2.1. TERMINOLOGY

Counter air operations are offensive and defensive operations intended to neutralise or destroy enemy air threats, both before and after launch (see Figure 2). Offensive counter air operations include fighter escort and sweep, attack operations against enemy air and missile capabilities, and operations to suppress enemy air defences by kinetic or electronic means. Defensive counter air operations include both active and passive air and missile defence.²⁷

²³ "РФ и Белоруссия завершили формирование объединенной системы ПВО (Russia and Belarus have completed the formation of a unified air defence system)," TASS, 6 April 2016, <http://tass.ru/armiya-i-opk/3182121>; Chris Biggers, "Russian Airbase in Belarus Remains in Limbo," Bellingcat, 27 December 2015, <https://www.bellingcat.com/news/uk-and-europe/2015/12/27/russian-airbase-belarus-remains-limbo/>.

²⁴ Eugene Rumer and Bogdan Belej, "Belarus: With Friends Like These...", Carnegie Endowment for International Peace, 31 May 2017, <http://carnegieendowment.org/2017/05/31/belarus-with-friends-like-these---pub-70135>.

²⁵ International Institute for Strategic Studies, "Russia and Eurasia, 204.

²⁶ Jaroslaw Adamowski, "Belarus to Acquire Su-30SM Fighters, Increase Strike Range," DefenseNews, 10 10 February 2016, <https://www.defensenews.com/2016/02/10/belarus-to-acquire-su-30sm-fighters-increase-strike-range/>.

²⁷ Joint Chiefs of Staff (US), *Countering Air and Missile Threats. Joint Publication 3-01* (2017), I-3 – I-5.

Active air and missile defence is intended to destroy or reduce the effectiveness of hostile air and missile threats against friendly forces and assets. It is conducted using a mix of air-, sea- and ground-based weapon and sensor systems, supported by secure command and control and communications systems, which work together to locate, identify, track and destroy enemy targets. Passive air defence does not involve the use of lethal weapons, but seeks to reduce the effects of enemy air attacks by measures such as camouflage, hardening, dispersal, electronic and infrared countermeasures, and stealth technologies.²⁸ An Integrated Air and Missile Defence System (IAMDS) brings together capabilities and operations to defend territory, protect forces and enable friendly freedom of action by negating an enemy's ability to use air and missile capabilities to create adverse effects. It includes offensive counter air attack operations, active and passive missile defence and additional capabilities such as counter rocket, artillery and mortars.²⁹

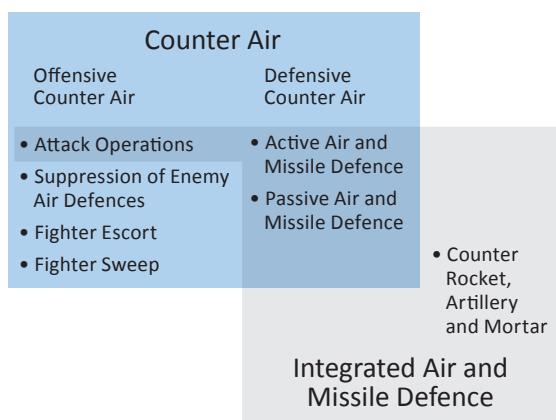


Figure 2. Counter Air and Integrated Air and Missile Defence (Adapted from United States Air Force, *Counterair Operations*)

In this report, we concern ourselves primarily with active air defence, which aims to create a favourable air operating environment in which Allied air power may be employed. Such a favourable environment is usually described as having 'air superiority', i.e. where friendly forces have sufficient control in particular time

and space combinations to operate without significant enemy opposition.³⁰ Air superiority has become a norm in recent decades in NATO and coalition operations against less sophisticated adversaries. Russia, however, would deploy a combination of tactics, strategies and capabilities to make the air environment in any future conflict 'contested', rather than 'permissive'.³¹

Active air defence aims to create a favourable air operating environment in which Allied air power may be employed

An IAMDS, then, is a system of systems with components that detect, identify, track and engage targets. Its command, control and communications sub-system synthesises sensor inputs and allocates sensor and engagement resources to discrete air defence tasks. A combination of weapon systems of varying range allows the defender to conduct a layered defence – one which seeks first, through offensive counter air, to deny an enemy the ability to launch air attacks, and then to defend critical assets through tiers of weapon systems of progressively reducing range.

The range of air vehicles that would challenge a contemporary IAMDS includes UAS, ballistic and cruise missiles, civilian aircraft used as terrorist weapons (the 'renegade' threat), and military aircraft employing stealth technologies. As noted earlier, counter rocket, artillery and mortar capabilities are also considered to be included in IAMDS, although these are not widely deployed and usually comprise weapon systems dedicated solely to these tasks.

2.2. SENSORS

Detection, identification and tracking is most commonly performed by active (i.e. emitting) or passive radar systems. Large geographical areas may be monitored with fixed or transportable/mobile air surveillance radars located to provide country-wide coverage. Weapon systems,

²⁸ United States Air Force, *Counterair Operations. Air Force Doctrine Document 3-01, interim change 2* (2011), 27-29.

²⁹ Joint Chiefs of Staff, *Countering Air and Missile Threats*, I-10 – I-12.

³⁰ Dag Henriksen, "Control of the Air," in *Routledge Handbook of Air Power*, ed. John Andreas Olsen (London and New York: Routledge, 2018), chap. 7, e-book.

³¹ Stephen Losey, "ACC boss: The Air Force's fighters must be ready to fly in contested air space," *AirForceTimes*, 17 September 2017, <https://www.airforcetimes.com/news/your-air-force/2017/09/17/acc-boss-the-air-forces-fighters-must-be-ready-to-fly-in-contested-air-space/>.

whether air-, sea-, or ground-based, will also usually include smaller radar systems for detecting, identifying and tracking targets. The inputs from several sensors are typically fused in the command and control subsystem to produce a Recognised Air Picture (RAP) – the most complete real-time picture of all aircraft within a specific airspace. This provides the situational awareness essential for understanding and reacting to rapid developments in the air environment. An Identification Friend or Foe (IFF) transponder interrogation system may also be used to positively identify friendly assets. NATO uses a common IFF system based on several interrogation modes, the latest being IFF mode 5.

2.3. WEAPON SYSTEMS

The weapon systems of an IAMDS may be based on the ground, at sea, or in the air. An IAMDS built largely around ground-based weapon systems will be considerably less expensive to acquire and operate than one built around sea- and air-based systems. Ground-based systems are thus routinely found in national armed forces, and even in the arsenals of some non-state actors. Although legacy anti-aircraft guns remain in service in some armed forces, most contemporary GBAD systems make use of missiles.

Depending on the range of these missiles and associated sensors, GBAD systems may be broadly categorised by their range as shown in Table 2. Very short- and short- range systems are useful for point defence tasks such as the defence of small manoeuvre units or of critical assets, while long-range systems provide large area cover. The weapon systems of an IAMDS may also include sea-based air defence missiles, and fighter or multi-role combat aircraft equipped with air-to-ground and air-to-air missiles. Sea-based missiles generally fall in the medium- to long-range bracket.³² The theoretical reach of an

³² For example: the Aster 15 and 30 missiles, used in the French-Italian-UK Principal Anti Air Missile System, are reported to have ranges in excess of 30km and 100km respectively. The Standard Missile-6, in service with the US Navy in anti-air, anti-ship and anti-ballistic missile roles, has a published range of 150 miles (240km) but is assessed to be able to reach targets more than 200 miles (320) distant. MBDA Missile Systems, "Aster 15 and 30," MBDA, <http://www.mbdasystems.com/product/aster-15-30/>; Eric Tegler, "The Navy's Air Defense Missile Will Become a Supersonic Ship Killer," Popular Mechanics, 10 February 2016, <https://www.popularmechanics.com/military/a19380/the-navy-is-turning-its-air-defense-missile-into-a-supersonic-ship-killer/>.

IAMDS with air-based missiles is limited only by the range of the aircraft themselves.

System	Illustrative Range (km)
Very Short-Range / Short-Range	<10
Medium-Range	10-50
Long-Range	50-200

Table 2. Illustrative Ranges of Ground-Based Air Defence Systems.

2.4. COMMAND, CONTROL AND COMMUNICATIONS

With potentially large numbers of various types of sensor and weapon systems, the efficiency and effectiveness of an IAMDS is dependent upon the degree to which its components can be integrated, networked and controlled. Sensor fusion, prioritisation of targets and allocation of sensor and engagement resources are provided by a command and control system which may employ anything from simple methods such as procedural or voice control, through to sophisticated artificial intelligence. The command and control system of an IAMDS thus comprises networked computers, and specially trained human operators in a variety of roles. Sensors, weapon systems and command

The efficiency and effectiveness of an IAMDS is dependent upon the degree to which its components can be integrated, networked and controlled

and control assets are connected through a communications network of Tactical Data Links (TDL) built upon a variety of radio or cable carriers, and employing one or more data link standards or protocols. Military data link standards relevant to this report include: Link 1, which provides tactical data exchange for air defence; Link 16, a jam-resistant, high-capacity TDL required to connect with many allied platforms; and the Joint Range Extension Applications Protocol, which allows the transmission of tactical data over media that were not originally designed for this purpose, e.g. satellite and internet protocol networks.³³

³³ Northrop Grumman, *Understanding Voice and Data Link Networking. Northrop Grumman's Guide to Secure Tactical Data Links* (San Diego: Northrop Grumman, 2014), 1-2 – 1-4.

3. CURRENT CAPABILITIES FOR AIR DEFENCE IN THE BALTIC STATES

The air defence of the Baltic states is currently realised through a combination of national, tri-national and NATO capabilities. Some elements, mostly those owned by the three Baltic states, are permanently in the region

The air defence of the Baltic states is currently realised through a combination of national, tri-national and NATO capabilities

and thus available for air defence missions on a continuous basis. Other elements owned by NATO or Allied nations may be brought to the region for exercises or periodic rotations. These latter elements are not available for air defence missions on a continuous basis, but are able to rehearse their crisis roles and, when deployed, to temporarily supplement local air defence capability. Table 3 summarises the provision of air defence capability in the Baltic region by NATO, by the states of the region collectively, and by the three Baltic states individually under the headings C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance), GBAD, and Air (i.e. air-based air defence). There are presently no sea-based capabilities contributing to Baltic air defence.

	C4ISR	GBAD	Air
NATO	<ul style="list-style-type: none"> • NATO NATINAMDS • ACCS/ASBE • AWACS 	<ul style="list-style-type: none"> • Deployments and exercises 	<ul style="list-style-type: none"> • Baltic Air Policing* • Deployments and exercises
Baltic tri-national	<ul style="list-style-type: none"> • BALTNET 	–	–
Individual Baltic states	<ul style="list-style-type: none"> • Surveillance radars 	<ul style="list-style-type: none"> • Legacy anti-aircraft guns • VSHORAD 	–

Table 3. Current Air Defence Capabilities in the Baltic States.

* Not an air defence mission – see section 3.3.

3.1. C4ISR

The air defence of the Baltic states is implemented through the NATO Integrated Air and Missile Defence System (NATINAMDS), an Alliance-wide capability to detect, track, identify and, if necessary, intercept air threats and thus protect Alliance territory, populations and forces from air attack.³⁴ NATINAMDS is currently based on legacy air command and control systems, which will be replaced by the NATO Air Command and Control System (ACCS) – a single, integrated system for “air mission control, air traffic control, airspace surveillance, airspace management, command and control (C2) resource management and force management functions.”³⁵ A parallel programme, the ACCS Software Based Element (ASBE), will extend ACCS capability to states that joined the Alliance between 2004 and 2009 (including Estonia, Latvia and Lithuania) to ensure their full integration into NATO air C2.³⁶

NATO Integrated Air and Missile Defence (NIAMD) operations are under the day-to-day tactical command of HQ Air Command (HQ AIRCOM), located at Ramstein Air Base in Germany. Most peacetime air C2 functions are delegated to two NATO Combined Air Operations Centres (CAOC). CAOC Torrejon, in Spain, deals primarily with operations in airspace south of the Alps, while CAOC Uedem, in Germany, deals with operations in airspace north of the Alps. The CAOCs provide command and control for NATO air policing from their peacetime locations, and also provide Deployable Air Operations Centres to support combat operations, usually through the augmentation of the HQ AIRCOM Joint Force Air Component (JFAC), a unit stood up to provide air C2 during times of crisis.³⁷ NATO also has a Deployable Air Command and Control Centre (DACCC) based in Poggio Renatico, Italy, to provide for forward deployment of air C2. Elements of the DACCC have from time-to-time

³⁴ NATO, “NATO Integrated Air and Missile Defence,” NATO, https://www.nato.int/cps/ua/natohq/topics_8206.htm.

³⁵ NATO, “NATO Air Command and Control System (ACCS),” NATO, https://www.nato.int/cps/en/natohq/topics_8203.htm.

³⁶ Hilary A. Whiteway, “Extending NATO’s new air command and control system,” NATO Communications and Information Agency, <https://www.ncia.nato.int/NewsRoom/Pages/150107-New-AirC2-control-system.aspx>.

³⁷ NATO, Allied Air Command, “NATO Air Command and Control Organisation,” Allied Air Command, <https://www.ac.nato.int/page925413>.



Figure 3. Baltic States' Principal Air Surveillance Radars.

deployed to the Baltic states, most recently to Lielvārde Air Base in Latvia for exercise Ramstein Dust II in 2017.³⁸

A second key C4ISR element provided by NATO is the NATO Airborne Early Warning

and Control (NAEW&C) Force, operating the Airborne Warning and Control System (AWACS) from peacetime bases in Germany and the UK. NAEW&C complements ground-based C4ISR with roles in airborne early warning and control, airspace surveillance, command and control, fighter control, airspace control, control of GBAD units, coordination of combat search and rescue operations and support to maritime operations.³⁹ The Alliance is currently studying options for NATO Alliance Future

³⁸ Latvia hosted the Deployable Air Control Centre, Recognised Air Picture Production Centre, and Sensor Fusion Post (DARS), which along with the Deployable Sensor Section (DSS) and the Deployable Air Operations Centre (D-AOC) comprise the DACCC. NATO, Allied Air Command, "NATO's deployable air surveillance and control capability established at Lielvarde, ready to start exercise," Allied Air Command, 8 September 2017.

https://www.airn.nato.int/archive/2017/nato_s-deployable-air-surveillance-and-control-capability-established-at-lielvarde-ready-to-start-exercise.

³⁹ NATO, HQ Airborne Early Warning and Control Force, "E3-A," HQ Airborne Early Warning and Control Force, <https://www.e3a.nato.int/organisation/awacs-fleet/e3a.aspx>.

Surveillance and Control (AFSC), a multi-domain C4ISR system to be introduced as AWACS is retired in around 2035. In addition, other Allied-owned early warning platforms, often deployed alongside Baltic Air Policing contingents, make an important contribution to C4ISR in the region.⁴⁰

The three Baltic states have developed the Baltic Air Surveillance Network, a military cooperation framework

For their own contribution to NATINAMDS, the three Baltic states have developed the Baltic Air Surveillance Network (BALTNET), a military cooperation framework to provide for the acquisition, co-ordination, distribution and display of air surveillance data within the three Baltic states, and also for limited air C2.⁴¹ Surveillance of the Baltic states' entire airspace is carried out by the three air forces using a variety of fixed and transportable air surveillance radars, which are nationally owned, but mostly under NATO command. Radar data is shared amongst the three states. Figure 3, based on open source information, illustrates the Baltic states' principal (mostly fixed) air surveillance assets.

A Combined Control and Reporting Centre (CRC), located at Karmėlava in Lithuania and manned by personnel from all three Baltic states, provides a tactical airspace command and control element. The Combined CRC: receives, processes and displays radar data from the three Baltic states; initiates tracking and identification of all aircraft in radar coverage; and is responsible for generating and disseminating the RAP, and executing the weapons control function. Additionally, each of the states operates a Control and Reporting Post (CRP) (at Āmari and Lielvārde Air Bases in Estonia and Latvia, and collocated with the CRC at Karmėlava in Lithuania). The Āmari CRP has the ability to operate as a backup

CRC should Karmėlava be unavailable, while both Āmari and Lielvārde support the day-to-day operations of the Baltic Air Policing and enhanced Air Policing missions. CRP Karmėlava mostly carries out national air force coordination duties.

The three Baltic Air Force Commanders have agreed to enhance the capability developed through BALTNET so as to develop, by 2020, the BALTNET Future Configuration (BFC). The BFC will comprise three CRCs (at Tallinn (replacing the CRP at Āmari), Lielvārde and Karmėlava), each fully integrated into NATINAMDS, each providing a TDL node and each producing a RAP from the shared sensor feed. The aim is to create, by enhancing cooperation between the three states, more robust NATO air C2 with multiple back-ups in the Baltic region. The weapons control function (i.e. the control of air defence weapons systems integrated into BFC air C2) will rotate between the three locations on a periodic basis; a second location will be designated back-up, while the third will be able to carry out maintenance, training, etc.

3.2. GROUND-BASED AIR DEFENCE

The three states themselves presently field only short-range GBAD systems. Long-range GBAD systems are beyond their financial reach. The US deployed a Patriot battery to Lithuania in 2017 to support the ground-based air defence exercise, Tobruq Legacy, and also participated in the parade to mark Estonia's centennial with a Patriot launcher.⁴² Shorter-range systems have also been deployed to the region, for example, the British Army has deployed the Rapier system to Estonia to exercise with the Estonian Air Force.⁴³

The Estonian Defence Forces include two VSHORAD battalions equipped with the

⁴⁰ For example, the recent visit to Estonia of an Italian Gulfstream G550 CAEW. Dario Cavegn, "Italian airborne early warning plane conducts flights in Estonian airspace," ERR News, 11 April 2018, <https://news.err.ee/745465/italian-airborne-early-warning-plane-conducts-flights-in-estonian-airspace>.

⁴¹ Kaitsevägi (Estonian Defence Forces). "BALTNET." Kaitsevägi, <http://www.mil.ee/en/defence-forces/international-co-operation/baltnet>.

⁴² "U.S. deploys advanced anti-aircraft missiles in Baltics for first time." Reuters, 10 July 2017. <https://uk.reuters.com/article/uk-usa-baltics-patriot/u-s-deploys-advanced-anti-aircraft-missiles-in-baltics-for-first-time-idUKKBN19V286>; Dario Cavegn, "Defense minister: Bringing Patriot system to Estonia a symbolic move," ERR News, 23 February 2018, <https://news.err.ee/685484/defense-minister-bringing-patriot-system-to-estonia-a-symbolic-move>.

⁴³ George Allison, "NATO capability enhancement training continues in Estonia," UK Defence Journal, 5 August 2016, <https://ukdefencejournal.org.uk/nato-capability-enhancement-training-continues-estonia/>.

MBDA Mistral system and Saab Giraffe 3D radars (and a number of legacy ZU-23-2 anti-aircraft automatic cannons). The main task of

The three states themselves presently field only short-range Ground-Based Air Defence systems

these battalions is to protect the manoeuvre of the infantry brigades. Estonia's defence plans include, by 2026, IFF mode 5 upgrade of air surveillance capability and GBAD, modernisation of GBAD C2, and procurement of air defence radar and C2 capabilities for the 2nd infantry brigade.

The Latvian National Armed Forces also operate VSHORAD systems. The Saab RBS-70 has been in service since the mid-2000s and is currently being supplemented with a procurement of Raytheon Stinger systems. Surveillance and targeting is provided by a combination of SAAB Giraffe 2D radars and the more recently procured Thales Raytheon Sentinel radars. As with Estonia, these systems are intended for point defence. In the coming years, Latvia plans to procure mobile C2 systems for its existing air defence batteries, medium-range air defence systems, and miscellaneous support systems.

Lithuania's VSHORAD requirement is also met by a combination of Saab RBS-70, Raytheon Stinger systems and Polish Grom Man-Portable Air Defence System (MANPADS), and Saab Giraffe and Thales Raytheon Sentinel radars. Additionally, the Air Defence Battalion operates radar-controlled Bofors 40mm anti-aircraft cannon. Unlike the other two Baltic states, Lithuania has also invested in medium-range air defence, with an ongoing procurement of two batteries of the Kongsberg Norwegian Advanced Surface to Air Missile System (NASAMS), command and control capability, and an associated training, logistics and integration package.

3.3. AIR

The principal Allied air presence in the Baltic states is the Baltic Air Policing mission. NATO air policing is not an air defence mission, but a peacetime mission carried out under

NATINAMDS to ensure the integrity of Allied airspace. NATO demonstrates cohesion, shared responsibility and solidarity across the Alliance

by assisting those Allies who do not have the means to provide air policing of their own territory.⁴⁴ Under this arrangement NATO has, since 2004, provided rotational deployments of (usually four) Allied fighter aircraft to Šiauliai Air Base in Lithuania to react

quickly to violations and infringements of Baltic airspace. Since 2014, following Russia's annexation of Crimea, NATO has also provided enhanced air policing of Baltic airspace. Today, an additional four aircraft operate from Ämari Air Base.

In addition, Allied and partner air power is regularly exercised in the Baltic region through the Ramstein Alloy (previously Baltic Region Training Events) training series, held three times per year to coincide with the Baltic Air Policing mission rotation cycle. The US, meanwhile, has periodically conducted training deployments of fighter aircraft to Europe (as well as A-10 Thunderbolt ground attack aircraft) under the European Deterrence Initiative, formerly the European Reassurance Initiative, which have also operated from Baltic airfields.⁴⁵

NATO air policing is not an air defence mission

3.4. THE WIDER REGION: FINLAND, SWEDEN AND POLAND

The demands of modern defence doctrines for more space, the lack of geographical depth for the defence of the Baltic states, and the likelihood that reinforcement routes will be contested will inevitably require the activation of Finnish, Swedish and Polish air defence systems in a Baltic crisis – if only to deter and defend against attacks on their own territories. The capabilities of the states of the wider Baltic region will thus be relevant to the air defence of the Baltic states. However, different political considerations pertaining to support from these nations apply: Poland is a NATO Ally

⁴⁴ NATO, "Air policing: securing NATO airspace," NATO, 20 April 2017, https://www.nato.int/cps/en/natohq/topics_132685.htm.

⁴⁵ For example: EUCOM. "Theater Security Package Deploys to Estonia." EUCOM, 18 January 2018. <http://www.eucom.mil/media-library/article/36198/theater-security-package-deploys-to-estonia>.

whose support is guaranteed under Article 5 of the NATO Treaty, while Finland and Sweden are militarily non-aligned. Still, Sweden and Finland are essential to a coherent air defence of the wider Baltic region. In the event of a large-scale conflict, Sweden and Finland on the one hand and NATO on the other will likely have very similar goals for air defence and cooperation will be mutually beneficial.

Poland operates a variety of GBAD systems across its three armed services, including the SA-6 (Gainful) and SA-8 (Gecko) mobile SAM systems, the ZU-23 automatic cannon,

In the event of a large-scale conflict, Sweden and Finland on the one hand and NATO on the other will likely have very similar goals for air defence

and the Polish-produced Grom MANPADS. As many of these are outdated legacy systems, Poland has embarked upon a high-priority, major modernisation of its GBAD capability. Three new programmes will introduce new VSHORAD, SHORAD and MRAD systems into service, while other programmes will enhance surveillance radar capabilities.⁴⁶ Poland and Lithuania are pursuing an agreement to share air surveillance data and have also agreed modalities for cross border operations for the Baltic Air Policing mission. The Polish Air Force, which includes MIG-29 and F-16 Fighting Falcon squadrons, also has a role in layered air defence and has participated many times in the Baltic Air Policing mission.

Both Finland and Sweden also operate layered air defence, with fighter aircraft as key elements of their overall approach.⁴⁷ Finland's GBAD systems include the ZU-23 automatic cannon, the German-Swedish ASRAD (Advanced Short Range Air Defence System), RBS-70 and Stinger VSHORAD systems, and the longer-range Crotale NG and recently

⁴⁶ Patriot will be procured for what Poland describes as its MRAD requirement. Lidia Kelly, "Poland signs \$4.75 billion deal for U.S. Patriot missile system facing Russia," Reuters, 28 March 2018, <https://www.reuters.com/article/us-raytheon-poland-patriot/poland-signs-4-75-billion-deal-for-u-s-patriot-missile-system-facing-russia-idUSKBN1H417S>.

⁴⁷ In Finland: F/A-18 Hornet equipped with AIM-9 Sidewinder, AIM-120 AMRAAM, and AGM-158 JASSM missiles. In Sweden: JAS 39 Gripen equipped with AGM-65 Maverick, RB-15, AIM-9 Sidewinder, IRIS-T, AIM-120 AMRAAM, and Meteor missiles.

acquired NASAMS II systems. Sweden's GBAD systems, include the RBS-70 and the somewhat dated MIM-23B Hawk. Sweden is currently looking to procure new longer-range GBAD systems; a \$1.2 billion deal with Raytheon to procure Patriot systems is reportedly close to completion.⁴⁸

4. SHORTFALLS

The air defence capabilities of the three Baltic states are acutely lacking. In the event of a crisis or war, Estonia, Latvia and Lithuania would be unable to support a shift from peacetime operations to a robust NATO air defence posture, and would themselves be able to protect just a handful of critical assets from attack from the air – and then only for a short period of time. Mobilisation of reserve forces – an issue for Estonia

especially since it relies heavily on mobilisation to build its wartime force structure – would be at risk from air attacks on mobilisation depots. Manoeuvre forces and critical institutions and infrastructure would also be vulnerable. The risks of air attacks on APODs and SPODS and transport routes on land and sea and in the air would degrade the ability of the Allies to effectively and safely reinforce the region. The viability of NATO's defence of the region, which presumably depends heavily on large-scale Allied reinforcement, is thus in doubt. In this section, we examine the shortfalls in Baltic air defence.

The air defence capabilities of the three Baltic states are acutely lacking

4.1. C4ISR

The C4ISR system for Baltic air defence is inadequate in several respects. This is a priority shortfall to address, as the effectiveness of air defence weapon systems, whether local to the region or deployed there in times of crisis, depends on their proper coordination through a reliable command and control system.

⁴⁸ Jen Judson, "Raytheon clinches another European Patriot deal, beats out Eurosam," DefenseNews, 7 November 2017, <https://www.defensenews.com/land/2017/11/07/raytheon-clinches-another-european-patriot-deal-with-swedish-decision/>.



Figure 4. Current Air C2 Connectivity in the Wider Baltic Region: Illustrative Scheme.

In surveillance, the news is mostly good. Recent investments in modern radar systems mean that airspace coverage meets and sometimes exceeds NATO minimum military requirements and shortfalls are being addressed – for example, Lithuania’s current defence plans include the procurement of additional long range radar and shorter range gap-filling radar.⁴⁹ Periodic upgrades to the surveillance network will, however, continue

to be necessary to maintain this capability and ensure that it is able to meet new challenges. Even so, the surveillance network has gaps and would be unable to detect some targets in some areas – notably, those operating at low flight levels such as helicopters and UAS.

Otherwise, the C4ISR system, falls short in four areas. First, in connectivity, the BALNET communications network does not provide the high availability and high reliability required to support an operational air defence architecture. The network (see Figure 4 for an illustrative connectivity scheme) has limited

⁴⁹ Ministry of National Defence (Lithuania), *White Paper. Lithuanian Defence Policy 2017* (Vilnius: Ministry of National Defence, 2017), 45.

redundancy and is vulnerable to failure of, or deliberate attack on its nodes and links. This may be tolerable in peacetime, for example for controlling the Baltic Air Policing mission, but cannot be accepted in times of crisis or war.

The BALTNET communications network does not provide the high availability and high reliability required to support an operational air defence architecture

Not all Baltic CRPs/CRCs are directly connected with the CAOC at Udem. In the configuration illustrated in Figure 4, if Lielvārde or the connections to it were lost, the Baltic states' air C2 network would be, at best, isolated. Looking to the wider Baltic region, there is also no direct connectivity between the Baltic states or Udem, and the Finnish and Swedish air operations centres in Jyväskylä–Tikkakoski and Stockholm. The lack of redundancy in this wider network is also a vulnerability.

The second C4ISR shortfall is in command and control, where the existence of a single CRC in the region (at Karmėlava) is also a weakness; if Karmėlava was lost, air C2 in the Baltic region would be severely degraded. The Ämari CRP has the technical means to act for short periods as a CRC and has occasionally done so when Karmėlava has been unavailable, but the Lielvārde CRP does not yet have this capability fully developed.

The existence of a single Control and Reporting Centre in the region is a weakness

In addition, there are insufficient trained personnel in the air forces of the three states to man more than one CRC on a continuous basis (Combined CRC Karmėlava is manned by personnel from all three states). In particular, there are not enough fighter controller personnel trained to the minimum NATO benchmark of 4 vs. 4, insufficient trained Surface to Air Missile (SAM) allocators for continuous operations, and insufficient data link managers.⁵⁰

⁵⁰ 4 vs 4: able to control 4 friendly fighter aircraft in operations against four hostile aircraft.

The third C4ISR shortfall is that not all the national systems developed under BALTNET are able to operate with Allied or NATO surveillance, command and control assets that might be brought into the region for rotations, exercises or in times of crisis. This is both a procedural and a technical problem. Procedurally, while NATO AWACS do visit the Baltic region, and more frequently operate in Poland, Baltic CRC crews have insufficient experience of operating with this capability in anything other than the air policing role. Technically, there is currently insufficient Link 16 equipment in the Baltic states to allow easy integration of incoming assets – specifically, the Lielvārde CRP does not have a link 16 terminal for line-of-sight operations with AWACS, although technical workarounds are possible. More widely, there is insufficient Link 16 capability across the whole of the Baltic area to allow for easy integration of key air defence assets such as the Patriot system. There are workarounds, but these are naturally more prone to failure.

The fourth C4ISR shortfall concerns the possible lack of air situational awareness in Finnish and Swedish airspace. Technical means have been put in place to allow Sweden and Finland to share limited air surveillance data with NATO (and vice versa) for flight safety purposes and thus to contribute to broader situational awareness. Given the geography of the wider Baltic region, and the lack of strategic depth of the Baltic states themselves, an understanding of air domain activity within or near Swedish and Finnish borders would be critical to NATO air planners in the event of crisis or conflict. However, Finnish and Swedish sensitivities over cooperation with NATO means that access to this data cannot be assured, nor is this something that can be achieved simply by throwing a switch in times of crisis – possible levels of cooperation in peacetime and wartime must be agreed, technical means for the control of data exchange by both sides must be established, and procedures exercised in advance.

A final consideration is that BALTNET assets are not configured for operations with the NATO Ballistic Missile Defence (BMD) programme or the European Phased Adaptive Approach (EPAA) that is the US contribution to NATO BMD. While not essential for Baltic air defence, there

would be merit in the Baltic states upgrading the capacity of their sensors to contribute to NATO BMD.⁵¹ This would both improve their own defences in the (unlikely) event of a ballistic missile attack from the Middle East, and more importantly to allow the three states to make a concrete contribution to this Alliance-wide deterrence and security effort to protect European territories and populations, as well as deployed NATO forces.

4.2. GROUND-BASED AIR DEFENCE

The Baltic states possess (or are in the process of acquiring) a variety of GBAD systems, but these provide only very limited defence of their territories and critical assets – an illustration of possible MRAD/VSHORAD cover provided by extant and soon to be acquired systems is presented in Figure 5.

The VSHORAD systems operated by all three states essentially provide only point defence

The VSHORAD systems operated by all three states essentially provide only point defence; even then it is unclear that Estonia, Latvia and Lithuania have sufficient missiles stockpiled to mount anything other than a short duration defence.⁵² Latvia has allocated funds for the procurement of medium-range systems in the coming years and Lithuania has already begun the acquisition of such systems, although the two batteries of NASAMS it will acquire will still afford only limited cover. Estonia aspires to procure such systems when funds allow, but these are not included in the extant 2017–2026 National Defence Development Plan. The three states have no long-range capability, and neither the plans nor the means to acquire it.

The three states' VSHORAD systems are, furthermore, essentially standalone systems. Integration with air command and control is limited, in some cases, to being able to receive messages and the RAP. Airspace control is thus possible by procedural means only, i.e. by designating exclusion zones for friendly aircraft.

⁵¹ Breedlove, *Towards Effective Air Defense*, 5.

⁵² See, for example, Jonatan Vseiov, Permanent Secretary of the Ministry of Defence of Estonia, discussing Estonia's need to spend a large proportion of its defence budget on ammunition, including for the Mistral system, to reach minimum stockpile levels, *Seitsmesed Uudised* (seven o'clock news), TV3 (Estonia), 13 February 2018.

Local air defence systems with such minimal levels of control provide a risk to friendly forces and limit the ability of the Allies to provide air defence from the air and Close Air Support to reinforcement and defence operations.

Baltic capability is thus a long way from the military ideal of a layered IAMD in which systems of varying capability are integrated to provide comprehensive defence of military forces, populations and critical assets.

4.3. AIR

The Baltic states have no fighter aircraft and there is no expectation that these might be acquired in current defence planning time frames. Baltic Air Policing, for which the three Baltic states provide substantial host nation support, is a mission to preserve airspace integrity in peacetime; it is not an air defence mission. Nonetheless, through Baltic Air Policing, Allies do deploy assets to the Baltic states that might be used for air defence in the event of a degraded security situation. The fact that there are few fighter aircraft in the region also adds to the problem of training fighter allocator personnel for the CRC – it is difficult for sufficient numbers of them to retain currency, particularly at or approaching the NATO benchmark of 4 vs 4, if there are too few aircraft available to generate training sorties.

NATO's enhanced air policing, currently operating from Ämari Air Base to supplement the standing contingent operating from Šiauliai Air Base, was put in place as one of the Alliance's assurance measures following Russia's annexation of Crimea. Despite the heavy volumes of air traffic in the Gulf of Finland and Baltic Sea, the increased presence of NATO forces in the region through eFP, the regular scrambling of aircraft from Ämari Air Base to intercept aircraft violating flight rules, and the distance of Šiauliai Air Base from Estonia, this mission has not been placed the same "essentially permanent" status as the mission operating from Lithuania.⁵³ Its continuation is thus not guaranteed.

⁵³ Ott Tammik, "NATO's Baltic Air Policing Mission 'Essentially Permanent'," ERR News, 8 February 2012, <https://news.err.ee/103143/nato-s-baltic-air-policing-mission-essentially-permanent>.

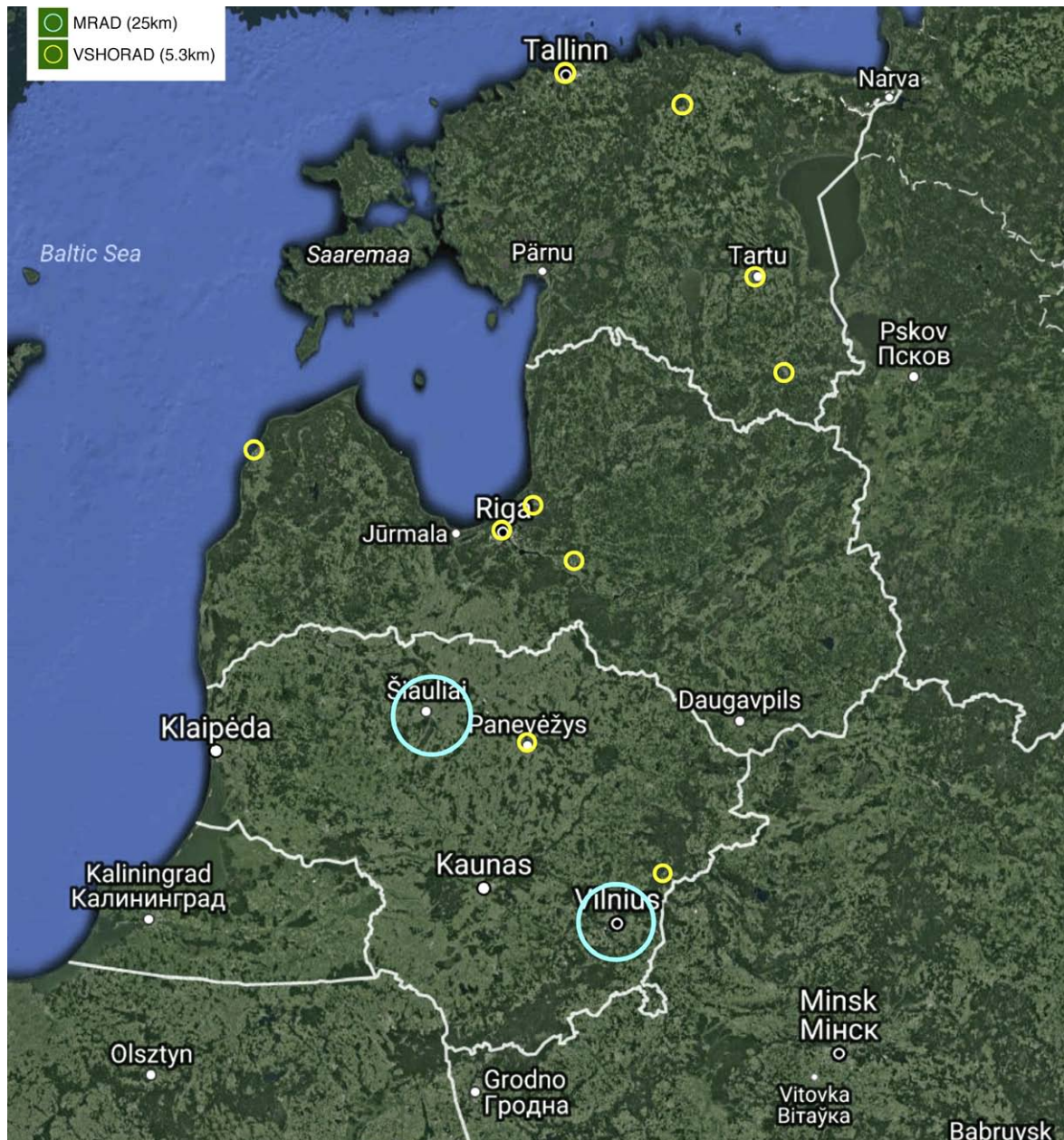


Figure 5. Illustrative Missile Ranges of Baltic MRAD and VSHORAD Systems.⁵⁴

4.4. THE JFAC

At the NATO level, the Alliance does not have a standing JFAC in peacetime. The JFAC provides air C2 in times of crisis and its operations are essential to permit the application of Allied air power to support NATO's reinforcement of the Baltic region. However, the standing up of the JFAC in times of crisis, which requires a NAC decision, will take several days (the core JFAC at HQ AIRCOM needs to be augmented, usually by personnel from Uedem and Torrejon, to reach a full complement) thus creating a potential gap in NATO's ability to execute effective air C2 in the early days of a crisis.

Further, despite the high speed of air operations, the SACEUR cannot stand up the JFAC without a NAC decision. For comparison, in the much slower land domain, the SACEUR has been granted the authority to alert, prepare and stage (but not deploy) the brigade-sized Very High Readiness Joint Task Force⁵⁴(VJTF).⁵⁵

⁵⁴ Illustrative missile ranges: VSHORAD, based on Mistral – 5.3km, MRAD, based on NASAMS – 25km. Ministry of Defence (Singapore), "Mistral," Ministry of Defence, https://www.mindef.gov.sg/oms/imindef/mindef_websites/atozlistings/air_force/assets/weapon_systems/Mistral.html; "Finland Updating Its Air Defense Systems," Defense Industry Daily, 26 January 2014, <https://www.defenseindustrydaily.com/finland-updating-its-air-defense-systems-05398/>.

⁵⁵ Klaus Olshausen, "NATO's Readiness Action Plan for Assurance and Deterrence – Progress & Challenges on the Road from Wales to Warsaw," *ISPSW Strategy Series*, no. 402, January 2016, 3.

5. SOLUTIONS

In this section, we make recommendations for the Baltic states and for NATO to mitigate shortfalls in Baltic air defence.

5.1. C4ISR

The Baltic air defence architecture can grow in terms of weapons systems as future finances and defence priorities allow, but investment in C4ISR capability to underpin this architecture must be a priority today. Much of the responsibility for improving C4ISR lies with the Baltic states, either individually or collectively.

5.1.1. SURVEILLANCE

The Baltic states should:

- *Implement and exercise short term radar gap-filling measures to detect and track low-level targets; collectively review air surveillance capability and identify permanent solutions to fill any gaps*
- *Proactively seek opportunities for collaborative acquisition of future sensors*
- *Include the ability to contribute to NATO BMD in future sensor purchases*
- *Ensure Link 16 capability at all Baltic CRP/CRC*

NATO should:

- *Continue to operate and exercise AWACS and other early warning assets in the Baltic region*
- *Ensure that these capabilities are visible to enhance deterrence*

Long-range surveillance of Baltic airspace currently meets NATO minimum military requirements; but given its role in national defence, the three states should continue to give the highest priority to maintaining this capability – air surveillance must not be allowed to deteriorate in the face of competing capability needs. Periodic upgrades will be required to the radar network to keep pace with evolving technology and evolving challenges.

Meanwhile, to provide short-term improvements in detection and tracking, especially of low-level targets, the three states should, where necessary, exploit all possibilities for gap filling with GBAD radar or radars belonging to other agencies such as coast guards. Any legal or bureaucratic obstacles to these solutions should be addressed today, and the use of gap-filling assets should be exercised to iron out technical difficulties and ensure personnel interoperability. The three states should also review, collectively, their air surveillance capabilities and consider whether more permanent gap-filling solutions could address vulnerabilities.

The Baltic states should look first of all for collaborative procurement solutions to meet any new requirements in this area, and should align their planning for this key capability in order to maximise the likelihood that collaborative opportunities will arise.⁵⁶ Any future surveillance radar programme should also include an (immediate or dormant) ability to contribute to NATO BMD in the statement of requirements.

Air situational awareness in times of crisis may be improved by the operation of AWACS or other Allied early warning assets in or near the Baltic region. In order for the full benefit of these to be realised, all Baltic CRP/CRC should be capable of directly interoperating with them; specifically, line-of-sight Link 16 connectivity should be introduced at Lielvārde. AWACS and other Allied early warning platforms should continue to deploy regularly to the region to exercise the Baltic interface, rehearse crisis measures and identify and resolve problems. The periodic presence of these key NATO capabilities will also send an important deterrent message; they should from time to time be visible on the ground in Baltic capitals.

⁵⁶ Estonia achieved savings in 2009 by purchasing two Thales-Raytheon Groundmaster 403 medium-range surveillance radars (at a reported cost of around €22 million) in a cooperative procurement with Finland. Ministry of Defence (Estonia), "Estonia concluded a contract for the procurement of two medium range radar systems," Ministry of Defence, 3 July 2009, <http://www.kmin.ee/en/news/estonia-concluded-contract-procurement-two-medium-range-radar-systems>.



Figure 6. Desirable Air C2 Connectivity for the Wider Baltic Region

5.1.2. CONNECTIVITY

The Baltic states should:

- *Ensure that connectivity is enhanced from the Baltic region to NATO C2 nodes, and to Sweden and Finland*
- *Ensure that C4ISR networks are ‘future-proofed’, in particular that they are able to exploit the opportunities offered by 5th generation fighter aircraft and Multi-Domain Command and Control*
- *Acquire additional Link 16 terminals to allow visiting air defence assets to ‘plug and play’ with Baltic C4ISR*

NATO should:

- *Provide connectivity from CAOC Udem to Sweden and Finland*
- *Accelerate the ACCS and ASBE programmes to enhance Baltic (and wider NATO) air C2*

The inadequacy of the current communications system should be addressed by providing additional secure data links between nodes. In particular, as a matter of priority: TDLs should be created between all Baltic CRC/CRP and the CAOC at Udem; and between Baltic C2 nodes and the air command and control centres in Finland and Sweden. Ideally, direct links should also be provided between the CAOC at Udem and the air command and control centres in Finland and Sweden. Figure 6 presents an illustrative robust C2 network for the Baltic region.

Some of the additional connectivity we propose will fall under NATO’s remit, and funding might also be sought from the NATO Security Investment Programme (NSIP).⁵⁷ Nordic and Baltic cooperation frameworks such as NORDEFCO and NB8 might also be useful settings for pursuing enhanced connectivity projects – the connectivity between Norway, Sweden and Finland is currently organised under NORDEFCO. In any event, NATO should accelerate the ACCS and ASBE programmes

⁵⁷ NATO’s common-funded long-term investment programme. It funds projects that provide capability beyond that which currently exists in the Alliance, and that an individual Ally could not be expected to finance alone. NATO, Allied Command Transformation, “NATO Security Investment Programme,” NATO ACT, <http://www.act.nato.int/nsip>.

to ensure that Baltic (and central and eastern European) systems are brought up to the same standard as those of the wider Alliance. ACCS will, for example, bring updated Link 16 capability to BALTNET systems as well as enhanced simulation and training capability.

More broadly, in developing C4ISR networks, the Baltic states should ensure that the systems they build are ‘future-proofed’ in order to avoid obsolescence and be able to exploit the opportunities offered by emerging concepts and technologies. For example, the technical capabilities of 5th generation fighter aircraft also bring (as yet not fully defined) opportunities for new concepts in air C2 and ISR – they are not simply replacements for 4th generation platforms – while Multi-Domain Command and Control thinking allows commanders to integrate capabilities across warfighting domains in complex battle spaces.⁵⁸

Finally, in order that assets such as Patriot are able to ‘plug and play’ with Baltic C4ISR, either during exercises, periodic deployments, or in wartime, the three Baltic states should acquire additional Link 16 terminals. While (collective) operational analysis will be necessary to establish the precise requirement, Baltic subject matter experts have estimated that somewhere between 10 and 20 terminals would be sufficient to allow for effective air defence operations in all three states. Lithuania’s ongoing procurement of MRAD systems will partially satisfy this requirement.

⁵⁸ Bart A. Hoebe, 5th Generation Air C2 and ISR (Canberra: Air Power Development Centre, 2017) 80-81; Mark Pomerleau, “How industry’s helping the US Air Force with multi-domain command and control,” DefenseNews, 25 September 2018, <https://www.defensenews.com/c2-comms/2017/09/25/industry-pitches-in-to-help-air-force-with-multi-domain-command-and-control/>.

5.1.3. COMMAND AND CONTROL

The Baltic states should:

- *Implement urgently the BALTNET Future Configuration to create CRC-level capability at Tallinn, Lielvārde and Karmėlava*
- *Recruit and train personnel to conduct air defence operations at these sites, including sufficient fighter controllers, SAM allocators, and TDL managers*
- *Upgrade simulation and training capabilities at C2 nodes to offer LVC training; develop and conduct a common air C2 training and exercise programme*

NATO should:

- *Continue to exercise deployable air C2 in the Baltic region*

A single CRC in the region is a vulnerability. In order to create a viable command and control system for Baltic air defence operations, redundancy should also be ensured in the command and control arrangements created under BALTNET. The three Baltic Air Force Commanders have agreed to develop, by 2020, the BALTNET Future Configuration (BFC) under which each of the C2 nodes at Tallinn, Lielvārde and Karmėlava will operate on a rotational basis as a CRC and a CRC back-up. We support this, and recommend the necessary augmentation and training of personnel should be undertaken as a priority.

NATO has established the minimum personnel requirements for continuous CRC operations – these should be met. If it is difficult to do so, unconventional staffing solutions, such as the recruitment of civilian rather than uniformed personnel, or the use of volunteer reserves along the lines of Estonia's Cyber Defence Unit of the Estonian Defence League, should be investigated.⁵⁹ All personnel should be trained to meet the minimum NATO fighter controller benchmark of 4 vs 4. Attention should be paid to ensuring that there are sufficient numbers of SAM allocators and TDL managers to support air defence operations.

⁵⁹ Sharon L. Cardash, Frank J. Cilluffo and Rain Ottis, "Estonia's Cyber Defence League: A Model for the United States?" *Studies in Conflict & Terrorism*, 36:9 (2013): 777-787.

CRC simulation capabilities should be upgraded to provide the requisite levels of training. The three states should aspire to blended Live, Virtual, and Constructive (LVC) training, i.e. involving combinations of real operators operating real systems (in operations against simulated adversaries) (Live), real operators operating simulated systems (Virtual), and simulated operators operating simulated systems (Constructive).⁶⁰ LVC training provides a less costly and safer alternative to live training, while the fidelity of simulated environments made possible by modern computing exposes trainees to situations that they may encounter in real operations in realistic conditions. LVC technology is rapidly developing. Baltic training and simulation capability needs to be built with an eye to future growth and thus on an open systems basis.

Training programmes built around simulation will allow identical capability to be readily available at all three C2 nodes. However, given the small size of Baltic airspace and the need for coordinated operations, the three states should develop and implement a common training plan for air C2 personnel and conduct joint training events.

In addition, building upon the experience of exercise Ramstein Dust-II, NATO's deployable air C2 capability should be regularly exercised in the Baltic region, to train both deployable and host nation personnel and to communicate a deterrent message.

5.2. GROUND-BASED AIR DEFENCE

While Baltic GBAD systems currently provide useful capabilities for localised protection, a C4ISR system providing credible situational awareness and robust air C2 will act as a force multiplier for GBAD and allow the construction of a more comprehensive air defence architecture. Once improved C4ISR is in place according to our recommendations above, the Baltic states should take steps to enhance their GBAD capability.

⁶⁰ Department of Defense (US), *Modelling and Simulation (M&S) Glossary* (Alexandria: Modelling and Simulation Coordination Office, 2011), 119, 85, 159

5.2.1. VSHORAD

The Baltic states should:

- Review and adjust manning and force development policies to ensure that existing VSHORAD capability is available from the start of a crisis
- Integrate existing VSHORAD systems into Baltic air C2
- Supplement, as necessary, VSHORAD missile stocks

NATO should:

- Encourage forces deploying to the Baltic region under eFP and EDI to include short-range air defence systems in their inventories
- Continue to exercise short-range air defence systems in the Baltic region

First, as a matter of priority, the three states should take measures to ensure that the full potential of their existing VSHORAD systems is realised. In particular, they should review their manning and force development policies to ensure that short-range air defence capability is available from the earliest days of a crisis, rather than being generated during the mobilisation process. This is especially an issue for Estonia, which relies more heavily on reserve forces than Latvia or Lithuania. While the air threat in the absence of active air defence may be mitigated by passive measures such as dispersed mobilisation, there are limitations to such an approach. A more effective solution may be found in reassessing force development priorities to give precedence to the development of air defence units.

All Baltic VSHORAD systems (and the NASAMS systems currently being procured by Lithuania) should be integrated into BALTNET air C2 to provide gap-filling surveillance capability and to ensure the centralised command and control (and decentralised execution) of GBAD necessary to conduct air defence operations in a single Baltic airspace. Technically, this should be achieved through the provision of Air Situation Data Exchange (ASDE) and Joint Range Extension Applications Protocol C (JREAP C) connectivity from air C2 to air defence units.

Finally, VSHORAD missile stocks should be assessed and, if necessary, augmented so as to ensure a sufficient wartime supply.

Air defence in the region would also be enhanced if forces rotating under eFP or European Deterrence Initiative (EDI) were to deploy with air defence assets (the US-led eFP battlegroup in Poland already includes a Romanian air defence battery).⁶¹ NATO should encourage forces deploying to the region to include VSHORAD/SHORAD systems in their inventories. Additionally, NATO should continue to exercise shorter-range GBAD systems in the Baltic states.

5.2.2. MRAD

The Baltic states should:

- Invest in a minimum level of interoperable MRAD systems, to be augmented as finances allow, and integrate these into Baltic air C2
- Acquire and operate such MRAD systems on a common basis, including common maintenance and logistics
- Establish a single air defence school, conduct common training and exercises

NATO should:

- Continue to exercise medium-range air defence systems in the Baltic region

The US should:

- Explore with the Baltic states opportunities for funding GBAD missile stocks through US defence assistance programmes

VSHORAD systems alone, however, are not sufficient to provide the level of air defence cover necessary to meet the air threat in the Baltic region. The Baltic states should thus invest in a minimum level (to be augmented later as finances and competing development plans allow) of medium-range GBAD systems. Manning and force development priorities may need to be re-evaluated to meet this need. As with VSHORAD systems, it is essential that MRAD systems are available on a continuous

⁶¹ NATO, "NATO's Enhanced Forward Presence," Factsheet, February 2018.

basis from the onset of a crisis and integrated into Baltic air C2.

To the greatest extent possible, the acquisition and operation of MRAD systems should be carried out by the three states in cooperation. Acquisition processes would be simplified if Estonia and Latvia were to procure systems similar to those already selected by Lithuania. The support, maintenance and logistics operations for the three states' MRAD systems should also be common. Given the small number of systems likely to be involved, the construction and operation of three maintenance facilities, for example, would be difficult to defend. To the extent that it is possible, given the different systems in use in the three states, VSHORAD support, maintenance and logistics should also be integrated into the same joint arrangements.

The three states should establish a single air defence school and conduct common training – either at a single local training facility, or by jointly negotiating for training provision from a third party. Any training facilities developed in the three states should, as with the arrangements we recommend for CRC personnel, provide blended LVC training. VSHORAD training should also be integrated into the same joint arrangements.

MRAD acquisition will unquestionably be an expensive undertaking. MRAD system costs will depend on the configuration procured, support options, and system integration requirements. For illustration, Lithuania's 2017 acquisition of two NASAMS batteries, including training, additional equipment, logistical support and system integration was reported to have cost some €109 million; while in the same year, Indonesia procured a single NASAMS system with command posts, radars, launchers, and radios plus integration, training and logistics support for a reported \$77 million.⁶² In addition to purchase price, there will be annual personnel, maintenance, training and operating costs associated with these systems. The cost

of the AIM-120 missile, meanwhile, upon which the Surface-Launched Advanced Medium-Range Air-to-Air Missile (SLAMRAAM) used by NASAMS is based, appears to vary between \$1.1 million and \$2.8 million per missile.⁶³ Each battery is typically equipped with a range of missile variants such that targets can be engaged with the most appropriate tool for the job.

The US and the three states should thus investigate the possibility of securing funding for MRAD missile stocks under the EDI. The 2018 National Defence Authorization Act allocates \$4.7 billion to EDI, including up to \$100 million to Estonia, Latvia and Lithuania for a single joint programme to improve interoperability and develop the capacity to deter and resist Russia; anti-aircraft weapons are included in the list of projects eligible for funding.⁶⁴ The White House has also announced plans to spend a further \$70 million from various programmes for training and equipping the Baltic states' armed forces.⁶⁵ The Raytheon SLAMRAAM missile, a US product, might be a suitable candidate for such funding. Cooperative US-Baltic ammunition procurements, such as the current programme to buy anti-tank and howitzer ammunition, have set precedents for this type of cooperation.⁶⁶

Once acquired, both medium- (and short-) range air defence should be regularly and jointly

⁶² Robin Hughes, "Lithuania, Indonesia Sign for NASAMS," IHS Jane's Missiles and Rockets, 31 October 2017, <http://www.janes.com/article/75322/lithuania-indonesia-sign-for-nasams>; Mike Yeo, "Indonesia Strikes \$77M deal for air-defense system by Norway's Kongsberg," DefenseNews, 1 November 2017, <https://www.defensenews.com/land/2017/11/01/indonesia-strikes-77m-deal-for-air-defense-system-by-norways-kongsberg/>.

⁶³ Defense Security Cooperation Agency, "Norway – AIM-120 C-7 Advanced Medium Range Air-to-Air Missiles (AMRAAM)," news release, 15 November 2017, <http://www.dsca.mil/major-arms-sales/norway-aim-120-c-7-advanced-medium-range-air-air-missiles-amraam>; Defense Security Cooperation Agency, "Poland – AIM-120C-7 Advanced Medium Range Air-to-Air Missiles (AMRAAM)," news release, 28 November 2017, <http://www.dsca.mil/major-arms-sales/poland-aim-120c-7-advanced-medium-range-air-air-missiles-amraam>; Defense Security Cooperation Agency, "Government of the Netherlands – AIM-120 C-7 Advanced Medium Range Air-to-Air Missile (AMRAAM)," news release, 11 October 2017, <http://www.dsca.mil/major-arms-sales/government-netherlands-aim-120-c-7-advanced-medium-range-air-air-missile-amraam>; Fergus Kelly, "US State Department Approves \$170 million air-to-air missile sale to Norway," The Defense Post, 15 November 2017, <https://thedefensepost.com/2017/11/15/aim-120-amraam-missile-sale-norway/>.

⁶⁴ Erik Marmei and Gabriel White, *European Deterrence Initiative: Bolstering the Defence of the Baltic States* (Tallinn: ICDS, 2018), 2-3.

⁶⁵ The White House, "President Donald J. Trump's Support for Estonia, Latvia, and Lithuania," 3 April 2018, <https://www.whitehouse.gov/briefings-statements/president-donald-j-trumps-support-estonia-latvia-lithuania/>.

⁶⁶ Aili Vahtla, "Estonia to buy anti-tank, artillery ammunition with US support," ERR News, 4 April 2018, <https://news.err.ee/693955/estonia-to-buy-anti-tank-artillery-ammunition-with-us-support>.

exercised, for example through participation in the ground-based air defence exercise, Tobruq Legacy which, in addition to offering live firing opportunities for participants, also rehearses multinational information sharing and air C2.⁶⁷ As with short-range systems, NATO should continue to exercise medium-range GBAD systems in the Baltic states, and encourage forces operating in the region under eFP and EDI to occasionally deploy with MRAD assets.

5.2.3. LONG-RANGE AIR DEFENCE

The Baltic states should:

- *Enhance the training opportunities and other host nation support for visiting long-range GBAD, and other air defence assets*

NATO should:

- *Continue to exercise long-range GBAD, and other long-range air defence assets in the Baltic region*

The Baltic states will be unable to contribute upper air defence layers in the foreseeable future as long-range GBAD and air- and sea-based systems are beyond their financial reach. There is, however, deterrent and practical value in Allies periodically deploying such systems to the Baltic states or exercising with them in the region. If Baltic C4ISR is enhanced as we recommend, visiting systems should readily be able to 'plug and play' with local infrastructure, creating a rewarding training experience for both visitors and hosts. NATO and the Allies should, therefore, conduct regular deployments and exercises of long-range GBAD (e.g. Patriot, MEADS), sea-based air defence systems (e.g. Aegis, the UK Type 45 Destroyer), and fighter aircraft in the air defence role.

While the US is by far the largest operator of air defence assets, it is important, for reasons of burden sharing, that other Allies should be encouraged to participate in Baltic deployments and exercises. Variants of the Patriot GBAD system, for example, are in service with Germany, Greece, the Netherlands

and Spain, and are shortly to be introduced in Poland and Romania. For their part, the three Baltic states should be ready to host exercises and to enhance their host nation support – for example by improving training opportunities – for incoming air defence units.

5.3. AIR

The Baltic states should:

- *Enhance training opportunities for fighter aircraft in the Baltic region*

NATO should:

- *Step up exercising of fighter aircraft in the Baltic region*
- *Transition Baltic Air Policing to an Air Defence mission once adequate C4ISR is has been put in place in the Baltic states*
- *Put the enhanced Air Policing mission operating from Ämari Air Base onto a permanent footing*

An enhanced programme of exercises for fighter aircraft in the Baltic region would ensure that more fighter controllers were able to retain currency at the NATO benchmark of 4 vs 4. Additionally, it would add variety to the training of Baltic Air Policing contingents and allow pilots to retain currency in more than the air policing role. A more active fighter presence would also send an important deterrent message. For their part, to support such a programme, the Baltic states should take steps to enhance the training opportunities available to fighter aircraft, such as making large blocks of airspace available and providing space for ranges.

Some experts argue that the Baltic Air Policing mission should be transitioned to a standing air defence mission now. We consider, however, that Baltic C4ISR is currently inadequate to support air defence operations. Once the improvements we recommend have been implemented, the Baltic Air Policing mission should be transitioned to an air defence mission.

In addition, the enhanced Air Policing currently operating from Ämari Air Base should, like the original Baltic Air Policing mission, be put on a permanent footing.

⁶⁷ Nicholas Vidro, "US, Allied forces celebrate Tobruq Legacy success," US Army, 22 July 2017, https://www.army.mil/article/191228/us_allied_forces_celebrate_tobruq_legacy_success.

5.4. THE JFAC

NATO should:

- *Empower SACEUR to stand up the JFAC in times of tension without specific NAC authority*

An aggressive air campaign could threaten the sovereignty of the Baltic states long before the JFAC can be stood up at HQ AIRCOM to manage the Allied response to this threat. This limits both deterrence and defence on the north-eastern flank. While a standing peacetime JFAC could be created at HQ AIRCOM, this would be an expensive solution for the short- to medium-term. Instead, in times of short-notice crisis, SACEUR should be given the authority to stand up the JFAC without needing specific instruction from the North Atlantic Council, bringing his authorities for air defence into line with those he currently has for the VJTF. The NATO Crisis Response Manual should be reviewed and adjusted accordingly.

5.5. OTHER RECOMMENDATIONS

The Baltic states should:

- *Create a new cooperative framework to replace and enhance BALTNET*

NATO should:

- *Enhance agreements with Finland and Sweden concerning the mutual exchange of air surveillance data, ensure technical means are in place on a dual-key basis, and exercise these arrangements.*
- *Develop a programme of small-scale reinforcement and integration exercises focused on the employment of air power in the Baltic region*
- *Develop and exercise plans to implement, step-by-step, a Baltic air defence posture in times of crisis*

For the Baltic states: BALTNET has proved a successful framework for Baltic defence cooperation. This and other frameworks such as the Baltic Battalion, Baltic Naval Squadron and Baltic Defence College, operating as required in technical, military, policy, and governance

configurations have fostered cooperation among the three states and helped to overcome the challenges that nations often find stand in the way of successful defence cooperation.⁶⁸ In order to provide for the wider Baltic cooperation we recommend in air defence, it would be beneficial to enhance the BALTNET framework. A new framework, 'BALTAD' for example, should be created and BALTNET subsumed into it for this purpose. Any collaborative arrangements will need to take account of Lithuania's greater progress in investing in MRAD systems and develop work and cost sharing schemes that do not disadvantage (of favour) any of the three states.

For NATO: the Alliance can achieve real practical benefits for Baltic air situational awareness through the exchange of air surveillance data between NATO and its Enhanced Opportunity Partners, Finland and Sweden (equally, Finland and Sweden can benefit from receiving NATO data). The willingness of Finland and Sweden to work with NATO on air defence issues should, however, not be taken for granted, and technical means to control data exchange, on a dual-key basis, should be agreed and put in place. Policies for the mutual exchange of air surveillance data should be discussed in appropriate NATO policy fora, and agreements exercised.

Also, in addition to exercising key assets such as Patriot and AWACS, there is a need to exercise more broadly the use of air power in the Baltic region, both to enhance interoperability and to heighten deterrence. NATO should develop a programme of routine, small-scale reinforcement and integration exercises in the Baltic states to meet this need.

Finally, NATO should develop plans to implement, step-by-step, a Baltic air defence posture during times of crisis, to include actions such as deploying NATO air C2 capabilities, increasing AWACS sorties, deploying long-range GBAD and additional fighter capability to the region, and increasing fighter operating locations. These plans should be regularly exercised.⁶⁹

⁶⁸ For an overview of why nations often find defence cooperation difficult see, for example, Dick Zandee, Margriet Drent, and Rob Hendricks, *Defence Cooperation Models. Lessons Learned and Usability* (The Hague: Clingendael, 2016), 38-47.

⁶⁹ Gorenc, Frank, "Deterrence and Collective Defence," in *Joint Air Power Following the 2016 Warsaw Summit. Urgent Priorities*, ed. the Joint Air Power Competence Centre (Kalkar: The Joint Air Power Competence Centre, c.2017), 92.

CONCLUSIONS AND RECOMMENDATIONS

Air defence is the biggest and most critical gap in military capabilities in the Baltic region. The three Baltic states are able to defend only a handful of locations for a short period of time, and there are no standing NATO air defence assets in the region to supplement local capabilities. Without adequate air defence, the three states would be vulnerable in times of crisis, but the risks of air attacks on transport routes on land and sea and in the air would also degrade the ability of the Allies to effectively and safely reinforce the region. Reducing the air defence gap is not only critical for the security of the Baltic states, but also for the security of NATO as a whole.

The key shortfalls in Baltic air defence are:

- in **C4ISR**, including gaps in low-level radar coverage, vulnerabilities in the communications network for air C2, insufficient trained personnel to command and control air defence operations in times of crisis, inadequate interoperability with deployed NATO air defence assets, a lack of situational awareness of Finnish and Swedish airspace, and the lack of a standing NATO JFAC for air C2 in times of crisis; and
- in **weapon systems**, including the lack of integration of existing GBAD systems with Baltic air C2 arrangements, limited missile stockpiles, the non-availability (in some cases) of GBAD from the start of a crisis, and the lack of anything other than short-range GBAD systems preventing the Baltic states from mounting a comprehensive layered air defence.

The three states alone will not be able to address these shortfalls and provide adequate levels of air defence for their territories. They must look to NATO and the Allies for assistance. But substantial investment from the Baltic states will be necessary if solutions that may be found at the NATO level are to achieve their full potential. The impetus for improving Baltic air defences should come primarily from the three states. Baltic solutions, in conjunction with support from NATO or a framework of NATO Allies will substantially enhance deterrence and air defence in the Baltic region.

SUMMARY OF RECOMMENDATIONS

We recommend that the **Baltic states** should:

- implement and exercise short term radar gap-filling measures to detect and track low-level targets; collectively review air surveillance capability and identify permanent solutions to fill any gaps;
- proactively seek opportunities for collaborative acquisition of future sensors;
- include the ability to contribute to NATO Ballistic Missile Defence in future sensor purchases;
- ensure Link 16 capability at all Baltic Command and Reporting Centres/Posts;
- ensure that connectivity is enhanced from the Baltic region to NATO command and control nodes, and to Sweden and Finland;
- ensure that C4ISR networks are 'future-proofed', in particular that they are able to exploit the opportunities offered by 5th generation fighter aircraft and Multi-Domain Command and Control;
- acquire additional Link 16 terminals to allow visiting air defence assets to 'plug and play' with Baltic systems;
- implement urgently the Baltic Air Surveillance Network Future Configuration to create Command and Reporting Centre capability at Tallinn, Lielvārde and Karmėlava;
- recruit and train personnel to conduct air defence operations at these Command and Reporting Centres, including sufficient fighter controllers, Surface to Air Missile allocators, and Tactical Data Link managers;
- upgrade simulation and training capabilities at command and control nodes to offer blended Live, Virtual and Constructive training; develop and conduct a common air command and control training and exercise programme;

- review and adjust manning and force development policies to ensure that existing Very Short-Range Air Defence capability is available from the start of a crisis;
 - integrate these existing systems into Baltic air command and control arrangements;
 - supplement, as necessary, missile stocks for these systems;
 - invest in a minimum level of interoperable Medium-Range Air Defence systems, to be augmented as finances allow, and integrate these into Baltic air command and control arrangements;
 - acquire and operate these systems on a common basis, including common maintenance and logistics;
 - establish a single air defence school and conduct common training and exercises;
 - enhance the training opportunities and other host nation support for visiting long-range air defence assets, including fighter aircraft; and
 - create a new cooperative framework to replace and enhance the existing Baltic Air Surveillance Network.
- We also recommend that **NATO** should:
- continue to operate and exercise the Airborne Warning and Control System and other early warning assets in the Baltic region;
 - ensure that these capabilities are visible to enhance deterrence;
 - accelerate the Air Command and Control System and Air Command and Control System Software Based Element programmes to enhance Baltic (and wider NATO) air command and control;
 - continue to exercise deployable air command and control assets in the Baltic region;
 - encourage forces deploying to the Baltic region under enhanced Forward Presence and the European Deterrence Initiative to include short-range air defence systems in their inventories;
 - continue to exercise or deploy short-range, medium-range and long-range air defence systems in the Baltic region;
 - step up exercising of fighter aircraft in the Baltic region;
 - transition Baltic Air Policing to an Air Defence mission once adequate C4ISR is has been put in place in the Baltic states;
 - put the enhanced Air Policing mission operating from Ämari Air Base onto a permanent footing;
 - empower SACEUR to stand up the Joint Force Air Component without specific North Atlantic Council authority;
 - enhance agreements with Finland and Sweden concerning the mutual exchange of air surveillance data; ensure technical means are in place on a dual-key basis, and exercise these arrangements;
 - develop a programme of small-scale reinforcement and integration exercises focused on the employment of air power in the Baltic region; and
 - develop and exercise plans to implement, step-by-step, a Baltic air defence posture in times of crisis.

Finally, we recommend that **the US** should:

- explore with the Baltic states opportunities for funding ground-based air defence missile stocks through US defence assistance programmes.

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INTERNATIONAL CENTRE FOR DEFENCE AND SECURITY
63/4 NARVA RD., 10152 TALLINN, ESTONIA
INFO@ICDS.EE, WWW.ICDS.EE



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