

# The future of the Air Forces and air defence units of Poland's Armed Forces



# **The future of the Air Forces and air defence units of Poland's Armed Forces**

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# Introduction

Poland's security environment has continued to deteriorate as of late. Only a few years ago, it was hardly imaginable any military conflict would emerge in Europe. The recent operations of the Russian Federation – the illegal annexation of Crimea and the Russian aggression in the east of Ukraine – have undermined the confidence in the inviolability of borders throughout Europe. Despite being a member of the North Atlantic Treaty Organization (NATO), one of the most powerful political and military alliances currently existing, it is still imperative that Poland exercise sound judgement about its security issues. The condition and future development of Poland's Armed Forces are of central interest in this context. In 2012, the *Armed Forces of the Republic of Poland Development Program for 2013-2022*, and the *Armed Forces Technical Modernization Program for 2013-2022* were adopted, outlining key weapon systems that are essential in order to maintain and develop the capacities of the Polish Army. *The Armed Forces of the Republic of Poland Development Program* coincides with NATO's defence planning cycles. It covers a period of 10 years, and the subsequent editions are released every 4 years. Accordingly, the next program will cover the period 2017 - 2026, and the *Armed Forces Technical Modernization Program for 2017 - 2026* will be adopted in parallel. *The Operational Capacity Requirements Review* is currently underway, and the outcomes are to be taken into account in the new plan. Therefore, the time is right to give consideration to and reflect on the direction that the Polish Armed Forces should follow in the future.

This report takes a closer look at Poland's air defence system, one of the cornerstones of state defence and security in general. To gain and maintain dominance in

the air is a precondition for any military defence operation to succeed, especially at this stage of development of military technologies. Moreover, effective and modern aviation as well as antimissile and antiaircraft defence would definitely reinforce Poland's position as a committed ally within NATO.

This report consists of 3 chapters. The first chapter analyses trends in Poland's security environment to identify major tasks to be completed in the area of Air Forces and air defence systems in the next 20 - 25 years. Chapters 2 and 3 outline a trend analysis in the development of military aviation as well as antimissile and antiaircraft defence systems, and discuss the existing options for the capacities development of Poland's Armed Forces in terms of offensive and defensive means of air defence. The last section seeks to answer questions about the optimum development options of the air defence system, taking account of the future tasks of Air Forces and air defence units.

This Report does not seek to resolve the dilemma over which and how many weapon systems are essentially necessary since, to answer this question, in-depth technical, economic, and political analyses would have to be conducted for each type of the weapon systems in question. This Report delineates more general development directions for Poland's air defence system, which will hopefully contribute to better and more effective planning in this area.



# Chapter I

## Challenges faced by the Air Defence System of Poland's Armed Forces

### 1. Security Environment of the Republic of Poland

The issues of security may be viewed from both a negative (absence of threats) and a positive (confidence in security) point of view. The notion of security may be perceived as the absence of threats or defence against factors posing a potential threat, or the feeling of confidence that either no threats are likely to emerge in the future, or – if any threats should arise – they can effectively be countered. Security may be examined in relation to both individuals and highly organized communities, such as the contemporary states. Another important aspect is that security as such should never be taken for granted – it requires proactive measures aimed at eliminating and safeguarding effective protection against threats<sup>1</sup>.

The threats we face may be either external or internal, and security per se should be seen as dependent on and related to the surrounding environment. In this context, we may refer to the security environment of individuals or organizations. In this respect, Poland's security may be threatened by both internal events (social unrest, etc.) and international conditions (military aggression of another state). In order to identify the potential threats for Poland's security and to determine means by which they can be deterred, one must analyse not only the domestic situation, but also the international environment.

Poland has gone through a radical change of its security environment in the past 25 years. In early 1990s, Poland was a member of the Warsaw Pact, and according to the military doctrine existing at that time any conflict between NATO states and the Eastern Block could expand into a conflict involving restricted or unrestricted use of nuclear weapons. Poland – without any active choice on its part – would be dragged into war. *For this reason, any war in Europe could bring with it the destruction of Poland's society, economy, and culture* – the doctrine warned<sup>2</sup>. Fortunately, these dire predictions have proved wrong and the Warsaw Pact was dissolved in July 1991. Eight years later, in March 1999, Poland joined the North Atlantic

Treaty Organization, the world's strongest military and political alliance of today. Since then, Poland's territorial integrity and political independence have been safeguarded under Article 5 of the North Atlantic Treaty, reading: *"The Parties agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and [...] will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area"*<sup>3</sup>. In May 2004, Poland joined the European Union, which also contributed to the strengthening of its security<sup>4</sup>.

Apart from activities in the international arena, Poland has taken measures to reinforce its own defence capacity. The main goal was to create a smaller, yet fully professional, well-trained and well-equipped army capable of defending Poland's territory and joining missions of allies elsewhere in the world. Reforms in this area have only been implemented partially. Poland's army has become fully professional. It was reduced to 120 thousand soldiers (including 20 thousand soldiers of the Reserve National Forces), and two strategic commands (General Command and Joined Armed Forces Operational Command). In 2001, the Act on reconstruction, technical modernization and financing of the Armed Forces of the Republic of Poland was adopted, under which *the annual spending from the stage budget to cover the defence requirements of the Republic of Poland is set to a minimum of 1.95 percent of the last year's Gross Domestic Product (Article 7)*.

<sup>1</sup>R. Zięba, *Pozimnowojenny paradygmat bezpieczeństwa międzynarodowego* [in:] R. Zięba (ed.), *Bezpieczeństwo międzynarodowe po zimnej wojnie*, WAIp, Warsaw 2008, p. 15-16.

<sup>2</sup>Resolution of the National Defence Committee of 21 February 1990 on the defence doctrine of the Republic of Poland.

<sup>3</sup>The North Atlantic Treaty, Washington D.C. – 4 April 1949, Polish Journal of Laws Dz.U.2000.87.970.

<sup>4</sup>Article 42(7) of the Treaty on European Union reads: *If a Member State is the victim of armed aggression on its territory, the other Member States shall have towards it an obligation of aid and assistance by all the means in their power, in accordance with Article 51 of the United Nations Charter. This shall not prejudice the specific character of the security and defence policy of certain Member States.*

Establishing stable financing framework for Poland's Armed Forces was a milestone in efforts to further promote the technical modernization of the Polish army, and encouraged progressive replacement of military equipment dating back to the Soviet era with weapon systems designed and produced in the West, most notably the F-16 aircraft multirole fighters, C-295 military transport aircrafts, spike anti-tank missiles, and Rosomak multi-role military vehicles. To continue this process, the *Armed Forces of the Republic of Poland Development Program for 2013-2022*, and the *Armed Forces Technical Modernization Program for 2013-2022* were adopted, outlining key weapon systems essentially required to maintain and develop the capacities of the Polish Army<sup>5</sup>. It is important to note that this plan can be said to have a sound financial base (public spending on technical modernization of Polish Armed Forces in the period 2014-2022 is estimated to reach PLN 131 billion). In September 2013, the Council of Ministers adopted a resolution establishing a multiannual program "*Priority Objectives of the Technical Modernisation of the Armed Forces of the Republic of Poland as part of operating programs*"<sup>6</sup> in furtherance of the goals stated in these two programs. It consists of 14 multiannual operational programs to be pursued between 2014 and 2022, worth PLN 91.5 billion<sup>7</sup>.

In early 21st century, the international balance of forces began to swing to the disadvantage of Poland. Soon after Poland joined the NATO, the USA, being the key ally of Poland outside Europe, responded to the terrorist attacks in New York City and Washington, D.C. on September 11, 2001 by launching "war against global terrorism", and NATO increasingly focused on developing its capability for rapid deployment of expeditionary missions at the expense of its traditional role of collective defence. This became explicitly apparent in November 2010, in the Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation in Lisbon<sup>8</sup>, which set forth, apart from three main NATO's tasks of collective defence and cooperative security, also crisis management, and across the crisis management spectrum the allies agreed to *further develop doctrine and military capabilities for expeditionary operations*,



The twin towers of the World Trade Center on 11 September 2001 in NYC Photo by M. Foran, Flickr.com.

*including counterinsurgency, stabilization and reconstruction operations*<sup>9</sup>. While pursuing *out of area missions*, NATO supported the US in the stabilization mission in Afghanistan<sup>10</sup>. However, there was a growing concern among experts and diplomats from NATO allies in Europe that the US would turn NATO into a toolbox to draw from its resources and capabilities required for particular military operations.

<sup>5</sup> The overall plan is to implement 30 armament programs broken down into 6 categories – antimissile and antiaircraft defence, unmanned aerial vehicles, helicopters, air forces, navy, and ground troops.

<sup>6</sup> Resolution No 164 of the Council of Ministers of 17 September 2013 concerning the incorporation of the multiannual program "*Priority Objectives of the Technical Modernisation of the Armed Forces of the Republic of Poland as part of operating programs*" (M.P. item 796). This Resolution was amended with the Resolution No 123 of the Council of Ministers of 23 June 2014 amending the resolution concerning incorporation of the multiannual program "*Priority Objectives of the Technical Modernisation of the Armed Forces of the Republic of Poland as part of operating programs*" (M.P. item 558).

<sup>7</sup> See R. Lipka, T. Smura (ed.), *Siłły Zbrojne RP – stan, perspektywy i wyzwania modernizacyjne*, The Casimir Pulaski Foundation, Warsaw 2014.

<sup>8</sup> See: *Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation. Adopted by Heads of State and Government in Lisbon*, last accessed on: 14.09.2015, [http://www.nato.int/cps/en/natolive/official\\_texts\\_68580.htm](http://www.nato.int/cps/en/natolive/official_texts_68580.htm).

<sup>9</sup> NATO's Strategic Concept also clarified that *NATO will actively employ an appropriate mix of those political and military tools to help manage developing crises that have the potential to affect Alliance security, before they escalate into conflicts; to stop ongoing conflicts where they affect Alliance security; and to help consolidate stability in post-conflict situations where that contributes to EuroAtlantic security*. *Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation, signed by Heads of State and Government in Lisbon*. BBN Unofficial Translation.

<sup>10</sup> At peak times, around 130 thousand soldiers from 51 countries across the world served under ISAF (*International Security Assistance Force*), including 2.6 thousand soldiers from Poland. NATO took the lead of the International Security Assistance Force operation in Afghanistan in August 2003. Following the completion of this mission in December 2014, a new, follow-on NATO-led mission called Resolute Support was launched.

At a time when the West was focused on the near and Middle East regions, the security environment in Europe began to deteriorate. This was mainly due to the redevelopment of the military power and increasingly belligerent attitude demonstrated by Russia, still struggling to find its place in the post-Cold War era. In early 2000, Boris Yeltsin, a conciliatory President of the Russian Federation, left the presidency in the hands of his chosen successor, Vladimir Putin, a prominent member of Yeltsin's administration and a former officer in the KGB. A new approach of Vladimir Putin to domestic and foreign policy was first seen during the Second Chechen War when Russian forces entered Chechnya to "restore order", and brutal fighting followed. The new President of the Russian Federation began consolidating power and tamed the almighty oligarchs. When Putin introduced his new stance of domestic and foreign policy, oil prices were soaring worldwide, which gave the Russian budget a major boost, bringing money and social stability. Putin also reinforced Russia's position in the international arena by tightening cooperation with the strong European economies of France, Germany, and Italy. These objectives have given him high endorsement and popular support, yet Putin did not attempt to change the Russian Constitution to run for a third consecutive presidential term. Instead, he supported this close ally, Dmitry Medvedev, in the next presidential elections. Dmitry Medvedev won the office in 2008 and appointed Putin as Prime Minister. However, in just 4 years, Putin was back in Kremlin for another term as President.

During the Putin-Medvedev rule, the Russian foreign policy grew increasingly aggressive. In 2008, in response to pro-EU and pro-NATO aspirations of Georgia (during the NATO summit in Bucharest, NATO declared it welcomed Ukraine's and Georgia's aspirations for membership in NATO<sup>11</sup>), Russian forces entered the territory of Georgia, allegedly to put a peaceful end to the conflict between Georgia and Ossetia, and inflicted very serious losses on Georgia's armed forces in the process. The Russo-Georgian diplomatic crisis in 2008 caused a major downturn in the relations between Russian and the West. Still, during the Dmitry Medvedev tenure as President of the Russian Federation, these

relations were largely rebuilt. However, the events in Georgia in 2008 exposed weaknesses of the Russian armed forces -attributed to a lack of appropriate equipment, poor mobility, and overstaffed command structures.

Soon after the conflict ended, a mass-scale overhaul began within the Russian armed forces. The main goal was to leave the Soviet model of mass mobilization behind in favour of smaller and more professional armed forces with the goal of attaining the highest-possible



A Russian infantry fighting vehicle BMP-2 during the Russo-Georgian crisis in 2008 in South Ossetia. Photo by: Yana Amelina (Амелина Я. А.), Wikimedia Commons.

levels of combat readiness. The division-based structure of the Russian ground troops was replaced with a brigade-based one. The number of military districts was reduced from 6 to 4 (Western, Southern, Central and Eastern Military Districts). The command structure were downsized as well. A huge effort was inaugurated to replace the Soviet military equipment with the latest combat means. A 10-year National Armament Program for 2011-2020 was adopted in December 2010 (GPW 2020).

<sup>11</sup> See Bucharest Summit Declaration. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Bucharest on 3 April 2008, last accessed on: 01.09.2015, [http://www.nato.int/cps/en/natolive/official\\_texts\\_8443.htm](http://www.nato.int/cps/en/natolive/official_texts_8443.htm).

According to its assumptions, Russians planned to acquire new weapons and run large-scale research and development works in the field of new military technologies by spending around RUB 19 billion (around USD 600 billion at that time). The main goal was to increase the share of military equipment in Russian service that could be categorized as “modern” from around 10 per cent in 2008 to around 70 per cent in 2020. The Russians intended to buy, inter alia, 600 aircraft and 1100 helicopters for the Russian Air Forces, around 100 vessels for the Navy – including around 25 corvettes, 14-15 frigates, and 24 submarines (8 Borei-class submarines with R-30 Bulawa submarine-launched ballistic missiles), 2300 battle tanks, 2000 artillery fire units, and 120 9K720 Iskander ballistic missile systems for their ground forces. More new equipment was planned for delivery to the Russian strategic forces (RS-24 Jars, RS-12M1/2 Topol-M missiles) and air defence forces (around 400 S-400 Triumf and 100 S-500 Triumfator-M systems)<sup>12</sup>.

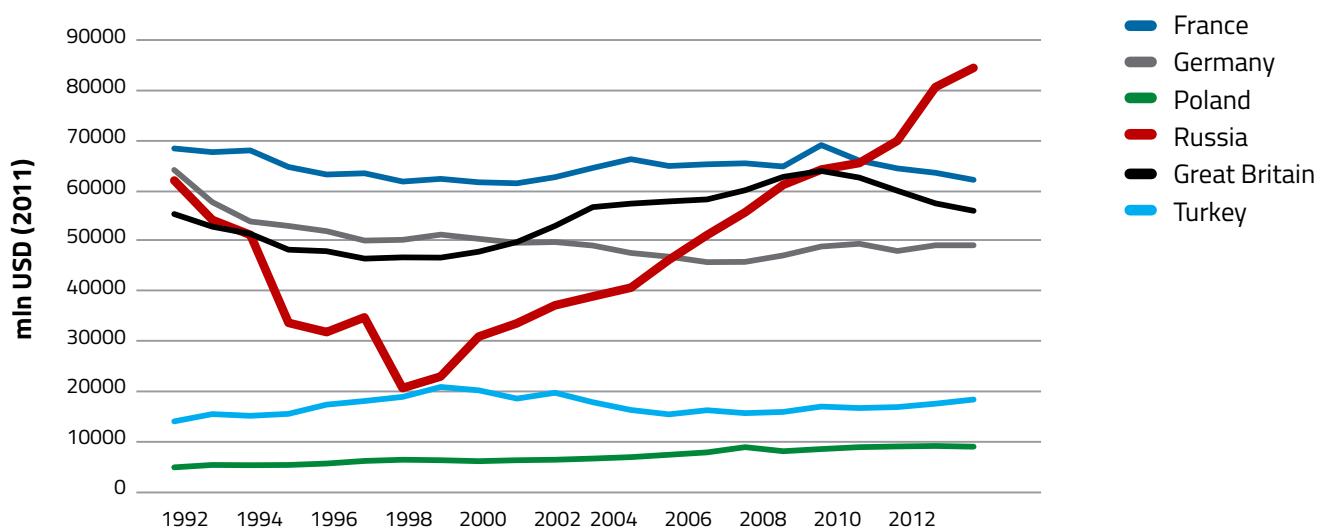
Increased military spending in Russian was accompanied by a reverse trend among the NATO states, whose public spending on the army has been progressively reduced since the end of the Cold War. The economic crisis of 2008 contributed to reduced military spending even further and forced the US and the

European allies to contain the costs and look for savings (according to NATO data, only 4 NATO members spent the target 2 per cent of their GDP on defence in 2014, while NATO member states in Europe spent no more than 1.5 per cent of GDP on defence on average)<sup>13</sup>. Moreover, the USA, as a guarantor of security in Europe, began shifting the focus of its foreign and security policy from Europe and Middle East to Asia and the Pacific. The new direction was reflected in the Pivot/Rebalancing strategy announced in 2011, which heralded the relocation of around 60 per cent of the US military bases into the Pacific region until 2020.

In 2014, we witnessed a change for the worse in Poland’s security environment. This was due to the conflict between Russia and Ukraine, which began with the ousting of the then- President of Ukraine, Viktor Yanukovich, in February 2014. The conflict escalated a few weeks later with the sabotage-diversion operations of Russia in Crimea, which led to the illegal annexation of the Crimea region by the Russian Federation and direct support (through unmarked Russian troops) for separatists in the Donbas/Eastern Ukrainian regions of Donetsk Oblast and Luhansk.

<sup>12</sup> See R. Lipka, T. Smura, *Program modernizacji Sił Zbrojnych Federacji Rosyjskiej – stan realizacji i perspektywy powodzenia* [in:] “Komentarz Międzynarodowy Pułaskiego” 2015, Vol. 2.

<sup>13</sup> *Defence Expenditures of NATO Countries (1995-2015)*, NATO, last accessed on: 23.07.2015, [http://www.nato.int/cps/en/natohq/news\\_120866.htm](http://www.nato.int/cps/en/natohq/news_120866.htm).



The military expenditure of the Russian Federation as compared to selected NATO member states between 1992-2012.  
Source: own analysis based on SIPRI Military Expenditure Database.



These Russian incursions were categorically condemned by the West, and following annexation of Crimea, the Russia-EU Summit was called off. Regular meetings of heads of states and governments between EU member states and Russia were no longer taking place. Assets have been frozen and visa restrictions imposed on individuals responsible for undermining or threatening the territorial integrity, sovereignty and independence of Ukraine (The EU list currently includes 150 names of individuals and 37 entities). In July and September 2014, in response to the Russian operations in Donbas, the EU imposed sector-specific economic and financial sanctions against Russia, for example, by restricting access to the EU market for financial instruments (with a maturity exceeding 30 days) for state-owned Russian banks and major Russian energy and defence companies.

Moreover, the EU nationals and companies were prohibited to provide any loans to five major, designated Russian state-owned banks. Embargoes have been introduced on the export of military technologies and of dual-use goods and technology for military use to Russia, as well as technologies and services necessary for deep-water oil and arctic energy resources exploration or production. Separate sanctions have been imposed by the US, Canada, Australia, and Japan. In March 2015, the EU leaders decided to align the existing sanctions regime to the complete implementation of the Minsk agreements<sup>14</sup>.

Despite the Minsk II agreement establishing a ceasefire between pro-Russian separatists and the Ukrainian army, Moscow has continued its provocative policy against the West, e.g. by sending combat aircraft near the airspace of NATO allies. Jens Stoltenberg, NATO Secretary General, announced on 20 November 2014 that NATO warplanes had to scramble 400 times in 2014 in response to an increase in Russian air activity, a rise of 50 per cent over last year. In 2014 and 2015, the Russians held numerous war games through the different regions of Russia. (The largest military manoeuvres were staged at the turn of March/April to examine the combat readiness of the Western and Central Military District, involving 150 thousand troops; followed by war games in June 2014 of the Central Military District with 65 thousand troops, and the

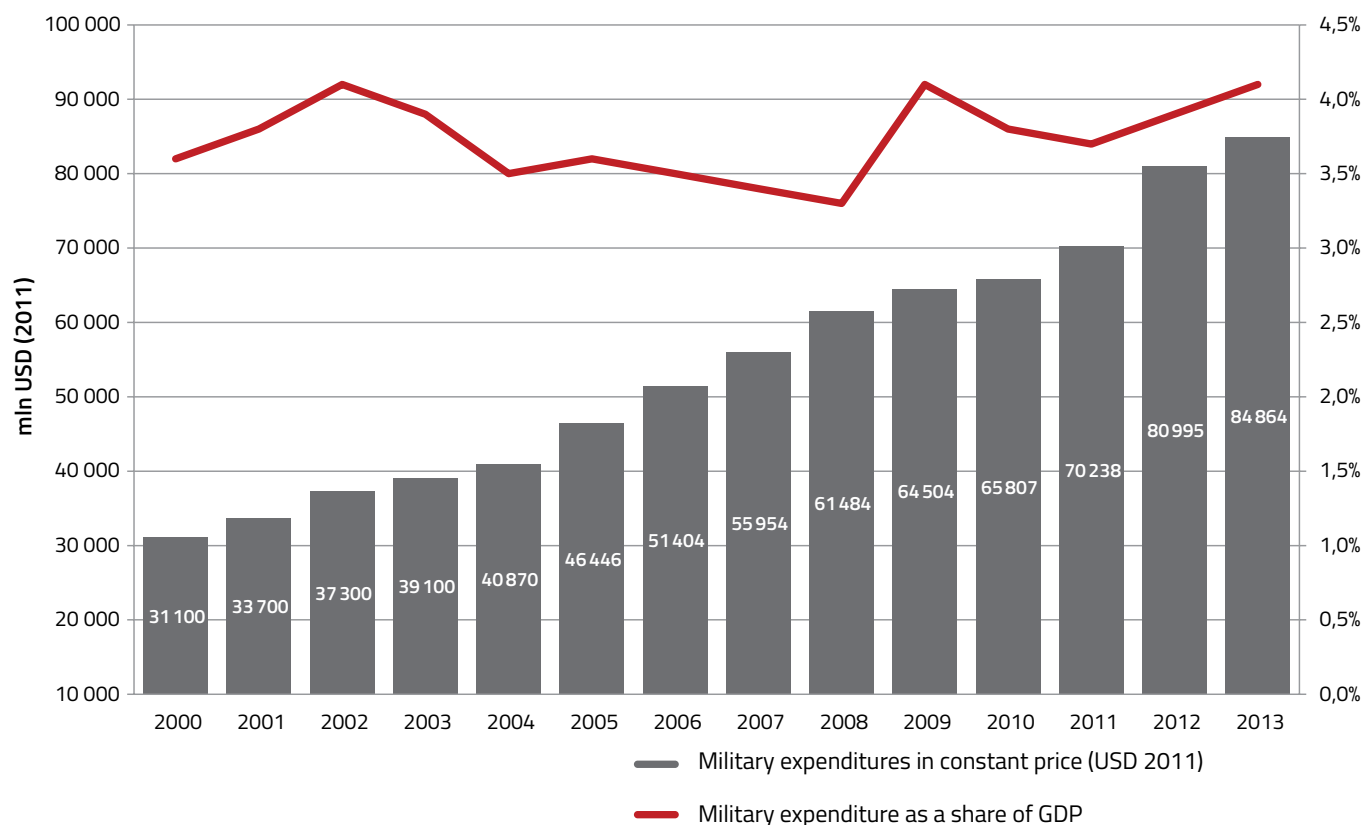
Eastern Military District with 160 thousand troops in September 2014, the Vostok-14 manoeuvres involving 100 thousand soldiers, and the organized military training of 80 thousand troops from selected military units from all over the country in March 2015).

In response to the military aggression by Russia against Ukraine, NATO's *Baltic Air Policing* mission was increased from 4 to 16 fighter jets to strengthen the security of the airspace of the Baltic States, which have no own air forces of their own. At the NATO Summit of Heads of State and Government in Newport in September 2014, NATO countries agreed to establish a continuous presence of allied forces on a rotational basis on the territories of the Alliance's eastern flank. According to NATO sources, the Alliance and individual member states held around 200 various military exercises in Europe alone in 2014. In an attempt to strengthen the eastern flank of the North Atlantic Alliance, large-scale *Steadfast Javelin I* war games were staged Estonia in May 2014, involving some 6,000 troops, followed by *Saber Strike* military exercise in the Baltic States in June, involving 4.8 thousand soldiers; *Steadfast Javelin II* manoeuvres in Poland and Germany in September with 2 thousand troops; Poland's *Anaconda* makeovers involving 12.5 thousand soldiers, staged in October; *Iron Sword* exercises in Lithuania in November with 2.5 thousand soldiers, and *Black Eagle* military exercise on Polish territory (October-December) with 2.3 thousand troops<sup>15</sup>.

In view of the abovementioned findings, Poland should take the issues of security as seriously as possible. The evolution of the security environment of Poland is long-running process and requires long-term adaptive measures. Apart from international efforts, specifically designed to adapt the North Atlantic Treaty Organization to the new strategic environment, the capabilities of Poland's Armed Forces should continue to be modernized and extended. A more exhaustive analysis of threats to Poland's security seems necessary, based on which a comprehensive vision may be compiled of how individual types of armed forces should be developed in the future.

<sup>14</sup> *EU restrictive measures in response to the crisis in Ukraine*, the European Council, last accessed on: 30.07.2015, <http://www.consilium.europa.eu/pl/policies/sanctions/ukraine-crisis/>.

<sup>15</sup> T. Smura, *Nowa zimna wojna – wpływ pogorszenia relacji Rosji z Zachodem na stan bezpieczeństwa w Europie* [in:] *Komentarz Międzynarodowego Pułaskiego* 2015, Vol. 11.



Military spending of the Russian Federation between 2000 and 2013. Source: own analysis based on SIPRI Military Expenditure Database.

## 2. Threat scenarios and missions of Air Force and Air Defense

### 2.1 An Armed attack on the territory of Poland and collective defense measures within the Article 5 context

It is no exaggeration to state that the phenomenon of war has accompanied mankind ever since more complex social forms, such as tribes and states, began to emerge. In addition, currently there are no indications that warfare being utilized, as a means to put an end to disputes, both international and domestic, will be eliminated in the foreseeable future. War is most commonly defined as an armed conflict involving at least two conflicted parties that use military forces and other means and methods of combat, during which a

certain continuity of warfare is maintained. According to the Stockholm International Peace Research Institute (SIPRI), war is defined as a *"major armed conflict" involving the use of armed force between the military forces of two or more governments, or of one government and at least one organized armed group*<sup>16</sup>. It is important to distinguish between the notions of "war" and "military conflict", the latter one having a broader meaning and referring to all forms of military struggle between actors, not necessarily subjects of international law.

<sup>16</sup> R. Artymiak, *Wojny i konflikty w XX wieku* [in:] R. Borkowski (eds.), *Konflikty współczesnego świata*, AGH, Kraków 2001, p. 39.

## Assumptions

Following the end of the Cold War, the possibility for an interstate military conflict in Europe has been significantly reduced. First and foremost this was due to the abolishment of the bi-polar constellation of global forces, an emerging co-operative conflict management between East and West, European integration, and progressive NATO enlargement. Still, while witnessing the Russo-Georgian War of 2008 and the current Russian military intervention in Ukraine (although Russia denies being a party to it, or that there is any involvement by Russian armed forces), it cannot completely be excluded that a conventional military conflict could once more break out in Europe. The *Security Strategy of the Republic of Poland* published in 2014 recognizes that *Poland is not free from forms of political pressure which use military arguments. In its closest vicinity, there is a large concentration of military potentials, also in offensive posture. Threats for Poland may, in unfavorable conditions, become non-military and military. As far as military threats are concerned, they may take the form of crisis threats or war threats i.e. of military conflicts of various scale – from military activities below the threshold of classical war to a less probable large scale conflict*<sup>17</sup>.

Regardless of the perceived lower likelihood of a military conflict, it still remains the most probable threat to Poland's security. According to the Constitution of the Republic of Poland, *the Armed Forces of the Republic of Poland shall safeguard the independence and territorial integrity of the State, and shall ensure the security and inviolability of its borders*<sup>18</sup>. Therefore, **any Armed Forces modernization and development plans, including those pertaining to the Air Force, should be essentially focused on leveraging Poland's capacity to counter an attack on its own territory**. This is all the more important as Poland, one of NATO member states on the eastern flank, is more exposed to a military attack as compared to countries which are far from the external borders of NATO.

While analyzing an armed conflict scenario affecting Poland, consideration should be given to the direction from which a potential attack could be launched. Assuming that the threat to the very existence and ter-

ritorial integrity of the Polish state may only emerge in its direct neighborhood, it must be pointed out that, among the countries bordering Poland, four of them (the Federal Republic of Germany, the Czech Republic, Slovakia, and Lithuania) are members of NATO and the European Union, while one of three remaining states (Ukraine) apparently continues along the path towards EU membership. As a result, it seems appropriate to assume that – **in the current circumstances – the Russian Federation and Belarus are the only neighboring countries that may pose a threat to Poland** (however, in another possible scenario, the power in Kiev is taken over by pro-Russian forces, and Ukraine once more moves closer together politically to the Russian Federation)<sup>19</sup>.

Considering the different scenarios of a military conflict, Poland's NATO membership is another factor that should be borne in mind. Since Poland's accession, NATO (currently consisting of 28 member states) has been the most important guarantor of Poland's security, and in the event of an armed attack against Poland, other Parties to the North Atlantic Treaty will take collective defense measures. It is worth noting that, under Article 5 of the North Atlantic Treaty, other NATO members are not bound to use military force to assist an ally under attack, and the parties agree to take *such action as they deem necessary* (meaning, for example, political and/or logistic support). On the other hand, when Poland joined NATO by signing the North Atlantic Treaty, it became the guarantor of security of all other allies, and therefore, in theory, Poland also may become involved in a military conflict without being the victim of an assault on its territory. This scenario would entail Poland's involvement in a war, for example, following the Baltic States being attacked by the Russian Federation.

Article 5 of the Washington Treaty was invoked for the first time in its history following the 9/11 terrorist attacks against the United States. How would other NATO members respond to an attack on the territory of Poland is at present difficult to predict. Even more so, if the attack was launched by a state in possession of nuclear weapons, the attacking enemy could attempt to blackmail other NATO members to stay out of the conflict.

<sup>17</sup> *Security Strategy of the Republic of Poland*, BBN, Warsaw, 2014, p. 20.

<sup>18</sup> *Constitution of the Republic of Poland*, Article 26.1.

<sup>19</sup> R. Lipka, T. Smura (eds.), *op. cit.*, p. 8.

On the other hand, by refusing to provide any assistance at all, NATO's position would be severely discredited, and the security of all NATO members would be badly compromised, resulting in serious repercussions worldwide (it would definitely undermine the credibility of US guarantees to Japan and South Korea). Hence, **the collective defense guarantees established under Article 5 of the North Atlantic Treaty may be considered fairly reliable.**

The mutual defense clause enshrined in Article 5 of the Washington Treaty is of key importance from the perspective of defense concepts pertaining to the territory of Poland, particularly because it greatly minimizes this likelihood of a hypothetical nuclear attack against Poland. Because of the existing nuclear balance of power between NATO and the Russian Federation, nuclear weapons could only be used as a measure of last resort (according to the current SIPRI data, the total stockpiles of nuclear weapons are as follows: Russia – 7500, the US – 7260, France – 300, and the UK – 215). The likelihood of the outbreak of a nuclear war is further reduced through NATO's *Nuclear Sharing* of weapons (tactical B61 nuclear bombs), a program involving the United States and some European countries: Germany, Italy, the Netherlands, Belgium, and Turkey.

The very essence of warfare also needs to be taken into account – in the Cold War era, both Western and Soviet planners embraced the mass-scale use of nuclear weapons ahead of combat operations by armored and mechanical military taskforces. According to the strategic documents of the Warsaw Pact dating back to 1980s, the Warsaw Pact forces were considered capable of reaching the French-German border within just two weeks, and of bringing the entire territory of Europe under control within no more than 30–35 days<sup>20</sup>. The concept of land invasion was rooted in the ideological war fought between the Soviet Block and the capitalist states in the second half of the 20th century; however, today it would be difficult to imagine a military operation – launched as a result of a hypothetical conflict between Russia and the NATO member states – on a scale comparable to that envisaged in the military plans dating back to the Cold War era.

Hypothetically, a war between NATO member states and Russia would only be possible under specific political conditions, and the ultimate goal would not be to conquer a significant chunk of Europe's territory. **In theory, the Russian Federation is most likely to attack a NATO member state (Poland) only if other NATO allies, parties to the North Atlantic Treaty, fail to take a firm stance** in the face of tense political situation in the region. **Military operations between NATO and Russia would simply be the result of miscalculations of the Russian decision-makers planning to discredit the North Atlantic Alliance**, by which Russia would hope to gain full freedom of action on the international front.

### **Tasks and capacities of Poland's Air Force and Air Defense**

Even in a positive scenario – in which Poland is offered direct military support offered by its NATO allies – it is imperative that Poland's Armed Forces remains directly accountable for the defense of its territory. In fact, the main burden of stopping and countering foreign aggression will be borne by Poland, at least until the allied armed forces come to rescue. If an attack is perpetrated on the territory of the Republic of Poland, the main tasks of Poland's Air Force (the joint force air component) and the Air Defense Units in cooperation with the allied forces would be to **take control of the airspace, to carry out strategic air operations, to pursue operations against land and naval force of the adversaries, and to support air operations.**

Depending on the stage of the conflict, the Air Force operations would be focused on the enemy's air force, infrastructure, important facilities and systems, as well as land and naval forces. Combat aircraft and land-based air defense systems would play the decisive role<sup>21</sup>.

<sup>20</sup> Refer to R. Kałużny, *Układ Warszawski 1955-1991* [in:] „Zeszyty Naukowe WSOWL” 2008, Vol. 1, p. 190-198.

<sup>21</sup> S. Zajas, *Siły Powietrzne. Dzień dzisiejszy i wyzwania przyszłości*, AON, Warsaw 2009, p. 20.



To **gain and maintain dominance in the air** is a precondition for the success of any military defense operation. Otherwise, any operations carried out by the air force assets or any other type of armed forces would be completely paralyzed. According to the accepted NATO classification, there are three degrees of control of the air:

1. *Favorable Air Situation*: A favorable air situation is one in which the extent of air effort applied by the air force of an adversary is insufficient to prejudice the success of friendly land, sea or air operations;

2. *Air Superiority*. Air superiority is defined as that degree of dominance in the air battle of one force over another, which permits the conduct of operations by the former and its related land, sea and air force at a given time and place without prohibitive interference by the opposing force;

3. *Air Supremacy*. Air supremacy is defined as that degree of air superiority wherein the opposing force is incapable of effective interference<sup>22</sup>.

The most important goal is to win air supremacy to secure the capability to put into effects air operations and to restrict the air capability of the opposing forces (this is where the allied air forces are free to carry out low-risk flights, and the enemy air forces are prevented from operating in the air or are exposed to considerable risk of losses). Air superiority or air supremacy can only be gained through effective air defense and attack measures – both defensive (anti-aircraft defense, radio engineering troops) and offensive (active combat aircraft). This is especially important since the potential enemies of Poland (the Russian Federation) have well-developed combat air force and advanced anti-aircraft defense systems. In addition, Poland's air defense units would have to counter the attack using tactical ballistic missiles. According to Military Balance estimates, the Western Military District<sup>23</sup> of the Russian Federation alone includes:

- » 180 fighter aircraft (20 MiG-29, 51 MiG-31, 109 Su-27/27UB),
- » over 98 active combat aircraft (28 MiG-29SMT, 6 MiG-29UBT, 44 Su-24 M/M2, 20+ Su-34),
- » over 42 reconnaissance aircraft and

electronic-warfare aircraft (4 An-30, 10+ MiG-25RB, 28 Su-24MR),

- » 23 fighter aircraft and attack aircraft assigned to naval aviation units of the Northern Fleet,
- » 60 Mi-24 attack helicopters,
- » 2 Tochka ballistic missile system brigades,
- » 1 Iskander ballistic missile system brigade<sup>24</sup>.

Of course, it is also important to note that it is virtually impossible for Russia to use all of its air force assets in an attack; however, units from other military districts may be easily redeployed<sup>25</sup>.

The Belarusian Air Force comprises:

- » 38 MiG-29S/UB fighter jets,
- » 34 Su-25K/UBK strike aircraft,
- » 69 Mi-24 helicopters (including 20 reconnaissance helicopters),
- » 36 R-70 and Tochka missile systems,
- » 60 R-300 Elbrus missile systems<sup>26</sup>.

At the same time, it should be made clear that under the 2010-2020 technical modernization plan of the Russian armed forces, Russia plans to acquire around 600 new combat aircraft, including Su-30SM (72 ordered, 30 delivered) Su-30M2 (16 ordered, around 10 delivered), Su-35S (48 ordered, around 30 delivered), MiG-29SMT (16 ordered) and Su-34 (a contract for 92 aircraft is currently being implemented, 30 of them have been delivered). The plan also envisages the acquisition of 400 attack helicopters, 120 Iskander-M missile launchers (so far 72 missile launchers, 2 missiles each, have been delivered to 6 missile brigades). S-400 Triumf systems and 100 S-500 Triumfator-M launchers are due to be delivered to 28 air defense regiments (16 missile launchers each)<sup>27</sup>. The exact number of arms units delivered to the Western Military District is not known, but one may suspect that the numbers will be considerable, given the current tensions between Russia and Western countries.

<sup>22</sup> Refer to J. Kaczmarek, W. Łepkowski, B. Zdrowski, *Słownik terminów w zakresie bezpieczeństwa narodowego*, AON, Warsaw 2008.

<sup>23</sup> The Western Military District was formed in September 2010 from the Moscow and the Leningrad Military Districts, and was further expanded to include the Volga-Ural and the Special Kaliningrad Military Districts in December 2010.

<sup>24</sup> *The Military Balance 2014*, ISS, 2014.

<sup>25</sup> Russia's Air Force is made of over 1300 combat aircraft and around 400 combat helicopters. *Ibid.*

<sup>26</sup> *Ibid.*

<sup>27</sup> R. Lipka, T. Smura, *Program...*, *op. cit.*



The structure and arrangement of the Russian military districts. Source: own analysis *The Military Balance 2014*.

Fighter aircraft play an essential role in **defensive operations against the enemy's air force** (air assault assets) aimed to attain air superiority. They are mobile and flexible enough to operate all over a target area at all altitudes. But, what is also important is that little time is needed to redeploy fighter jets to a given location. Fighter aircraft are kept on active duty at airbases in order to be available to police assigned airspace<sup>28</sup>. Currently, Poland has around 100 fighter jets of different combat capacities, ready to take part in defense operations. F-16 C/D fighter jets are the most technically advanced combat aircraft used by the Polish Air Force; Poland ordered a total of 48 F-16C/D fighter aircraft, now stationed in 2 air bases (at the 31st Tactical Air Base in Poznan and the 32nd Tactical Air Base in Łask). Poland's F-16 fighter aircraft are equipped with the Northrop Grumman AN/APG-68(V)9 multifunctional radar set that is capable of track-while-scan of up to 10 targets at a maximum range of up to 270 km for large objects and 130 km for other fighter aircraft. When used for combat against airborne targets, they can carry the Raytheon (RTN) AIM-120C-5 AMRAAM (Advanced Medium-Range Air-to-Air) missiles (the maximum head on range is

60-80 km, and 25-30 km in tail chase). In combat operations at short distances, RTN AIM-9X Sidewinder missiles are used, fitted with an infrared homing guidance system (overall, F-16 fighters can carry up to 9942 kg of air-launched weapons mounted on up to 11 hard points). F-16 aircraft are also equipped with the M61A1 Vulcan rotary cannon which fires 20 mm rounds with a fire rate of 6000 or 4000 rnds/min; the ammo drum has a 511-round capacity.



Polish and American F-16 multirole fighters at the Eielson Air Force Base in Alaska, during Red Flag military exercise in 2012.

<sup>28</sup> S. Zajas, *op. cit.* s. 23.

The Mikoyan MiG-29 is another fighter aircraft of the Polish combat air forces. There are two squadrons of MiG-29 fighters (32 aircraft: 25 combat ones and 6 MiG-29UB training&combat aircraft) stationed at the 22nd Malbork Tactical Air Base and the 23rd Mińsk Mazowiecki Tactical Air Base. MiG-29 combat fighters use the Phazotron RŁPK-29 radar system with the N019E Rubin radome. The N019E radar station can track up to 10 targets (and launch against 1 target); the maximum head-on range is 70 km against a target the size of a fighter aircraft. MiG-29 aircraft are mainly equipped with GSz-301 rotary cannon which fires 30 mm rounds with a fire rate of 1800 rnds/min; the ammo drum has a 150-round capacity. At short visual range distances, a helmet-mounted sight SZCZEL-3U targeting and display system is used, which cues Vympel R-60MK and R-73E short-range missiles (with a maximum operating range of 8-10 km and 15-20 km, respectively). MiG-29 combat-version fighter jets are also equipped with medium-range Vympel R-27RE missiles (with a maximum range of around 45-60 km). The MiG-29 has been designed as a light-weight limited-range frontline fighter, and is therefore mainly used for air defense purposes. Crucially, however, the capacities of MiG-29 will progressively be limited unless advanced retrofitting efforts are taken to integrate new types of Western weapons systems into their weapons mix and on-board systems configuration.

The Polish Air Force also has Sukhoi Su-22 fighter-bombers, which have been progressively withdrawn from service: 32 single seaters (Su-22M4) and trainer-version two-seaters (Su-22UM3K) are currently stationed at the 21st Świdwin Tactical Air Base. The Su-22 has 2 NR-30 cannons firing 30 mm rounds with a 160-round capacity, and R-60MK infrared homing short-range missiles (it has no radar set and cannot carry air-to-air radar homing missiles to neutralize targets at beyond visual range). Despite the obsolete avionics, nearly exhausted stocks of spare and a soon-to-expire service life, the Ministry of National Defense announced in April 2014 that it plans to continue using 18 Su-22 aircraft for the next 10 years (including 12 Su-22M4 and 6 Su-22UM3K machines), mainly for training purposes. The decision was criticized as too expensive (upgrading and retrofitting contract covering 18 Su-22 aircraft by Wojskowe Zakłady

Lotnicze No. 2 S.A. (WZL2) at cost of PLN 160 million) and short-sighted.

According to a former Commander of the 32nd Łask Tactical Air Base, Colonel Krystian Zięć, the scarcity of modern fighter aircraft is the primary concern of Poland's Air Force. He estimates that in order to win and maintain air superiority on the eastern border, Poland needs around 40 aircraft to be assigned to combat air patrol (CAP) flying missions. In addition to fighter aircraft, Poland also needs tanker aircraft, tanker escort aircraft, C2 (command and control) protection aircraft, and reserve aircraft. Taking into account the 'on active duty' ratio of the aircraft equipment, Poland's Air Force should include around 150 fighters. Colonel Krystian Zięć also argues that F-16 fighters are the only aircraft capable to meet the challenges of contemporary battlefield (with some reservations, especially in terms of training). The combat capacity of MiG-29 is considerably inferior – the training levels are unsatisfactory, and no tactical evaluation of the system has taken place (TACEVAL)<sup>29</sup>. *The very structure of MiG-29 is considered obsolete (the gas-guzzling engine leaves a visible vapor trail, the aircraft cannot be refueled in air, and the armament is outdated); on the other hand, MiG-29 modernization and retrofitting can turn out to be very expensive and economically impractical.*

Defensive operations against the enemy's air forces largely rely on the ground-based Air Defense Forces. Poland's Air-Defense Force is armed with NEVA-SC (modernized by the Polish industry into S-125M Neva-M) and Vega C (S-200WE Vega-WE) anti-aircraft missile systems, which, due to their structure and combat capabilities, fail to satisfy the current needs and contemporary threats. NEVA is a single-channel system that can engage with only one target at a time (Poland's Armed Forces have 17 NEVA systems, with 4 missile launchers each) and has a low- and medium-intercept altitude between 20 m and 18 km covering targets travelling at a maximum speed of 300 m/s in pursuit and up to 700 m/s closing in.

<sup>29</sup> TACEVAL programme is designed to check the capacity of the air force to launch combat operations for the period specified by the NATO military command, in conditions of limited support from the host state.

The destruction zone by range is from 3.5 to 24 km. In 1990s, attempts were taken to modernize the NEVA systems (by replacing analogue optical circuits with integrated circuits). Digitalization of the system has improved the system to some degree: it reduced the number of operating staff and improved the system's operational readiness and mobility. S-200 VEGA surface-to-air missile system (Poland's Armed Forces have 1 S-200 VEGA missile system with 6 missile launchers stationed in Mrzeżyn) is designed to combat distant targets (operational range of up to 255 km) at the flight altitude ranging from 300 m to 35 km, travelling at the speed of 300 m/s (in pursuit) to 1200 m/s (closing in). Poland's S-200VE anti-aircraft missile systems were upgraded between 1999 and 2001 into Vega C systems (in order to divide S-200VE into 2 independent missile battalions and to step up the command performance and fire control). The protection of Polish Land Forces is based on single-channel Kub (maximum range – 24 km, flight altitude – 10 km) and PRWB Osa-AK (maximum range – 10 km, flight altitude – 5 km) anti-aircraft missile systems, as well as ZUR-23KG and ZSU-23-4MP anti-aircraft artillery and missile systems, ZU-23-2 artillery systems, and the Grom man-portable air-defense system produced in Poland<sup>30</sup>.

The anti-aircraft missile systems currently used by the Polish Armed Forces are planned to be gradually replaced with novel technical solutions under the Wisła Program (from 2018 onwards, Poland will have 8 new medium range anti-aircraft batteries with the operating range of up to 100 km, capable to combat ballistic missiles) and the Narew Program (from 2019 onwards, 19 new short-range anti-aircraft systems with the operating range of 25 km will be acquired). Poland's Air-Defense Force will have 6 new Pilica close-range anti-aircraft artillery and missile systems, 79 Poprad anti-aircraft mobile missile launchers, and new-generation mobile air defense missile systems. In April 2015, the MoND announced it intended to acquire Raytheon's Patriot PAC-3+ systems under an intergovernmental contract with the USA, for the Wisła air- and missile-defense system.

Air reconnaissance is another element of successful air operations against airborne threats. Poland's Radar



Patriot missile defence system of the Bundeswehr (Armed Forces of the Federal Republic of Germany). Photo by Mark Holloway, Flickr.com.

Forces operate several dozen radars deployed all over Poland. Old-generation radar devices, including NUR-31MK pathfinders and mobile NUR-41 highfinders, are being progressively withdrawn from use. The oldest group of radars dating back to 1980s also includes NUR-31, NUR-31M radars, and the Airport Surveillance Radar Avia W. This equipment is replaced by 3D surveillance radars that can distinguish between hostile and friendly targets on radar, operating under the Supraśl system. The Polish Radar Forces currently use two types of stationary Backbone long-range radars – NUR-12M made in Poland and RAT-31DL made in Italy – based in 6 different locations. Other radars are deployed in 17 permanent posts. Some of the radar stations have been financed by NATO (RAT-31DL radars have anti-ballistic missile capabilities). NUR-12M and RAT-31DL radars have an operating range of 470 km; they can detect targets travelling at an altitude of 30 thousand metres. Stationary radars are also the first targets to be destroyed by the enemy forces in the event of a military conflict. To address this risk, mobile radar stations are also used, including mobile medium-range NUR-15 Odra 3D surveillance radars, soon to be replaced with new-generation NUR-15M radars (in 2013, a contract was signed for 8 new radars, to add to 4 ones already in use). The currently operating radar reconnaissance system is fully integrated with the Control System "DUNAJ", the backbone of Polish Air Defense System.

<sup>30</sup> A. Radomyski (eds.), *Podstawy obrony powietrznej*, AON, Warsaw 2014.



The Polish Radar Forces currently use two types of stationary Backbone long-range radars – NUR-12M made in Poland and RAT-31DL made in Italy – based in 6 different locations. Other radars are deployed in 17 permanent posts. Some of the radar stations have been financed by NATO (RAT-31DL radars have anti-ballistic missile capabilities). NUR-12M and RAT-31DL radars have an operating range of 470 km; they can detect targets travelling at an altitude of 30 thousand metres. Stationary radars are also the first targets to be destroyed by the enemy forces in the event of a military conflict. To address this risk, mobile radar stations are also used, including mobile medium-range NUR-15 Odra 3D surveillance radars, soon to be replaced with new-generation NUR-15M radars (in 2013, a contract was signed for 8 new radars, to add to 4 ones already in use). The currently operating radar reconnaissance system is fully integrated with the Control System “DUNAJ”, the backbone of Polish Air Defense System.

Another means to obtain air superiority is through launching an **air offensive**, in an attempt to destroy and overpower the enemy’s air forces on the territory from which they operate. This can be achieved through air strikes on airbases, military bases, air-defense missile systems, tactical ballistic missile launchers, air infrastructure and assets, or through overpowering the air defense forces. Offensive operations are conducted by active combat aircraft alongside air support forces (including early detection and guidance systems, electronic combat, and aerial refueling), as well as fighter aircraft<sup>31</sup>.

Combat aircraft can also be applied in strategic air operations, and to attack land and navy forces. **Strategic air operations** are where attacks are launched against strategic targets to weaken the political, military and economic capacity of the state to pursue military actions (strategic targets include power plants, oil refineries, communication centers, and production infrastructure). **Operations against land forces** can be either be in direct support (the use of aircraft to attack targets in close proximity to friendly forces) or air interdiction (the use of aircraft to attack tactical ground targets that are not in close proximity to friendly ground forces, including second echelons or ground-based reserves, or delivery

networks and sources). In **operations against naval forces**, aircraft are used to combat surface vessels and submarines and support landing operations<sup>32</sup>.

The capabilities of the Polish Air Force to carry out an air offensive against the enemy’s air power, strategic air operations, or operations against land and naval forces are even more limited than in the case of defensive air campaigns. It is true that F-16 multirole fighters have excellent air offensive capability, but MiG-29 and Su-22 fighters are dramatically less capable of carrying out offensive operations. The weapon systems integrated with the Polish F-16 fighters with capabilities against ground-based threats include: AGM-65G2 Maverick air-to-ground infra-red guidance tactical missiles, AGM-154C JSOW (*Joint Standoff Weapon*) precision guided weapons, and Mk 82 (227 kg) / Mk 84 (907 kg) bombs with JDAM guidance kits that convert unguided bombs into smart bombs guided by satellite systems (GBU-38/B and GBU-31(V)1/B). Poland’s precision guidance capabilities include GBU-12E/B Paveway II and GBU-24 Paveway III systems that convert Mk 82 and Mk 84 bombs, respectively, into laser-guided bombs. In December 2014, a contract was signed with the US government for the delivery of 40 state-of-the-art AGM-158 JASSM (Joint Air-to-Surface Standoff) missiles with the range of over 370 km. The first of these AGM-158 JASSM missiles are scheduled to be delivered during the second half of 2016.

In terms of the capability against ground-based targets, MiG-29 aircraft are integrated only with traditional, “dumb” bombs (100-500 kg), KMGU-2 munitions dispensers (that can be fitted with small weight bombs: general-purpose fragmentation bomb, anti-armor bombs, and incendiary bombs) as well as non-guided S-8 80 mm rockets (fired with B-8M1 rocket launchers with 20 rockets each). Compared to the MiG-29, the Su-22 is better-equipped to attack ground-based targets. Apart from non-guided bombs, Su-22 can carry laser-guided air-to-ground Ch-25MŁ missiles and Ch-25MP anti-radar missiles.

<sup>31</sup> S. Zajas, *op. cit.*, s. 24-25.

<sup>32</sup> *Ibid.*, p. 26-30.

Polish Su-22 aircraft are integrated with heavy-weight laser-guided Ch-29L missiles, and TV-guided Ch-29T missiles. The Su-22 can also carry the following guided rocket weapons: S-5 (57 mm, UB-32A-73 airborne rocket launcher), S-8 (80 mm, B-8M1 rocket launcher), S-24 (240 mm, APU-68UM3E rail-type launcher), S-25 (250 mm, 340 mm and 420 mm, and O-25 tube-type launcher) air-to-ground rockets, and SPPU-22-01 munitions dispensers with 23 mm cannons.

In theory, the offensive capability of Su-22 against ground-based targets is considerable; however, their actual military value is highly questionable since no retrofitting of this type has been undertaken throughout the past 20 years. Just as in the case of MiG-29 fighters, the expiring service life of guided rocket weapons and their scarcity have become a growing concern. According to the latest data, there are no more than around 250 Ch-25/29 rockets left (which have not been used since 2010). The capabilities of the Polish combat aircraft against naval targets are virtually non-existent. The service life of Ch-25MP has expired, and the Polish Air Force has no anti-radar missiles. The Russian and Belarusian armed forces have acquired new S-300 and S-400 anti-aircraft weapon systems (the latter ones, with the maximum operating range of around 400 km for targets of large radar reflection surface, can in fact reach every corner of the Polish territory), with which Poland's air offensive and defensive operations can be effectively deterred.

Colonel Krystian Zięć also believes that the weapons integrated with MiG-29 and Su-22 aircraft have become inadequate to meet the contemporary challenges of the battlefield, and their operability is very limited. It would be highly advisable to acquire modern anti-radar missiles for F-16 fighters; however, the few F-16 fighters belonging to the Polish Air Force are intended to fulfill so many different tasks that adding new combat capabilities would be hardly possible. Problems also persist over the existing F-16 weapons, including the highly-precise AGM-65 air-to-ground tactical missiles. To be able to use these missiles, pilots have to be trained to master special combat skills (low-altitude flights with dynamic maneuvering are performed to avoid being shot down by anti-aircraft defense systems), and therefore tasks where missiles are intended to be used must be performed by a squadron of aircraft operated by well

trained pilots. Air missions against ground-based targets have to be supported by targeting (the ability to pinpoint the targets of an attack) and *weaponneering* (which is a process of precisely determining the quantity of a specific type of weapons required to achieve a specific level of damage to a given target). Unfortunately, the Polish Air Force targeting and weaponneering capabilities are also very limited (inability to precisely determine coordinates in 3D environments, etc.).

Finally, **air support operations** are carried out to secure the tasks of the air, naval and ground force components. Support operations include air surveillance and aerial reconnaissance, electronic combat, air transportation, aerial refueling, as well as research and rescue.

Within the framework of collective defense, Poland's Air Force and air-defense units would have to execute multiple tasks having quite limited resources at their disposal. The situation would become even more complicated if the enemy would prevail in terms of the number of combat aircraft and a strong air-defense system. Quite fortunately, large-scale conventional military conflicts are the result of a long-term process of disputes and escalation of tensions in political relations rather than an overnight phenomenon. Clearly, in the event of an imminent attack, there would be considerable number of allied forces deployed on the territory of Poland or in its direct neighborhood to effectively support and assist Polish Air Force and air-defense units.

### **Scenario No. 1 Direct attack on the territory of Poland and collective defense**

It is clear that the risk of a large-scale military conflict in Europe between NATO member states and non-allied states, such as the Russian Federation, is currently very unlikely, but not entirely impossible. However, it should be noted that the present status quo largely depends on the core assumption that an attack against one Ally is considered as an attack against all Allies.

Regardless of the conditions that theoretically could lead to the outbreak of a conflict, it should also be accepted that military operations would be conventional in nature (clearly there is always a risk of an attack with warheads carrying tactical nuclear weapons effectively destroying, for example, key air bases; however, this would lead to a complete isolation of Russia on the international front). This scenario, in which a conflict between NATO and Russia would be most likely, is very simplified.

In a scenario of a military conflict between the Russian Federation vs. Poland and its NATO allies, military operations would have to be preceded by long-term political crisis on a regional scale. This assumption is of fundamental importance as there would be room for operations in anticipation of the conflict, to prepare the Polish Armed Forces for the attack.

#### **Attack from the territory of Kaliningrad and/or Belarus**

Given the relatively high capability of the Polish Air Force as compared to other states of the Alliance's eastern flank, it shall be presumed that a potential attack on the territory of Poland would start with a massive-scale missile attack and air strikes to destroy critical Polish infrastructure (both civil and military). In theory, such an attack could only be launched from the Kaliningrad Oblast, although this scenario is highly unlikely. Russian troops deployed in the Kaliningrad Oblast are heavily armed, but the weapons they have are mainly outdated. Quite obviously, the offensive capability of these armed forces could be enhanced through redeployment of other military units of the Western Military District, but still, to relocate massive amounts of equipment and troops to the Kaliningrad Oblast would involve considerable logistical activity in conditions where they would be under direct threat from the Alliance's forces.

In terms of a hypothetical missile attack against Poland, the 152nd Rocket Brigade can pose a serious threat as it is equipped with 9K79-1 Tochka-U and 9K79M Tochka-M tactical ballistic missile systems with the operating range of 120 km and 185 km, respectively. Also, a considerable share of Poland's territory is within the range of Iskander-M mobile missile systems (400-500 km). There is therefore no doubt that, despite the possibility to quickly relocate the road-mobile

missile systems to Kaliningrad, other military units of the Western Military District operating in Belarus would definitely have to be involved to effectively attack and destroy Poland's Armed Forces in conditions of a conventional military conflict. Based on the known details of *Surface Based Air Defense Detachment (SBAD-Detachment)* exercises under the Operation *Atlantic Resolve*, it appears that military bases (including tactical airbases), energy infrastructure, Vistula bridges, and stationary radar stations would be the most likely targets for the Russian missile troops and air force in the event of an attack.

Moreover, there are reasons to suppose that the great majority of missile attacks would be launched from the territory of Belarus. Apart from ground-launched ballistic missiles, the attack capabilities of the Russian air force would be in play. The most powerful systems are: Tupolev Tu-160 and Su-34 strategic bombers, capable of carrying Raduga Kh-55/555 cruise missiles (with either nuclear or conventional warheads, maximum range of 2500 km for Kh-55 standard missiles, 3000 km for Kh-55SM, and 3500 km for conventional Kh-555 missiles<sup>33</sup>) and Raduga Kh-59 cruise missiles (maximum ranges: 115 km – Kh-59ME, 140 km – Kh-59M2E, 285 km – Kh-59M2<sup>34</sup>) designed to strike ground-based targets. With the missile systems of this kind, it is possible to launch a missile from Belarus to damage assets on the territory of Poland without any risk for Russian air assets outside the range of the Polish Air Force or anti-aircraft defense systems (however, the targeting precision of these systems should be also accounted for, together with the selection of targets, baseline coordinates, or skills of the guidance system operators during the final launching phase).

<sup>33</sup> KH-55/-55SM/-555/-65SE, *Missile Threat: A Project of the George C. Marshall and Claremont Institutes*, last accessed on: 20.08.2015, <http://missilethreat.com/mis-siles/kh-55-55sm-555-65/>.

<sup>34</sup> C. Kopp, *Soviet/Russian Tactical Air to Surface Missiles Technical Report APA-TR-2009-0804*, Air Power Australia, last accessed on: 20.08.2015, <http://www.airspacepower.net/APA-Rus-ASM.html#mozTocId154704>.

It would be very difficult to prevent a missile attack – according to General Bogusław Smólski, former lecturer at the Military University of Technology, who claims that the contemporary Western anti-missile systems are not capable to intercept Russian ballistic missiles<sup>35</sup>.

Critical to the success of next-stage defense operations will be to anticipate the plans of the Russian Armed Forces. As long as the vectors of the military conflict can be predicted from the rising tensions in international relations, it should be assumed that the key decision will be to prepare the Polish Armed Forces (and the Air Force in particular) to face missile and air attacks launched by the Russians. In the event of a missile attack on tactical airbases, Polish combat aircraft would have no more than a few minutes to scramble (the missiles used in Iskander-M systems can travel a distance of 400 km within just 9 minutes). To do this, the aircraft would have to be repositioned before the airbases are destroyed (it would be necessary to develop a system of backup



Range of Russian Iskander-M missiles is estimated at 400-500 km. Source: [www.globalsecurity.org](http://www.globalsecurity.org).

airbases using old airports in the west of Poland as well as highway strips (or road runways); detailed plans and regular exercises would be also needed to quickly reposition aircraft and ground-based support services). No matter how the situation evolves, NATO should respond to an attack on the territory of the Poland by initiating measures to provide assistance to the attacked country under Article 5 of the North Atlantic Treaty. In this scenario, the main task of Poland's Armed Forces would be to delay and, where possible, deter the enemy's attack in anticipation of or preparation for the intervention of other allied forces.

In order to increase the chances of a successful air defense later in the conflict, Poland's tactical air forces would have to survive the initial attack before the arrival of other allied forces, and accumulate arms supplies ahead of these events. If the Russians attain air superiority, defensive operations carried out by Land Forces and the Navy would lack the necessary support, which would most likely imply the imminent breakdown of military units because of the absence of support and protection from the air. Apart from supporting military operations of other types of armed forces, the Air Force should be capable of launching attacks against strategic military targets in the Kaliningrad Oblast and Belarus, outside the range of air-defense systems of the Russian Federation (for example, using AGM-158 JASSM cruise missiles).



Russian 5th generation Suchoj T-50 (PAK FA) fighter. Photo by Alex Polezhaev, Flickr.com.

<sup>35</sup> Z. Lentowicz, *Czy Patrioty i Astery dadzą radę Iskanderom* [in:] „Rzeczpospolita”, last accessed on: 20.08.2015, <http://www.ekonomia.rp.pl/arttykul/1152081.html>.



In order to be able to successfully complete defense operations in this scenario, a multilevel air defense system would have to be put in place, capable of fighting a variety of different threats – ballistic and cruise missiles in the early stage of the conflict, followed by the Russian air warfare, including combat helicopters and attack aircraft that deliver direct support to the Russian Land Forces and the Navy.

#### **Challenges for the air defense system:**

- » detecting threats and intercepting missiles at the earliest time possible;
- » safeguarding the capability of tactical air force to survive a missile attack;
- » ability to protect strategic assets and assembly areas of national and allied forces;
- » ability to carry out offensive operations against the enemy's air power, and retaliatory strikes against strategic targets.

#### **Scenario No. 2 Poland's involvement in a collective defense of the Baltic States**

In another scenario, Poland would face a military conflict in the Baltic States, leading to collective defense operations by the NATO allied forces in accordance with Article 5 of the North Atlantic Treaty. A theoretical conflict in the Baltic States could be either a hybrid warfare scenario, or a conventional conflict involving the Russian Federation.

##### **Variant 1. Hybrid warfare in the Baltic States**

Drawing on the past experience with the Russian-Ukrainian conflict, a hybrid warfare scenario in the Baltic States appears to be more likely than a conventional warfare conflict. Assuming Poland and other NATO allies provide assistance to the Baltic States when faced with a hybrid war, the Alliance operations would be limited to the defense of the territory of the attacked state. In this variant, NATO's air force would be involved only to attack ground-based targets of a non-state agent (a hypothetical equivalent of the Donetsk People's Republic or the Luhansk People's Republic in Donbass) and to support the redeployment of NATO's land forces in the region of military operations. In a scenario based

on the Russian-Ukrainian crisis, the adversary would have a powerful air defense system (i.e. anti-aircraft systems supplied by the Russian Federation) as well as armored and mechanized taskforces, most likely supported by Russian Special Forces.

In this variant, instead of using aircraft, the enemy would have access to relatively modern anti-aircraft systems, which would considerably limit the range of operations of the NATO air force. In theory, NATO would have to use precision-guided munitions capable of targeting the enemy's assets from outside the area within the range of foreign anti-aircraft systems. The victory in a hybrid war against a non-state enemy would largely depend on the type of anti-aircraft systems used, and in some circumstances, NATO would find it difficult to transfer its troops and equipment in the region of the conflict. The separatists in Donbas employed Buk-M1 missile systems with a maximum missile range of around 30 km. This system could be used mainly to protect the armed forces of the non-state enemy. In theory, the enemy could also use a long-range surface-to-air missile systems, including the Russian mobile anti-aircraft missile system S-300, whose latest version can attack targets at a range of around 200 km. If a system of this kind were deployed in either of the Baltic States, which are rather small in size, the vast majority of their territory would be within its operating range. Given these circumstances, NATO's air forces would mainly pursue offensive measures – through the use of combat aircraft – with the aim to destroy anti-aircraft missile assets of the enemy, to attack groups of hostile military taskforces, and to deliver direct support to other types of armed forces during land operations.

#### **Challenges faced by the Air Defense Systems:**

- » ability to quickly redeploy military forces assigned to allied defense operation;
- » ability to identify and neutralize ground-based threats by the units of tactical air forces, assigned to take part in the operations under collective defense arrangements

## Variant 2. Conventional military conflict between the Baltic States and the Russian Federation

Direct attack of the Russian Federation on the Baltic States is considered less likely. The conditions that might precipitate a conventional military conflict would be similar to the political factors discussed earlier in the scenario of a direct attack on the territory of Poland (i.e. a long-standing political and military crisis). The risk of a military conflict of this kind could be discouraged by the permanent presence of NATO's armed forces in the Baltic States under the Baltic Air Policing mission (in this scenario, the conflict would be mainly caused by political tensions). Therefore, it can be assumed that the Russian political strategies take into account the fact NATO would immediately respond to any attack on the Baltic States by deploying NATO's armed forces to protect the air space in this region (by taking appropriate countermeasures).

In the event of a conventional military conflict in the Baltic States, NATO would face the challenge of coming forward, as quickly as possible, with defensive operations to aid the attacked state. The Baltic States have no combat aircraft or air defense capabilities, they also lack sufficient number of troops, equipment and weapons to be able to pursue long-term defense operations. According to the current modernization programs, the Baltic States plan to acquire MANPADS, or man-portable air-defense systems, which are shoulder-launched surface-to-air missiles of a very short range.

It can be expected that, a military attack would be launched from the territory of the Kaliningrad Oblast and the adjacent Western Military District (and/or Belarus). There is a considerable Russian population residing in the Baltic States, and as such the Russian Federation could aim to gain control over the whole or a part of the territory of these countries. Collective defense would attempt to defend the territory of the Baltic States, but in theory, a strike on Russia (Kaliningrad Oblast) could also be launched, most probably from the territory of Poland. In this scenario, the Russian Federation could attempt to use tactical nuclear weapons (particularly when faced with a direct attack on the Russian territory) in order to demonstrate its dominance and capability to

defend the Russian state or to destroy the outnumbering enemy forces<sup>36</sup>.

### Challenges faced by the Air Defense Systems:

- » ability to quickly redeploy military forces assigned to the allied defense operation;
- » ability to identify and neutralize ground-based threats by the units of tactical air force, assigned to take part in the operations under collective defense arrangements;
- » ability to carry out air operations to gain control in the air over the region directly affected by the military conflict.



A Polish F-16C multirole fighter during international Steadfast Jazz 2013 exercises. Photo by Ian Houlding, NATO.

<sup>36</sup> Refer to A. Turkowski, *Rola taktycznej broni jądrowej w doktrynie bezpieczeństwa Rosji* [in:] „Biuletyn PISM” 2013, Vol. 11 (987).

## 2.2 Low-intensity conflict, including actions below the threshold of war

In the discussed scenario of a conventional military conflict involving Poland, the Polish Armed Forces, and the Air Force in particular, would have to deal with a wealth of challenges. Today, this type of a military conflict appears to be less likely, although it is not entirely impossible, especially within a 20 to 25-year time horizon. Although a war in the traditional sense, as described in the words of Carl von Clausewitz, should not be considered the most likely scenario, the possibility of other types of incidental use of military forces should not be called in question.

The Russian-Ukrainian conflict – despite the multitude of contributing factors and conditions that are very specific and do not necessarily apply to Poland – is a perfect example of the broad spectrum of risks and challenges we may be faced with on our own doorstep. It also shows that state actors can also refuse to claim responsibility, or admit involvement in military conflicts that they themselves created or exacerbated. This may be seen as an unusual strategy, especially in this region of the world. Most important of all, it could give rise to various consequences much to the disadvantage of Poland, including the weakening the Alliance or situations where coming to a consensus would be difficult, when, for example, some of NATO member states would not feel committed to assist Poland by delivering direct support, or even refuse to allow other NATO states to come to the rescue.

Apart from the discussed political aspects, these developments could have some serious operational and tactical implications for the Polish Air Force, for example, limited access to satellite data, or refusal to authorize the use of airborne early warning aircraft or tanker aircraft of other NATO allies. Operational plans of the Polish Armed Forces should also embrace these type of challenges and risks. In the face of a low-intensity conflict or operations below the threshold of war (hybrid warfare – the term which has gained wider usage recently – fall into this category), the Polish Air Force should be capable of conducting independent air operations to protect and defend the

national airspace, and (if necessary) to support other Polish Armed Forces, both in terms of combat capabilities, and other military operations (redeployment of Polish Special Forces). Clearly, the scale and timing of these operations would be limited, but still, the ability to carry them out should be one of the key factors at the centre of interest during the future modernization and development of the Armed Forces.

### **Low-intensity missile attack or combined air and missile attack**

The purpose of a military conflict involving Poland need not be to seize the whole or a part of Poland's territory, and the attacking state could adopt an essentially different strategy. Instead of directly attacking and destroying the Polish Armed Forces, the adversary state could attempt to reduce their capabilities, or gain influence over political decision-makers by narrowing down the political options available. Hence, the ability of the Polish authorities to control the situation in their immediate operational area would be limited, and the operations of the attacking forces would not face any substantial political resistance. In order to accomplish this goal, the enemy would not necessarily have to seize control over Warsaw, but simply demonstrate Poland's vulnerability. A possible military action would likely be preceded by a political campaign to discredit Poland on the international front and to isolate it from its allies. Also in this scenario, Poland would not have to be subjected to threats or aggression (instead, aggression could be directed against the Baltic States or Ukraine).

The purpose of a single air and/or missile attack (or a small series of attacks) would be to limit Poland's capability to command the armed forces (an attack against political centers, or the Armed Forces command nodes) or to prevent the Polish Armed Forces from pursuing its mission (an attack against military infrastructure or specific weapon types or assets). Also, an attack against key civil infrastructure could destabilize the current political situation. It can be reasonably presumed that the scale of damage in this scenario (at least in the initial phase of the conflict) would be of secondary importance.

Here, it would be much more important to make the decision makers aware of the shortcomings in the defense system and to create the impression that the upcoming attacks might inflict much greater damage, and the capabilities to deter them would be limited. The ability to avert damage, to contain losses and to take possible retaliatory actions are the preconditions to maintain credibility and empowerment of the Polish Armed Forces in this type of critical situations. Prevention measures would involve, in particular, but would not be limited to, political actions to reduce the impact of attempted estrangement of Poland in international politics and in relations with its allies, but these concerns are outside the scope of this report.

The ability to contain losses essentially depends on the existing intelligence-gathering, warning, command and destruction subsystems (effectors), with which a broad spectrum of air and missile threats could be countered, both aerodynamic and ballistic. To this end, emphasis should be placed on network-centricity, interoperability, synergies and complementarities between different solutions. It should be borne in mind that it takes many years to build a sustainable, future-proof and upgradable air defense system to effectively deliver protection against contemporary and future threats. **In order to provide for cost-effectiveness, it appears necessary to determine air threats that are primary, and those considered secondary.** A detailed analysis of this issue should seek to answer, for example, the question whether ballistic missiles are more dangerous than (manned and unmanned) aircraft and helicopters or cruise missiles. Spending huge amounts of money to expand capabilities against secondary threats could adversely affect the capability to combat other types of targets, both in technical (acquisition of systems dedicated to a specific type of threat) and quantitative terms (acquisition of large amounts of more expensive medium-range missiles may reduce allocations of funding for short-range and very short range missiles used against unmanned aircraft or cruise missiles).

#### **Capability to carry out retaliatory operations (attacks) as an integral part of deterrence and defense posture.**

The capability of retaliatory operations expands the range of options with which a crisis or a conflict below

the threshold of war can be responded to. Moreover, without a doubt, to destroy the enemy's rocket launcher is much more risky in political terms, however, from the operational point of view, it offers more benefits than an attempt to intercept approaching ballistic or cruise missiles. The Air Force (as well as land and maritime forces) should be able to use missile systems with the operating range of 100 to at least 500 km<sup>37</sup>. One of the main weaknesses of the Polish Armed Forces is that they lack this capability.

As in the previous scenarios, it should be assumed that within the next two decades, the military threats to Poland may only originate from its neighbors who are not members of NATO or the EU, i.e. the Russian Federation, Belarus, or perhaps Ukraine, where the situation is still unstable and, hence, unpredictable. Given these assumptions, low-intensity conflict scenarios may be as follows.

#### **Scenario No. 1 Low-intensity missile attack, with no official claim of responsibility**

A missile attack of this kind might take place in a situation where some of the territories of one of Poland's neighboring states are not controlled by central government and are instead commanded by separatist or occupying forces. If this situation occurs or continues, and if Poland attempts to influence what happens further down the line while insisting on a political settlement of the conflict, the separatist forces (or their supporters) may try to blackmail or coerce the Polish government into getting what they want. A single attack (rather than a series of attacks) might reveal Poland's vulnerability, thereby discouraging Warsaw from interfering with the conflict, whether bilaterally, or alongside international organizations. From the attacker's point of view, the target of the attack should be unspecific, or directed at an empty space to cause no fatalities. Also, the attacker might refuse to claim responsibility for the attack, or even accuse the opposing party of launching it.

<sup>37</sup> Estimated range of existing Iskander missile versions.

It would be even more difficult to attempt to deter an attack in these circumstances, especially in the absence of earlier warning signals, such as deterioration of the political situation, or a surge in international tensions. Thus, there would be no reason to put the air defense units, or the Polish Armed Forces in general, on alert. At the same time, it is important to note that, in this situation, Poland would have no problem accessing satellite data of its allies, or data from the NATO's missile defense systems (as long as it is fully operational).



Mobile launcher with two Iskander-M missiles.  
Source: Russianmilitaryphotos.wordpress.com.

If there is a risk that the attack might happen again or if non-reaction to the attack could make things worse, the Air Force would have to eliminate a single or a few missile launchers through an air raid, or by deployment and subsequent evacuation of Special Forces. This mission most probably would have to be carried out using Poland's own assets, possibly based on NATO's reconnaissance data.

#### **Challenges faced by the Air Defense System:**

- » detection of an approaching missile as early as possible,
- » attempt(s) to intercept the missile.

#### **Scenario No. 2 A series of air and missile attacks for coercion**

As in the first scenario (low-intensity attack, with on official responsibility claiming), a series of air and missile attacks for coercion would be launched by one of

Poland's neighboring states in the east, engaged in a military conflict. The attacking state would have to consider Poland's political engagement in resolving the conflict so burdensome that it would decide it is worth putting pressure on Warsaw by demonstrating its vulnerability to a military attack and to destabilize the political situation in Poland. Unlike in the first scenario, military operations would have to be foreshadowed by political actions to discredit Poland's position internationally (in relations with its allies). A "blank" attack seems less likely as in the first scenario – the concept and targets of the attack would have to be clearly determined, perhaps in a few variants, and based on Poland's actions and the scale of allies' response (or lack of it).

It can be assumed that, in the first place, the attack would be targeted at military infrastructure, especially air defense assets. Depending on the variant of the attack, there would be a single target (for example, a radiolocation station or an airport runway) or several (of several dozen) targets, in order to break down the defense system (SEAD or DEAD)<sup>38</sup>. In this case, a series of air and missile attacks would hit radiolocation stations, airports, anti-aircraft and/or anti-missile systems, and air force command systems, etc.

Depending on the scale of the attack, the enemy would use up to several ballistic or cruise missile launchers (the equivalent of a brigade) and around two squadrons of active combat aircraft (most likely with the support of unmanned systems), under the shield of electronic-warfare aircraft, reconnaissance aircraft, and air command aircraft. Some of the air strikes could be launched without invading Poland's airspace, from outside the range of Polish air defense systems, in which case the attack deterrent measures would be limited to the shooting down of ALCMs (*Air Launched Cruise Missile*).

<sup>38</sup> SEAD – *Suppression of Enemy Air Defense*; DEAD – *Destruction of Enemy Air Defense*.



In both cases of an incidental attack and a series of attacks, possible targets would not have to be limited to military assets – an attack against critical civil infrastructure, including oil terminals, gas terminals, oil refineries, fuel depots, communication hubs, power plants, telecommunication infrastructure, or civil airports, would produce massive psychological impact and would definitely force Poland's government to consider taking or discontinuing the implementation of certain measures. It is likely that, one of the core assumptions of the attack would be to minimize fatalities among the civilians.

In the second scenario, an attack by surprise is less probable – it would be heralded by a deterioration of interstate relations, attempts to discredit or alienate Poland from its NATO allies, or verbalized threats.

In this scenario, a non-consensus situation may arise in which one of NATO's members would believe that the limited scale and time of the attack (or earlier political actions taken by Poland) do not justify or determine the need to take the defensive measures dictated under Article 5 of the North Atlantic Treaty.

#### **Challenges faced by the Air Defense System:**

- » early detection of approaching missiles and airplanes (including unmanned ones);
- » shoot-down attempt(s);
- » immediately scrambling as many warplanes as possible to mitigate losses and to deter the threat;
- » preventing radio signal and electromagnetic interference by the aggressor;
- » further on, also the capability to launch retaliatory operations to eliminate at least some of the assets used in the air strike (e.g. ballistic or cruise missile launchers) through direct air and missile attacks or deployment and subsequent evacuation of Special Forces.

#### **Scenario No. 3 Air-and-missile attack to prevent a response from NATO**

In this scenario, a low-intensity attack on the territory of Poland will be launched to prevent Poland from engaging in operations against the aggressor state

following its earlier attack against NATO member(s). In military terms, this scenario is similar to scenario no. 2, but the political circumstances are quite different. First, Poland would not be the only, or even the main target; instead, the main attack would be directed against the Baltic States (individually or in the aggregate). NATO would take military action, and Poland would stand against the aggressor state in the company of its allies; in this case, the adversary would act to undermine the political will of Poland to launch defense operations to assist its allies, and to reduce Poland's technical capabilities as the host-state where the allied forces would be stationed. In this scenario, the attacks would be targeted at military and civil infrastructure to prevent redeployment of troops and military equipment, including airports, naval bases, railway and road junctions, as well as individual elements of the air defense system (SEAD/DEAD strikes), followed by other infrastructure (both military and civil) and areas where troops are concentrated.

Like in the previous scenario, the emergence of a direct threat would be heralded by a period of intensifying crisis and direct military aggression against the allied state.

In order to inflict as many losses as possible in the short term, the aggressor state would use more air strike assets, i.e. up to several dozen manned aircraft, supported by a similar number of unmanned aircraft, as well as ground-based ballistic and cruise missile launchers, the number of which would be similar to that in the previous scenario. Apart from the air force, the attack could also involve naval aircraft and ship-based missile launching systems.

It should be acknowledged that, in of all of the above scenarios, the last one appears to be least likely, but it can have the most serious consequences, including the risk of a mass-scale conflict.

### Challenges faced by the Air Defense System:

- » early detection of approaching missiles and airplanes (manned and unmanned);
- » (repeated) shoot-down attempts;
- » immediately scrambling as many warplanes as possible in the air to contain losses and to deter the threat;
- » preventing radio signal and electromagnetic interference by the aggressor;
- » coastal defense, counteracting risks on the sea;
- » further on, also the capability to launch retaliatory operations to eliminate at least some of the assets used in the air strike; in this scenario, we are most likely to witness concerted operations of the allied forces (early warning and command aircraft, electronic-warfare aircraft, attack aircraft, satellite data, etc.)

This list of scenarios does not exhaust the full possible challenges and threats that may arise in the event of a conflict below the threshold of war, but apparently includes the most representative ones.

## 2.3 Airspace infringement and the Renegade procedure

Protection of the state border and airspace of the Republic of Poland are the priorities of the Air Force in peacetime and in crisis. Under Article 7 of the *Act of 12 October 1990 on the Protection of the State Border*, the responsibility to protect Polish airspace is vested in the Minister of the National Defense, and the tasks of the Minister in this area are performed by the Operational Commander of Polish Armed Forces through an executive body, the Air Operations Centre – Component Command Air (COP – DKP). The Operational Commander and COP – DKP are the key authorities in charge of airspace security and the functioning of Poland's Air Defense System; they also exercise direct control and command over assets and forces assigned by the General Commander<sup>39</sup>. In consideration of the central role of the Air Force in peacetime – the protection and defense of Poland airspace – the Operational Commander, acting through COP – DKP, is primarily responsible for determining the needs and maintaining

operational capabilities of the Air Defense System, as well as controlling and commanding fighter aircraft in their air policing operations<sup>40</sup>.

Airspace policing (and securing its sovereignty) is a means to deter potential enemies, and a guarantee of compliance with international agreements governing the use of airspace<sup>41</sup>. Fighter airplanes assigned to perform air-policing operations are in fact one of the key elements of Poland's Air Defense System. Not only are they active combat aircraft, they also allow for a quick response to any emergency situations (hijacking of a civil passenger airplane, a threat from a foreign military aircraft). Currently, air-policing operations are carried out on rotational basis by a pair of fighter aircraft on active duty, stationed at the 22nd Tactical Air Base in Malbork (MiG-29), 23rd Tactical Air Base in Mińsk Mazowiecki (MiG-29), 31st Tactical Air Base in Poznań-Krzesiny (F-16C/D), and 32nd Tactical Air Base in Łask (F-16C/D). On-duty aircraft police the assigned airspace 24 hours a day for 7 days a week, and other pairs of fighter aircraft are on RS 15 standby, meaning that the pilots must be ready to scramble fully armed fighters within 15 minutes of hearing the command. Commanders of the on-duty units are directly responsible for performing the air policing tasks and for the preparation of aircraft and staff to carry out these operations<sup>42</sup>. The Available Air Defense Commander in charge of the operations of COP – DKP Duty Operation Service coordinates all airspace (sovereignty) defense and protection operations of the Air Force and is Poland's representative to the NATO Integrated Air Defense System (NATINAMDS)<sup>43</sup>.

<sup>39</sup> Decision No. 416/MON of the Minister of National Defence of 23 December 2013

<sup>40</sup> *Ibid.*

<sup>41</sup> A. Radomyski, *op. cit.*, p. 169.

<sup>42</sup> B. Grenda, *Dowodzenie siłami powietrznymi w układzie narodowym*, AON, Warsaw 2014, p. 100.

<sup>43</sup> The system known as the NATO Integrated Air and Missile Defence System (NATINAMDS) detects, tracks, identifies and monitors airborne objects (for instance aircraft, helicopters, unmanned aerial vehicles and ballistic missiles), and – if necessary – intercepts them using surface-based or airborne weapons systems. *NATO Integrated Air and Missile Defence*, last accessed on: 10.07.2015, [http://www.nato.int/cps/en/natolive/topics\\_8206.htm](http://www.nato.int/cps/en/natolive/topics_8206.htm).

The duties of the Available Air Defense Commander are governed by the *Regulation of the Council of Ministers of 2 November 2011 on the competent authority in charge of commanding air defense forces and the procedure for the use of air defense assets against foreign airborne objects that refuse to follow the commands of the national air traffic control*. Under this Regulation, the Available Air Defense Commander is the responsible decision-maker whenever any foreign military aircraft need to be intercepted, and for monitoring civilian aircraft subject to the Renegade procedure.

Polish laws and regulations governing the interception and handling of foreign military aircraft (in the event of an unauthorized entry into Poland's airspace) and of civilian aircraft subject to the Renegade procedure: – the Act of 3 July 2002 – *Aviation Law*; Act of 12 October 1990 on the Protection of the State Border; Regulation of the Council of Ministers of 2 November 2011 on the competent authority in charge of commanding air defense forces, and Regulation of the Minister of Transport, Construction and the Maritime Economy of 31 July 2012 on the National Civil Aviation Protection Program.

### Scenario No. 1 Airspace infringement by foreign military aircraft

Following the illegal annexation of Crimea by the Russian Federation and its military involvement in Donbass, the Western democracies have imposed sanctions on Russia. Political and economic tensions have resonated in the military sector. In November 2014, Jens Stoltenberg, the Secretary General of NATO announced during his visit in the Baltic States that the Russian air activity in NATO's airspace has risen 50 percent above that which occurred in 2013. By that time in 2014, NATO jets had been scrambled over 400 times close to NATO airspace, including 100 times in the Baltic Sea region<sup>44</sup>. According to NATO data, by the end of 2014, NATO carried out over 150 interventions in this area, four times more than in the year before<sup>45</sup>.

Based on lessons learned from the operations of the Russian air forces over the past few months, a scenario in which a foreign aircraft enters the Polish airspace without clearance appears the most probable one. From the information published by NATO and the Polish Air

Force (during the Polish Military Contingent Orlik 4 mission from 27 April to 31 August 2012, the *Alpha Scramble*<sup>46</sup> alert was released several dozen times; during the Polish Military Contingent Orlik 5 mission, there were 30 intercepting flights reported), and in consideration of the aggressive Russian policy and the perceived lack of prospects for improvement of the situation, it can be concluded that, in the near term, the Russian activity in the airspace will continue to be a problem for the NATO air forces. It should be stressed that, in response to the provocations of the Russians, NATO members decided it was necessary to expand the allied air forces under the *Baltic Air Policing* from 4 to 16 aircraft. Since April 2014, the Alliance has enhanced its air-policing operations by introducing quarterly missions of combat aircraft from 4 NATO member states, carried out on a rotational basis. The current NATO contingent (on combat duty between May and August 2015) includes 8 Eurofighter Typhoon fighter jets from Italy and the UK, and 8 F-16AM fighter jets from Norway and Belgium (as of August 2015). Polish military contingents (4 MiG-29 fighters) have joined two out of four Baltic air policing missions.

The operations of the Russian military aircraft are a challenge not only for the military decision-makers in charge of airspace control. The provocations of the Russian Federation Air Force are an increasing threat to commercial aviation and naval ships belonging to the NATO member states. A report on the Russian air activity in Europe (between March 2014 and March 2015) by Thomas Frear, a Research Fellow at the European Leadership Network (ELN), describes 2 cases where Russian military aircraft, flying without using its transponders, flew within close proximity of commercial passenger carriers in the area of Malmö and Copenhagen<sup>47</sup>. In one of the most serious incidents within the last few months, two Su-24 bombers intentionally overflew the USS Donald Cook *Arleigh Burke*-class missile destroyer featuring the *Aegis* combat system.

<sup>44</sup> Joint press conference with NATO Secretary General Jens Stoltenberg and President Andris Bērziņš of Latvia, NATO, last accessed on: 10.07. 2015, [http://www.nato.int/cps/en/natohq/opinions\\_115033.htm](http://www.nato.int/cps/en/natohq/opinions_115033.htm).

<sup>45</sup> Norway takes the lead in NATO's Baltic Air Policing mission, NATO, last accessed on: 10.07.2015, [http://www.nato.int/cps/en/natohq/news\\_119113.htm](http://www.nato.int/cps/en/natohq/news_119113.htm).

<sup>46</sup> Alfa Scramble signal is a take-off alert to intercept an intruder aircraft as part of the air policing operations.

<sup>47</sup> T. Frear, *List of Close Military Encounters Between Russia and the West, March 2014–March 2015*, European Leadership Network 2015.





Mig-29 fighter on a mission of the Polish Military Contingent "Orlik" in January 2006. Source: The Ministry of National Defence

The events of recent months have been diversified and have not necessarily involved the Alliance's fighters carrying out air-policing missions. However, the reported incidents clearly indicate that the air force assets need to be action-ready so that all threats and provocations from intruder aircraft can be promptly responded to.

In the event of a potential threat from intruder military aircraft, and in response to violations of the national airspace, the Polish Air Force are bound to act according to the *Act of 12 October 1990 on the Protection of the State Border, and the Regulation of the Council of Ministers of 2 November 2011 on the competent authority in charge of commanding air defence forces*. These regulations directly address issues concerning procedural matters and the actions of military decision-makers in charge of Poland's airspace defense and protection.

In specific cases listed in the *Act of 12 October 1990 on the Protection of the State Border*, no official clearance is necessary for foreign military aircraft to enter the Polish airspace. The clearance procedure is not mandatory for NATO aircraft that carry out the tasks of the NATO Integrated Air Defense System. Also, the clearance does not apply to military aircraft with state officials who pay official state visits to Poland, and the escorting aircraft. No clearance is necessary for aircraft on rescue missions or for those who carry out operations sanctioned under international agreements to which Poland is a party, and situations where Poland's airspace is entered for reasons of security (i.e. to avoid danger). In all other cases, in the event that an unauthorized military aircraft enters Poland's national airspace, all air traffic control bodies are expected to promptly react, and the intruder

is immediately ordered to turn back and leave Polish airspace. If the intruder fails to react to the commands of the air traffic control, an alarm signal is generated to scramble on-duty interceptor aircraft.

The scrambling command is given to F-16C/D and MiG-29 aircraft. During *air-policing* missions, F-16C/D multirole aircraft carry AIM-9X Sidewinder short-range air-to-air missiles, M61A1 Vulcan rotary cannon with supplies of ammunition, and the Lockheed Martin AN/AAQ-33 SNIPER XR targeting pod (mounted onto one of on-duty aircraft, with which the type of aircraft and external equipment can be identified from a long distance). MiG-29 fighters have R-73E or R-60MK short-range air-to-air missiles and GSz-301 cannon. The role of the interceptor aircraft (two on-duty aircraft) is to identify the intercepted aircraft, and to try to contact it through radio and visual signals. The most important task to be completed by interceptor aircraft is to cause the intruder to either turn back or land on the airport of choice<sup>48</sup>. Where the intercepted aircraft refuses to follow the orders of the pilot of the interceptor aircraft, the interceptor aircraft shall fire warning shots, and, only as a last resort, may bring the aircraft down on the authority of the Operational Commander of the Armed Forces Branches<sup>49</sup>. Shooting down of an intruder aircraft must be preceded by consultations with the authorities that supervise the mission of the interceptor aircraft, or if the intercepted aircraft attacks or maneuvers to attack Poland's air force assets. Polish pilots have the freedom to decide to bring a foreign aircraft down where any objects on the territory of the Republic of Poland are threatened by the foreign aircraft, on the condition that their communication with COP – DKP is interrupted.

### Challenges for the Air Defense System:

- » detection of a foreign military aircraft approaching the Polish border, as fast as possible;
- » immediate response from the Air Defense System to a detected threat from a foreign military aircraft – scrambling of interceptor aircraft, target identification;
- » appropriate dislocation of forces assigned to the air policing mission.

<sup>48</sup> Article 18(b) of the *Act of 12 October 1990 on the Protection of the State Border*.

<sup>49</sup> *Regulation of the Council of Ministers of 2 November 2011 on the competent authority in charge of commanding air defence forces*

## Scenario No. 2 Hijacking of a civil airplane

A 'renegade' is a civil passenger aircraft that has entered Poland's airspace unauthorized and, while intruding the national airspace, violates aviation regulations; moreover, there is a potential risk that the aircraft has come under the control of hijackers and may be used for a terrorist attack against targets on the territory of Poland. Hijacking a civil passenger aircraft by terrorists is a relatively new phenomenon. A scenario in which an aircraft is hijacked in order to destroy important targets that are fundamental to the functioning of the State should be considered unlikely, but not impossible. It should be noted that a similar scenario is where a member of the crew (instead of a terrorist) takes control of an aircraft and deliberately brings it down. Recently, the Germanwings Flight 9525 co-pilot deliberately seized controls of Airbus A320-211, prevented other crew members from re-entering the cockpit, and then crashed the plane into the French Alps, in Prads-Haute-Bléone. The co-pilot suffered from mental problems and most probably destroyed the plane in suicide, killing himself and 149 other crew members and passengers.

In this case, no other objects were destroyed and there were no other casualties, apart from those on board. However, it is not unimaginable that another incident of this kind takes place in which infrastructure and other objects are massively damaged. In 2003, an armed man threatened to crash with a small plane into the ECB-tower, and then landed on Rhein-Main Airport and was arrested. In 2005, a small aircraft crashed close to the German parliament, Bundestag (at 200 m altitude). It was later concluded that the crash was an act of suicide by the pilot.

Regulations governing the operations and procedures of aviation safety authorities have changed considerably after the terrorist attacks of 9/11 in the United States. The events of 9/11 have disturbed the traditional perception of air threats in the 21<sup>st</sup> century. The unpredictability of terrorist operations and the use of conventional and unconventional means of terror are one of the most serious challenges for countries threatened by global terrorism, not only in terms of the capability of special forces to prevent terrorist attacks,

but also in terms of proper legal mechanisms. The ability to make quick and effective decisions is the basic precondition to deter a potential terrorist attack. Time is of essence in any terrorist attacks in which commercial passenger planes are used. If a passenger jet aircraft is hijacked, travelling at the speed of 800-950 km/h, the existing procedures may prove inadequate. According to the MoND and the Civil Aviation Authority (ULC), if Warsaw was at risk (as the most likely target of a terrorist attack with a hijacked aircraft), immediately protection measures would have to be taken since the estimated flying time of a passenger aircraft from the state border to Warsaw is around 15-25 minutes. The Air Force should respond within 20-25 minutes, while in reality, all procedures, including the scrambling of an interceptor aircraft, may take as long as 40 minutes<sup>50</sup>. Circumstances where a civilian aircraft shooting down may take place are laid down in the Act of 2 July 2004 amending the *Act on the Protection of the State Border and certain other acts*. In 2008, the Constitutional Tribunal ruled that the contested provision of Article 122(a) of the *Aviation Law Act of 3 July 2002* and Article 18 (b) of the *Act of 12 October 1990 on the Protection of the State Border* in fact allow shooting down of a civilian aircraft with passengers on board, and therefore were declared unconstitutional<sup>51</sup>.

Due to the difficulties in determining the causes of abnormal behavior of pilots of passenger planes (no contact caused by uncontrolled decompression, which was the case with Helios Airways flight no 522 in 2005), the Renegade procedure is complicated to implement. The suspected aircraft must be first assigned one of the following three categories: Suspected Renegade, Probable Renegade, or Confirmed Renegade. Detailed criteria on the classification of the renegade aircraft are detailed in the *Regulation of the Council of Ministers of 2 November 2011 on the competent authority in charge of commanding air defense forces*. The categories are assigned by the Available Air Defense Commander.

<sup>50</sup> 126/7/A/2008 Decision of 30 September 2008. File No K 44/07.

<sup>51</sup> *Ibid.*

A suspected renegade is a passenger aircraft of undetermined intent, meeting at least two of the following criteria:

- a) the aircraft violates the flight plan,*
- b) refusal to carry out an order or no reaction to an order from air traffic control, civil and military air traffic services units, or air defense command bodies;*
- c) unexpected change in the flight parameters,*
- d) interruption of radio communication, especially when accompanied by a change of flight characteristics,*
- e) unjustified change of SSR transponder code or excessive use of the identification signal, without authorization from air traffic control,*
- f) the crew using non-standard phraseology or other changes in the radio communication,*
- g) the pilot sending hijacking, radio failure or emergency code in mode 3/A (7500, 7600, 7700, respectively),*
- h) conversation irrelevant to aviation,*
- i) interruption or discontinuation of secondary surveillance radar (SSR) transponder signals,*
- j) notification by other national authorities, the authorities of neighboring countries, or by other non-governmental institutions and individuals on the intentions of the aircraft,*
- k) an unspecific threat of violence by a third party,*
- l) notification of an item, device, substance or any other hazardous material present on board, which can be used in a terrorist attack.*

Identification of a Suspected Renegade aircraft is mainly based on the information collected about an abnormal situation involving a passenger aircraft. In theory, a hijack code (7500) sent from the transponder does not necessarily mean that the aircraft will be used for a terrorist attack, or that the "hijacking attempt" was incorrectly assessed by the pilots (in April 2014, the pilots of Boeing 737-800 belonging to Virgin Australia

airlines, flight no VA41, transmitted the 7500 code in a hijack alert after a drunk passenger stormed the cockpit).

After identifying a Suspected Renegade aircraft, actions are taken to initiate procedures under which the Available Air Defense Commander becomes authorized to give orders to fighter aircraft assigned to the NATO Integrated Air Defense System. The Available Air Defense Commander reports the incident to his immediate superior, the RSZ Operations Commander. An aircraft is identified as a Probable Renegade when more suspected aircraft are detected or if the aircraft ignores or continues to fail to carry out orders from the air traffic control or from the interceptor aircraft. If a Probable Renegade is identified, the intervening fighter aircraft can be authorized to fire warning shots.

Finally, a Confirmed Renegade category refers to aircraft which meet at least two criteria listed in the Regulation: aircraft continues to ignore or fail to carry out orders from the air traffic control, air defense forces, or from the interceptor aircraft, and all the gathered data confirm (beyond any doubt) that the aircraft is to be used in a terrorist attack.

Further measures are laid down in the *Act of 12 October 1990 on the Protection of the State Border*. If forced landing succeeds, the aircraft, along with all passengers and cargo, is seized by the Border Guards. According to the current laws, a shooting down of a passenger aircraft (and the firing of warning shots) is only possible when the aircraft carries no passengers or if all people on-board intend to use it in a terrorist attack<sup>52</sup>.

<sup>52</sup> It is worth noting that, according to the ruling of the Constitutional Tribunal, shootingdown of a civilian aircraft can be considered allowed under specific circumstances. The Constitutional Tribunal argued that, *if an illegal decision is taken to destroy a civilian aircraft with passengers on board, the consequences of this decision may be depenalized by recognizing the absence of fault on the part of the decision-maker; however, a purposeful killing of innocent people cannot be made legal by establishing substantive and/or formal conditions under which such an act would be considered justified. The decision to destroy a civilian aircraft, causing the death of innocent people on board, cannot become a standard legal instrument used by the state authorities to protect the life of other people, even much less to protect assets other than human life (including to avert the potential risk of destruction by terrorists of evacuated buildings on the territory of the Republic of Poland).*

According to the Act, “a terrorist attack” is defined as actions aimed at widespread intimidation of civilians, enforcing certain action of the national government or international authorities, and to negatively affect Poland’s political system and the economy. The decision to shoot down a foreign aircraft is within the authority of the Operational Commander.

### Challenges for the Air Defense System:

- » identification and monitoring of atypical flight characteristics of passenger aircraft;
- » quick detection of a potential threat from a passenger aircraft and scrambling of interceptor aircraft to follow up the situation;
- » fast decision-making in the event an aircraft hijacked by terrorists has to be shot down (where there are only terrorists on board who intend to use the aircraft in a terrorist attack).

## 2.4 Protection of critical infrastructure and airspace while facing the threat of aviation terrorism

We live at a time of the greatest advancements in science, progressive urbanization and human developments. Today’s world largely relies on highly developed banking, energy and IT systems, which are interoperable and mutually supporting. Many of these systems are considered a part of the so-called critical infrastructure<sup>53</sup>. We are dependent on these systems to

the extent that, whenever specific elements of critical infrastructure are distorted, damaged or destroyed, it can endanger human life or health, or inflict serious material losses, or negatively affect the economic developments of the entire country. Therefore, even in time of peace, critical infrastructure must be still considered to be highly tempting objects for terrorists. To carry out terrorist attacks, terrorist groups may seize all types of civilian aircraft, including unmanned ones, mainly for suicidal missions. In view of the increasing risk of aviation terrorism, critical infrastructure should be protected in a comprehensive and flexible manner, responsive to the changing conditions and processes, both domestically and internationally. This includes the air transport system, which is classified as critical infrastructure. The air transport system of people, goods, and services is fast and effective, and should be properly protected. While analyzing new developments in aviation terrorism, it can be concluded that, until recently, the most common form of a terrorist attack was to hijack a plane with passengers on board. Today, terrorists are developing new capabilities, such as hijacking passenger aircraft to fly them into civil, military or official buildings or sites.

<sup>53</sup> Critical infrastructure shall be understood as systems and the functionally connected structures, facilities, installations and services of key importance for the security of the state and its citizens, serving to ensure efficient functioning of public administration authorities, institutions and enterprises. Refer to *The Act of 26 April 2007 on Crisis Management*, Article 3(2) (Polish Journal of Laws Dz. U. of 21 May 2007).



Flight paths of the four planes used on September 11 and their targets

Source: [https://en.wikipedia.org/wiki/September\\_11\\_attacks](https://en.wikipedia.org/wiki/September_11_attacks), last accessed on: 12.05.2012.



These new threats are best exemplified by the 9/11 attacks in the USA. The scale and impact of the terrorist attack to the World Trade Center and Pentagon were so overwhelming that they have completely changed the perception of aviation terrorism, and have become an important determinant of terrorist threat on a global rather than a national scale.

Using passenger aircraft essentially as a pilot-guided explosive missile or *Kamikaze* aircraft from WWII proved to be particularly dangerous. In the future, aircraft will continue to be vulnerable to terrorist attacks. By taking control of an aircraft, terrorists can travel rapidly across the globe. Also, any hijacking incident involves very serious consequences for air traffic, and focuses the attention of the world through news coverage<sup>54</sup>. Another important aspect to be considered in the forecasts on aviation terrorism is that terrorists may in fact use many types of aircraft: commercial passenger aircraft, cargo aircraft, helicopters, light and ultra-light aircraft, as well as remote controlled aircraft.



Commercial aircraft and unmanned air vehicles that can be used to carry out terrorist attacks Source: own analysis

In analyzing airspace risks, it seems safe to say that aviation terrorism will soon become one of the most threatening and destabilizing air security problems at international and regional level. Terrorist attacks can also be carried out with unmanned airborne vehicles (drones). An unmanned aerial vehicle (UAV) is a type of aircraft that can be loaded with and drop explosives<sup>55</sup>, or spray over dangerous chemicals and biological agents<sup>56</sup>. UAVs can be flown over long distances at very low altitudes, which is a major advantage for potential terrorists. UAVs can fly unnoticed by ground-based

radar stations and can approach ground-based targets undetected. Another convenience for terrorist groups is that UAVs are able to take off from and land on a variety of different surfaces. Light aircraft can take off from and land on concrete and grass-covered runways and short sections of roads, which makes it easy to ensure the surprise effect.

There are two types of targets that are exposed to the increased risk of terrorist assaults. They are either "hard targets", which are protected, monitored, or supervised, and "soft targets", which are relatively unprotected or protected to a lesser extent. "Soft targets" are not a part of critical infrastructure, are mainly civilian or private sites. They are more vulnerable and exposed to terrorist attacks, but do not constitute any serious security risk for the state, despite receiving mass publicity. Soft targets are typically public places and civilian-centric venues attended by many people on a daily basis.

These include:

- » shopping centers;
- » hospitals;
- » tourist resorts;
- » market places;
- » cinemas;
- » large railway and bus stations;
- » places of worship;
- » high-rise residential buildings.

Hard targets are typically restricted-access sites or areas and can only be entered by authorized persons. Apart from being protected against unauthorized entrance, these places are supervised by designated guards and security systems. Hard targets include:

- » governmental facilities, financial institutions, embassies and diplomatic missions;

<sup>54</sup> K. Jałoszyński, *Współczesne zagrożenie terroryzmem powietrznym, kierunki przedsięwzięć w zakresie przeciwdziałania mu oraz walki z tym zjawiskiem [in:] Bezpieczne niebo. Materiały z konferencji naukowej*, AON, Warsaw 2002, p. 119.

<sup>55</sup> Terrorists may attempt to use unmanned aerial vehicles, including model-aircraft, which become increasingly sophisticated, in terrorist attacks against concert halls or similar places of assembly. In this scenario, a UAV or a model-aircraft could take off from a place located within several kilometers from the target and then approach and fly into a building or a closed space through a window and detonate explosives inside.

<sup>56</sup> Also, terrorists may use agricultural aircraft. This type of machines have containers and spraying systems attached to their wings, with which nonconventional toxic chemical or biological agents may be sprayed over large distances. M-18 Dromader, the most popular agricultural aircraft in Poland, can carry up to 2500 litres of chemicals.

- » nuclear power plants;
- » producers and distributors of hazardous materials (e.g. petrochemical plants);
- » means of transport of hazardous substances (radioactive waste, etc.);
- » public utilities (drinking water intakes, pumping stations, filters, dams, water tanks, etc.)
- » key communication infrastructure, including bridges, tunnels, railway junctions, airports, telecommunication aerials, etc.
- » venues hosting economic summits, political meetings, official state celebrations and events attended by public officials,
- » sporting and cultural venues during massive events (Olympic Games, sports competitions, concerts);

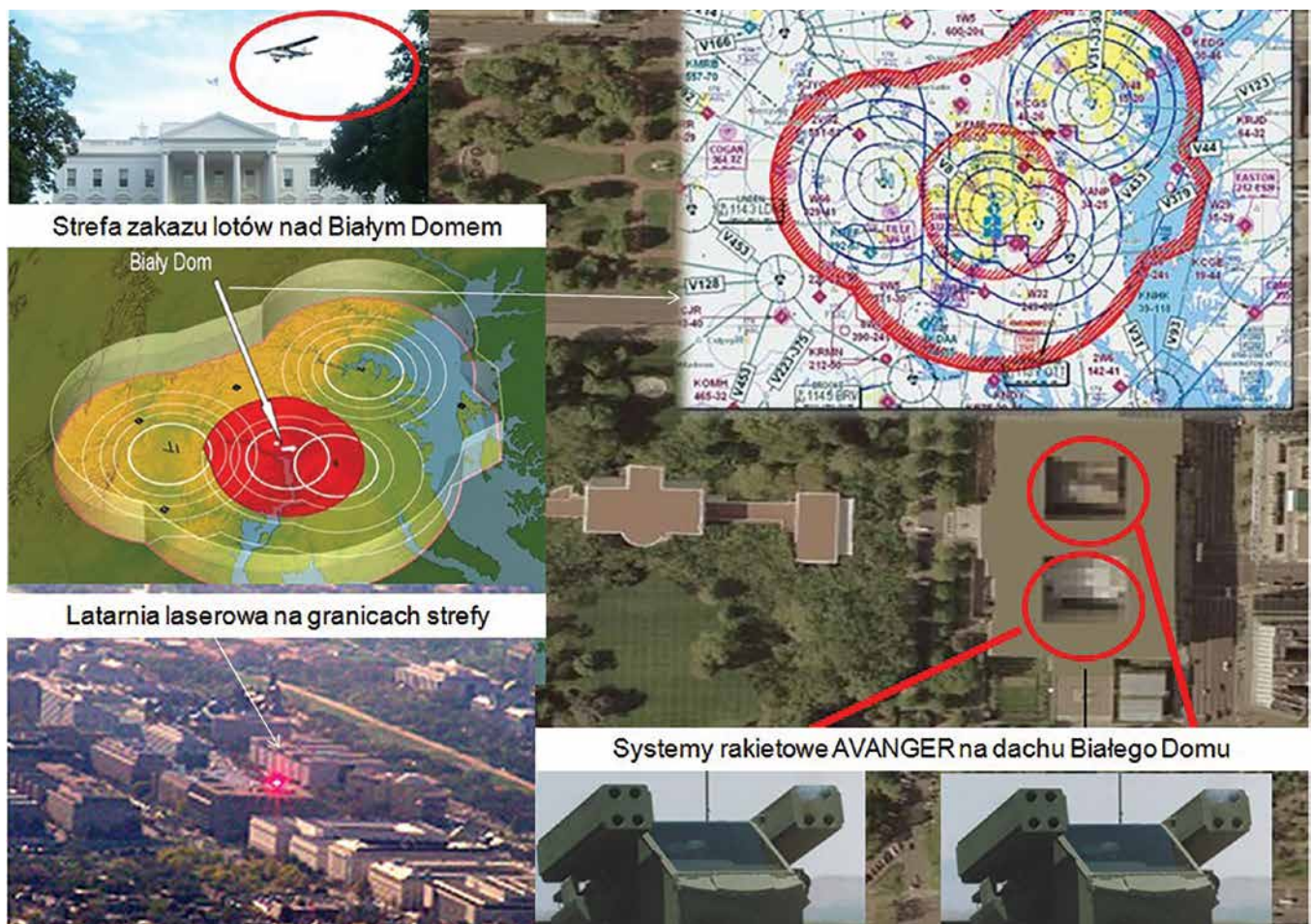
Only few hard targets are protected by establishing a *No Fly Zone* and by deploying air defense systems<sup>57</sup>. The no-fly-zones can be either permanent (such as the no-fly-zone over Washington D.C.) or temporary (occasional), e.g. around sporting or cultural venues during mass events. Local no-fly-zones are also in place

during economic summits, political meetings, official state celebrations and events attended by public officials.

In principle, therefore, hard targets are particularly threatened by aviation terrorism as the most critical part of the state infrastructure which, despite the elaborate land-based protection systems, remain vulnerable to air attacks.

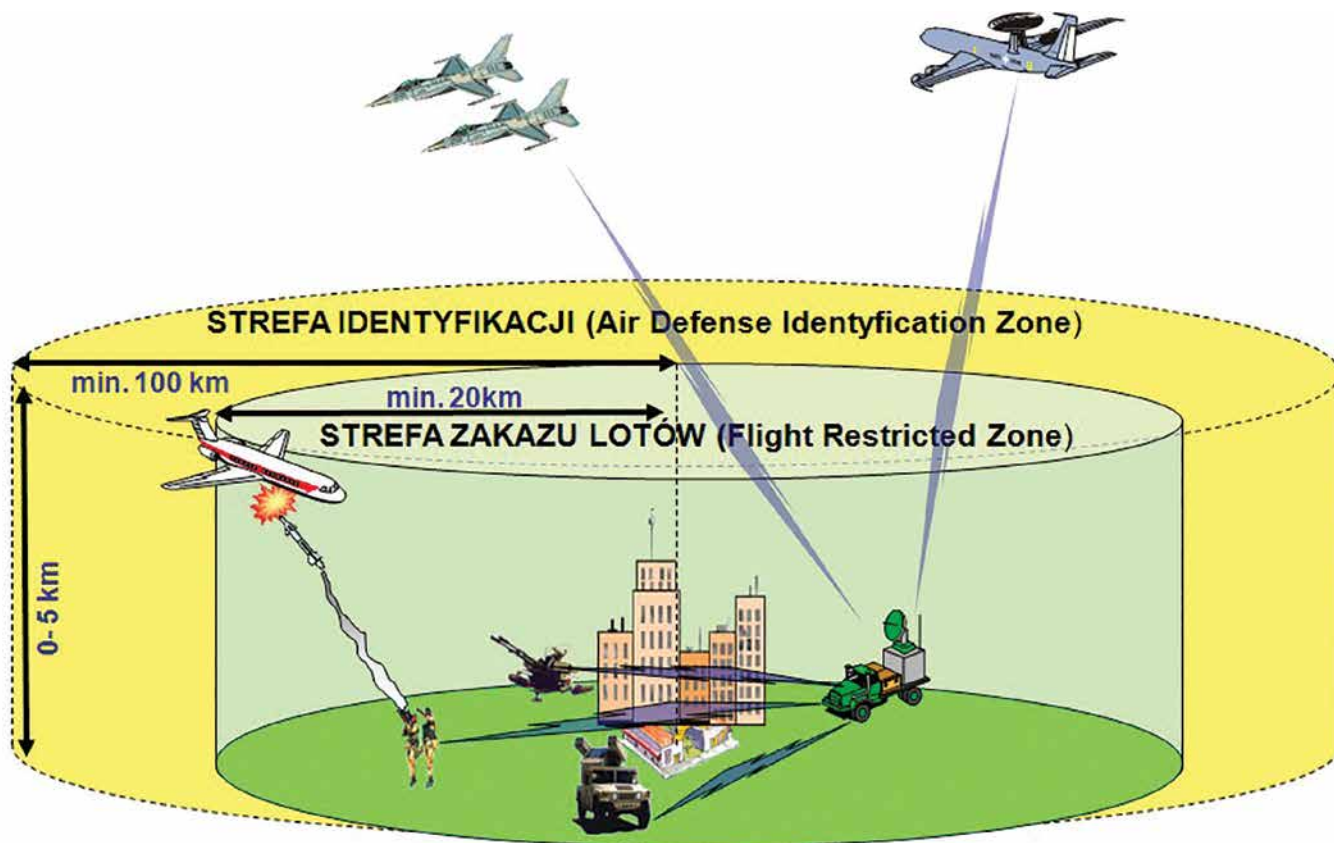
“Hard target” venues where official state celebrations or political economic, cultural, religious, sport or entertainment events take place are particularly at risk. These can be either local, national, or international events, staged on an occasional basis or regularly. What is common for all these venues, however, is that they are mass-scale events attended by crowds of people – all of them can become targets of an attack in a building or within a specific area, while their safety cannot be fully guaranteed (including safety against acts of aviation terrorist).

<sup>57</sup> A permanent no-fly-zone was declared over Washington D.C. in 2002. There are anti-aircraft air defence systems mounted on the roofs of building surrounding the White House.



Elements used to protect air space around the White House. Source: own analysis





Model counter-air defense system protecting buildings exposed to terrorist attacks. Source: own analysis

In order to be able to more effectively use air defense assets in combating aviation terrorism, the existing operational methods need to be streamlined, while the procedural assumptions should be flexible and freely adaptable, but still based on the underlying model of anti-aircraft combat, reconnaissance and command operations.

Based on past experience with the use of security arrangements during mass-scale international events (NATO<sup>58</sup> or G8<sup>59</sup> summits, etc.) or economic meetings (EXPO, etc.), it is now evident that air defense systems are essentially necessary on this type of occasions. Aviation-based defense measures during mass events in fact limit the rapid response capability in the event of an attack using unmanned aerial vehicles, radio-controlled models, or paramotors. In less prosperous states, the air defense measures should be economically practical, and it is incomparably more expensive to use aircraft rather than air defense systems.

### Scenario – protection of airspace during international mass sporting events

Sporting venues attended by numerous sportsmen and mass audiences, such as the Olympic Games or the FIFA

World Cup, are particularly important in terms of security issues. An international nature of these events, as well as media attention around the world are arguments justifying extra security measures to prevent terrorist attacks and enhance security. During sporting events, terrorists may target both, citizens of the host country and foreign visitors. Acts of terror during mass outdoor and indoor sport events may take place at:

- » sporting arenas – stadiums where sporting competitions or opening and closing ceremonies are staged;
- » accommodation facilities, press centers and hotels where sportsmen, referees, reporters, and sports authorities are accommodated;
- » public viewing sites where huge screens and loudspeakers are placed to broadcast the sporting events in front of a large audience, accompanied by other events.

<sup>58</sup> One such example was the NATO Summit in Prague in 2002, during which NATINADS (NATO Integrated System of Anti-Air Defence) was used for monitor the airspace over the venue, under the *Summit CAP – Combat Air Patrol* operation. The operation was carried out with US fighter jets, AWACS aircraft from Germany, as well as fighter aircraft and air-defense missile systems of the Czech Republic. Backup RAF aircraft were on active duty in the UK.

<sup>59</sup> During the G8 Summit in 2004 held in Sea Island in the US, Patriot anti-aircraft missile systems were used for fear of new forms of terrorist attacks, including cruise missiles and tactical ballistic missiles.

The highest level of risk of a terrorist attack is reported for stadiums where major competitions or matches and the opening and closing ceremonies are staged.

Stadiums may be filled with thousands of people, including VIPs, public officials and members of governments of other states. Therefore sporting venues are typically surrounded by ground-based security zones; civil protection monitoring and surveillance systems are also in use to prevent intrusion of terrorists.

Practice has shown that the counter-terrorist measures employed during international mass sporting events should also comprise anti-aircraft defense measures that:

- » are capable to detect and destroy small-size targets flying at low altitudes in various proximities to the protected venue;
- » are cheap to operate, as compared to aircraft;
- » are capable to remain on-duty on continuous basis, and can operate under different weather conditions.

The very presence of air-defense systems around the sporting venues may deter potential terrorists. In practice, the use of air-defense systems to enhance security of and around sporting venues needs to be coordinated with the air force, command and control centers, intelligence systems, and many other national and international authorities in charge of public security during mass events.

The Summer and Winter Olympic Games are the most spectacular mass sporting events. Security during the Olympic Games have grown in importance specially since 2001. As part of a massive security plan during the Olympic Games in Athens in 2004, Patriot PAC-2 and PAC-3 anti-aircraft systems were used together with S-300 surface-to-air missile systems and a wealth of short-range anti-air systems, including the French Crotale NG short-range anti-air missiles and the Russian SA-15 Tor systems.



Air defense assets used to safeguard the airspace during the Summer Olympic Games in Athens in 2004. Source: own analysis



Air defense systems used data transmitted by AWACS aircraft stationed at the operating Base Aktio-Preveza in the west of Greece, as well as RC-135 and EP-3s reconnaissance aircraft of the US Air Force. Greek jet fighters made air-policing missions and patrolled the airspace surrounding the sporting venues.

During the Olympic Games in Torino in 2006, the scale of air defense measures was somewhat smaller. The Hawk air protection squadron and F-16 and Eurofighter aircraft were deployed to protect the sporting venues. The Hawk Squadron was of limited use over a mountainous terrain, in locations where many of the sports competitions were staged. For this reason, the airspace was mainly monitored by fighter aircraft, and the Hawk Squadron protected the Olympic Village and the Turin Stadium.

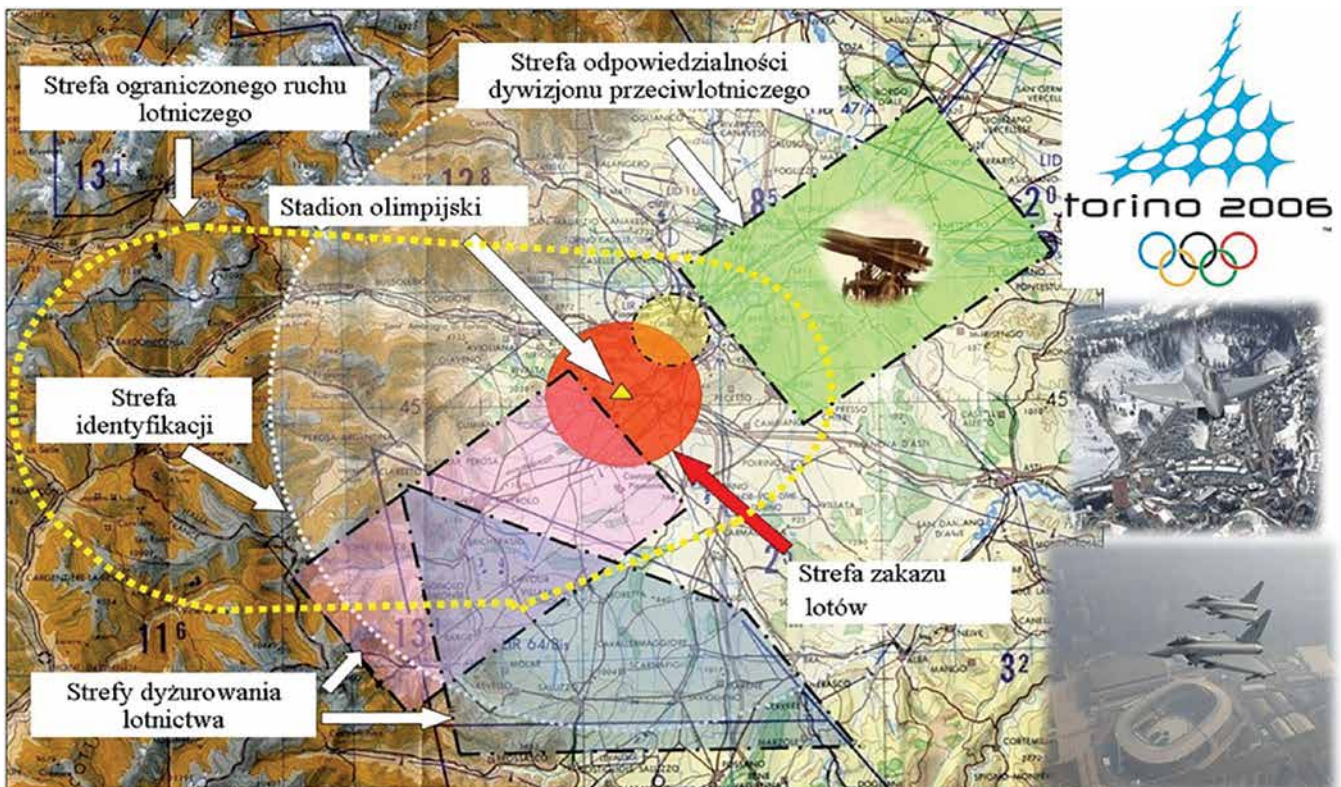
Again, the security issues were taken very seriously during the next Summer Olympic Games in Beijing in 2008 and the Winter Olympic Games in Vancouver in 2010.

In Beijing, robust air defense arrangements were built, based on an anti-aircraft missile system around the

main Olympic venues. The airspace around the sporting venues includes Chinese HQ-7 short-range air defense missiles<sup>60</sup> and the integrated radar systems located around the new Beijing National Stadium, also known as the Bird's Nest. This is where the opening and closing ceremonies were staged. A detailed airspace control plan was also devised. The airspace over the Olympic sporting arenas was regularly patrolled by military aircraft; there were no-fly-zones established during the Olympics, in order to prevent intrusion by any unauthorized aerial vehicles, balloons, or small-size aircraft. The airspace control system continued to operate during the Paralympics Games.

The Summer Olympic Games in London in 2012 are a very positive example of anti-terrorist protection during a mass sporting event. The air defense system during the Olympics heavily relied on anti-aircraft missile systems. The basic assumption was to deploy air defense elements in six regions located around London, in the vicinity to the main sporting venues where the sports competitions were taking place.

<sup>60</sup> HQ-7 short-range air defense missile system is designed to destroy targets flying at low altitudes, within the distance of 500 m to 15 km.



Air defense assets used to safeguard the airspace during the Winter Olympic Games in Turin in 2006. Source: own analysis





Military assets safeguarding the airspace during the Summer Olympic Games in Beijing in 2008. Source: own analysis



Military assets used to safeguard the airspace during the Summer Olympic Games in London in 2012. Source: own analysis



To the Russian authorities, the security issues during the Olympic Games in Sochi, located on the Black Sea coast, were of top priority. Several Tor-M missiles systems were deployed to protect the main sporting venues. Tor-M is a tactical weapon designed to detect, track and destroy ballistic and cruise missiles, aircraft bombs, unmanned aircraft and probably also stealth aircraft. The airspace over Sochi was also protected by Buk-M1, S-300PS, and S-300PM anti-missile systems, and three S-300V4 defense missile batteries. 6 sets of the latest generation future-proof short-range surface-to-air missile and anti-aircraft artillery weapon systems were in operation. Russian warships were deployed to protect Sochi from the sea, mainly frigates armed with M-22 Uragan sea-to-air missiles. The airspace was patrolled by squadrons of Su-25 bombers, Su-27, MiG-29, and MiG-31 interceptor aircraft, and Mi-8, Mi-24 and Mi-28 military helicopters, all stationed in Krymsk.

Military assets of this kind – including air defense systems – have been used during mass sport events, including FIFA World Cup and UEFA European Championships in Germany, Austria, Switzerland, Poland, Ukraine and Brazil in 2014. It can be presumed that the issues of air protection against acts of aviation terrorism will continue to be an important aspect taken

into consideration during preparations ahead of major sporting events worldwide.

#### Challenges faced by the Air Defense System:

- » capability to detect and identify small-size aircraft and aerial vehicles of very small radar reflection surface, at distances and altitudes where they can be effectively seized or destroyed under any weather conditions and at any time;
- » capability to continuously remain combat ready;
- » capability to use intelligence from ground-based and aerial reconnaissance systems;
- » flexibility and the capability to quickly concentrate forces at a particular place and time, depending on the particular air threat scenario, detected by the anti-aircraft defense system;
- » quick response capability of individual elements of the air defense system; maintaining confidentiality of data and prevention of disinformation on all communication channels;
- » availability of fully functional digital means of communication to be able to immediately share reliable information using wireless, radio and radio&wire communication channels.



Military forces and assets used to safeguard the airspace during the Winter Olympic Games in Sochi in 2014. Source: own analysis

## 2.5 Out-of-area operations alongside Poland's allies

Out-of-area operations alongside allies do not count as the key development priorities of Poland's Air Force; however, in the future, Poland perhaps will need to assign limited military contingents to this type of missions. Polish military aircraft have not taken part in any out-of-area combat missions of its allies (Iraq, Afghanistan), although they regularly join *air policing* missions over the territory of the Baltic States (6th round of the Polish Military Contingent "Orlik", consisting of 4 MiG-29M fighters and over a hundred troops and military staff, returned from an air policing mission in April 2015). Out-of-area missions only featured Polish cargo aircraft: C-130 Herkules and CASA C-295. It should be noted, however, that even NATO and EU members states which do not have many fighter aircraft (including the Netherlands, Belgium, Denmark, Norway or Sweden) have joined international air combat operations alongside other NATO allies or in Coalition military operations (Operation Odyssey Dawn in Libya, or Operation Inherent Resolve against ISIS in Iraq, involving Netherlands, Belgium, and Denmark). Some of the EU missions (Operation Atalanta, a counter-piracy military operation at sea off the Horn of Africa) may need contribution of air force, which should be accounted for in the modernization and development plans of the Polish Air Force.

Poland currently has 48 F-16 C/D Block 52+ multirole fighter aircraft, 32 MiG-29/29UB (16) and MiG-29M/29UBM (16) fighters, and 32 Su-22M4/UM3K fighter-bombers. The 2013-2022 Modernization Plan does not specifically provide for the acquisition of more aircraft<sup>61</sup>, but this option should be discussed as soon as possible. To upgrade and continue to operate 18 Su-22 aircraft for another decade can be hardly considered a looking-forward approach, but only reflects the current circumstances (if Su-22 aircraft continue to be used, MiG fighters can be maintained as well). It takes a long time, a decade or even longer, to select and put to operation a new type of aircraft (2-3 squadrons), so Poland cannot afford to put off decisions on this matter any longer, otherwise in 2025 and later on, Poland will not have any new aircraft while the combat capabilities (and the

service life) of existing aircraft, produced by the Soviet Union, will be progressively reduced.

To meet the current demands, the Polish Air Force would need to have least 100 fighter aircraft, although it would be still not enough to keep air supremacy in a conflict against Russia. Buying new 4.5 or 5th-generation jet fighters is a strategic necessity since there are now 15 jet fighter squadrons and 5 bomber and bomber-fighter squadrons in the Russia's Western Military District. Moreover, increasing the number of jet fighters is the only way to prepare the Polish Air Force to take part in out-of-area missions alongside its allies.

Still, the absence of multirole fighters that are eligible to be used in out-of-area missions is just part of the problem. A separate issue which deserves more attention is the necessity to have enough munitions, or more specifically, advanced precision-guided munitions. During the "first" Gulf War in 1991, only 8 percent of the total weapons in air attacks were PGMs; eight years later in Yugoslavia – PGMs accounted for 36 percent of all weapons, in Afghanistan in 2001 – 57 percent, and in Iraq in 2003 – 68 percent. During the military campaign in Libya in 2011, France and the UK painfully learned of the negative consequences of PGM shortages, and the mission succeeded only because of US intervention. The operations against ISIS, carried out in conditions of absolute air supremacy, are largely based on the use of precision-guided munitions. Otherwise massive civilian casualties would probably call into question the rationale of this mission. To address the demand for Poland's engagement in out-of-area missions, the Polish Armed Forces should be in possession of a reasonable number of guided bombs and missiles.

<sup>61</sup> In 2014, it was rumoured that MoND intended to buy 60 fifth-generation aircraft, or 12 fifth-generation fighter jets to add to the existing 48 F-16 fighters (60 aircraft in total). The Ministry of the National Defence denied any of this was true.

The allied forces may also need to deploy medium-range air defense systems in the territory of some of NATO members as reassurance measures. This was repeatedly the case with Turkey<sup>62</sup>. Once again, Poland has to remedy many years of shortfall in this area. Adding 8 Patriot missile batteries (under the Wisła Program) will not drastically improve the capabilities of the Polish Armed Forces. Poland, one of NATO's border states, will be able to send a squadron instead of a full missile battery to an out-of-area mission. It should, however, be pointed out that the acquisitions under the Wisła Program are scheduled to be delivered in 2018, and therefore Poland will amass the discussed capabilities in the second half or at the end of the next decade.

Shortage of fighter aircraft, lack of proper munitions, and – to a lesser extent – absence of short-range anti-aircraft and anti-missile defense systems are the main reasons why the Polish Armed Forces cannot as yet join its allies in out-of-area combat missions. The possible out-of area mission scenarios are outlined below.

#### **Scenario No. 1 Poland's involvement in a short-term air operation to protect civilians and overthrow a regime**

As illustrated by the example of Libya, an operation of this kind, even in conditions of complete air supremacy, can last at least several or a few dozen weeks and may be even more challenging than first supposed. Shortages of particular types of munitions can be only one of a number of challenges. In realistic terms, Poland's involvement in this types of operations would be limited to 4-8 multirole fighters (to keep 4 fighters combat-ready, 6 aircraft need to be deployed), supported by cargo aircraft (and ships, if applicable), to deliver the necessary staff, assets, and arms to the target region<sup>63</sup>. In this scenario, the operations would be directed against the governmental forces of a hypothetical state, and the mission, at least in the initial phase, would be have include SEAD/DEAD operations carried out by the allied forces. On the other hand, Poland could as well join the allied forces later on, as soon as air superiority has been secured.

In this scenario, the operations would be primarily intended to eliminate significant military assets and /or combat personnel of the enemy, and prevent the enemy from operating on the ground. Other targets would include elements of transport, telecommunication, or industry infrastructure, while the top priority would be to avoid civilian casualties. The duration of the operations would largely depend on the geopolitical circumstances and third-party support for the regime, its morale, and the scale of forces engaged in the mission, as well as the presence of forces opposing the government, operating as a land military component of the operation. It is also possible that the main goal or one of the main goals would be to set up a non-fly zone over a specific territory, in order to protect an ethnic minority. In this case, the operation could take up to several months or a few years (as in Iraq after the "first" Gulf War) to complete. As a result, Poland would have to deploy an air force contingent on a rotational basis.

#### **Challenges for the Air Force:**

- » capability to deploy and operate a limited military contingent (4-8 multirole fighter aircraft) alongside other allied forces;
- » capability to redeploy troops and assets in the region of the military operation;
- » capability to carry out air operations for a few or several dozen weeks.

#### **Scenario No. 2 Poland's involvement in an air operation to combat non-state threats and to protect civilians**

In another scenario, Poland would take part in an operation against a non-state (or a quasi-state) actor, similar to that of the ISIS caliphate. Since 2014, we are witnessing the overwhelming challenges

<sup>62</sup> Turkey has appealed to its NATO allies for reassurance measures against a missile threat from Syria through the deployment of Patriot missile batteries on the Turkish border. American, German and Dutch (later replaced by Spanish) Patriot missile batteries have been stationed around the cities of Gaziantep, Kahramanmaraş and Adana since 2013.

<sup>63</sup> Clearly, in fulfilling a mission of this kind, Poland would not necessarily have to be rely solely on the capabilities of the Polish Armed forces. As a member to the Strategic Airlift Capability Initiative, Poland could use NATO C-17 Globemaster III fighters stationed in Papa, Hungary.



accompanying operations targeted at this type of enemies<sup>64</sup>. An air operation carried out in these conditions would be a long-term mission, and the targets would be difficult to identify. The situation would be further complicated by difficulties in differentiating between civil and non-civil targets. Just like in scenario 1, Poland could deploy 4-8 multirole fighters accompanied by cargo aircraft from Poland or the allied states.

There would be mainly air patrols and reconnaissance flights; combat operations would only be initiated if the presence of the enemy's forces or supply convoys would be confirmed, or if the enemy was found to take control of particular infrastructure. The ultimate goal would be to destroy combat personnel, vehicles, and munitions at the hands of the terrorists, and to limit / prevent attacks against civilians.

The duration of operations and the necessity to reduce as far as possible the number of casualties among civilians would determine the use of precision-guided munitions (laser-guided and GPS-guided bombs, and short-range ballistic missiles). The Polish military contingent would have several rotations.

#### **Challenges for the Air Force:**

- » capability to deploy and operate a limited military contingent (4-8 multirole fighter aircraft) together with other coalition forces (or only the use of reconnaissance intelligence, tanker aircraft, or operations under a joint command system);
- » capability to redeploy troops and assets in the region of the military operation;
- » capability to conduct limited-scale, yet long-term air operations.

#### **Scenario No. 3 Air policing missions**

Although, as a rule, air policing missions are non-combat missions, an air policing mission scenario involving Polish Air Force deserves a closer attention. It becomes evident from the discussion of scenarios 2 and 3 in the previous section. If an aggression against the Baltic

States is considered possible, another possibility is that an attack takes place during the Polish Military Contingent "Orlik" assignment. In the future, the Polish Air Force may be engaged in similar missions on the territory of another NATO member, whether at a risk of, or under an attack. The tasks of the Polish Military Contingent would be a direct result of a decision taken by the competent NATO bodies; in the initial phase of the conflict, an incidental fire exchange with the hostile forces is one of possible developments. Depending on the region of an air policing mission, the characteristics of the hostile forces, and the degree in which Poland's own territory would be at risk, the Polish Military Contingent would have to be either immediately evaluated or implement defense operations to support local air defense and ground-based defense operations.

It should be considered relatively unlikely that an air policing mission escalates into a combat mission. Moreover, it is highly unlikely that such developments would take place in a manner which is sudden, without being preceded by a growing crisis. Therefore, it cannot be assumed that the Polish Military Contingent would be the only contingent present in the theatre, but rather it would operate alongside its allies.

In this type of missions, carried out in conditions of a continued / growing crisis, the most probable scenario is the one in which air incidents have to be prevented and countered on a frequent basis, such as violations of airspace or escorting hostile aircraft approaching the state border.

#### **Challenges for the Air Force:**

- » capability to deploy and maintain a limited contingent of air forces (a pair of multirole fighter aircraft), without compromising own defense capability;
- » in the event of a conflict – the capability to take part in a defense operation in order to establish or maintain domination in airspace and to support the operations of land forces and the navy;
- » capability to evacuate all of the Polish Military Contingent from the danger zone.

<sup>64</sup> Air raids of USA and the allied forces (NATO and the Arab States of the Gulf) against ISIS started in August 2014; a month later, the region of the operation was extended to include Syria.

#### **Scenario 4. Supporting the anti-aircraft and anti-missile defense systems of an ally**

The case of Turkey discussed earlier has demonstrated that a NATO member may ask its allies to support its air defense system by deploying one or several short-range missile batteries for reassurance. As already mentioned, in this scenario, Poland's capabilities to react are virtually non-existent, and it may take at least a decade to develop them from scratch. Poland's capability to deploy one Patriot missile squadron under the Wisła Program to an allied state should be taken into consideration in plans to modernize (or rebuild) the air defense system.

NATO's flank states, under specific circumstances, may feel threatened by a ballistic missile or an air raid. It may also be necessary for NATO allies to set up a ground-based defense against ballistic and cruise missiles to protect the allied taskforces. In both cases, Poland should develop its capability to deploy a limited air defense contingent (as described above).

Poland's involvement could be necessary in the initial phase of the crisis, and later on, if the crisis continues. In the latter case, Poland could take over the tasks of another allied state in a mission carried out on rotational

basis. Further still, it can also be assumed that the main goal of the mission would be to demonstrate political solidarity between the allied states instead of carrying out any combat operations.

#### **Challenges for the Air Force:**

- » capability to deploy and maintain for the period of several months a limited contingent of anti-aircraft and anti-missile defense forces, without compromising its own defense capability;
- » ensuring full interoperability of the allied battle groups;
- » capability of national armed forces to redeploy the allocated military contingent to the place in which important military events occur (theatre).

Military missions abroad will never be the top priority of the Polish Air Force; however, every effort should be made to avoid a situation where secondary goals become in fact impossible to achieve. Poland's involvement in operations carried out alongside allied forces under NATO or the EU, be it on a limited scale or in all probability confined to a specific period of time, will help Poland build its credibility in these organizations.

## Chapter II

### What are the development options of the Polish Air Force capabilities?

#### 1. Main challenges for the development of air force capabilities in the 21st century

The term 'no-contact war' was coined from the underlying reflections and conclusions about the international transformations following the Cold War era and the military conflicts we have witnessed recently. The essence of a no-contact war lies in informational superiority and the use of long-range weapons in air and space operations in order to score a quick victory without suffering any substantial losses. Through these measures, there is no need to send large groupings of invading land forces to fight against local armed forces that are more mobile and more rapidly reacting because they know the local area better.

There is a widespread view that losses in one's own military forces, civilians, or even in the enemy's armed forces should be minimised to the lowest practicable level. On this premise, and in consideration of the technological progress, efforts are being made to robotise the battlefield. This is an on-going process in the aviation forces, best exemplified by unmanned aerial vehicles (unmanned aerial systems) used not only for reconnaissance, but also for strike operations.

Also, the precision of weapons evolves from up to several metres to a direct hit. Therefore, there is an increasing trend towards reduction of the size of aircraft warheads and more autonomous, multispectral and individually-controlled guidance systems. In consequence, the pattern of fire operations carried out by air forces will increasingly change from several aircraft firing at a single target to a single aircraft attacking several targets. Additionally, it is increasingly likely that air forces will use directed energy weapon systems (laser, microwave, plasma weapons) during combat missions.

The concept of network-centric battlefield management systems is the fundamental innovation in the capabilities to collect and manage military intelligence. Today, the combat capabilities of military aircraft largely depend on the performance of military intelligence networks. The speed of exchange and

analysis of reliable information will increasingly become the fundamental imperative in the assessment of battlefield situation. Due to informational superiority and the resulting rapid and sound decision-making process, the best-informed armed forces may remain in full control of the situation (superiority in decision-making). Within a short while, all operations are becoming naturally synchronised, the command is exercised continuously, while the active means of combat remain dormant (reconnaissance and active combat systems). In the near future we will witness a reconversion from conventional approach to warfare based on dispersed counter air attacks to surprise-effect precisely-guided attacks fired from long distances to eliminate key targets of the enemy (i.e. those which are critical for the proper operation of the hostile forces). In this context, the air force will definitely keep its dominant position in military deterrence operations.

With the progressive development of military space forces and the persisting gaps in the international space law, the theatre of military operations may soon be relocated into outer space. The outer space offers the freedom of operations on an unprecedented scale at much higher speeds; it extends long-range precision strike capabilities and the ability to travel in 360-degree three-dimensional space. This mix of possibilities will underpin the future concepts of how air and space capabilities can be used for military purposes. Airspace and outer space offer the unique advantage of quickly concentrating and redeploying military forces over a specific area or region all over the world.

One may speculate that aircraft and spacecrafts will carry out deterrent operations and stabilisation missions in peacetime, as well as emergency response operations and defence tasks during war. In cases of emergency or during war, aircraft and spacecrafts will be involved in defence operations of states (or allied forces) and will deliver air and space support for other types of armed forces. In peacetime, air and space forces will take on their defence duties. All in all, air and space defence will soon become one of the key tasks and the core type of operations carried out by the armed forces. In a general sense, air and space assets will become a part of state or alliance defence capabilities;

they will be used to eliminate threats from the air and space in order to ensure that the core public authorities, resources and armed forces of a state (or an alliance) are safe. Defence against air and space threats can be exercised through anti-aircraft, anti-missile, or anti-space systems.

Air and space defence operations of states (or alliance) in their national territories can have two different goals: to safeguard uninterrupted state governance and to ensure continuous control and command of the armed forces, and to protect defence infrastructure and operational forces during mobilisation and defence preparations and operations. Air and space defence goals can be pursued by all types of armed forces in peacetime, at the time of crisis and during war. However, the role of air and space forces is likely to remain crucial; they will integrate all other types of armed forces.

A uniform intelligence and command systems will be established for the overall air and space defence assets and all other types of military forces. This will serve as a basis for the formation of integrated air and space defence systems, which is very important in performing collective operations in the national territory of a state or allied states. Commanders of air and space forces will be mainly responsible for developing systems of this kind.

The prioritisation of air and space defence tasks and their assignment to particular types of armed forces carrying out defence operations will be closely linked to the different stages of defence operations, depending on how the situation unfolds.

In more general terms, the relationships between tasks of air and space units and other types of armed forces in defence operations within own territory are as follows:

- » priorities of air and space forces: information superiority, winning over air and space superiority, mainly by protecting air and space aviation bases and missile systems, tight protection of redeployment directions and groupings of strategic military assets, with a focus on land forces and warships;

- » the core tasks of air and space forces that protect land forces and warships will be to directly protect groupings of land forces and naval forces against enemy aircraft and missiles, which the enemy will be using to gain superiority in air and space.

The basic tasks of air and space forces will be as follows: information war, operations to achieve air and space superiority or supremacy, attacking the enemy's military capabilities from air and space, air and space reconnaissance, and air and space transportation.

Defensive and offensive operations will continue to be of fundamental importance. The essence of defence operations will be to destroy enemy's air and space strike assets operating from the outer space and airspace (satellites, stations and space bases, missiles, manned and unmanned aircraft) using anti-satellite weaponry, fighter aircraft (interceptor aircraft) and anti-aircraft and anti-missile defence systems. Here, the main goal will be to repel attacks of hostile forces from air and space and to secure mobilisation and operational conditions for and the continuous protection of land forces and naval forces as part of defence operations.

Defence operations are of undeniable strategic significance. Defence operations against air and space assets of the enemy will be carried out in space and in upper layers of the atmosphere; defence operations against air assets of the enemy will be concluded by means of strike capabilities supported by air refuelling capabilities.

Still, it will be considered necessary to optimally combine defence operations and offensive efforts to achieve air and space superiority. Offensive operations will mainly consist of missile attacks from outer space supported by air strikes against key military space assets and air forces of the enemy. Attacks will mainly be targeted against elements of reconnaissance systems, missile bases, airbases, control and command assets, and the air force infrastructure of the enemy. By carefully selecting the targets and due to the high precision of attacks, offensive operations will weaken the active combat capabilities of air and space forces of the enemy, but will also eliminate or drastically limit strike capabilities of the enemy's space and air assets.

However, it should be clearly stated that only a few countries worldwide have mastered practical military potential in the outer space; they will group around them other countries that do not possess any military space capabilities. As a result, new military pacts, coalitions and alliances are likely to emerge. Smaller countries will have no other choice but to rely on the military space capabilities of their allies. In order to address shortcomings in their military self-reliance, these countries will ask other countries or coalition members to extend their air and space defence capabilities over their national territories and will rely on the air and space assets belonging to other states. At the same time, they will seek to find the balance between the desire to procure modern weaponry and military equipment and the costs of their maintenance and utilisation. In order to leverage their own space combat capabilities, they would still have to rely on a stronger ally.

The first decades of the 21st century are marked by continuous advancements in aviation. Air power is still playing a major role and is the most significant element of the armed forces. It offers huge combat capabilities and is able to face emerging threats to security and achieve the goals set out by politicians.

Air power is considered a particularly effective means to deter and counter military aggression; it is capable of maintaining and restoring peace (operations other than war), effectively preventing infringements of international law (fight against terrorism and organised crime) and delivering airlift capabilities (humanitarian aid). For many years, air power was used as a coercive measure to achieve the fulfilment of obligations or conditions; as a rule, other types of armed forces are only marginally used for this purpose; under more favourable circumstances, air power alone can achieve political and military objectives of allied forces operating jointly. Military deterrence remains to a large extent the domain of the air force. It is largely due to its responsiveness, the impact range and the increasing sophistication of precision-guided munitions.

Aircraft can continuously monitor the situation, especially in conditions of rising tensions in international relations at almost any spot in the world in real time. No

other means of combat has such a unique capability to confirm whether presumptions concerning growing threats to security are in fact true or false. This is because of the technical advancement and the massive potential of military aviation assets. Increasingly, the traditional classification of different types of air power and aircraft classes no longer reflect the assigned range of tasks in the majority of operations. With the richness and diversity of on-board warfare and equipment, which becomes increasingly miniaturised and universal, supported by airborne refuelling equipment, the growing military impact capabilities of aircraft navigated by satellite navigation systems, and the massive use of precision-guided munitions – the demarcation line between different categories of aircraft used in strategic and tactical operations becomes vague and indistinct. Today, it is not the type of aircraft, but the effect of their operations that determines whether the tasks entrusted to air forces are in fact strategic or tactical.

## 2. Technical modernisation of Air Force aviation

### Combat aircraft – global trends

In the recent decades, we have witnessed far-reaching technical changes in combat aircraft and their capabilities in various types of military conflicts. Fourth-generation jet fighters were put into service, including Boeing F-15 Eagle/Strike Eagle, Lockheed Martin F-16 Viper, Boeing F/A-18 Hornet/Super Hornet, Mikoyan MiG-29, Sukhoi Su-27 (single-seater) and Su-30 (two-seater), Dassault Rafale, Eurofighter Typhoon, and Saab Gripen. Manoeuvrability was enhanced by adding new aerodynamic designs coupled with active flight control systems (and improved power-to-weight ratio), digital avionics with a central mission computer and multifunction LCDs, data transmission systems, improved combat assets, integrated search & track systems and electronic warfare assets.



The United States have taken a step further in the development of jet fighters. This is where fifth-generation jet fighters are now in use, including F-22 Raptor and F-35 Lightning II (both produced by Lockheed Martin). F-22 was combat-ready in 2005; F-35 was declared combat-ready in 2015. These are lightweight stealth multirole fighters with the super-cruise capability and internal weapon bays (additional weapons and fuel containers can be carried externally), more advanced avionics, search and track systems and data transmission systems.

Apart from that, the United States is the only country that has initiated preliminary research on sixth-generation *Next Generation Air Dominance* jet fighters (NGAD). They are scheduled to be combat-ready in 2035 (the research is concluded in parallel and independently by the US Navy and US Air Force). NGAD fighters are planned to replace the F/A-18 Super Hornet and F-22 Raptor (in the latter case, excessively high operation costs are the reason). Preliminary data shows that the new jet fighters will be less visible at maximum speed of Mach 4 and above the altitude of 25,000 metres or more; they will be armed with directed energy weapon systems (microwave and laser weaponry).

Fifth-generation jet fighters are also being developed by the Russian Federation (Sukhoi PAK- FA) and the People's Republic of China (Chengdu J-20 – equivalent of F-22 Raptor, and Shenyang J-31 – equivalent of F-35 Lightning II). Modernisation programs are underway for fourth-generation jet fighters: Dassault Rafale, Eurofighter Typhoon, Saab Gripen (Gripen NG), Mikoyan MiG-29 (MiG-35), and Sukhoi Su-27 (Su-35); fourth-generation airframes are retrofitted with new avionics, search and track systems, and data transmission systems typical for fifth-generation fighters.

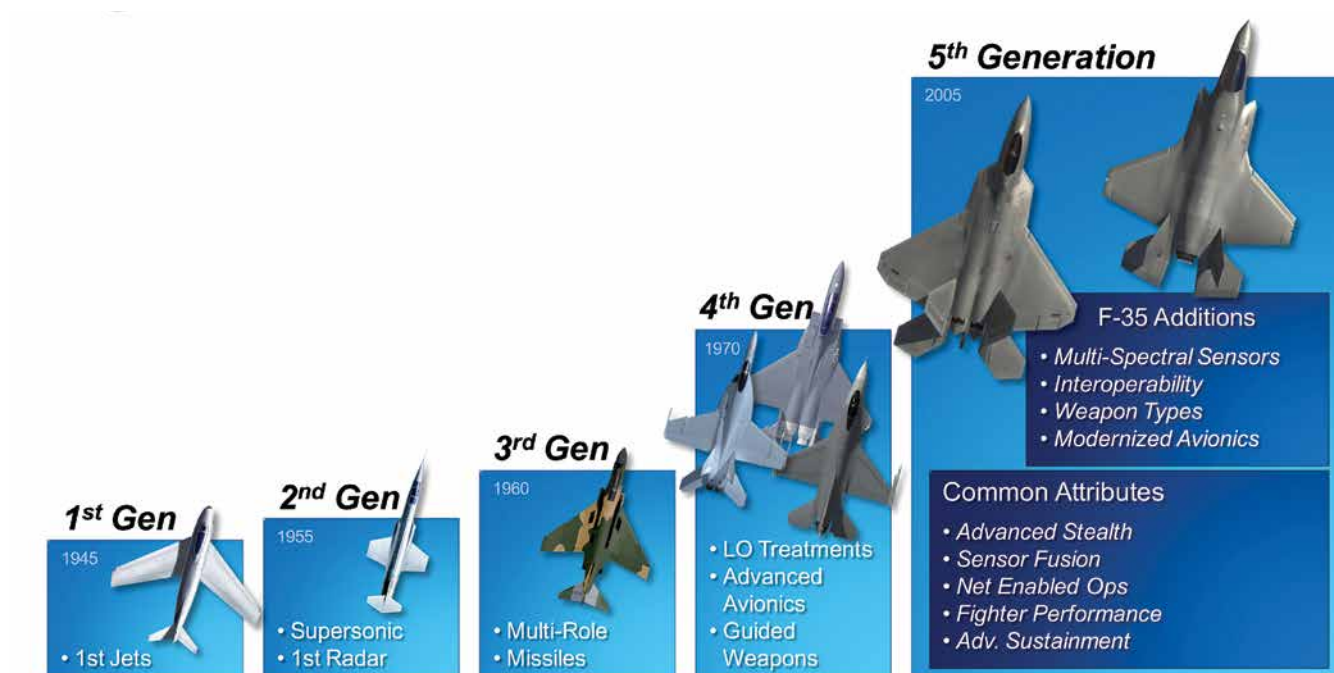
New airframe construction materials and radar-absorbent materials have been developed to reduce the surface reflectivity of fourth-generation jet fighters. Also, to increase the chances of survival in hostile environments, the fighters are fitted with medium-range and long-range missiles (MBDA Meteor

active radar guided beyond-visual-range air-to-air missiles and Storm Shadow air-launched cruise missiles).

Fifth-generation jet fighters, generally modelled on the American F-35 Lightning II jet fighter, are also being developed in the Republic of Korea (Korea Aerospace Industries KF-X, with financial contribution of Indonesia) and Turkey (Turkish Aerospace Industries TF-X, with the support of Swedish engineers after negotiations to set up a joint project with the Koreans have failed).

Similar developmental projects are being conducted in Japan on the twin-engine Mitsubishi ATD-X experimental jet fighter. The Mitsubishi ATD-X was developed after the US refused to sell F-22 Raptor stealth tactical fighter aircraft to Japan. According to Japan, ATD-X is a sixth-generation fighter (Japan has recently acquired the F-35 Lightning II, which it considers a fifth-generation fighter).

India has continued, with a long delay, to work on Hindustan Aerospace Limited Tejas, a four-generation multi-role light fighter, and has been actively involved in the Sukhoi PAK FA project to develop its own version of the Russian fifth-generation FGFA fighter.



Technological progress on the example of jet fighters Source: Lockheed Martin.



Basic characteristics of Sukhoi T-50 (PAK-FA) airframe. Source: Lockheed Martin.



Basic airframe characteristics of Chinese J-31 jet fighter. Source: Lockheed Martin.

To recap, F-16 Viper and Eurofighter Typhoon fighters will be the cornerstones of the NATO Air Force; F-35 Lightning II fighters will be added progressively. F-35 Lightning II fighters, modernised in the course of normal operation, will be replacing the F-16 Viper fighters in the long run. F-35 Lightning II aircraft will be licensed-produced in Italy, in cooperation with several other countries involved in this project. It is not ruled out that some of the North Alliance countries with military budget constraints will either jointly set up international air regiments (the Baltic States: Lithuania, Latvia, Estonia) or will not have any supersonic aircraft at all (Croatia, Slovenia). In the latter case, air defence tasks can be carried out by other allied states.

It can also not be excluded that these countries may opt for Gripen jet fighters (Gripen NG) or combat versions of supersonic advanced jet trainer aircraft (e.g. Korea Aerospace Industries T-50 Golden Eagle, F/A-50). The Philippines are currently preparing KAI F/A-50 aircraft for service in their air force; several other countries in Asia, South America and Africa have also been considering this option. A similar fighter aircraft can be also created in the future, based on the American

supersonic advanced jet trainer aircraft currently in development (T-X project for the US Air Force; the contract is scheduled to be awarded in 2017).

The fourth-generation Saab Gripen NG jet fighter is basically developed by the Swedish air sector within the framework of a broad-based international cooperation (the term 4.5-generation aircraft was coined recently to distinguish this type of fighter from the recently modernised fourth-generation aircraft). Sweden sells a production licence for Saab Gripen NG, and such a licence was recently bought by Brazil; Gripen NG aircraft produced in Brazil will be offered for sale to several South American states in 2020s.



Saab JAS 39 Gripen of the Czech Republic Air Force



The fourth-generation Chengdu Pakistan Aeronautics Complex JF-17 Thunder jet fighter produced in cooperation with China is a cheaper alternative. It has been operated by the Pakistani Air Force for several years now. The Chinese military aviation relies on its own fourth-generation J-10 fighter, which is also available for sale (Iran plans to acquire it from China). It is also offered to other countries with lower military budgets in the Middle East, Asia and Africa. The first contract for a J-10 sale was signed with Bangladesh – the deliveries will be initiated in 2017.

Another cheaper option is to acquire surplus F-16 Viper aircraft from the United States. For example, the US have sent used aircraft to Indonesia (Jakarta agreed to pay for their repair and retrofitting). Other countries will also have the chance to acquire used F-16 on similar terms as these F-16s will be progressively replaced by F-35 fighters by the US and in other allied countries.

### **Combat aircraft of the Polish Air Force after 2020**

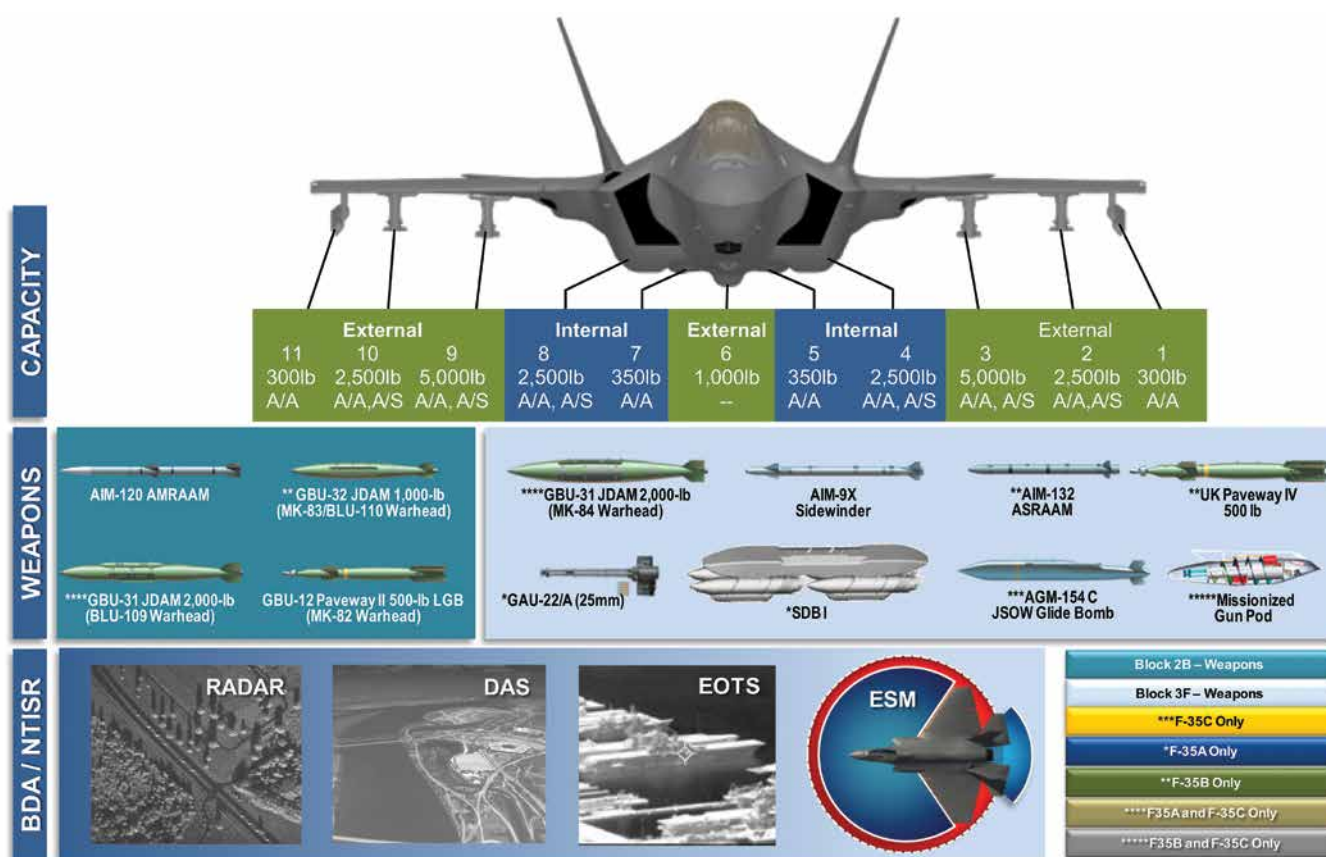
In early 2020s, the Tactical Air Force will have 96 jet fighters divided into 6 tactical air force squadrons grouped in two tactical air wings. The 1st Tactical Air Wing (with the command post in Świdwin) will have a squadron of Su-22 bomber-fighters (including 12 single-seat Su-22M4 fighters and 4 two-seat Su-22UM3K training aircraft) stationed at the 21st Świdwin Tactical Air Base, and 2 squadrons of MiG-29 fighters (including 26 single-seat MiG-29 combat aircraft and 6 two-seat MiG-29UB training and combat aircraft) stationed at the 22nd Malbork Tactical Air Base and the 23rd Tactical Air Base in Mińsk Mazowiecki (with 16 combat aircraft and training-combat fighters each). The 2. Tactical Air Wing (with the command post in Poznań-Krzesiny) will have 3 squadrons of F-16 Jastrząb multirole aircraft (including 36 single-seat F-16C combat fighters and 12 two-seat F-16D training-combat fighters). They will be stationed at the 31st Poznań-Krzesiny Tactical Air Wing (two squadrons) and the 32nd Tactical Air Base (one squadron, with air reconnaissance capabilities delivered by DB-110 day/night reconnaissance pod).

However, by that time, F-16 Jastrząb multirole aircraft (put into operation over the period 2006–2008) will be

the only modern combat aircraft of the Polish Air Force. Until then, F-16 Jastrząb will be retrofitted with the Sniper XR targeting pod and AGM-158A JASSM tactical cruise missiles for target identification and tracking to improve their combat capabilities in direct air support operations (Sniper XR allows streamlines cooperation with ground-based controllers; enhanced digital CMDL (*Compact Multi-band Data Link*) upgrade communicates seamlessly with the fielded ROVER family of ground stations).

Su-22 (1984–1988) bomber-fighters and MiG-29 (1988–1990) jet fighters will be considered obsolete by then. In 2020s, they will fail to meet the demands of contemporary battlefield (this is already the case today – these aircraft have not been modernised; retrofitting programs have been performed only to adapt them to the standards of NATO's communication, identification and navigation systems, otherwise the Su-22 and MiG-29 would neither be able to fly across international airspace, nor to take part in any training missions alongside Poland's allies). In 2020s, these aircraft will have to be replaced by new ones.

In consideration of the discussed development trends in combat aircraft, Poland may choose either of two directions to develop its air combat capabilities.



F-35 capabilities and weapon systems. Source: Lockheed Martin.

One option is to acquire the most technically advanced fifth-generation **Lockheed Martin F-35 Lightning II jet fighters** as a replacement for MiG-29 fighters and Su-22 bomber-fighters. Today, Su-22 aircraft are mainly used as training aircraft for MiG-29 pilots (Su-22 can no longer be used in intensive combat training because of soon-to-expire service life).

The replacement process should be initiated over the period 2020–2022 (notice of invitation to tender, awarding the contract) so that F-35 Lightning II jet fighters can be ready for operation within the next few years. The exact delivery date would depend on the production capabilities and the volume of orders. The producer encourages buyers to order more F-35 Lightning II aircraft to be delivered progressively over a longer period of time.

Poland will have 48 MiG-29 (32) and Su-22 (16) jet fighters, but for budget reasons (costs of acquisition and operation), it is unlikely that all of these aircraft are replaced (at 1 to 1 ratio). In the most probable scenario, Poland will acquire 32 Lockheed Martin F-35 Lightning II

all-weather stealth multirole fighters to replace MiG-29 aircraft (Su-22 substitution will be discussed later).

Another modernisation cycle should be planned for F-16 Jastrząb fighters to upgrade avionics and data transmission systems, to replace the AN/APG-68(V)9 multifunction radar system with an AESA (*Active Electronically Scanned Array*) radar and to modernise the weaponry (to address the expected large increase in the anti-aircraft defence capabilities, F-16 Jastrząb will have to be retrofitted with more anti-air medium-range and long-range missile systems and made ready to carry more small-size munitions). One option for an AESA solution is the Northrop Grumman AN/APG-83 SABR model.

An AESA radar will significantly enhance the combat capabilities of F-16 Jastrząb aircraft. This way, the aircraft will be able to perform several tasks simultaneously. For example, the F-16 Jastrząb will be capable of air defence and data collection operations during a strike mission (with automatic data storage by on-board sensors and data transmission to other



combat platforms within the common battle space – in air, on land, and on sea – almost in real time).

In 2030s, F-16 Jastrząb aircraft should be replaced with more F-35 Lightning II fighters (the replacement ratio will depend on the progress in the development of unmanned aircraft vehicles). The most probable scenario is the acquisition of another 32 F-35 Lightning II fighters.

A scenario in which air combat assets consists of one type of a combat aircraft is typically preferred by countries which have no more than 64 fighters (4 squadrons).

**In another scenario, Poland would acquire two types of jet fighters: Eurofighter Typhoon and Lockheed Martin F-35 Lightning II.** In this scenario, Eurofighter Typhoon (2020s, as a replacement for MiG-29 and Su-22) should be bought in the first place, followed by F-35 Lightning II (2030s, as a replacement for F-16 Jastrząb) fighters. According to the available data, Eurofighter Typhoon multirole fighter has several advantages over F-35 Lightning II, most notably higher airlift capacities of munitions carried on more external stations – more broadly, the types of external munitions can be adapted to a specific combat mission characteristics and increases the aircraft performance during a combat flight (this is particularly evident in defensive operations when the aircraft is used as an interceptor fighter) – and the improved tactical scope of operations without in-flight refuelling carried out, which is not always possible, especially during operations deep within the enemy territory.



Eurofighter Typhoon multirole jet fighter belonging to RAF.  
Photo: Peter Gronemann, Flickr.com.

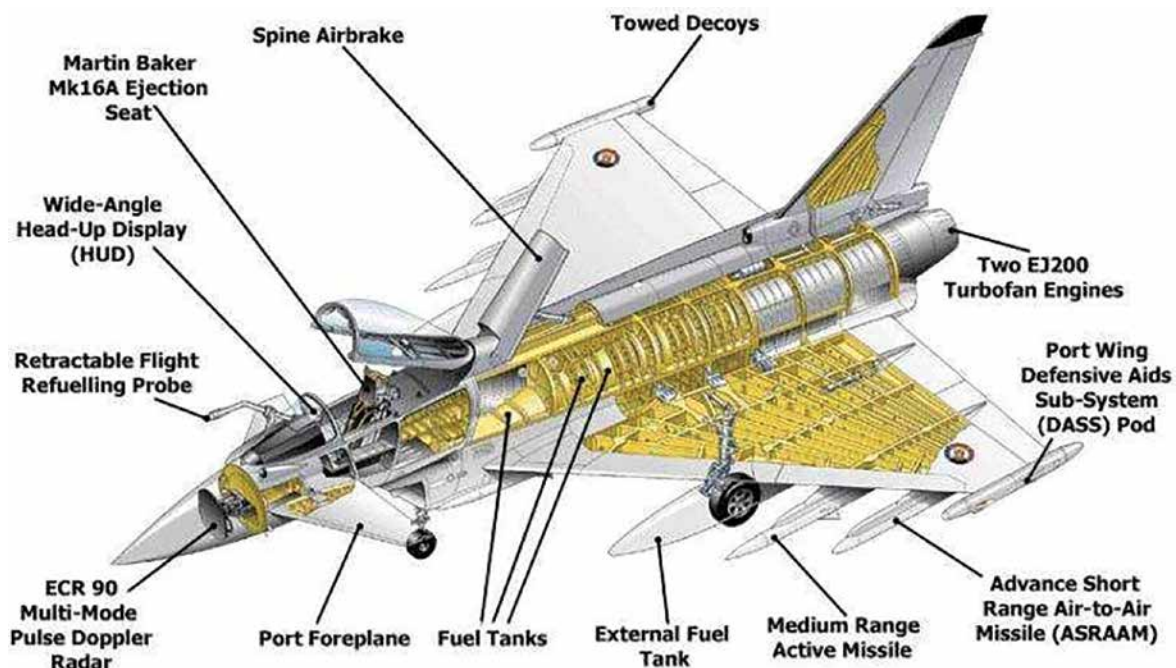
In this scenario, Poland would have 80 jet fighters, including 32 Eurofighter Typhoon aircraft (1st Tactical Air Wing) and 48 Lockheed Martin F-35 Lightning II aircraft (2nd Tactical Air Wing). Eurofighter Typhoon jet fighters would cooperate with unmanned aerial vehicles (manned aircraft would play the leading role, delivering defence against electronic warfare, anti-aircraft defence, and would eliminate ground-based anti-air defence systems of the enemy), mainly geared to carry out reconnaissance tasks, followed by strike operations. Second-generation unmanned aircraft, likely to be introduced to the Polish Air Force in 2030s, would be based on the stealth technology (first-generation medium-altitude long-endurance UAV [MALE] are likely to be introduced to Poland in the late 2010s or early 2020s).

In the third possible option in which unmanned aerial vehicles are quickly developed in the coming years, Poland should only acquire **an additional (fourth) squadron of F-16 Jastrząb multitask fighters**, to be stationed at the 32nd Łask Tactical Air Base. Poland would have 24 more aircraft, including 8 aircraft used to train, refresh and develop the skills of fighter pilots (in this case, Poland would have 72 combat jet fighters). The 1st Tactical Air Wing would be transformed into a tactical base consisting of unmanned aerial vehicles.

In this case, F-16 Jastrząb multirole aircraft would be replaced by F-35 Lightning II jet fighters in the 2030 time frame (all F-16 Jastrząb would be upgraded and retrofitted as described), following the introduction of the 1st (transitional) generation of unmanned aircraft vehicles) (in 2020s; first MALE UAVs would be delivered in late 2010s).



The US MQ-1 Predator is armed with AGM-114 Hellfire missiles.



Eurofighter Typhoon aircraft structure and armaments.

A fourth direction is also possible, in which Poland – for economic reasons – chooses to buy Eurofighter Typhoon instead of Lockheed Martin F-35 Lightning II fighters (Poland is less likely to opt for Dassault Rafale aircraft as they are relatively expensive, and Saab Gripen NG, whose combat capabilities are relatively limited, taking into consideration NATO standards). Poland would be able to buy only 64 aircraft of this kind (4 combat squadrons, 16 aircraft each) in order to replace all currently used combat aircraft.

In this option, the Polish Air Force would have to keep 2 tactical air wings, and each wing would have manned aircraft (fighters) and unmanned aerial vehicles (for reconnaissance and strike missions, carried out autonomously and in cooperation with jet fighters, operating as, for example, “information hubs”).

However, this does not mean that, in defence planning, Poland would not have to secure access to unique combat capabilities of stealth fighter aircraft. These aircraft would belong to the allied forces: Americans, Belgium, the UK, the Netherlands, etc. (these countries have or soon will have combat capabilities of this kind, and regularly train with the Polish military aircraft).

This is the strategy of the German Air Force. In the future, Germany will have only one manned combat fighter:

Eurofighter Typhoon (Tornado IDS combat-fighters, Tornado IDS/R reconnaissance aircraft, and Tornado ECR electronic combat/reconnaissance aircraft in 2020s).

The discussed scenarios are based on the assumptions formulated by Poland’s political and military authorities and are explicitly stated in the *2013-2022 Polish Armed Forces Technical Modernisation Plan*, the basic assumption of which was that Poland would not be at risk of any direct military conflict in the near future. These assumptions may be called into question, given the recent operations of the Russian Federation, which seems determined to restore its political influence, also by means of military forces (conflict with Ukraine, military intervention in Syria). If the international situation deteriorates, the *2013-2022 Polish Armed Forces Technical Modernisation Plan* will have to be amended. In terms of tactical aircraft, **MiG-29 fighters and Su-22 bomber-fighters would have to be replaced in the first place, and new F-16 multirole aircraft would have to be acquired** with the accompanying modernisation package (in this case, the F-35 acquisition would be postponed to the fourth decade).

## Airlift capabilities

Military transport aviation was dynamically developing after the Cold War era, when the North Atlantic Treaty Organisation extended its traditional scope of operations (covering Europe, North America, and the adjacent sea basins) to take up global-scale missions (stabilisation and humanitarian missions). NATO has permanently increased its airlift capabilities – the airlift performance of military transport aircraft have increased along with number of such aircraft.

Contemporary military transport aircraft can be divided into the following categories:

- » very heavy and heavy strategic military transport aircraft,
- » medium and light tactical military transport aircraft,
- » very light military transport and communications aircraft, or communications aircraft.

A uniform military transport aircraft configuration has been developed: a classical high wing aircraft with engines mounted in two side nacelles on the wings. The landing gear is retracted to recesses in the fuselage. Diagonal edge wings are used in high-speed aircraft powered by jet propulsion.

Turbine engines (turbo-prop or turbo-fan version of air-breathing jet engines with double-flow configuration) are most common. Turboprop engines are most popular in light and very light aircraft. Loading and unloading operations are carried out quickly through rear cargo door with vehicle trackway ramps. Some aircraft can be loaded and unloaded through front cargo hatch. Newer versions of military transport aircraft have pressurised cargo holds. With multiple low-pressure wheels in the landing gear, large cargo aircraft can take off from unpaved runways. Advanced wing mechanisation, thrust reversers and reverse pitch have improved take-off and landing characteristics of military transport aircraft.

Lockheed C-5 Galaxy and Antonow An-124 Rusłan are examples of very heavy military cargo aircraft. Their features include a turbine jet engine, +120,000 kg max payload and intercontinental flight range. These very heavy military cargo aircraft are only in possession of

the United States Air Force (C-5) and the Russian Federation (An-124), as well as commercial airlines (in Russia and Ukraine) providing services to military and civil clients (including NATO allies, when they maintained airlift to deploy and support military forces engaged in the peace-keeping mission in Afghanistan).

The family of heavy military cargo aircraft is much bigger and includes: Airbus Defence & Space A400M Atlas and Antonow An-70 (currently in test) with turboprop engines, Boeing C-17 Globemaster III, Ilyushin IL-76 (IL-476 with improved avionics and a stronger and more fuel efficient engine), and Xi'an Y-20 (currently tested) with jet propulsion aircraft engines. They offer from 40,000 kg to 80,000 kg payload; although the maximum payload is limited for intercontinental flights, they have the critical air-to-air refuelling capability. Heavy military cargo aircraft are owned by countries with high military budgets; smaller countries can afford only a few heavy cargo aircraft or can agree to operate international aircraft together with other allied countries. NATO countries, including Poland, have agreed to acquire, manage, support and operate C-17 Globemaster III strategic transport aircraft out of Pápa Air Base in Hungary, under the command of the Heavy Airlift Wing.

The real military airlift power lies in medium cargo aircraft with around 20,000 kg payload and continental flight range. The Lockheed Martin C-130 Hercules/Super Hercules is the most popular cargo aircraft of this kind. For many years, the Antonow An-12 was its main competitor, but is now slowly going out of service. Antonow (An-178), Embraer (C-390 – cargo version, KC-390 – cargo/transport aircraft), Ilyushin (IL-214 – developed under Russian-Indian cooperation), Kawasaki (C-2), and Shaanxi Y-9 (developmental version of An-12 copied, improved and massively produced by the People's Republic of China) are attempting to fill a niche in the market and compete with the C-130 Hercules/Super Hercules.

There are many more light transport aircraft to choose from: Airbus Defence & Space C-295, Alenia C-27 Spartan, Antonow An-32 (An-132 – developmental version created by Ukraine and Saudi Arabia), An-72 (the only light transport aircraft with a turbine jet engine), and Xian Y-7 (development version of An-24 copied and produced by the People's Republic of China). They can carry from 5000 to 10,000 kg of cargo. The Boeing Bell V-22 Osprey tiltrotor military aircraft with vertical takeoff and landing is also classified as a light military transport aircraft. Currently it is only operated by the US Navy, but the first export contracts are being concluded with Japan and Israel. India are also interested in the acquisition of Bell Boeing V-22 Osprey.

V-22 is the first serial produced tiltrotor military aircraft with nearly 12 meter-diameter rotorblades mounted together with engines and transmission and fitted into nacelles on the wings. The aircraft takes off and lands like a helicopter with the nacelles pointing straight up (rotorblades positioned vertically). Once airborne, the nacelles rotate after just 12 seconds for horizontal flight. The takeoff and landing capability of short takeoff and landing (STOL) aircraft is achieved by having the nacelles tilted forward up to 45 degrees. Wings and rotors can be collapsed in just 90-120 s so that the aircraft occupies less space.

Very light transport aircraft have turboprop engines and can carry from 100 kg to 3000 kg of cargo. They are being widely used for transportation and support operations (policing and reconnaissance, sanitary, parachute drop, training missions, etc.). Examples of very light transport aircraft are as follows: de Havilland Canada DHC-6 Twin Otter, Dornier Do 228, Harbin Y-12, and PZL Mielec PZL M-28.



VTOL V-22 Osprey multi-mission military aircraft with vertical takeoff and landing capability.

## Airlift capabilities of the Polish Air Force after 2022

In early 2020s, the airlift capabilities of the Polish Air Force will be based on 5 Lockheed Martin C-130E Hercules medium transport aircraft, 16 Airbus Defence & Space C-295M light transport aircraft, and 18 PZL M-28 very light transport aircraft. They will all belong to the 3rd Tactical Air Wing (with the command post in Powidz), consisting of: the 1st Warsaw Airlift Base (including 2 special airlift squadrons to carry the highest officials, consisting of aircraft for intercontinental and continental flights, respectively; these aircraft will be acquired in the near future, in two stages; and 2 more squadrons, consisting of W-3 Sokół and H225M Caracal helicopters for domestic flights), the 8th Kraków Airlift Base (with 2 airlift squadrons: one with C-295M aircraft, and the other one consisting of PZL M-28 aircraft), and the 33rd Powidz Airlift Base (with an airlift squadron of C-130E Hercules and PZL M-28 aircraft, and 7th special squadron of combat helicopters acquired in the "Kruk" programme and H225M Caracal transport and multirole helicopters).

The 3rd Tactical Air Wing will also include 3 air research and rescue groups with EH225M Caracal helicopters stationed at the following airports: the 1st Polish Search and Rescue Group – in Świdwin, the 2nd Polish Search and Rescue Group – in Mińsk Mazowiecki, and the 3rd Polish Search and Rescue Group – in Krakow.

C-130E Hercules military transport aircraft will be the only relatively obsolete cargo aircraft belonging to the Polish Air Force in 2020s. Unless their service life is extended (C-130E Hercules aircraft were produced in 1970s and are increasingly less reliable), they will have to be replaced urgently.

There are two options available (as long as the third option – absence of medium military transport aircraft in the Polish Air Force – is rejected). Poland can either replace its C-130E Hercules in the next decade by acquiring 4 to 6 C-130J Super Hercules medium transport aircraft, or 4 A400M Atlas heavy transport aircraft. Given the fact that the Polish Air Force already has access to heavy military transport aircraft of its allies (C-17 Globemaster III strategic transport aircraft at Pápa Air Base in Hungary), the first scenario seems to suit us best.



Airlift capabilities are linked air refuelling capabilities. Military transport aircraft are typically cargo and tanker aircraft that can be used for many different purposes (they can also be used either as communications aircraft or electronic reconnaissance aircraft).

Considering the latest decisions, Polish pilots of combat aircraft are likely to be trained in aerial refuelling in 2020s, mostly on Airbus Defence & Space A330 MRTT transport and tanker multirole aircraft. These aircraft will belong to the Air-to-Air Refuelling Squadron, most probably stationed at Eindhoven Air Base, the Netherlands (established on the initiative of Poland, Netherlands and Norway). The Air-to-Air Refuelling Squadron will be set up in two stages, with 3-4 transport and tanker aircraft introduced in each stage of the project. The decision to buy A330 MRTT aircraft is due in 2016, the squadron is scheduled to be ready to operate by 2019.

Many transport aircraft are also retrofitted to become electronic reconnaissance aircraft. Poland does not have any aircraft of this kind and this situation should be remedied as soon as possible. According to the available data, C-295M light transport aircraft can be used for this purpose. Poland has intended to acquire 6 additional aircraft of this type, including 3 aircraft that are planned to be retrofitted to be used for sea policing and anti-submarine operations (replacing PZL M-28 Bryza), and 3 more for electronic reconnaissance.

### **Training capabilities of the Polish Air Force after 2020**

The training system for military pilots is a stepwise process consisting of elementary (initial, selective part of the process), basic, advanced and tactical/combat training stages. Over the recent years, the Polish training system for pilots has undergone significant changes. Accordingly, beginning from 2020s, the training programme for the Polish fighter pilots will rank among the most modern in the world and will create optimum conditions to transform the Polish Air Force Academy in Dęblin into an International Academic Centre for Military Aviation Training. Elementary training will be delivered at the Academic Centre for Aviation Training (AOSL) in Dęblin. Next, the prospective pilots of combat fighters of the 4th Training Aviation Wing will undergo basic training programme on PZL-130TC-II Garmin turboprop trainers; advanced training will be delivered on

PZL-130TC-II Glass Cockpit aircraft (1st stage). Advanced (2nd stage) and tactical/combat training will be provided on the M-346 Master trainer aircraft.

The 4th Training Aviation Wing (under Dęblin airbase command) will consist of: the 41st Training Airbase in Dęblin, consisting of a squadron of 12 M-346 Master aircraft and a squadron of 24 SW-4 Puszczyc helicopters (basic training) and 8 W-3 Sokół helicopters (advanced training), and the 42nd Training Airbase in Radom, consisting of a squadron of 16 PZL-130TC-II Garmin trainer aircraft, a squadron of 12 PZL-130TC-II Glass Cockpit aircraft, and a flight of PZL M-28 aircraft (for comprehensive airlift trainings).

If Poland opts for F-35 Lightning II stealth fighter aircraft, it will face the major task of reducing operational costs of these aircraft to the lowest possible levels. For example, cheaper aircraft, such as M-346 Master, could be used for basic and refresher flying skill trainings for F-35 Lightning II pilots. This appears even more likely since Lockheed Martin does not plan to produce a two-seat trainer versions of F-35 Lightning II because of high cost-per-flight-hour rates.

MiG-29 fighters (followed by F-16 Jastrząb aircraft) would be replaced by F-35 Lightning II fighters, and additional M-346 Master aircraft (16) would substitute Su-22 fighter-bombers. In this scenario, another question is whether to use M-346 Master for training only, or should these aircraft be armed. One possible option is to use M-346 Master for direct air support operations.

M-346 Master can also be used as battlefield simulators (these aircraft are especially suitable for this type of missions because of favourable aerodynamic characteristics: very high angles of attack and good thrust-to-weight ratio). In this context one has to underline that this element of the tactical/combat training cannot be trained on a simulator only. Simulator training improves flying skills, but cannot adequately reflect the actual spatial position (for example, pilot's experience while flying on the back) and the emotions in dynamically changing conditions (acceleration, exposure to pressure changes during the flight and the resulting limitations in the control of airspace).



Colonel Krystian Zięć argues that the acquisition of M-346 Master aircraft and the modernisation of PZL-130 trainer aircraft would be the first step to create Poland's training programme dedicated to the pilots of modern air fighters. Polish pilots of F-16 fighters have been trained in the US (the training costs equalled USD 2 million per pilot and around USD 2 million per flight instructor; overall USD 20 million annually), but this training programme will no longer be available given the gradual transition to F-35. An important challenge is the insufficient number of flight instructors. This problem can be solved by setting up an F-16 Military Training Centre, a Polish commercial training&logistics initiative (to provide training to pilots from Romania, Bulgaria or Croatia, and to improve the operational capabilities of the Polish Air Force by delivering parallel trainings to navigators and ground crew instructors) to deliver training to around 6 pilots and 3 instructors annually.

#### Unmanned aerial vehicles of the Polish Air Force after 2020

According to the *2013-2022 Polish Armed Forces Technical Modernisation Plan*, in early 2020s Poland will have 5 basic categories of unmanned aerial vehicles (UAVs): very short range mini UAVs (codename "Wizjer", up to 40 sets) to be used at the battalion level, vertical takeoff and landing mini UAVs (codename "Ważka", up to 15 sets), capable to operate in urban areas (hovering and uninterrupted point observations), tactical short-range UAVs (codename "Orlik", up to 15 sets), to be used at the brigade level, tactical medium-range UAVs (codename "Gryf", up to 10 sets) to be used by Land Forces and the Navy, and operational long-range UAVs (codename "Zefir", up to 4 sets) operated by the Air Force.

All UAVs will be capable to carry out battlefield reconnaissance and surveillance operations, while larger UAVs acquired under "Gryf" and "Zefir" programmes will also be able to carry weapons.

Moreover, Poland will be one of 15 NATO member states to take part in the Alliance Ground Surveillance AGS project. It will include 5 strategic unmanned (UAV) surveillance aircraft Northrop Grumman RQ-4 Global Hawk flying at 20,000 m altitude and providing broad overview and systematic surveillance (SAR) capabilities. The data collected will be transmitted in real time to the

main database in Italy (Sigonella), where the Main Operating Base will be located, and the national reconnaissance, command and command systems. The system will be made available to the Alliance in 2018 timeframe.

The NATO Airborne Early Warning & Control Force (NAEW&CF) is also fully operational. It consists of 16 Boeing E-3 Sentry aircraft (one aircraft has crashed, another one was recalled for excessive wear and tear) designed for surveillance, command, control, and communications tasks.



E-3 Sentry airborne early warning and control (AEW&C) aircraft escorted by F-16C multirole fighters.

E-3 Sentry is carrying its radar in a rotating dome mounted at the top of the tail. The NATO Airborne Early Warning & Control Force involves multinational aircrews from 16 out of NATO member states, including Poland. It operates from the NATO Air Base Geilenkirchen, Germany, with Forward Operating Locations in Norway, Turkey and Italy. E-3 Sentry aircraft regularly visit Poland to take part in air defence training missions and are stationed at the air operations base in Poznań.

E-3 Sentry's radar has a range of up to 400 km for low-flying targets at its operating altitude. It also has a range of approximately 650 km for aircraft flying at medium to high altitudes. It takes only 3 E-3 Sentry aircraft to monitor airspace over the entirety of Central Europe. They cooperate within a network and can direct fighter-interceptor aircraft to their target. Their function is to control combat operations and deliver position and tracking information on the enemy to other command centres, aircraft and ships by means of data transmission systems.

The NATO Airborne Early Warning & Control Force operates since early 1980s, therefore NATO plans to operate E-3 Sentry aircraft only until early 2030s (they are upgraded and retrofitted on an ongoing basis – the last modernisation is scheduled to be completed in 2018). After that, E-3 Sentry aircraft can be replaced by new generation airborne early warning and control aircraft, or a combination of manned and unmanned airborne vehicles. In another scenario, only unmanned airborne vehicles will remain in use, as is the case with the Alliance Ground Surveillance (AGS) system. AGS was originally considered to include Airbus Defence & Space A321 AGS (AGS 321) aircraft, then a combination of AGS 321 aircraft and RQ-4 Global Hawk unmanned surveillance aircraft, and finally it was decided that AGS will only consist of RQ-4 Global Hawk aircraft.

Another problem is to create unmanned combat aerial vehicles (UCAV, second-generation UAVs) using stealth technologies that are capable to operate in conditions of intensive air defences. This category will include mainly reconnaissance and strike systems capable of being jointly operated from manned airborne platforms (semi-autonomous operation) independently, including in a flock of UAVs exchanging information about the battlefield and the targets of attack.



RQ-4 Global Hawk unmanned (UAV) surveillance aircraft.

No unmanned fighter aircraft are currently developed and traditional jet fighters will remain in use (there is a tendency to increase the share of two-seat fighters in the military air forces). On the other hand, some advanced unmanned airborne vehicles are specifically designed for electronic warfare, operations targeted against ground air defence systems, and air-to-air refuelling, including for the refuelling of aircraft flying over the enemy's territory.

Lockheed Martin RQ-170 Sentinel is the first stealth unmanned aerial vehicle (UAV) operated by the United States Air Force. It has been operated since 2007 and has been reported to have operated in Afghanistan during the peace-keeping mission (it was observed operating from an American air base in Kandahar). This year, another American stealth unmanned aerial vehicle (UAV) surveillance aircraft, Northrop Grumman RQ-180, is scheduled to be put into service. Northrop Grumman RQ-180 is larger, it has a longer range and more advanced weapons (it is said also to include microwave weapons).

Stealth reconnaissance and strike drones are developed in the United States (Northrop Grumman X-47B), Europe (nEUROn programme in cooperation between France, the UK and a few other countries), the Russian Federation, and the People's Republic of China. The American X-47B unmanned combat air vehicle (UCAV) is scheduled to be put into service in early 2020s. The contract for the development of the X-47B was awarded by the United States Navy; the vehicle can take off from and land on aircraft carriers. Demonstrator aircraft was first flown in 2011.

However, X-47B is not expected to be made available to the allied forces any time soon, not earlier than in the next decade, under special conditions (after gaining sufficient experience, following technical modifications and completion of F-35 Lightning II fighters delivery, and as soon as adequate infrastructure has been created). When X-47B is put into operation, nEUROn air tests will only begin to gain momentum.

## Chapter III

# What are the development options of air defence capabilities of the Polish Armed Forces?

### 1. Modernisation of Poland's anti-missile air defence system

Polish air defence capabilities should be essentially analysed in consideration of the extent to which Poland is prepared to fight off an air and land attack. To be appropriately prepared, Poland would have to continuously develop its air defence capabilities to protect its entire territory – not only along the planned defence lines, but also deep within national territory.

In military terms, air defence is defined as means devoted to protect various types of targets against airborne threats<sup>65</sup>, and all interdependencies between air defence measures used during military operations against air assault assets. Air defence intrinsically embraces aircraft, missiles of various ranges, as well as reconnaissance and command assets belonging to different types of armed forces.

The possible risk scenarios cover a wide spectrum of security threats. This is due to the fact that the potential adversary may have a wide range of air assault assets, including:

- » manned aircraft (MA), including aircraft and fighters of air, land, maritime and other special forces;
- » Unmanned Aerial Vehicles, UAV;
- » Cruise Missiles, CMs;
- » Tactical Ballistic Missiles, TBMs.

The spectrum of air threats can be extended even further to include the following assets:

- » Rockets, Artillery, Mortars, RAM;
- » Precision Guided Munitions, PGM;
- » Lighter than Air Sensor Platforms<sup>66</sup>.

Based on the likely scenarios for the development of air assault assets, it may be concluded that air threats will apply to all actors of military operations, including support personnel and civilians, or infrastructure and facilities deep within the territory of the attacked state.

In the scenario discussed below, the assumption is that until 2022, the number of possible targets to be

protected against air attack will progressively increase with the economic and military development of Poland. The possible targets will include military assets (military bases, radar posts, airports), but above all government facilities and public venues, as well as industrial, power engineering and transport infrastructure. If many of these targets are destroyed in the initial phase of an air strike, the enemy has the chance to gain superiority and the attack is likely to succeed. Due to this extensive diversification of air threats, qualitative changes in air defence must be introduced on an ongoing basis. This particularly applies to the core functional subsystems: command, air surveillance, and assault assets. In order to be able to join a collective defence effort conducted alongside NATO member states involving air defence assets, Poland has to adapt its air defence system to the functional requirements of NATO Air and Missile Defence System, NATINAMDS.

In this scenario, the external circumstances continue to be favourable, i.e. Poland is still a member of EU and NATO. Another optimistic assumption is that the political elite – in cooperation with the military circles – are ready to pursue the concept of modern armed forces, including effective air defence. The key idea adopted in this scenario is the use of knowledge to the benefit of civilians and the military by collecting intelligence from a variety of different sources – widely disseminated among all relevant stakeholders, wisely protected and effectively used to enhance the innovativeness of the defence sector and more generally to improve the competitiveness of the Polish economy. Comprehensive reforms are needed in order to turn this vision of Poland and the Polish armed forces into reality. A single, coherent and long-term vision of the future can become a foundation to formulate the mission, the strategy, plans and programmes of investments to develop specific defence capabilities.

<sup>65</sup> *Zagrożenie powietrzne to możliwość ataku przy użyciu statku (obiektu) powietrznego na obiekty wojskowe lub obiekty cywilne istotne dla funkcjonowania państwa. Bezpieczne niebo (conference materials)*, eds. J. Gotowała, AON, Warsaw, 2002, p. 53.

<sup>66</sup> *Interim conceptual Ideas, NATO Ground Based Air Defense Operations (2020), Version 0.4*, Brussels, April 2011.

In doing so, account should be taken of the fact that this vision will embrace different goals and objectives. In other words, it is one of many concepts of the future to reflect the directions in which Poland's air defence may be developed by 2020. Therefore, the discussed scenario specifies no concrete figures in terms of the number of air defence troops or assets. It does not clarify this issue because of the distant time horizon, but instead it is focused on the problems of how specific capabilities should be obtained for use in the Polish air defence system, and in consequence, how to reasonably determine and plan the structures of air defence force, its volume, assets and other resources necessary to support and safeguard air defence operations.

When identifying specific capabilities, it is essential to ensure that they are acquired *in toto* as specified by the requirements spelled in national threat assessment and national security requirements, otherwise the final outcome will be far from expected. As regards air defence capabilities and their development by 2020, this will only be possible if the strategic modernisation process is consistently implemented. Well-devised plans and programmes have an important role to play in the air defence development strategy as guidelines for research and development efforts in the Polish defence industry. This is an important aspect from the point of view of Polish businesses operating in the defence sector. If the air defence development plans are announced within reasonable time, they will be better placed to play an active role in the process of air defence modernisation.

A wise social dialogue and social consultations, improved performance of military structures, and effective implementation of the 'secure state' concept by promoting armed forces as a guarantor of the national security are important conditions to achieve a satisfactory pace of air defence modernisation. New equipment and weaponry for the air defence forces could preferably be acquired under dormant contracts<sup>67</sup> with commercial companies. Another solution would be to acquire the required (necessary) capabilities from an allied state or a partner state.

Another step is to determine which capabilities are to be acquired independently, or procured through the pooling strategy<sup>68</sup>. Finally, consideration should be given to the

capabilities that may become Poland's a "national specialty" and "export goods" to be offered to other allies or partner states.

Development plans for the Polish air defence system should be convergent with the concept of NATO's integrated anti-aircraft and anti-missile warfare or counter-air defence concept that specifies in detail the Alliance air defence capabilities and organisation<sup>69</sup>. Therefore, the development of national air defence capabilities should go hand in hand with the implementation of NATO's air defence concept – in consideration of the financial capabilities and the national interest of Poland – if only due to the requirements of collective defence.

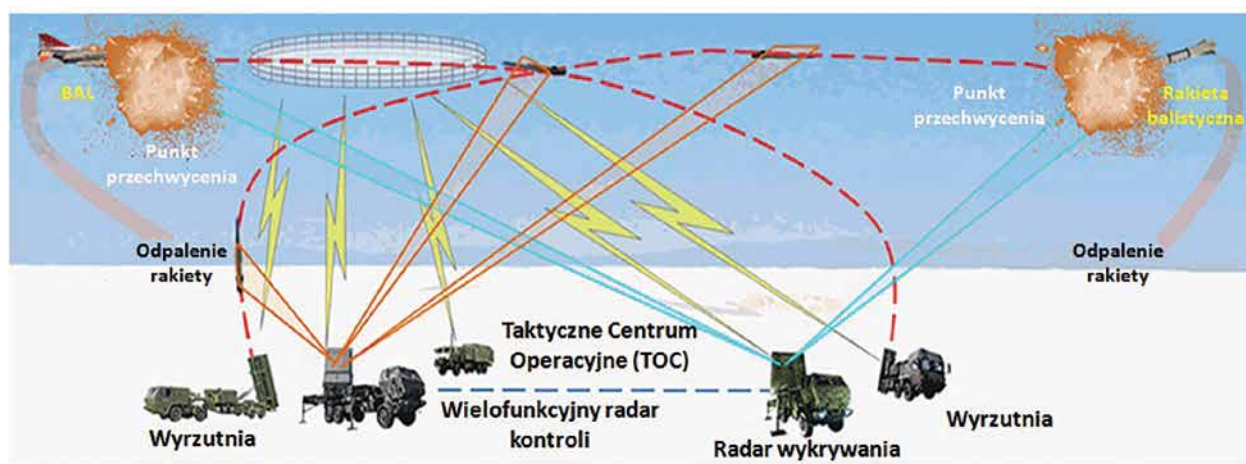
In this context, a rational approach would be to progressively extend the capabilities of the air defence system to combat an increasingly wider scope of airborne threats. This can be achieved by spending less, yet wiser and more regularly. As a result of skilfully orchestrated actions, Polish air defence system can achieve the desired technical advancement levels. However, one must distinguish capabilities that can be achieved at the national level, and those that require international cooperation within NATO. NATO's integrated counter-air defence concept is not intended to be a replacement for national air defence systems of NATO members; instead, it is designed to integrate them. The role of Alliance's air defence command is to integrate the capabilities of national air defence systems in peacetime, in crisis and in war, according to the agreed interests of the allied countries.

<sup>67</sup> Dormant contracts are open long-term agreements executed upon demand, under which payment is made for the provided services. The client covers the costs of the contractor's being ready to provide the service at any time, as requested.

<sup>68</sup> *Pooling* is a term for consolidation of resources (assets, equipment, efforts, etc.) to leverage benefits and / or reduce risks for users.

<sup>69</sup> The core assumptions of NATO's integrated counter-air defence concept are that the anti-aircraft and anti-missile defence should be based on three main pillars: active defence, passive defence, and conventional counterforce against air and space attacks in regions of dislocation (before the start or launch, or in the initial flight phase). These pillars are controlled and coordinated through air defence management, command and detection assets. It should be emphasised that – in the final implementation stages of NATO's defence concept – a uniform air defence and air force command system will be established to operate during any mission and in any region where NATO operations will take place.





New generation anti-aircraft missiles for concurrent combating of a range of air targets Source: own analysis.

In order to enhance Poland's air defence capabilities, it will be necessary to achieve a sustainable (in qualitative and quantitative terms) capacity to use active combat, surveillance and command assets in order to ensure highly effective counterforce against airborne threats and to maintain the full operability of the national air defence system. As regard the air defence including anti-aircraft and anti-missile weaponry, Poland should develop its capability to fight off various types of air assault assets on medium distances, under the coverage of direction-based or zone-focused air defence operations. This is especially important during defence operations within its own territory; in this case, the key priority would be to survive the first air attack and use NATO support measures. In Poland's defence doctrine, surviving the initial air attack (which is typically sudden and massive) and maintaining full operability of the armed forces and the capability to carry out retaliatory actions are the fundamental challenges for the air defence system. It would be appropriate to create strong air defence around specific zones or facilities covering critical infrastructure, main military facilities, and groupings of military forces. This process has to be implemented progressively, in coordination with the acquisition timetable of medium-range and short-range missile systems that will initially be combined with the older missile systems: S-125SC, KUB and OSA.

Ultimately the new medium-range and short-range missile systems would constitute the core of the assault subsystem, but only after 2020. Following successful completion of the entire acquisition cycle, around six combat modules would be available after 2020, based on medium-range missile batteries. These modules would cover the most important facilities – groupings of

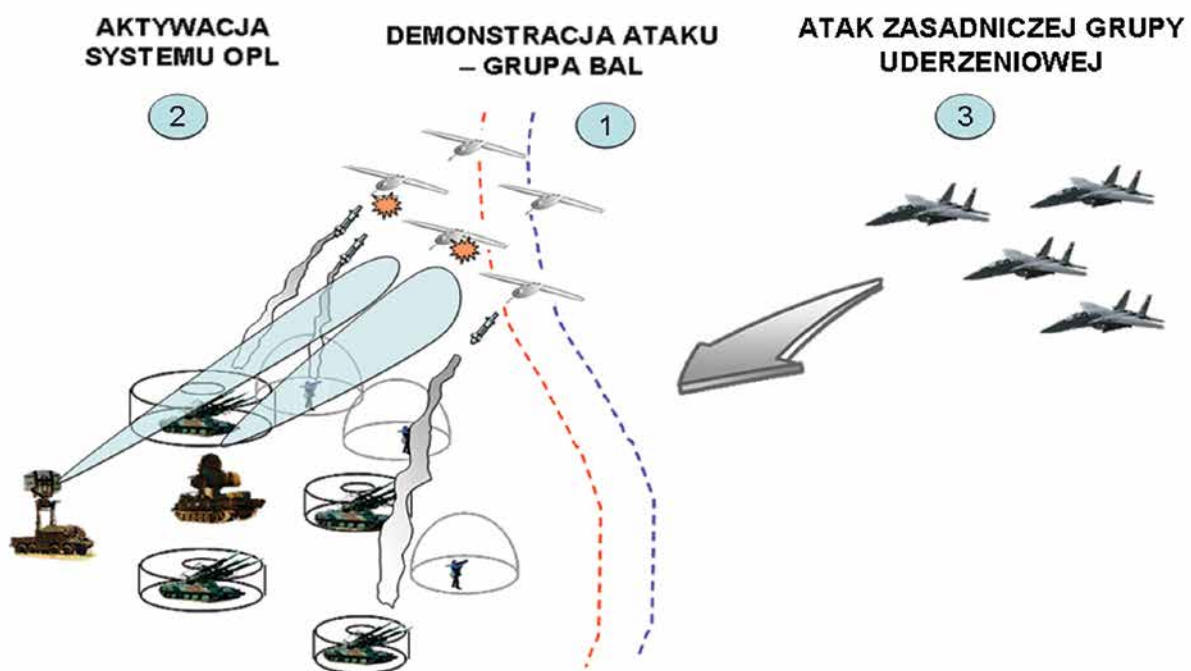
operational forces, command posts, logistic facilities, administration and economic centres – against a broad spectrum of air assault assets, including tactical ballistic missiles.

Over the next years, combat modules should be strengthened by short-range missiles. The basic task of short-range missile systems would be to cover troops and facilities (and airbases) on the area where military operations are taking place, and to support middle-range missiles at low altitudes. A short-range missile system will be ready to operate during the day and at night, at national, alliance and coalition levels. It will target air assault assets, cruise missiles and UAVs flying at low altitudes.

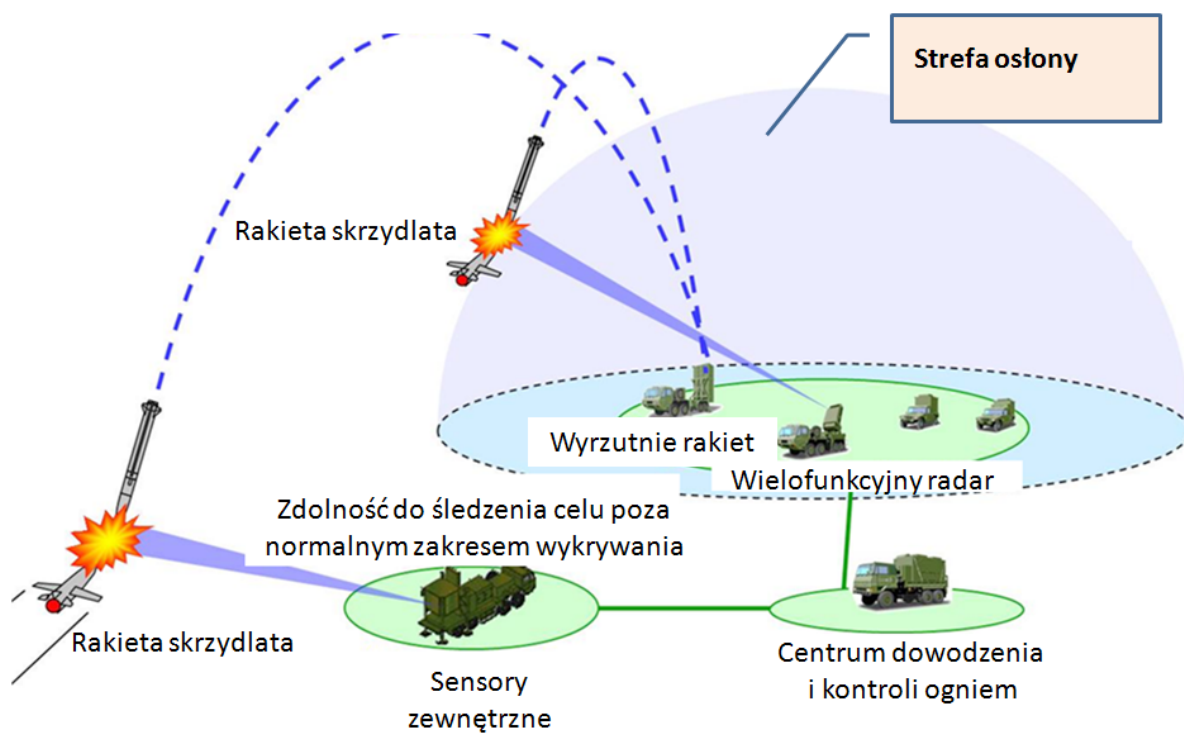
New generation anti-aircraft missiles will meet NATO's interoperability and network-centric criteria. They will also serve as mobile and autonomous platforms that are able to survive and are resistant to radio frequency and electronic interference. New missile systems are required to have excellent firepower capabilities and must be able to attack several targets at a time, including cruise missiles. They should be also able to attack groups of targets (manned and unmanned) operating at low and very low altitudes.

Another important feature is the ability to operate out of line-of-sight (LOS). The idea is that a missile battery that is unable to detect target with its own sensors can use necessary aiming and targeting data obtained by another subdivision nearby (third-party targeting).





The concept of fighting off group attacks by manned and unmanned air assault assets Source: own analysis.



The concept of fighting off cruise missiles by short-range missile systems based on external sensors. Source: own analysis.

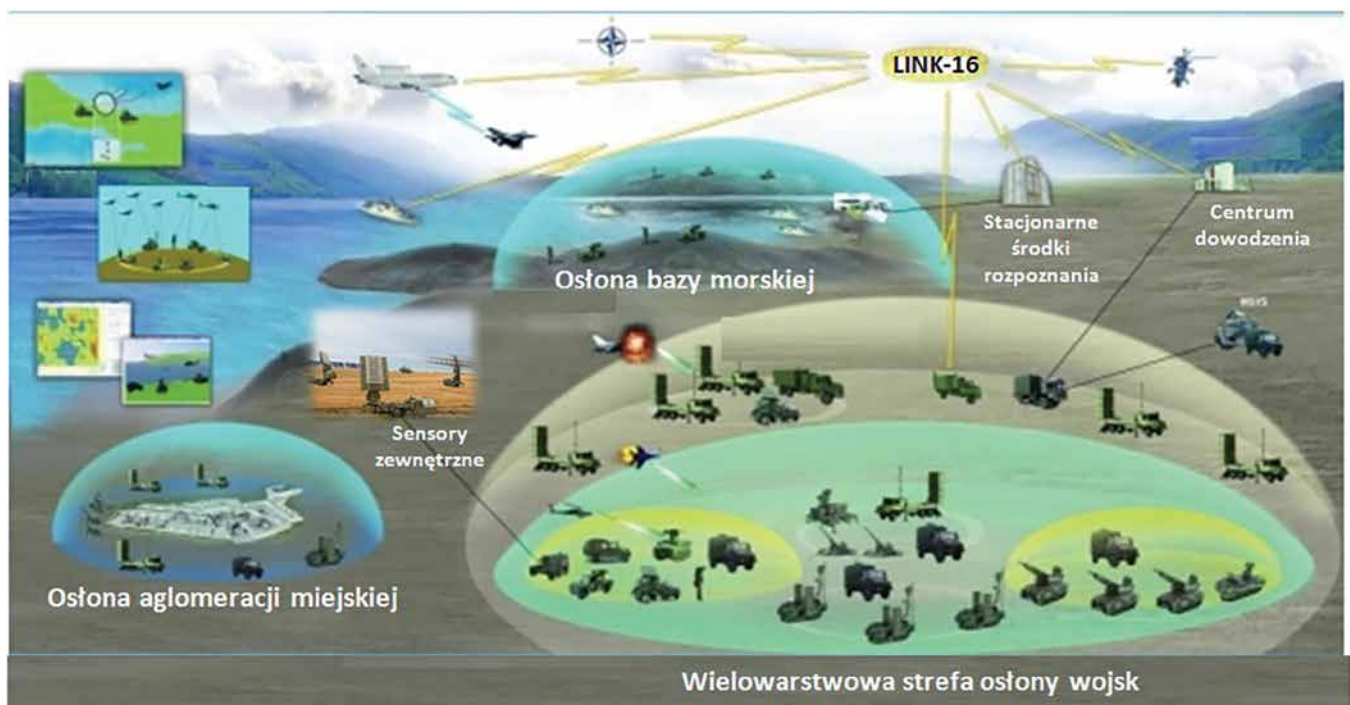
Very short range air defence (VSHORAD) systems may become an important element of the air defence system. VSHORAD is designed as a stand-alone system (an independent missile battery) to cover a single target or an area, for instance, an airbase or logistical support base, a command post, or a subdivision of troops. In standard configuration, very short range air defence battery can be made of 35 mm anti-aircraft artillery or artillery-missile guns, a mobile command post, a mobile 3D radar station, and wireless / radio communication means to secure communication between the weaponry components and the air defence command. Other modules can be added to integrate the combat module into a multilayer air defence system.

MANPADS (*Man-Portable Air Defence Systems*) are another important addition to the assault assets used in direct coverage of individual facilities. Here, the assumption is that MANPADS will be delivered by the Polish defence industry and will become a part of the integrated air defence system.

Another crucial aspect to be taken into consideration while introducing new missile systems is their ability to operate collectively and comprehensively while being assigned to various organisational units equipped with different weaponry systems (to create united mixed

groupings of medium-range and short-range systems) in order to improve the coverage, to deliver improved resistance to electronic interference, and to strengthen the performance of combat groupings. In conditions like these, information exchange compatibility and multifunctionality need to be secured at national and international levels. After 2020, combat modules consisting of mixed structures would be the core of the strategic air defence in Poland, focused on the coverage of crucial state infrastructure.

It will be a massive challenge to achieve centralised command of missile modules scattered all over the country. However, this is the precondition for effective deterrence of air strikes or coordinated attacks of aircraft and missiles directed at targets located at a great distance from one another. In order to effectively respond to an air attack, all components of the air defence system need to be integrated in the fight against air assets of the enemy. Otherwise the system will fail.



The concept of air defence arrangement after 2020 Source: own analysis.

One may speculate that the coverage of specific areas or facilities will be based on modern missile systems as part of an integrated NATO counter-air defence extending over Europe. Therefore combat modules made of state-of-the-art short-range and medium-range anti-aircraft missiles in Poland should comply with all obligatory NATO standards to allow Poland to join with the NATO Integrated Air and Missile Defence System (NATINAMDS)<sup>70</sup>. Also, by incorporating new sensors and command assets into the Polish air defence system, Poland will take part in the development of the Active Layered Theatre Ballistic Missile Defence (ALTBMD). This is important from the point of view of organising a joint command and communications system based on NATO Missile Defence (NATO MD) to expand the system to cover the protection of civilians, territory, and troops in Europe. Some of the costs will be shared according to the standard cost-sharing principles within the framework of NSIP (NATO Security Investment Programme).

## 2. Development of Poland's anti-aircraft and anti-missile defence system after 2020

The vision of Polish air defence after 2040 can be hardly called a harmonious composition of mutually complementing elements. Trends in the development of air defence systems in the 21st century are full of discrepancies and conflicting tendencies and processes. One may only attempt to synthesize all elements into a general vision of air defence development directions viewed in the framework of technical advancements in reconnaissance, combat and command systems.

By relying on the evaluation of political and economic developments in the short and long term, it can be concluded that the major threats will include terrorism, proliferation of weapons of mass destruction, regional conflicts, collapse of states, and organised crime<sup>71</sup>. As a result, Poland will have to increase its contribution to the pan-European security system to reinforce its position as a reliable partner and a member of NATO and the EU. The need to have more capabilities to address security threats will require more flexible and mobile armed

forces able to effectively carry out their tasks and react according to the situation<sup>72</sup>. By improving various aspects of air defence capabilities, however, we should mainly be thinking of how to protect the national territory.

The vision of the air defence system embraces the latest developments in science and technology. According to the assumptions we have made, the future air defence system should be able to destroy all types of airborne assault assets of the enemy at any time and in any section of the airspace it covers. To achieve this goal, the air defence system should be properly arranged in terms of both air defence resources and organisational structure.

In order to enhance the capability of the future air defence system, its prospective development should be closely correlated with the latest achievements of the technical evolution of this class of weapon system. With the technical progress, new defence systems that may now seem purely futuristic will be progressively introduced into service. New equipment and weaponry will be added to the present air defence assets, offering unimaginable capabilities to detect and destroy airborne targets. Technologically advanced air defence systems will be using laser weapons (directed-energy weapons) with which the capabilities to fight off cruise targets and low-altitude targets will be greatly improved<sup>73</sup>. For example, it can be expected that, in the coming years, HELLADS (High Energy Liquid Laser Area Defence System) will be put into service.

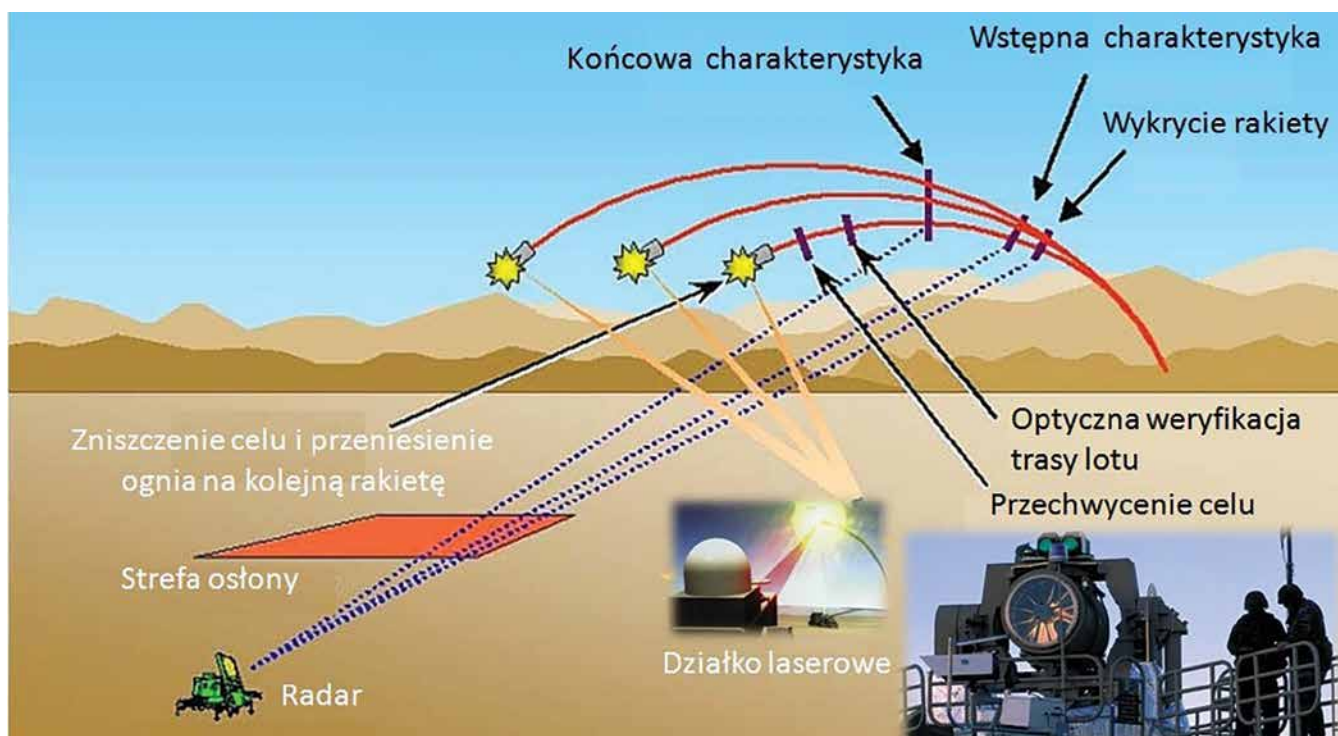
<sup>70</sup> The main features of NATINAMDS are as follows: collective armed forces planning, stationing of troops outside the native territory where necessary and on reciprocal basis, uniform mode of operation in emergency and support operations, consultation procedures, common standards for the weaponry, military exercises, and logistics.

<sup>71</sup> W. Czarnecki, S. Chmur, *Przyszłość sił zbrojnych RP – miejsce Polski w Euroatlantyckich strukturach bezpieczeństwa*, "Polska wizja przyszłego pola walki. Wymagania i potrzeby" conference, Warsaw 2004, p. 1.

<sup>72</sup> The transformation of the armed forces is a process of continuous adaptation to the ongoing changes in the security environment. The essence of this process is to search for and introduce changes in the operation of the armed forces operate and in the surrounding environment. It includes not only the organisation and operation of the armed forces, but also technical modernisation, trainings, funding, and relations with the civil society. M. Ojrzanowski, *Kierunki rozwoju sił zbrojnych – podejście polskie [w:] Profesjonalizacja Sił Zbrojnych Rzeczypospolitej Polskiej*, "Zeszyty Naukowe AON", Special Issue 2 (71) A, Warsaw 2008, p. 41–42.

<sup>73</sup> *Defense Science Board Task Force on High Energy Laser Weapon Systems Applications*, Office of the Under Secretary of Defense for Acquisition Technology and Logistic, Washington D.C. 2001, p. 41–90.





The concept of anti-missile defence by laser area defence system. Source: own analysis.

MTHL (Mobile Tactical High Energy Laser) and stationary systems on warships will be introduced as well in order to further enhance self-defence capabilities against an attack with cruise missiles.

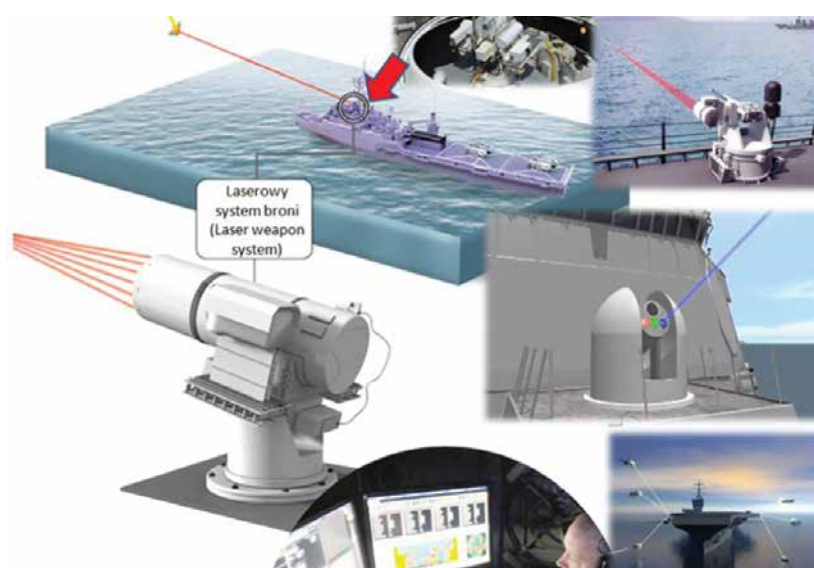
This type of systems is likely to be introduced to the air defence forces by 2040, both in the armed forces and in the defence of civilian facilities most exposed to the risk of air attack. Some of the innovative R&D programmes that have been suspended (mainly for financial reasons)

can be expected to continue in the future. These can be either air defence systems based on electromagnetic radiation<sup>74</sup> (dating back to 1980s<sup>75</sup>, studies on electromagnetic weapons were initiated in mid 1980s in the Soviet Union)<sup>76</sup>.

<sup>74</sup> T.E. Bearden, *Tesla's electromagnetics and its Soviet Weaponization*, *Proceeding, IDEE, Tesla Centennial Symposium 1984*, T.E. Beardem, *Fer de Lance*, *Briefing on Soviet Scalar Electromagnetic Weapons*, 2002.

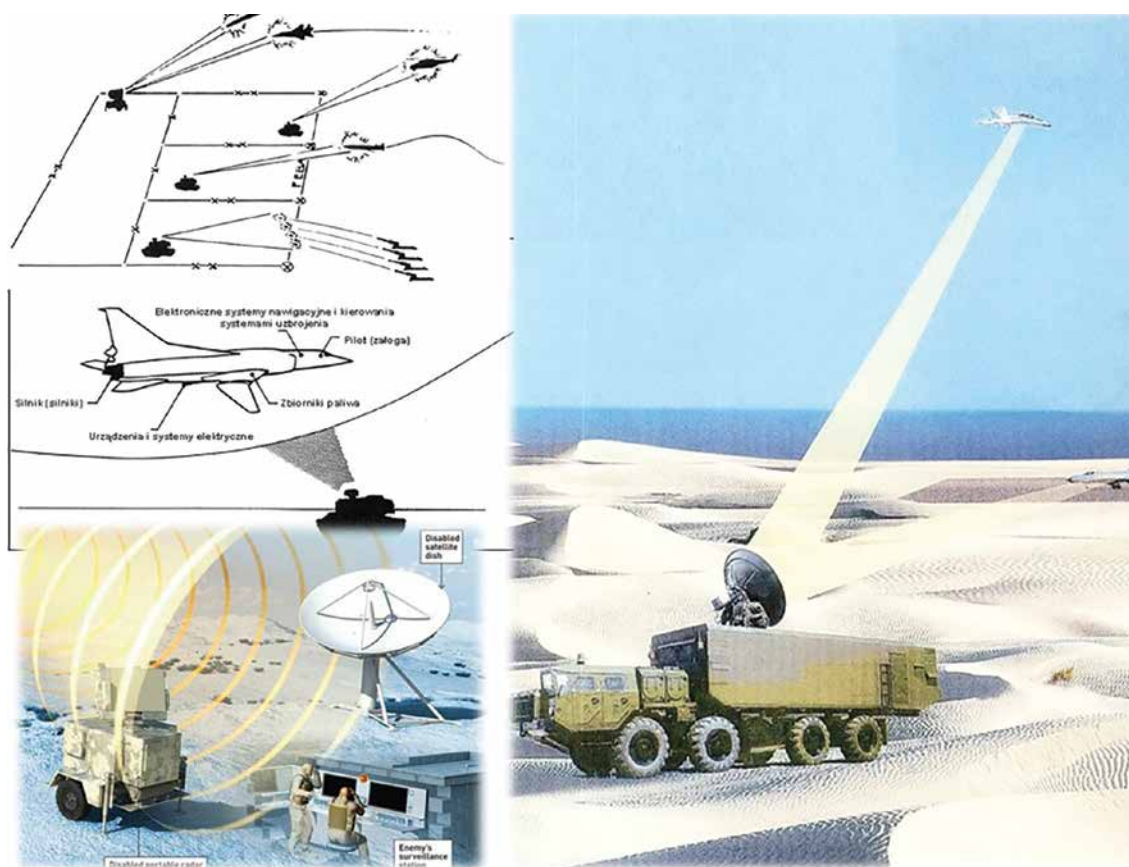
<sup>75</sup> Zob. T.A. Heppenheimer, *Electromagnetical Guns*, „Popular Science Bugging”, August 1987, p. 54–58.

<sup>76</sup> T.E. Beardem, *Fer de Lance...*, p. 271.



The concept of anti-aircraft laser systems on warships. Source: own analysis.

<http://www.businessinsider.com/heres-how-the-us-navys-new-laser-system-burns-up-its-targets-2015-1>.



The idea of using electromagnetic radiation in weaponry against airborne targets in air defence systems in the future. Source: own analysis.

A directed-energy anti-aircraft gun emits highly focused electromagnetic energy to intercept not only tactical ballistic missiles and aircraft, but also supersonic aircraft and cruise missiles<sup>77</sup>. A powerful electromagnetic pulse can destroy electrical and electronic equipment used for navigation and for guiding weapons<sup>78</sup>. It can also incapacitate the aircraft crew (by affecting the human nervous system). Other types of directed energy weapons will most probably cease to be a technical novelty by that time and will open the door for quantitative changes in the future air defence system.

The development of air defence will be extremely difficult and complicated. Undoubtedly, it will also be influenced by the complicated nature of combat in airspace and outer space. Account will need to be taken of the high qualitative requirements for technical equipment, weapons, and servicing. All these elements will create intricate interdependencies. Under these conditions, the question of detecting and identifying air targets as well as data transmission and sharing airspace monitoring information will be of particular importance. This will have a decisive impact on the

quality of command over combat assets that need to be combined in a way that makes them fully controllable, yet with the engagement of the fewest troops possible. The future strength of the air defence system will be directly linked with its complexity. This can be achieved by implementing an air defence system termed "3M".

<sup>77</sup> Refer to R.J. Kaye, *Operational Requirements and Issues for Coilgun Electromagnetic Launchers*, IEEE Transactions on Magnetics, vol. 41, no.1, January 2005, p. 194–199.

<sup>78</sup> Refer to T. E. Beardem, *Scalar wars. The Brave New World of Scalar Electromagnetics*. Fer de Lance, 2002.





concept of the future air defence system Source: own analysis. [http://en.citizendium.org/wiki/Terminal\\_High\\_Altitude\\_Area\\_Defense\\_%28missile%29](http://en.citizendium.org/wiki/Terminal_High_Altitude_Area_Defense_%28missile%29).

According to this vision of air defence development, we will definitely witness major changes in anti-aircraft and anti-missile defence assets. The technical progress in this area will reach the level that will enable detection and destruction of any airborne target. When military robots are introduced to the air defence systems<sup>79</sup>, we may witness the first ever military engagements between military robots (airborne and land-based) in airspace supervised by human<sup>80</sup>. The development of the air defence system will be accompanied by introduction of artificial intelligence to the air defence equipment and weapons. Increasingly advanced, precise, effective data identification, collection, processing and transmission systems will be put into service to streamline the command operations.

The intelligence level of the air defence system will depend on the performance of the underlying subsystems. Note that this is not an exhaustive list of the determinants of the future development of the air defence system by 2040. One cannot win air superiority without profound and reliable knowledge about the battlefield and the surrounding area. Superiority in the cyberspace will belong to the one who is faster and better prepared to organise or administer

the processes of collecting and processing of information about the operations of the armed forces of both sides of the conflict, and the data about environment, land and weather. In other words, the one who is able to better process information into a general overview of the situation and protect it against unauthorised access will be more likely to prevail<sup>81</sup>. This is the main development direction to obtain organisational supremacy since, in the future, cyberspace will become the place where the future of military operations is likely to be decided. It is undeniable that the process of organising cyberspace for air defence purposes will be intensified in the future, supported by the new developments in information technology<sup>82</sup>.

<sup>79</sup> Refer to H. Moravec, *Robot: Mere Machine to Transcendent Mind*, Oxford University Press, New York 1999, p.1.

<sup>80</sup> Refer to P. W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, Penguin Press HC, New York 2009; P.W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, „Strategic Insights”, Winter 2009, Vol. 8 (5), p. 129-131.

<sup>81</sup> T. Węsierski, *Strategiczna reorientacja sił zbrojnych*, part I. *Analiza sytuacji strategicznej sił zbrojnych*, „Przegląd Sił Powietrznych” 2005, Vol. 1, p. 15-16.

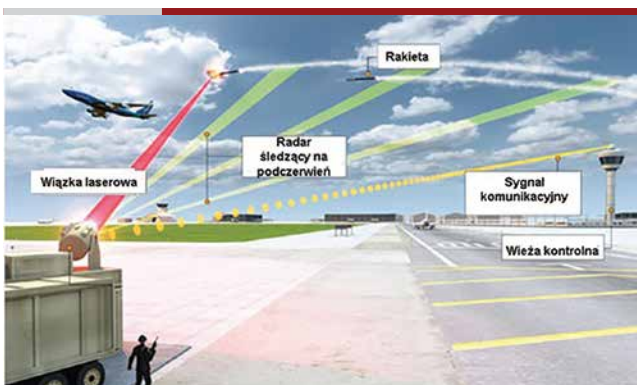
<sup>82</sup> *Ibid.*, p. 16.

In view of the fact that cyberspace is the most best environment to collect, process and deliver information, and airspace is where military resources can be relocated the fastest, these two places are most likely to be at the focus of military operations. As a result, various subsystems will be combined under a single integrated air and space defence system. Modular missile systems will operate on a plug-and-play basis. Missile systems of this kind will provide the backbone of the air defence forces in the future.



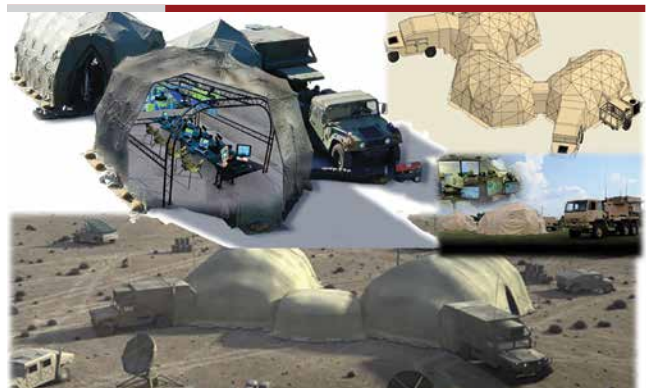
Examples of modular and fully automated anti-aircraft missile systems  
Source: own analysis.

Modern anti-aircraft missile systems will operate as pluggable modules connected to integrated fire control sectors in charge of the assigned sections of the airspace<sup>83</sup>. *Civilian infrastructure (airports, stadiums) most likely exposed to acts of air terrorism will be covered by dedicated air defence systems, such as LADS (Laser Area Defence System)<sup>84</sup>. LADS will be able to fire several missiles aimed at various targets within just a few seconds. This system will be placed in 2-3 mobile cabinets located across airports, close to runways. It will emit a powerful laser beam targeted at a missile approaching a passenger aircraft before it reaches its target<sup>85</sup>.*



Laser air defence systems to provide coverage over a civil airport.  
Source: own analysis. <http://www.popsoci.com/scitech/article/2006-12/missile-proofing-runways>.

All air defence system components are likely to be remote controlled from regional military command and control centres connected wirelessly to mobile tactical command posts.



Mobile air-defence command post at anti-aircraft subdivision level  
Source: own analysis.

Surveillance and reconnaissance operations will be based on sensors and radars offering large coverage area. They will be supported by active and passive detection and surveillance infrared sensors and passive radars detecting airborne targets based on the location of electronic energy emissions. Missiles used in a network-centric environment will be able to update and correct the parameters of an airborne target on an ongoing basis. By means of data transmission lines and terminals, missiles will be ready to react to the manoeuvres of the airborne target. By combining components of the air defence system, several missiles launched from a number of different anti-missile systems located at various directions will be able to intercept a single target. This will increase the likelihood of successfully intercepting the target and will streamline combat operations in conditions of massive air strike. A tendency also emerged to develop vertical launching systems.

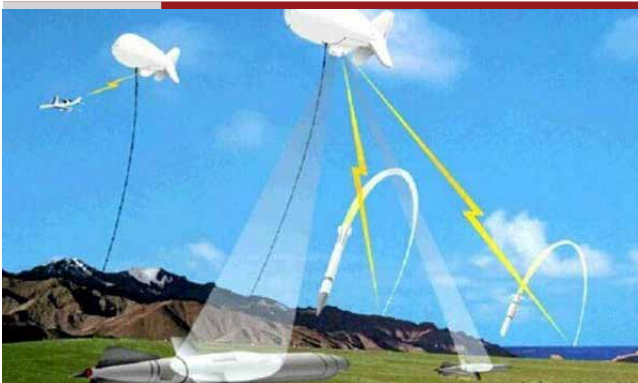
<sup>83</sup> R. Czaczkowski, *Początek przeobrażeń w siłach lądowych Stanów Zjednoczonych – siły obrony powietrznej i przeciwrakietowej w XXI wieku*, „Przegląd Sił Powietrznych” 2006, nr 3, p. 10.

<sup>84</sup> The production costs of a system of this kind are estimated at around US\$ 150 million, although large-scale production will probably be around USD 30 million cheaper. S. Waidenberg, *Second Life for Laser Defense?* „Danger Room”, August 7, 2007.

<sup>85</sup> Refer to J. McHale, *Northrop Grumman proposes high-energy ground laser to defend commercial aircraft*, Military & Aerospace Electronic, September 2006.

Typical missile systems will be able to fire several missiles in short time intervals, aimed at airborne targets located within various airspace sectors. Anti-aircraft systems will be using very advanced missiles. The ability to use air and space reconnaissance data in real time will be of major importance. This will be achieved by combining intelligent surveillance, combat and command systems into a modern communications network highly resistant to electronic war assets that can paralyse the entire air defence system.

To obtain this level of capability, the detection range of air defence systems will have to be extended. To be future-proof, components of the reconnaissance subsystem should be capable of detecting targets of small and very small radar reflection surface flying at low altitudes using the natural landscape. Aerostat radar systems used for surveillance and reconnaissance operations are another important technology<sup>86</sup>. They will be able to detect aircraft and airborne vehicles over long distances<sup>87</sup>.



The concept of anti cruise missile defence based on an aerostat radar system  
Source: <http://www.defenseindustrydaily.com/jlens-coordinating-cruise-missile-defense-and-more-02921>.

Surveillance and reconnaissance support by the satellite systems belonging to the allied states will be also important. Satellite systems monitor ballistic missile launchers on a continuous basis, and when ballistic missiles are launched, they can send information to the command centre and the missile systems.

Individual subsystems of the reconnaissance assets will be also required to operate undetected as long as possible. Passive surveillance based on thermo-vision sensors will become the main type of surveillance measures. Radar surveillance would be either used over large distances or as a supportive measure when the

operation of passive video and night vision equipment is limited under specific circumstances. Another solution to eliminate these restrictions is the technology of selective scanning of airspace sectors (pencil beam scanning)<sup>88</sup>. *The radar data can be translated into a "flickering" radioelectronic camouflage. Airborne targets, including artillery assets, can only be effectively combated using extremely sensitive sensors that detect, identify and trace targets of very low surface reflectivity between several thousandths and several hundredths of a meter.*



Holographic war game room to train air defence experts.  
Source: <http://www.afit.af.mil/Schools/PA/gall3.htm>, courtesy of Gene Lehman, AFIT/LSEC.

Military staff will be the decisive factor. Well-trained experts – creative and ready to work under extreme and evolving conditions in peacetime and in war – will be the key to the success of any air defence mission or operations. Air defence staff will be trained at specialised training centres using the latest technical solutions.

<sup>86</sup> JLENS (Joint Land-Attack Cruise Missile Defense Elevated Netted Sensor System) is a prototype of an aerial detection system of this kind. It can detect small-size targets flying at the altitudes of 0 - 4500 m above sea level within the distance of 320 km. A radar is carried to the altitude of around 5000 m provides significantly greater operational range than ground-based systems and the ground reflections are no longer present.

<sup>87</sup> K. Dobija, *Obrona przeciwlotnicza w działaniach wojennych i innych niż wojenne*, „Przegląd Wojsk Lądowych” 2010, Vol. 8, p. 10.

<sup>88</sup> A radar that scans airspace with a pencil beam has small side lobes and low pulse power. It can select low-flying targets against the background of reduced surface-reflected signals. This parameter is translated into better radar camouflage and protects it against destruction by anti-radar missiles.



The stability of air defence system development will crucially depend on intensifying research and development works over latest generation equipment designed to combat air and space assault assets.

It can be expected that in the future, countries like Poland will not be able to provide enough funding to cover the costs of major military programmes. Specifically, they will not be able to endlessly continue buying military technologies from international defence conglomerates. There is no doubt that extensive funding has to be allocated to research and development of new technologies to produce modern air defence systems. The component of R&D costs can be expected to increase (together with other costs of upgrading the existing and newly developed technologies), resulting in the increase of unit costs of systems and limited number of potential customers (high costs of air defence systems, political factors). Therefore Poland should skilfully rationalise and coordinate air defence modernisation projects. If the situation continues to evolve in this direction, highly specialised enterprises would be most likely to succeed as providers of air defence systems (as contractors or subcontractors, for example under the “Wisła” project). The actions undertaken in Poland should lead to the establishment and stabilisation of a specific technical structure of air defence equipment, reflecting the contemporary standards of modern armed forces. State-of-the-art equipment would account for 5-10 percent of the overall air defence force capabilities. The rest of weaponry and technical equipment could be classified as follows: modern equipment would account for around 25-30 percent; there would be 30-40 percent of equipment following one or two modernisation cycles, and 20-40 percent of equipment after three modernisation cycles or soon to be withdrawn. State-of-the-art weaponry should be modular, multi-channel, autonomous, high-performance, interoperable and future-proof. Surveillance, command and assault features are likely to be even more integrated.

In terms of anti-aircraft missile aiming methods, more and more systems will have double systems, extended frequency bands and will become increasingly automated. Modern missile systems will be the backbone of air defence forces (countermissiles, similar

to ARROW or ERINT missiles). They will be linked to a satellite-based ballistic missile early warning system to create **the first air defence layer**. It is designed to destroy air assault assets of the enemy over long distances, in cooperation with medium-range and short-range missile systems. The second and third air defence layers will be used to leverage the effects of operations against the air assault assets of the enemy to cover the entire operational area, including direct coverage of military forces and the most important infrastructure.

The **second air defence layer** will be created by medium-range and short-range systems. New multirole missile systems introduced to the air defence forces should be able to combat various airborne targets at up to around 50 km distance (or 100 km – for military transport aircraft and electronic-warfare aircraft) and at max. 30 km altitude. Second-layer systems should operate according to the look-down/shoot-down principle. Second-layer anti-aircraft systems should also be able to destroy airborne targets that manage to get through the first air defence layer. These can be unmanned airborne vehicles, combat helicopters, or attack aircraft. The second air defence layer should also provide protection against missile strikes.

The third air defence layer should be made of SHORAD and VSHORAD (short range and very short range anti-missile and anti-artillery air defence) located within the covered facilities. They will be supported by mobile radars. The distance between the systems should ensure maximum concentration of the fire on air defence deterrence and air assault assets of the enemy.

The arrangement of firing capabilities of the air defences should create autonomous destruction zones of the enemy's air assets, delivering comparable effectiveness at various altitudes. The three layers of the air defence system should be networked by combining multiple sensors and various types of weapons. By operating in a network, multiple firing units can be coordinated on a much bigger scale while maintaining high degree of independence and continuous coverage during air attacks. This will involve both internal and external changes. The status of the air defence system will have to be modified (internal changes). External modifications will apply to the structure of the air defence system.



In the short term, internal changes should concern large organisational structures, e.g. anti-aircraft defence brigades, with smaller autonomous combat modules used for stabilisation operations. These could be mainly used outside national territory, in cooperation with the allied or coalition forces. Their capabilities, however, would be quite different from the capabilities of air defence used for the protection of the national territory. They would involve the capability to redeploy the allocated air defence assets into the target region and to effectively eliminate other categories of targets: unmanned airborne vehicles, mortar attacks, or surface-to-surface missiles. They would be armed with C-RAM systems to provide better protection of military and civilian facilities against missile and mortar attack, as well as artillery attacks in the future.



Mobile and stationary C-RAM systems Source: own analysis. <http://www.msl.army.mil/Pages/C-RAM/faadc2.htm>; [http://www.rheinmetall-defence.com/en/rheinmetall\\_defence/public\\_relations/themen\\_im\\_fokus/rheinmetall\\_hel\\_live\\_fire/index.php](http://www.rheinmetall-defence.com/en/rheinmetall_defence/public_relations/themen_im_fokus/rheinmetall_hel_live_fire/index.php).

*Advanced-Hit Efficiency and Destruction (AHEAD)* will continue to be developed<sup>89</sup>. Successful concept studies on the development of operational architecture and the operation of C-RAM systems may contribute to the creation of mobile autonomous 100 kW laser air defence systems that can be connected to the existing command and control systems.

Qualitative changes will involve both technical assets and human resources. By progressively implementing automated assets into the air defence forces, the command structure will become decentralised, which will inevitably bring about more flexible organisational patterns, such as a task structure. Expert systems will become particularly useful, although the “computer revolution” proved to be less revolutionary for the organisational structure of the



The vision of mobile anti-aircraft laser systems to combat small-size air targets at short distances Source: own analysis.

air defence forces than previously anticipated. The role and significance of decision-support systems is likely to increase. Automated systems will become increasingly commonly used in air defence as they streamline the operation of the entire system. Intellectual skills of the command and management staff, professional combat training and effective control of the air defence system may become increasingly relevant.

To recap, the air defence system of the future should be regularly improved in operational and tactical terms in order to deliver effective protection against airborne threats to security, and in the long run, also against threats from the space. How successfully the air defence system faces the future challenges will largely depend on the capabilities of the armed forces to transform and evolve. The armed forces of the future should become better prepared to operate jointly and to carry out expedition operations. They should be technically advanced and operate in a net-centric environment while relying on an integrated logistic support. Another important issue will be to integrate efforts and resources to create a uniform multilayer “umbrella” protecting military forces operating in the field without disrupting the functioning of the economic system of the state.

# Conclusions and recommendations

## Projected tasks of the Polish Air Force and air defence units

1. Considering the geopolitical position of Poland, and regardless of how likely we assess the probability of armed conflict, when developing any plans for the modernisation of the Air Force and air defence units, ensuring their ability to repel an attack on the Polish territory should be the primary focus.
2. In the foreseeable future, only the Russian Federation and Belarus could be viewed as potentially hostile neighbours. However, a scenario in which pro-Russian forces took control of Ukraine, bringing that country closer politically to the Russian Federation, cannot be excluded. Russia could theoretically decide to attack a member of NATO, such as Poland, only in the absence of a firm stance of the other signatories of the Washington Treaty. Military conflict between NATO and Russia would be the result of a miscalculation on the part of the Russian decision-makers whose main goal would be to discredit the North Atlantic Alliance in order to obtain freedom of action in the international arena.
3. In the event of an attack on Polish territory, basic tasks of the Air Force and air defence units in cooperation with Allied forces would include winning dominance in the air, strategic air operations (at the moment the capabilities in this area are very limited), actions against the ground and naval forces of the opponent, and air support activities. Winning dominance in the air would be so difficult that the superiority of potential opponents (particularly the Russian Federation) in the field of combat aircraft is clear (the state of aviation of the Western Military District of the Russian Federation consists of approximately 180 fighter aircraft, MiG-29, MiG-31 and Su-27, and approximately 100 fighter-bombers, MiG-29 and Su-24 and Su-34). Whereas Poland would be able to present approximately 100 combat aircraft, with radically different capabilities (the requirements of the modern battlefield are fully met by only 48 F-16s, whereas 32 MiG-29s may only serve to cover point objects in the area of dislocation, while the combat value of Su-22 aircraft is only illusory and they are already mostly used for training). In order to win, and maintain air superiority Poland would need approximately 150 modern aircraft. Whereas in a defensive fight against the potential enemy air defence units are supplied with aging surface-to-air missiles launchers, whose structure and combat capabilities do not meet today's needs and threats. To conduct other types of activities the Polish Armed Forces possess even more limited resources (e.g. in terms of air to ground capabilities only the F-16s meet the requirements) than in the field of defensive actions. In addition, the Air Force and air defence units would be facing an attack with the use of tactical ballistic missiles. Therefore, it is necessary to develop a system of backup facilities, for

example, based on using the old airports in the western part of Poland and the so-called road runways, develop detailed plans for rapid redeployment of aircraft and ground services, and conduct regular exercises in this respect.

4. A more likely threat to Poland than an armed conflict is a conflict of a limited size, below the threshold of war. In this case the Polish air defence system could face actions such as a limited missile attack (without official aggression and the aggressor) or a series of air and missile strikes, designed to enforce certain behaviour. The most important challenges for the Air Force and air defence units would include, in the latter case, early detection of incoming missiles and aircraft, immediate raising into the air of a large part of aviation (to both minimize losses and counter the threat) and conducting retaliatory operation (to eliminate at least some part of the means of air attack, which is impossible without proper C2ISTAR system, Command and Control plus Intelligence, Surveillance, Target Acquisition, and Reconnaissance).
5. The remaining tasks of the Polish Air Force and the air defence units in the perspective of two decades also include preventing violations of airspace by foreign aircraft and implementing Renegade procedures, protecting critical infrastructure and air space in the event of a threat of terrorism and allied operations, including out-of-area type operations.

## Possible directions of development of the Polish Air Force and air defence units

6. In the next decade the basic equipment of the Air Force of NATO countries will include F-16 Viper fighters and the Eurofighter Typhoon aircraft, gradually supplemented by F-35 Lightning II aircraft. In the longer term the F-35 Lightning II, modernised in the course of operation (they will be produced under license in Europe by Italian aerospace, which cooperates with several other countries, having their share in the project), will ultimately replace F-16 Viper aircraft (some of them will be taken over by the countries of Eastern Europe).
7. At the beginning of the third decade of the 21st century Tactical Air Force of the Polish Air Force will be in possession of 96 combat jet aircraft. Only multi-task F-16 Fighting Falcon aircraft will remain modern machines at this time. In contrast, Su-22 fighter aircraft and MiG-29 fighters will be already old and will not meet the requirements of modern warfare (in practice this state of affairs is taking place right now, due to lack of upgrades; work that was actually conducted on them was carried out in order to only adjust their communication, identification and navigation means to NATO standards). Thus, in the near term, there will arise an urgent need to replace them

with new machines.

8. Poland has several options as far as strengthening its combat aviation. The first direction is the gradual purchase of Lockheed Martin's most advanced fifth generation aircraft, F-35 Lightning II, which would be the first to replace MiG-29 aircraft and Su-22 attack aircraft (then also the F-16). The second direction is the purchase of two classes of fighters: the Eurofighter Typhoon and Lockheed Martin F-35 Lightning II. In such a scenario, Eurofighter Typhoon should be bought first (the third decade of the 21st century, introduced to replace MiG-29 and Su-22). So the second option assumes purchase of F-35 Lightning II (4th decade, to replace the F-16 Fighting Falcon). In the third possible option, assuming rapid development of unmanned aircraft systems in the coming years, Poland should only purchase an extra (the fourth) multi-task aircraft squadron of F-16 Fighting Falcon. This would result in both transforming the 1st Tactical Aviation Wing into a unit featuring only tactical unmanned aircraft systems. There is also the fourth option, where Poland, for economic reasons, would totally resign from the purchase of fighter planes with the stealth capabilities – Lockheed Martin F-35 Lightning II, for the benefit of Eurofighter Typhoon (Dassault Rafale option seems less likely due to its high cost in relation to capabilities and Saab Gripen NG whose combat capabilities are limited, taking into account the standards of NATO).
9. In the first years of the third decade of the 21st century transport aviation of the Polish Air Force would be in possession of 5 medium transport aircraft: Lockheed Martin C-130E Hercules, 16 light transport aircraft Airbus Defence & Space C-295M and 18 very light transport aircraft PZL M-28. In this timeframe only medium transport aircraft C-130E Hercules will be considered not modern. Given that their service life can no longer be further extended, their successors need to be quickly found. There are two possible courses of action here. To replace C-130E Hercules, Poland in the next decade would purchase from 4 to 6 medium-sized transport aircraft C-130J Super Hercules or it will decide to buy 4 heavy transport aircraft A400M Atlas. However, given that Poland already has access to heavy transport aircraft (C-17 Globemaster III, the allied wing in Papa air base), the first scenario seems more appropriate for our needs.
10. As far as training, acquisition of M-346 Master aircraft and modernization of PZL-130 aircraft are only the first step to build Poland's own system of training pilots of modern combat jets. Until now, Polish F-16 pilots were trained in the United States (the cost of training of one pilot is approximately 3 million U.S. dollars; an instructor costs approximately 2 million, which translates into expenditure of approximately 20 million dollars per year). Due to a gradual transition of

the U.S. Air Force to F-35 aircraft this system will no longer be available. A particular problem is the lack of sufficient instructors of pilots, hence a possible solution: creating a military training centre for the F-16 pilots, supported by Polish commercial training and logistics enterprise (with a possibility of paid training for pilots from Romania, and possibly also for pilots from Bulgaria and Croatia and increasing the operational capacity of the Polish Air Force by a simultaneous training of navigators and ground training instructors) which might enable the training of approximately 6 pilots and 3 instructors annually.

11. In terms of air and missile defence, after 2020, when the adopted schedule of purchase (a cycle) have been completed, it would be possible to organize about six manoeuvring combat modules, whose backbone would be medium-range missile batteries. These types of sets should be able to provide protection of important objects: operational troops, command posts, logistic, administrative and economic centres, against a wide range of threats from the air, including against tactical ballistic missiles. In subsequent years, the modules would be enhanced with combat short-range missiles sets. The main task of these type of missiles sets would be providing a cover for troops and facilities in the area of operations (including air bases) and enhancing sets of medium-range missiles at low altitudes, with piloted air assault media, cruise missiles and UAVs.
12. Sets of a new generation of anti-aircraft missiles must meet the requirements of NATO interoperability and network centric system operations. Besides, they must be mobile autonomous platforms, with a great ability to survive and be immune to radio-electronic clashes. As for the fire capabilities, the basic requirement for new missile sets is high firepower, allowing simultaneous firing of multiple targets, including cruise missiles. This type of missiles should also be capable of destroying group targets (manned and unmanned), operating on small and very small altitudes. Impact capability on targets outside the 'line of vision' will also be important (a fire battery which cannot see their own sensors will be able to obtain the necessary information about the air attack media from a neighbouring subdivision - third party targeting).

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