Airspace Strategy for Poland

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Contents

Foreword from the Ministry of Infrastructure

In the period from 2003 to 2017, the number of passengers transported in Poland by Polish and foreign air carriers increased over six times. During the same period, IFR traffic movements in the Polish airspace increased almost three times. All the available forecasts (from the Polish Civil Aviation Authority, the International Air Transport Association (IATA) and EUROCONTROL) indicate further dynamic development of the aviation market in Poland. The growing demand for air transport will bring a significant challenge for airspace management. In this context, Poland as an EU border State, plays a key role in the performance of the wider European airspace network.

We are aware that we have to provide the necessary conditions to accommodate the forecast traffic growth, therefore I welcome the joint efforts of the Polish Air Navigation Services Agency (PANSA) and IATA to create the first edition of the "Airspace Strategy for Poland" (ASP 2018).

The ASP 2018 provides the opportunity to set and confirm the direction for development of the Polish airspace in the light of the growing aviation market. This document reflects the expectations of the key stakeholders in the aviation sector.

The airspace is an invisible but crucial part of our transport infrastructure. Its development will increase capacity and bring benefits to the aviation industry, passengers and the general public. Airspace development will enable new

flights and destinations, reduce delays, improve connectivity and generate economic growth, while maintaining high safety standards.

The ASP 2018 sets out the necessary modernization actions required from a range of aviation stakeholders to develop the airspace. I believe that the strategy will contribute to ensuring the greatest possible efficiency and safety of airspace management with respect to the responsibilities that Poland has in those fields and taking into consideration our obligations under international and European law.

ASP 2018 will also be a support tool in the process of updating Polish strategic documents on transport, as well as the preparation of a new governmental programming document on air transport development in Poland. The ASP 2018 has been developed following a bottom-up approach that draws together a range of new and existing solutions that are fully aligned with the Single European Sky initiative and SESAR programme.

Aviation stakeholders can use the ASP to identify the actions required to maintain and enhance the performance of the airspace network, ensure fair competition and maximize the opportunities to deploy new solutions. I believe that this approach may bring more benefits than traditional approaches to airspace development like new legal regulation or other top–down initiatives.

We are pleased that IATA, recognizing the essential role of Poland in the European airspace network, decided to cooperate with PANSA to create the first edition of the ASP. The dynamic development of the Polish aviation market might cause congestion challenges in the future and underpins the State's decision to prepare a concept for a new airport – the Central Communication Hub for the Republic of Poland. This future airport will enable greater connectivity for Poland and the entire region. The first edition of the ASP provides a starting point for discussions with all aviation stakeholders about the development of the Polish airspace and will be maintained as a living document, able to respond to emerging challenges and opportunities.

We are sure that big changes in aviation are coming and we have to be ready for them. ASP 2018 provides the industry with a vision for how to properly address coming challenges.

Mikołaj Wild

Plenipotentiary of the Government for the Matters of the Central Transport Hub for the Republic of Poland,

Secretary of State, Ministry of Infrastructure, Republic of Poland.

MINISTRY
OF INFRASTRUCTURE

PART 1: INTRODUCTION

1.1 Aviation in Poland

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1.1 Aviation in Poland

The Airspace Strategy for Poland (ASP) describes the strategy for the modernization of Polish airspace. The strategy should be treated as advisory material which is complimentary to State-level strategic documents that set the direction for the future of airspace, air traffic management (ATM) and the aviation sector in Poland.

The ASP is intended for all those with an interest in the Polish aviation sector and its connections with the country's wider transport network, including - passengers, consumers, the military, aircraft operators, airports, air navigation service providers (ANSPs), companies that rely on air transport to conduct their business and communities that may be affected by the environmental impact of flights.

| Aviation in Poland

Aviation keeps people connected with one another and provides the international access that Poland needs for economic growth, business and tourism. The aviation sector has a long history in Poland. The first international air route was established in the 1920s, shortly before LOT Polish Airlines launched its first operations. Air traffic levels have grown significantly since – especially following Poland's accession to the European Union in 2004, which prompted the liberalization of the aviation sector and allowed more foreign operators, including low cost carriers, to enter the market.

In 2005, approximately 4.6m passengers travelled by air in Poland, served by five licensed operators. By 2017, passenger numbers had grown 800% to 39.9m, with services offered by 28 international airlines.

Economic benefits of airspace modernization in Poland:

- Air transport delivers over **€5bn** in economic benefits to Poland per year and supports over **140,000 jobs.**
- Polish airspace modernization is expected to increase GDP by **€6bn**, provide a further **65,000 jobs** and generate **€400m a year in benefits** for Polish consumers out to 2035.

Source: IATA

Aviation is a key part of Poland's transport infrastructure and the sector relies greatly on the performance of the airspace to operate efficiently and continue to grow. The Polish aviation market is now growing above the average in the EU. Demand forecasts predict that traffic levels in Polish airspace will continue to rise, driven in part by the development of the new Solidarity Airport – a main feature of the Central Transport Hub (CTH) project. Irrespective of the CTH project, airspace modernization is needed in Poland to accommodate the growth in demand at existing airports, while enhancing safety, operational resilience, environmental performance and market competitiveness.

1.2 Overview of Polish airspace

Flights in Polish airspace can be categorised into three types: commercial air transport carrying fare paying passengers and freight, general aviation and the military. There were over 340,000 commercial air transport flights in 2017 travelling to and from 15 airports*, of these:

- 82% were international flights; and
- 18% were Polish domestic flights;

Polish airspace and more specifically the Warsaw Flight Information Region (Warsaw FIR) is divided into two main categories, controlled and uncontrolled. The majority of commercial flights operate in controlled airspace under the monitoring and direction of PANSA – the organisation responsible for the provision of air traffic control services in Poland. The 10 largest commercial air transport operators in Poland today are set out below. Operations are dominated by LOT Polish Airlines, Ryanair and Wizz Air that currently hold 76% of the market*.

Poland's seven largest airports handle the majority of the commercial air transport. These airports are listed by size, in terms of 2017 annual traffic numbers below*:

Airport	# flights
Warsaw Chopin	157,044
Krakow	44,188
Gdansk	36,504
Katowice	27,295
Wroclaw	22,899
Warsaw Modlin	17,279
Poznan	15,773

The general aviation sector that includes private pilots, light aircraft pilots, gliders and a range of other operators mainly use uncontrolled airspace. Airspace modernization is expected to improve the access to airspace for general aviation by enabling greater integration of different airspace users.

The military is a significant user of both controlled and uncontrolled airspace to protect the country's borders and often operates within the confines of flexible airspace structures that can be reserved on a temporary basis and released when they are not required.

In addition, Polish airspace is increasingly required to accommodate drones or unmanned aerial vehicles (UAVs) that will fly beyond visual line of sight without airspace segregation.

*Source: Polish Civil Aviation Authority, www.ulc.gov.pl

| Overview of Polish Airports

Chart 01 sets out the size and locations of the 15 Polish airports. The chart includes the number of passengers (PAX) and air transport movements (ATMs) at each airport in 2017 and the location of the new Solidarity Airport that will be constructed as part of the CTH project.

Along with passengers, the airports also managed 106.7m kilograms of freight travelling to, from and within Poland in 2017. Air transport is crucial for the distribution of high value to weight products. Air freight typically accounts for less than 1% of the tonnage of Polish trade with the rest of the world, but in value terms it makes up around 25% of the total.

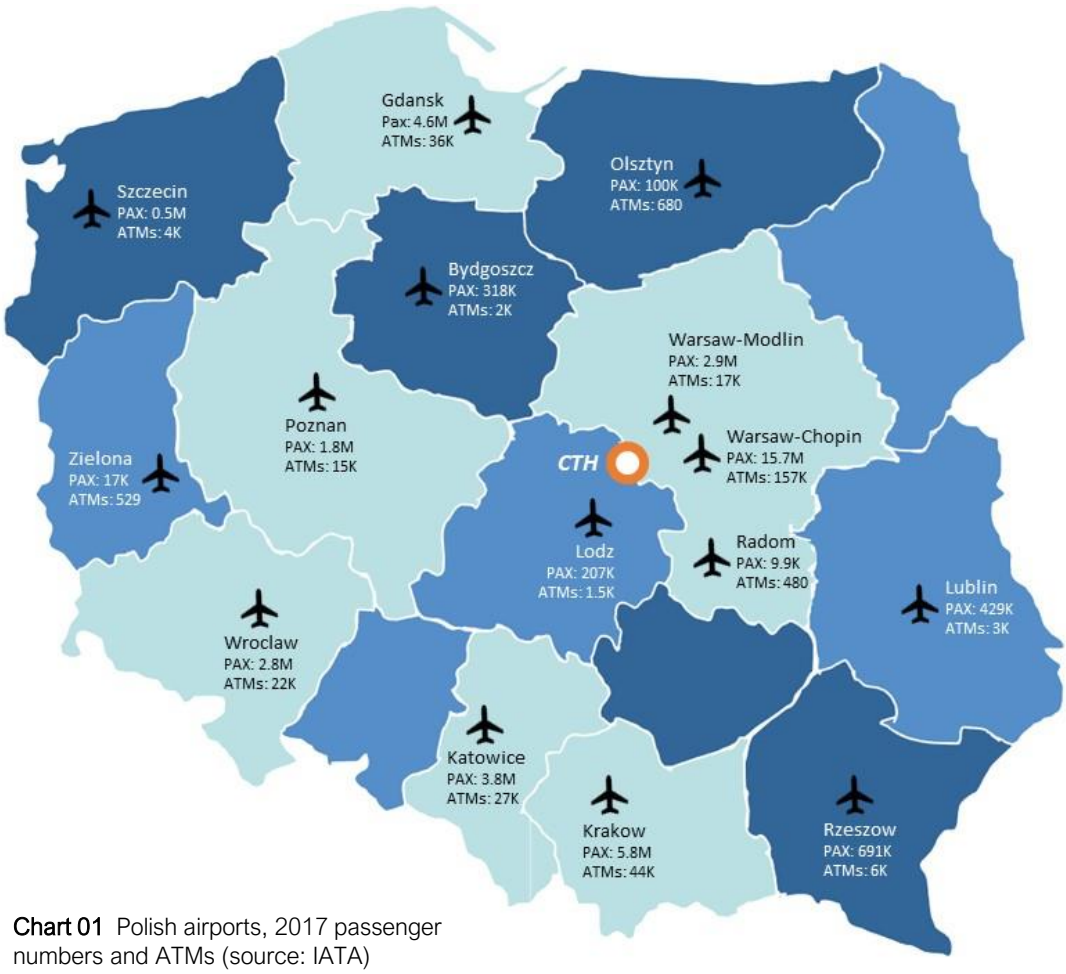

Chart 01 Polish airports, 2017 passenger numbers and ATMs (source: IATA)

1.3 Policy & drivers for airspace modernization

| Airspace modernization policy

Poland's airspace modernization policy objectives are derived from three State-level strategic documents:

- The Responsible Development Strategy - 2020 (with a 2030 view).
- The Transport Development Strategy - 2020 (with a 2030 view); and
- The National Spatial Development Concept – 2030.

The Responsible Development Strategy sets out the high-level economic development goals and includes the case for the CTH project. The Transport Development Strategy lays down the directions for the development and integration of all transport modes, including aviation, to improve the movement of goods and people. The National Spatial Development Concept is the most important strategic document on spatial planning and management in Poland.

The goal of the CTH project is to establish a universal passenger transport system through the development of a new central hub that will become one of the largest in Europe, and through the re-development of the railway network so that it becomes an attractive alternative to road transport.

The Solidarity Airport will be located between Łódź and Warsaw and aims to serve around 45m passengers per year when it enters into service in 2028. The location of the new airport will offer the opportunity for further uninterrupted development, allowing growth to around 100m passengers per year over the life of the infrastructure.

The CTH project will require significant investments to modernize the surrounding airspace and connect the new airport into the existing air transport network. Airspace modernization in Poland will be guided and driven by the rich outputs of the Single European Sky (SES) initiative and SESAR programme.

| Drivers for airspace modernization

There are seven main drivers that the policy objectives for airspace modernization in Poland aim to address, in line with State-level transport and development strategies, these are:

1. **Safety:** The need to deliver continuous improvements in aviation safety by reducing risk factors and controlling them at an acceptable level in line with the approach to safety and risk management set out in Annex 19 to the ICAO Convention on International Civil Aviation.
2. **Capacity and Growth:** The need to introduce additional capacity to accommodate growing demand from airspace users, especially growth generated by the new Solidarity Airport.
3. **Punctuality:** The need to tackle hotspots of congestion within the current airspace network and optimize the performance of existing airport infrastructure, especially operations from Warsaw Chopin, prior to the opening of the new Solidarity Airport.
4. **European integration:** The need to implement internationally agreed requirements set out as part of the SES initiative and SESAR porgramme that are designed to increase the overall safety, capacity and efficiency of the European airspace network.
5. **Unmanned Integration:** The need to integrate unmanned operations into the existing Polish airspace and air traffic management arrangements safely and efficiently.
6. **Resilience:** The need to continuously improve the resilience of the airspace network to adverse weather and other forms of disruption, including mitigating the impact of disruptions in neighbouring European airspace.
7. **Environment:** The need to develop new policies and operational approaches to better manage the environmental impacts of aviation, especially aircraft emissions and noise.

The ASP describes a range of airspace modernization initiatives that aim to address these drivers, including:

- **Replacing the fixed route structure in the upper airspace** with the free route airspace (FRA) concept, allowing aircraft to follow optimized flight paths with fewer restrictions.
- **Improving the Flexible Use of Airspace** to provide civil and military users with efficient access to the airspace in line with the demands of their operations.
- **Redesigning the busy terminal airspace** to accommodate the new Solidarity Airport and optimize the performance of existing airport infrastructure.
- **Deploying new ATM systems and infrastructure** that will improve the flow of traffic to better manage ground delays and pinch points across the airspace network.
- **Redesigning airport arrival and departure routes** so flights can climb and descend continuously, and better manage the impacts of aircraft noise.

1.4 Benefits and challenges

| Benefits of airspace modernization

Airspace modernization is expected to generate a range of benefits for a broad mix of stakeholder groups. Due to the complexity of the airspace, realising benefits for some stakeholders may at times create disbenefits for others. The arrangements established to coordinate airspace modernization in Poland will be required to trade-off benefits at times to optimize performance in the round.

For passengers, the benefits of the airspace modernization are clear – fewer flight delays and service disruptions at short-notice are expected to save time and improve the passenger experience.

For commercial air transport, airspace modernization will introduce more capacity, reducing delays while maintaining high levels of safety. Modernization is also expected to improve flight efficiency, predictability, punctuality and costs per flight, enabling the airlines to capitalise on their investments in new technology.

For airports, the greater integration of airport ground operations with airborne traffic flows is expected to improve runway throughput and resilience.

For the environment, although there will be environmental impacts associated with the growth in traffic levels, important environmental improvements are also expected from airspace modernization as aircraft can follow more fuel-efficient routes, climb sooner, descend quieter and navigate more accurately around population centres.

For general aviation operators, modernization offers the opportunity to access more volumes of airspace that are not required by commercial air transport, either through the rationalisation of controlled airspace structures or greater flexibility in the reservation and release of areas temporarily reserved for a specific use. Modernization is also expected to improve safety by enhancing the quality and availability of communications, navigation and surveillance (CNS) information.

For military operators, modernization is expected to enable more efficient operations throughout Polish airspace, supported by greater dynamism in the reservation and release of flexible airspace structures that are used for training and testing. The benefits for military operators will be enabled by expanding the cooperation between civil and military ATM systems and standardizing the management of flexible use airspace across European States.

For unmanned operations, modernization will aim to enable safe and efficient access to the airspace for unmanned aerial vehicles (UAVs) flying beyond visual line of sight (BVLOS). The benefits for unmanned operators are enabled by the introduction of a reliable UAV Traffic Management (UTM) system that provides real time airspace restriction information and dynamic permissions for flight where required, taking into account the pre-tactical and tactical constraints of conventional aviation operations, and airspace capacity. The UTM system will facilitate the coordination of UAV flights between unmanned operators and PANSA and provide those offering air traffic control and flight information services with a useful tool for non-verbal communication, increasing the situation awareness of all stakeholders.

For the economy and consumers, the capacity to add routes and accommodate new flights will lead to better value, more choice and enhanced global connections that can help drive the economy forward, in particular by enabling the introduction of the new Solidarity Airport.

| Environmental challenges

Aviation brings significant benefits to the economy and society, but these benefits come with an environmental cost, both at the local and global level. The aviation sector has an important role to play in ensuring that the outcomes of airspace modernization are sustainable and enable improvements in environmental performance.

The ASP aims to provide clear direction for industry stakeholders to build on the progress already made and ensure that Poland leads the way in exploiting opportunities to better manage the environmental impacts aviation.

| Aviation emissions

Aviation Green House Gas (GHG) emissions in Poland are increasing relative to other transport sectors and in absolute terms. Globally, it is estimated that aviation will account for 22% of all emissions by 2050 if no action is taken. In Europe, aviation GHG emissions have increased by almost 25% since the year 2000 and continue to grow at an average rate of 2% per year.

While progress is being made to increase aircraft engine efficiency, these technological improvements are not sufficient, placing greater focus on operational and airspace modernization opportunities.

The Polish State is contributing to ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (known as CORSIA), which is designed to complement the actions that the aviation sector is already taking to reduce GHG emissions. The CORSIA scheme includes within its scope the deployment of technical and operational improvements enabled by airspace modernization.

Implementation of CORSIA projects will begin with a pilot phase from 2021 through to 2023, followed by the first full phase, from 2024 to 2026. In Poland, the main technical and operational projects will be delivered by PANSA, in line with the SES initiative and SESAR programme and include:

- Optimization of the overall Polish route network so that it is one of the most environmentally efficient in Europe.
- Implementation of free route airspace generating significant reductions in aircraft fuel burn and GHG emissions.
- Implementation of more direct flight paths designed using advanced Performance-based Navigation (PBN) that remove the reliance on fixed ground based infrastructure.
- The redesign of airports' standard departure and arrival routes to allow for environmentally efficient climbs and descents where needed.

These projects are described in greater detail in Part 2 of the ASP.

| Aircraft noise

One of the most important environmental impacts associated with the airspace at lower altitudes is the effects of aircraft noise. Overall, airspace modernization is expected to see a reduction in average noise levels per flight, but the redistribution of noise impacts between different areas may often lead to disruption for communities living under flight paths. The effects of new, more frequent or more concentrated noise may increase the risks of causing general annoyance, sleep disturbance, lower levels of productivity and health impacts.

Aviation noise performance has improved significantly in recent decades, driven by the introduction of quieter aircraft. However, some communities experience more noise due to the continued growth in traffic levels. In addition, the introduction of PBN routes based on satellite navigation can bring more intense levels of aircraft concentration and therefore noise.

The precision and flexibility offered by PBN routes also creates opportunities to deploy new operational techniques that can improve the management of aircraft noise, for example by introducing multiple flight paths for noise dispersion and more predictable respite. The ASP encourages these opportunities to be exploited wherever feasible, taking into account local circumstances and community preferences.

Some of the operational techniques to better manage aircraft noise will involve trade-offs with other ASP objectives such as increasing airspace capacity and reducing GHG emissions. These trade-off decisions will need to be factored into the implementation process through engagement and consultation with stakeholders (see Part 3).

In general, there are four main techniques to better manage aircraft noise as part of the airspace modernization process – Traffic Dispersion, Traffic Concentration, Noise Respite and Noise Redistribution.

Traffic Dispersion refers to air traffic controllers instructing departing traffic to follow the same general routing but fly a variety of different flight paths when measured over the ground. And to deploy similar traffic distribution techniques for inbound traffic.

Traffic Concentration is the opposite of dispersion and is a consequence of the accuracy of PBN routes, where aircraft avionics are coded to automatically follow the same flight paths consistently and fly very similar tracks over the ground. The accuracy and predictability associated with PBN means it is possible to make more efficient use of the airspace and add capacity by allowing larger volumes of traffic to route through smaller areas, potentially avoiding population centres. The costs of traffic concentration fall to the minority of stakeholders that are affected by more frequent and intense noise impacts.

Noise Respite involves greater planning and predictability of aircraft noise impacts. For example, the planned use of different runway ends at different times of day, providing communities with predictable relief from the noise impacts of departures. Another example could be alternating flights between multiple departure routes according to a pre-planned schedule. Respite can be designed into airspace structures more easily once arrival and departure routes are upgraded to PBN standards because flight paths can be designed with greater accuracy and flexibility.

Noise Redistribution refers to the redesign of airport arrival and departure routes at lower altitudes that allows for noise impacts to be re-distributed away from more sensitive areas. Of course, this assumes that there are adjacent areas that are less sensitive to noise that the routes can be moved over. The relative noise sensitivity of areas is difficult to estimate and must be carefully considered when the re-distribution technique is applied.

PART 2: INITIATIVES

2.1 Modernizing the terminal airspace

- a. Airspace to enable the new Solidarity Airport
- b. Airspace to optimize existing airport infrastructure

2.2 Modernizing the upper airspace

- a. Implementing free route airspace
- b. Improving flexible use airspace

2.3 Modernizing ATM systems & infrastructure

2.4 Integrating unmanned operations

2.1 Modernizing the terminal airspace

| Overview of the terminal airspace

The terminal airspace is designed to manage high volumes of traffic, climbing and descending between individual airports and the upper airspace. The result is a complex web of intersecting flight paths to and from nearby airports.

The terminal airspace in Poland includes all terminal control areas and control zones supporting the airports of Gdańsk, Krakow, Katowice, Wroclaw, Poznań, Warsaw, Modlin, Łódź, Szczecin, Rzeszów, Bydgoszcz, Lublin, Zielona Góra, Olsztyn and Radom.

Over the past few decades, many areas of the terminal airspace in Poland have been added to and adapted in response to growing traffic levels. This approach has created some issues. In an ideal world, departures would climb quickly and continuously through the terminal airspace, and arrivals would descend continuously to the runway.

However, in practice, continuous climbs and descends are interrupted by the need to provide separation between constantly evolving traffic flows and reduce the number of congestion hotspots. The high workload placed on controllers to manage crossing traffic also limits the capacity of the terminal airspace.

The overall complexity of the terminal airspace and the lack of spare capacity has weakened its resilience to adverse weather and disruption (e.g. technical problems or industrial action). As a result unplanned events can lead to significant delays.

The overall goal of terminal airspace modernization is that airspace capacity should not be a constraint to growth and throughput at the new Solidarity Airport or Poland's existing airports and that any limitations would instead come from the number of runways and any restrictions on their usage.

| a. Terminal airspace modernization to enable the new Solidarity Airport

The development of the new Solidarity Airport as part of the CTH project presents the opportunity to fundamentally redesign and modernize the terminal airspace that serves the Warsaw region.

It is envisaged that the Solidarity Airport will be located between Łódź and Warsaw, initially with two parallel runways on the east to west line. The absence of major obstacles and environmentally sensitive areas close to the airport is expected to enable a 24/7 operation that will serve c.45m passengers per year (with the scope to rise to 100m with further development).

The scale of the new airport and its proximity to existing operations at Warsaw Chopin, Modlin, Łódź and Radom will impact the surrounding airspace, creating a driver for modernization using new concepts developed, for example, as part of the SESAR programme, like:

- The widespread use of accurate and flexible PBN routes.
- The widest possible application of continuous descent and continuous climb operations (CDOs and CCOs).
- Greater systemisation of the airspace to minimise tactical airspace management.
- The use of new sequencing tools to manage traffic flows and delays.

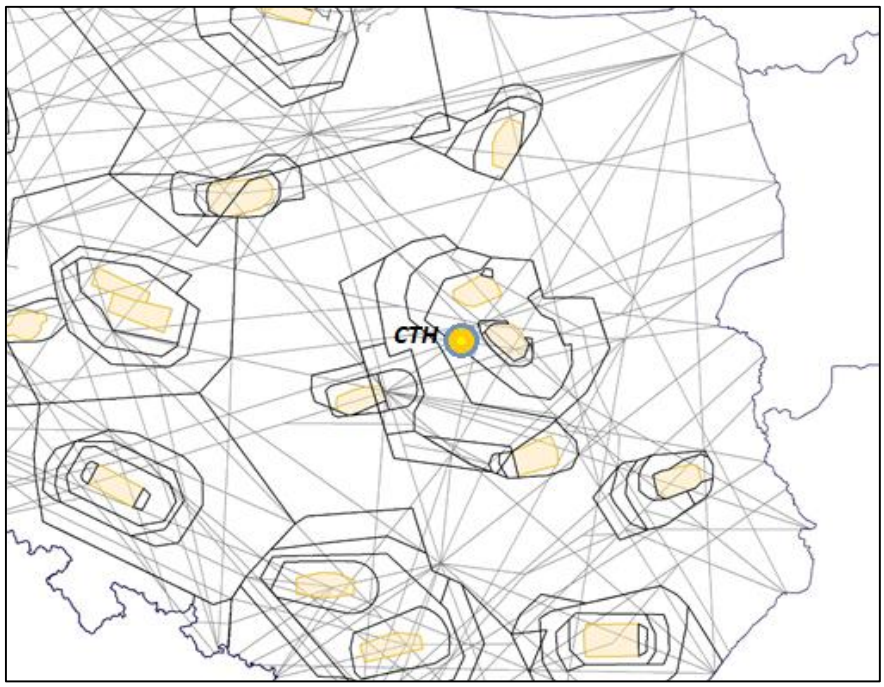

Chart 02 highlights the location of the new Solidarity Airport (CTH) relative to the current terminal airspace. (source: PANSA)

Having in mind the scope of the CTH project, there will be a need to reorganize the existing terminal airspace, including designing a new controlled zone and making significant changes in the terminal control area of Warsaw. New PBN routes will be required that connect efficiently with free route airspace (see section 2.2), along with the reorganization of temporary restricted areas and adjustments to the Area Control Centers (ACCs) to accommodate different traffic flows.

In order to initiate works on a dedicated terminal airspace design plan to accommodate the new Solidarity Airport it is necessary to know the previously indicated conditions and growth plans of the existing airports operating near the CTH location and specific technical plans for the construction of CTH itself.

Following the acquisition of the necessary information, PANSA will proceed with the appropriate work to prepare the infrastructure and airspace design plans for the new Solidarity Airport. Of course, the abovementioned activities will be performed in line with development stages of the CTH project.

Building the Solidarity Airport will also create the need to invest in new state-of-art CNS infrastructure – including primary and secondary surveillance radars, integrated data and communications networks. All the necessary investments are being defined by PANSA in its investment plans for the 2019 – 2024 period.

| b. Optimizing the existing airspace supporting Warsaw Chopin airport

The preparatory work to design the new Solidarity Airport is expected to be completed in 2019. The airport itself will be constructed in the following eight years, entering into service in 2028.

Warsaw Chopin is located approximately 40km to the west of the new Solidarity Airport, raising important questions about the future role and scale of Chopin from 2028 onwards and nearby operations at Modlin, Łódź and Radom. The changes required to the terminal airspace in the Warsaw region are ultimately dependent on how aviation demand will be served by new and existing airport infrastructure.

In the short term, several airspace modernization concepts are under consideration to optimize the performance of Warsaw Chopin and ensure there is adequate capacity to meet growing demand over the next decade. Two of the key concepts under consideration are:

- The redesign of arrival and departure routes using PBN capabilities; and
- The deployment of an Airport Collaborative Decision Making system.

Chopin's arrival and departure routes are designed around long established ground navigation beacons. Although well-known and highly structured, the fixed locations of these beacons creates inflexible and at times less efficient flight paths. The limited number of beacons mean many flights converge at the same points over the ground, concentrating noise and constraining capacity.

Adding more capacity and improving the management of aircraft noise at Chopin is enabled by the redesign of arrival and departure routes using PBN capabilities. PBN removes the reliance on ground beacons, offering much more flexibility in the way that routes can be designed. Capacity can be added by implementing more closely spaced routes into the same volumes of airspace.

The precision and flexibility offered by PBN routes also creates opportunities to better manage noise impacts (as described in section 1.4), for example by designing flight paths that avoid population centres.

Airport Collaborative Decision Making (ACDM) involves the introduction of new systems and processes at Chopin to enable the creation, refinement and exchange of runway and airspace data, including:

- The progress of each flight turnaround;
- Up to date times for each flight to push back from stand and take off; and
- Improvements in the sequence of departures to maximize runway and airspace performance and reduce aircraft fuel burn.

With this information ACDM systems allow air traffic controllers to construct an optimized sequence of departures tailored to maximizing runway throughput and airspace capacity. ACDM systems also gather the latest estimated landing times for inbound flights to improve the management of ground operations that are often the cause of air traffic delays.

ACDM is planned for implementation to support the optimization of the Warsaw Chopin operation in two phases. The first phase will see Chopin become one of Europe's Advanced Tower Airports by automating the process by which departing aircraft are granted permission to push back from the stand (known as a TSAT, or Target Start Up Approval Time). A module of the overall ACDM system known as a TSAT Generator will calculate the optimal time for each flight to start their departure sequence. The optimized sequence is based a range of information about all other aircrafts' departure plans, the performance of the runways and the capacity of the airspace.

The TSAT Generator is expected to reduce ground delays and increase runway throughput, enabling Chopin to increase its declared capacity, should all the relevant environmental requirements be met.

The second phase of ACDM implementation will extend the systems and processes that support airport capacity and demand planning at Chopin to a broader range of operational stakeholders, including Ground Handling Agents, Border Control and nearby airports that use the same volumes of terminal airspace such as Modlin, Łódź and Radom.

In the longer term, there is a possibility to extend ACDM implementation to other Polish airports if operational needs justify the investment.

| Terminal modernization at other airports

In addition to the fundamental changes that will be needed to support the new Solidarity Airport and the investments to optimize operations at Warsaw Chopin, the other Polish airports are also expected to modernize their terminal airspace, associated ATM arrangements and infrastructure.

Kraków Airport plans to invest around PLN 1 billion in infrastructure development over the next 20 years, including the potential for a new runway, extended passenger terminal and new cargo terminal. Traffic growth forecasts indicate that Kraków Airport will handle as many as 12m passengers per year by 2035. (Source: Krakow Airport).

Gdansk Airport is expected to grow its operations from 4.6m passengers in 2017 to 9.1m by 2035, requiring additional airfield infrastructure and new arrival and departure routes. (Source: Gdansk Airport Master Plan).

Katowice Airport is the second largest freight airport in Poland (after Chopin). The airport has recently invested in PBN arrival and departure routes to future proof its operations. (Source: Katowice Airport)

Wroclaw Airport is expanding its operations with a second terminal and associated ground and airspace developments that will increase its capacity to 3.3m passengers per year. (Source: Wroclaw Airport)

Poznan Airport has recently completed an infrastructure expansion project that will add the capacity to accommodate growth in line with 2035 forecasts. The airport plans to deploy a set of new PBN routes to support the expansion in due course. (Source: Poznan Airport).

Rzeszow Airport has recently completed a terminal expansion project that has grown the airport's capacity to 1.5m passengers per year. The project is supported by the planned implementation of new PBN arrival and departure routes. (Source: Rzeszow Airport).

Warsaw Modlin Airport is currently served exclusively by Ryanair, who's modern fleet will be able to take advantage of advanced PBN routes when they are deployed.

Radom Airport has been acquired by a new owner, the State enterprise 'Polish Airports', that have plans under development to significantly expand its operations. If approved, the expansion will involve significant runway, airfield, terminal and airspace modernization investments.

Lublin Airport has plans underway to expand the terminal and airfield infrastructure that will be accompanied by airspace developments. Lublin expects the project to complete in 2019. (Source: Lublin Airport).

Zielona Góra Airport is focused on growing domestic services between Polish cities and plans to increase its operations from 17k passengers a year in 2017 to c.0.5m by 2035, supported by accompanying airspace developments. (Source: Zielona Góra Airport).

Szczecin Airport plans to expand its cargo operation through the construction of a new logistics terminal which is scheduled to launch in 2019 and will significantly expand on the 130,000kgs of freight handled in 2017. (Source: Szczecin and Polish CAA).

Olsztyn Airport re-opened for scheduled commercial air transport operations in 2016, following a major development of the terminal, runways and surrounding airspace. In 2017 the airport served over 100,000 passengers (Source: Polish CAA).

Bydgoszcz Airport has experienced significant growth in the past two decades with flight numbers growing steadily to c.6,800 movements per year in 2017. The local airspace is designed to accommodate a diverse mix of users because the airport also serves the general aviation community and hosts a flight training school. (Source: Bydgoszcz Airport).

Łódź Airport opened a new terminal 3 in 2012 with the capacity to serve 1.5m passengers. The airport operates in close proximity to Warsaw Chopin, Warsaw Modlin and the location for the new Solidarity Airport, creating complex, co-dependent airspace arrangements.

| Terminal modernization benefits summary

In support of the extensive plans to expand airport infrastructure in the Warsaw region and across Poland, terminal airspace modernization is expected to generate the following benefits.

Additional Airspace Capacity: by implementing more closely spaced PBN arrival and departure routes to individual airports that are separated by design and require less tactical intervention by controllers to manage traffic interactions.

Greater Flight Efficiency: by designing routes with greater precision and flexibility, reducing track miles and increasing the potential for continuous climbs and descents.

Safety Enhancements: by reducing risk factors in the terminal operation and ensuring they are controlled at an acceptable level in line with the Safety Management System concept set out in ICAO Annex 19, for example by designing out traffic pinch-points and unnecessary route interactions.

Greater Resilience: Additional capacity and the introduction of dedicated routes to/from each airport will strengthen the resilience of the operation to adverse weather and other forms of disruption.

Environmental Improvements: The precision and flexibility of PBN routes creates opportunities to reduce emissions and better manage noise impacts. These opportunities must be balanced against the challenges created by more precise routes that concentrate aircraft noise into narrower contours, and can have a more intense impact on those areas that are affected.

2.2 Modernizing the upper airspace

| Overview of the upper airspace

Aircraft often fly further than necessary in the upper airspace, following routes that are determined by a fixed structure of way points, rather than the shortest, most direct tracks to their destinations. A range of factors determine the sequence of way points that aircraft follow, including weather conditions and the location of flexible airspace structures that can be reserved for military activity.

The capacity and resilience of the en-route operation is largely determined by the ability of air traffic controllers to safely manage the limited volume of airspace. Flow restrictions are applied to sectors when the volume and complexity of traffic exceeds a level that the controllers can manage safely. The restrictions cause aircraft to be delayed or re-routed onto different flight paths.

| a. Implementing free route airspace

The goal of free route airspace is to remove the fixed structure of way points in the upper airspace, enabling aircraft to fly as close to their preferred trajectory as possible.

Free route airspace provides aircraft with the flexibility to flight plan and fly the shortest, quickest, most efficient routes through the upper airspace.

Aircraft route directly between the most efficient combination of free route airspace entry and exit points. Operators can plan and re-plan routes through large volumes of airspace with less restrictions than following the established fixed structure. Flights in free route airspace remain subject to the provision of air traffic services.

Free route airspace is expected to generate the following benefits:

- Additional Airspace Capacity: Created by removing fixed way points and enabling controllers to manage flights through sectors in a more efficient way.
- Greater Flight Efficiency: Created by the flexibility to flight plan and fly more direct routes at more efficient altitudes than available when following the fixed structure. PANSA estimate potential track mile savings of around 4,500 nautical miles per day, equivalent to over 1,650,000 miles per year across all aircraft operating in Polish airspace.
- Safety Enhancements: Generated by additional airspace capacity that reduces the risk factors associated with traffic congestion and peaks in controller workload. Safety benefits are supported by improvements in the predictability of traffic flows and will be managed in line with the SMS approach described in ICAO Annex 19.
- Greater Resilience: Created by the flexibility to plan and re-plan flight paths in response to adverse weather, disruption in other State's airspace and segregated areas.
- Cost savings: Created by optimized airline flight plans resulting in aircraft carrying and burning less fuel. Also, as aircraft weight optimization reduces trip fuel, there is the potential for aircraft to carry more and heavier cargo.
- Environmental Improvements: Created by the reduction in aircraft GHG emissions linked to the fuel burn savings of free route airspace.

| POLFRA Implementation

Free route airspace in Poland (known as POLFRA) is being deployed in line with an Implementing Rule set out in the SESAR Pilot Common Project (PCP), which instructs all European States to remove fixed way points above Flight Level (FL) 310 (31,000ft) before the 1st of January 2022. PANSA aim to deploy POLFRA across Polish airspace from 2019 following an implementation process that will:

- meet safety all objectives in line with the SMS approach in ICAO Annex 19.
- be compatible with existing operations.
- be sustainable through further development.
- be capable of expansion and connectivity with adjacent State's airspace (e.g. through the Baltic FAB).

POLFRA will enable airspace users to freely plan a route from around FL095 (9,500ft) to cruising altitude between any defined entry and exit point on the boundary of the Warsaw FIR, with the possibility to route via intermediate way points if required. The existing route structure will be adapted to reduce complexity, maximize throughput and maintain capacity. Flight plans do not need to reference the fixed ATS route network but will remain subject to air traffic control. POLFRA will not be applied in the terminal airspace, in controlled zones around airports or in uncontrolled airspace.

Chart 03 illustrates the boundaries of POLFRA from FL095 to FL115 along with the locations of Poland's terminal airspace. Chart 04 illustrates the boundaries of POLFRA from FL285 to FL460. Airspace users can file free route airspace flight plans with intermediate points in order to optimize their profile, circumnavigate a particular area, indicate a change in flight level, flight rules or speed, or remain compliant with FIR boundary rules. There is no restriction on the number of intermediate points that can be used.

Aircraft departing from airports located within Poland must plan their flights via the ATS route network from the end of the runway to a published departure connecting point into free route airspace. After that point they may flight plan according to free route airspace rules.

PANSA plans to expand and improve the capability of POLFRA in the years following the initial implementation by removing some of the constraints linked to the ATS route network and establishing efficient cross-border arrangements with free route airspace in Lithuania (through the Baltic FAB) and in Germany, Ukraine and Scandinavia.

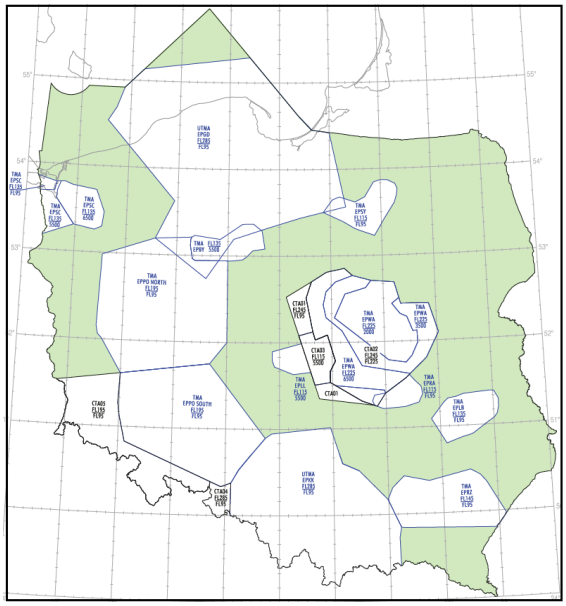

Chart 03 POLFRA boundaries, FL095 - 115

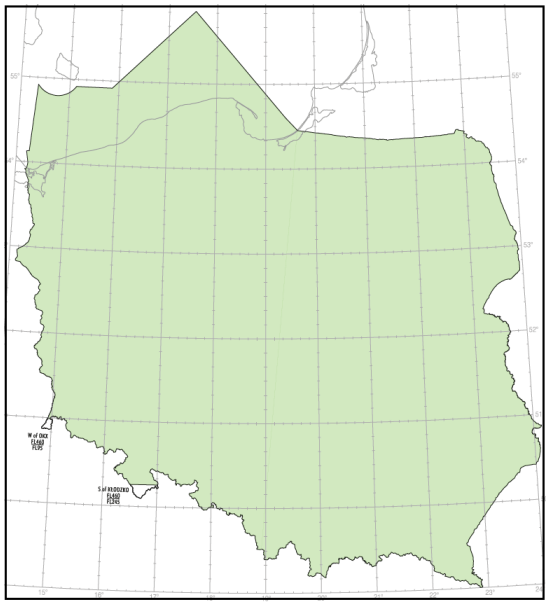

Chart 04 POLFRA boundaries, FL285 - 460

| b. The flexible use of airspace concept

There are flexible use airspace structures established in Polish airspace for essential military activities like training and weapons testing. The military reserve the airspace on a temporary basis and hand it back for civil use when it is not required. The process of temporary reservation and handing back flexible airspace structures that are shared between civil and military users is known as the flexible use of airspace (FUA).

The concept of modernizing the systems and processes used to manage FUA is known as Advanced FUA (A-FUA). The goal of A-FUA is to enable airspace users to fly as closely to their preferred trajectory as possible without being constrained by areas that are segregated for Military activities. A-FUA is a key enabler for free route airspace and allows military users to reserve and release segregated areas more efficiently to best meet their mission requirements.

Improvements in the management of FUA can optimize the use of existing airspace capacity and help to increase capacity. PANSA, the Ministry of National Defence and the Polish CAA are working together to deploy A-FUA by strengthening the technology and processes used for reserving flexible airspace structures.

Flexible airspace structures are essential to maintain operational capability and meet a range of military training and development objectives. While the adoption of new technology and processes provides scope for greater dynamism in the reservation and use of segregated areas, to increase airspace capacity, national security requirements will mean some volumes of airspace will remain inaccessible to non-military users at certain times.

| A-FUA benefits summary

Improving FUA is expected to generate the following benefits:

- Additional Airspace Capacity: by maximizing the opportunities for civil users to plan and fly through segregated areas when they are not activated, allowing air traffic controllers to manage more flights through the same sectors.
- Safety Enhancements: by adding airspace capacity that reduces the risk factors associated with traffic congestion and peaks in controller workloads and by better information about airspace usage that reduces infringements by civil users into segregated areas. Safety benefits will be tracked and controlled following the SMS approach in ICAO Annex 19.
- Greater Flight Efficiency: by the flexibility for civil users to plan and fly more direct routes through segregated areas when they are not activated, reducing flight times and track miles.
- Greater Resilience: by the flexibility to plan and re-plan flights through segregated areas that are not activated to avoid adverse weather and other forms of disruption.
- Environmental Improvements: by the reduction in aircraft GHG emissions linked to the fuel burn savings.

2.3 Modernizing ATM systems and infrastructure

| Modernizing ATM systems

The ASP includes plans developed by PANSA to modernize the ATM systems used by air traffic controllers to manage the flow of traffic safely and efficiently. The modernization of ATM systems is required to enable other key initiatives within the ASP, including the introduction of free route airspace, improvements to FUA, and the modernization of the terminal airspace. The integration of Polish airspace with the wider European network is also enabled by the modernization of ATM systems, which are standardised across State ANSPs through the SESAR programme.

In general terms, the modernization of ATM systems aims to enable air traffic controllers to manage a larger number of flights with more routeing options. Better sharing of flight information between air traffic and other operational stakeholders allows controllers to detect conflicts between traffic flows sooner and more easily, allowing them to increase capacity.

| PEGASUS_21 Upgrades

PEGASUS_21 (Polish Enhanced Generation ATC system for Unified Solutions of the 21st Century) is the main ATM system used by Polish air traffic controllers and is deployed at 150 operational positions in PANSA's control centres and at many airport towers.

The system is currently being upgraded to support the initial introduction of free route airspace by offering better flight tracking and medium-term conflict detection information. The upgrades will also see the introduction of a traffic sequencing tool that enables better arrival management of inbound traffic flows. Arrival management capabilities are an important enabler for the optimization of operations at Warsaw Chopin. In the long-term the PEGASUS system will be replaced by the solution developed according to iTEC principles where leading European States are working together to create a common ATM software platform using a joint set of requirements.

| iTEC - convergence of ATM Systems

iTEC (Interoperability Through European Collaboration) is a family of next-generation ATM systems that brings together the ANSPs of Spain, Germany, the UK, the Netherlands, Norway, Poland and Lithuania. The iTEC concept aims to enable widespread improvements in safety, capacity, flight efficiency and environmental performance across European airspace by enhancing interoperability between control centres and allowing aircraft operators to optimize their flight paths.

The costs of developing iTEC's core components is shared between the participating ANSPs. Where applicable, the development and deployment activities are conducted within the SESAR programme. Systems based on the iTEC principles will feature advanced 4D trajectory management functions and new conflict management tools. The systems will also allow volumes of airspace to be managed in a more flexible and dynamic way, responding to changes in traffic demand, weather conditions or adapting to reservations of restricted airspace.

I Common Airspace Tool - CAT

In order to support and enhance the airspace management process, PANSA has developed an airspace management (ASM) system known as CAT (Common Airspace Tools). The functionality of the system encompasses all phases of airspace management, starting from long term event planning to airspace management in the pre-tactical and tactical phases of the operation.

The system supports both the free route airspace and the conventional environment, including automated processes for the provision of air traffic services, conditional direct routes, the management of restricted areas and real-time coordination of airspace activations.

The CAT system is being used successfully by the Airspace Management Cell in Poland (a joint civil-military unit) and by dedicated ATS units, both civil and military.

At present, a new version of the system is under development by PANSA to meet the requirements coming from the SESAR programme. Some of the features of the new version include:

- Airspace data according to the Eurocontrol AIXM 5.1 format, with requirements for free route airspace.
- Dynamic creation of Updated Airspace Use Plans (UUPs) and online distribution to the Network Manager (via the Network Operations Plan Portal).
- WEB interfaces for external users.
- Visualization of air traffic flow and capacity management data to optimize airspace allocation.

| Flight information displays

In today's operation, many of the decisions made about managing the flow of traffic through Polish airspace in line with available capacity are not based on accurate information. There is often little consistent up to the minute information about when flights plan to arrive at airports, turnaround and then depart. Airports, airlines, air traffic controllers and other operational organisations like the European Network Management Operations Centre (NMOC) all use different information, managed by different systems, and updated at different times.

The gaps in information, and the time and effort needed to close them, reduces the effective capacity of the airspace. For example, the lack of accurate information about inbound, turnaround and outbound traffic flows impacts punctuality at airports. Poor punctuality often has knock on effects throughout the day in the form of rotational delays.

PANDORA is an Information Display System (IDS) designed by PANSA to support controllers by displaying real time data about the current operational situation from a range of different sources, including those internal to PANSA and externally from cooperating organisations such as MET providers, the military, airports and other State ANSPs.

All information is collected in one database and then presented through a customized client software, considering the needs of the individual services being offered.

PANDORA is constantly being developed and modified, allowing it to:

- Adapt to new requirements from the SESAR programme.
- Display new information from new sources.
- Meet the expectations of new and existing users.
- Improve the safety of the system.

2.4 Integrating unmanned operations with manned aviation

Demand for unmanned operations in Poland are expected to increase significantly in the next decade. By 2035 unmanned operations are predicted to become the dominant form of air traffic in terms of the number of flights. During the same timeframe, demand from the established commercial air transport, general aviation and military sectors will continue to grow. New airspace designs, ATM concepts and CNS capabilities are required to integrate unmanned operations with manned aviation in a safe and efficient way that protects resilience and business continuity.

Initiatives to support the integration of unmanned operations in Poland must also align with the wider European approach that is currently under development. The drone sector in Poland has been steadily growing since the publication of the first regulations dedicated to the unmanned operations in 2013.

Unmanned operators are already offering services in sectors that were previously reserved exclusively for manned aviation, including aerial photography, mapping, inspections, agriculture and logistics. Overtime, with the development of new aerial vehicles and supporting services, drones are expected to expand into the air-taxi and personal transport markets.

At present, flights of unmanned aircraft are regulated for operations performed in the visual line of sight (VLOS) and for aircraft weighing no more than 150kg (flights for "commercial" purposes in the weight range 25kg-150kg are subject to additional restrictions). Other operations can only take place in segregated airspace structures. Intensive work is being carried out at international and national level on the possibility of allowing more forms of unmanned operations beyond visual line of sight (BVLOS) and outside segregated volumes of airspace.

PANSA's strategic objectives are focused on accommodating and supporting the rapid expansion of the drone sector and the safe, efficient integration with existing airspace users. These objectives are supported by the design and development of Poland's UAV Traffic Management (UTM) system for the coordination, integration and management of drone flights.

The existing ATM systems that focus on conventional manned aviation (as described in section 2.4) are considered too expensive to adapt directly to the requirements of the unmanned sector.

PANSA is currently working on the development and implementation of an initial UTM system to accommodate existing demand for unmanned operations. However, in a short period of time the demand for drone flights is likely to far exceed the capacity of PANSA air traffic controllers to accommodate. Dedicated IT systems for the management of unmanned operations are expected to be required in the medium to long term. As a result, a dedicated UAV unit has already been created within PANSA.

The initial UTM system is focused on supporting the operation of smaller drones (up to 25kg) in very low-level altitude airspace and the link with DTMs (Drone Traffic Management), which will be deployed for specific purposes (i.e. for metropolitan areas). The UTM system will enable greater automation of the flight coordination process through electronic non-verbal communications between drones operators and PANSA.

Automatic messaging will inform drone operators about the possibility to conduct flights and the conditions necessary to ensure safety and compliance with the regulations. The UTM system will also include the functionality to instantly pass information to operators, so as to ground all UAVs due to, for example, an emergency medical flight.

PART 3: IMPLEMENTATION

3.1 Coordination, engagement and consultation

3.2 Conclusion

3.1 Coordination, engagement and consultation

| European coordination

Many aspects of the ASP form part of the wider SES initiative and SESAR programme. The SES initiative is sponsored by the European Commission and provides the overarching framework to modernize the airspace and ATM network across Europe. The SESAR programme is a key strand of the SES framework that aims to implement new concepts and technologies in support of airspace modernization.

PANSA plays a key role in the development, testing and implementation of key SESAR outputs through the PCP Implementing Rule. The PCP coordinates the deployment of six core ATM functionalities (AFs) that are considered essential for the modernization of airspace across Europe. It is important that the ASP supports the implementation of the functionalities required by the SESAR PCP in the timelines required.

| National approach

In addition to the European level coordination provided by SESAR, the ASP at a national level, aims to provide guidance for the aviation industry on airspace modernization within Poland and in close collaboration with other States' airspace (for example with Lithuania through the Baltic FAB).

Having in mind that the ASP is a document developed between IATA and PANSA and positively recognized by the Minister responsible for civil aviation – it represents a first step in the extension of the strategic coordination for airspace modernization between Polish aviation stakeholders.

European ANSPs operate in highly regulated environment through the planning and monitoring system established by the EU regulatory framework dedicated to the performance scheme for air navigation services and network functions. On the other hand, PANSA is an active player in European and regional initiatives dedicated to the optimization of air navigation services such as the Baltic FAB, A6 alliance, Gate One, B4 Consortium and CANSO. The development of the ASP aims to support and add value to PANSA's inputs into these forums and coordination platforms.

It is important that the ASP document establishes an overview and strategic direction for airspace modernization in Poland, as agreed so far between PANSA and IATA. Thus the national strategy's main role will be, but not limited to:

- Providing the government and regulator with well-considered strategic industry advice on airspace modernization and ATM related matters.
- Providing an assistance to the government works dedicated to the new Solidarity Airport – assuming that the CTH project will have a pivotal role in the development of the whole aviation market in Poland.
- Providing aviation stakeholders in Poland with strategic directions for airspace modernization and a set of key initiatives agreed so far between PANSA and IATA.
- Development of an industry position on the implementation of the key airspace modernization initiatives.
- Assisting stakeholders in the development and deployment of specific airspace and ATM related projects.

| Stakeholder engagement and consultation

The ASP sets out a framework of airspace modernization initiatives, incorporating the requirements of key aviation stakeholders. It also refers to some important factors which will have an impact on all aviation stakeholders, in particular:

- The Central Transport Hub as a 'game changer' in the map of Polish airports and the structure of Polish airspace.
- Forecast air traffic growth in Polish airspace – in terms of numbers of passengers and movements.
- The need to avoid a capacity crunch that is already impacting aviation performance in the core European area, through generating additional airspace capacity.
- Better canalization of air traffic flows – having in mind that Poland is considered a "gateway" between western and eastern air traffic.
- Special attention to research, development and innovation aspects related to ATM (especially those linked to the SESAR Programme).

This edition of ASP is a first step in gathering the common approach and jointly agreed initiatives between all aviation stakeholders on the national level. It is not the complete picture of the Polish aviation sectors requirements and strategic direction regarding airspace and ATM – but the settlement of a solid basis for future works.

A variety of stakeholders will be invited to provide their feedback and contribution to the future editions of the ASP. In this context, stakeholders are invited to:

- Identify how best to incorporate and coordinate the adoption/integration of new and emerging technologies including integration of unmanned operations.
- Develop of a whole of industry view of what communications, navigation and surveillance systems should be capable of achieving in the short, medium and long term.
- Make recommendations regarding continuing investments in, maintenance, or disposal of, key air traffic infrastructure.
- Provide contributions to reviews and make recommendations for the updating of future editions of the ASP.

3.2 Conclusion

The Airspace Strategy for Poland is an expression of the common perspectives of IATA and PANSA. The document covers the agreed scope of initiatives on airspace modernization. In addition, both parties believe that PANSA will provide an important contribution to airspace modernization across Europe. The current evolution of aviation market needs, especially the growing demand for airspace capacity is a major factor which encouraged IATA and PANSA to undertake this bottom-up initiative.

Having regard to the Central Transport Hub project – the ASP aims to contribute to shaping the perceptions of the aviation industry on the role and scope of developments needed not only on the ground (i.e. infrastructure) but also within the airspace structure. The ASP also raises the relevance of the period directly before opening the CTH, which will be crucial for a smooth transition of air traffic management arrangements and passenger traffic flows.

The ASP is positively recognized by the Minister responsible for civil aviation and it aims to be a guidance and advisory document, especially for airspace and ATM modernization related matters, during the preparation of the State-level strategic documents dedicated to the overall development of the aviation sector, Poland's transport infrastructure and the wider economy.