

## RNP APPROACH IMPLEMENTATION IN THE SLOVAK REPUBLIC

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**Summary.** Article describes RNP approach implementation in the Slovak Republic, reasons, drivers, plans, processes and successful completion.

**Keywords:** RNP Approach, PBN concept, implementation

### 1. INTRODUCTION

To keep abreast of technology trends in aviation LPS SR š. p. (Slovak Air Navigation Services Provider) has started to implement PBN concept within Bratislava FIR. The crucial and the most challenging part of the concept is RNP approach implementation. Our intention is to be as much as possible in line with ICAO recommendations and implement approaches with vertical guidance (APV) for all instrument runway ends by the end of 2016.

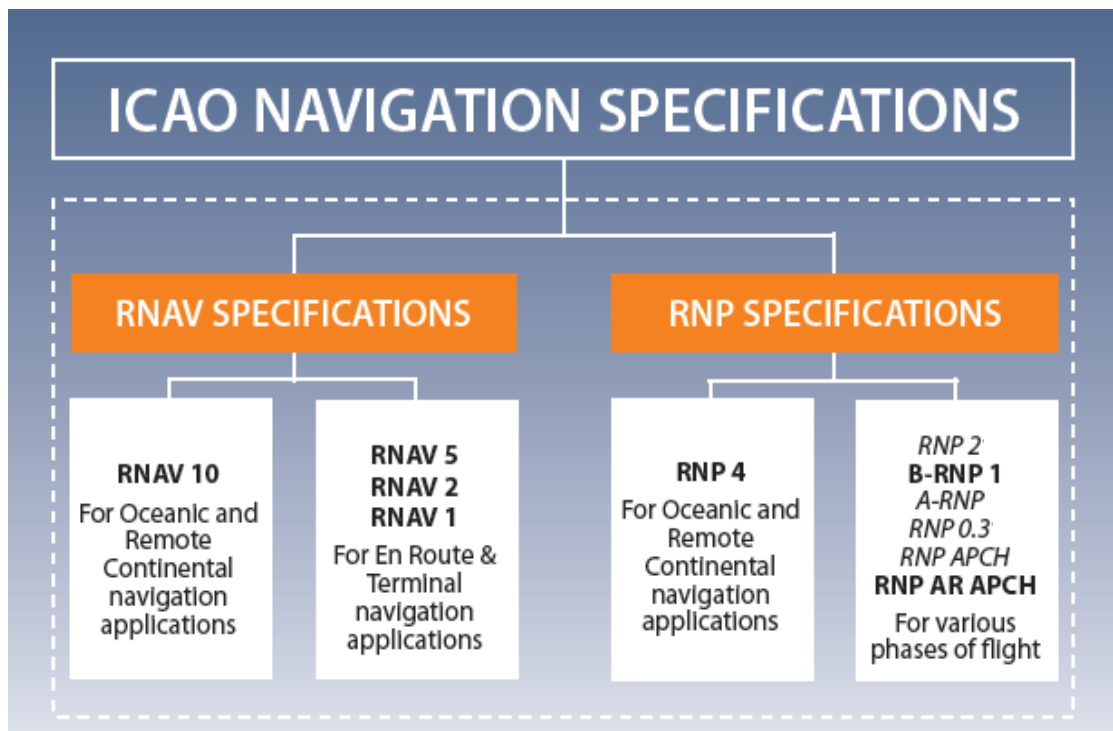
### 2. CIRCUMSTANCES

#### 2.1. Prior to Performance based Navigation (PBN)

Instrument navigation was originally based on use of ground navaids such as NDB, VOR and DME. From early 1970s, digital avionics have begun to appear on board, enabling aircraft automatically fly the ATS route network. These computers are known as area navigation (RNAV) systems, which allowed a restructuring of the route network independent from ground navaids. In 1998 BASIC RNAV (B-RNAV) equipment became mandatory en-route in ECAC area. The first decade after introducing of Area Navigation was influenced by developing of a variety of navigation applications. To bring more quality on area navigation, definitions and terminology the standardisation was required.

#### 2.2. The PBN Concept

In 2008 PBN concept was introduced, which allows global harmonization of existing implementations and establishes a basis for harmonization of future operations. The standardisation of navigation application, based on limited number of navigation specifications and navigation infrastructure was the main objective of the concept. There are two types of navigation specifications in PBN concept, RNAV and RNP. The only difference between them is that RNP specifications include requirements for on-board performance monitoring and alerting.



**Figure 1** Navigation specifications

### 2.3. ICAO Recommendations

The main drivers of RNP Approach implementation have been ICAO recommendations. The first was resolved at the 36<sup>th</sup> ICAO Assembly (Oct 2007):

“Implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30% by 2010 and 70% by 2014.

Concerning Approach with vertical guidance (APV), the resolution of 37<sup>th</sup> ICAO Assembly Oct 2010) added:

“Implementation of straight-in LNAV only procedures, as an exception, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations.

### 3. RNP APPROACHES

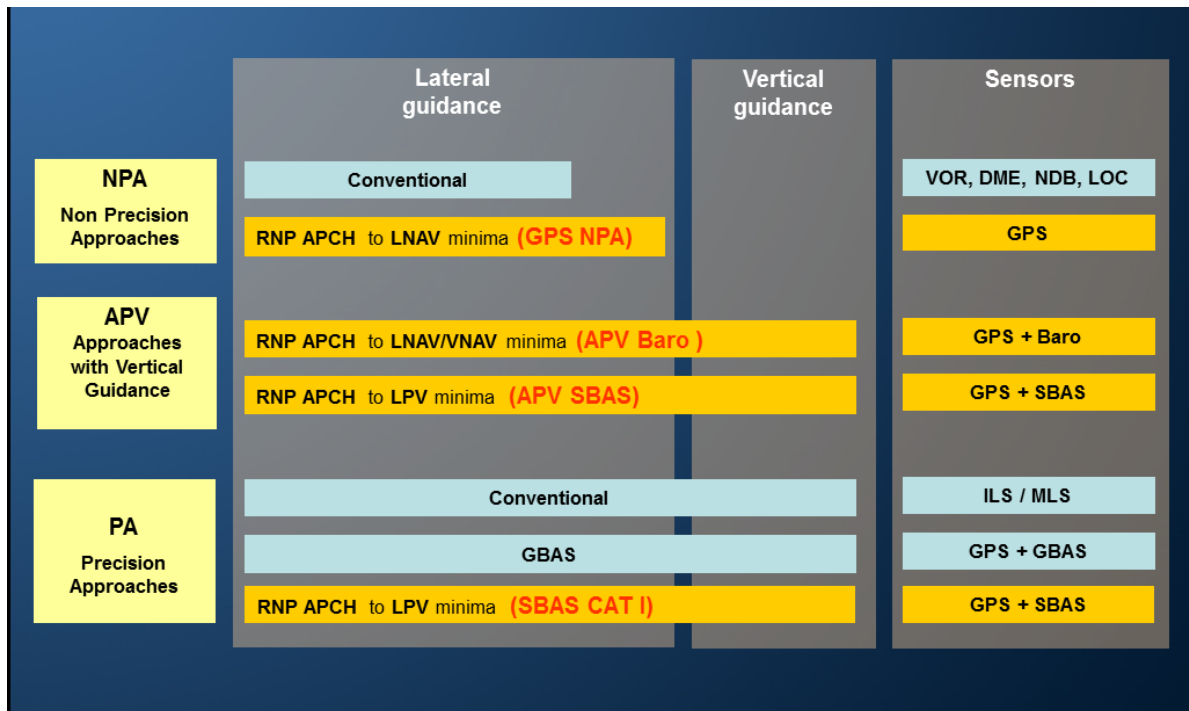


Figure 2 RNP APCH in-between conventional approaches

In accordance with implementation process in the Slovak Republic we can speak about 3 types of RNP approaches distinguishable by the minima they are leading to (LNAV, LNAV/VNAV and LPV) as shown in Fig. 2. The values of OCH minima per approach type are shown in Fig. 3.

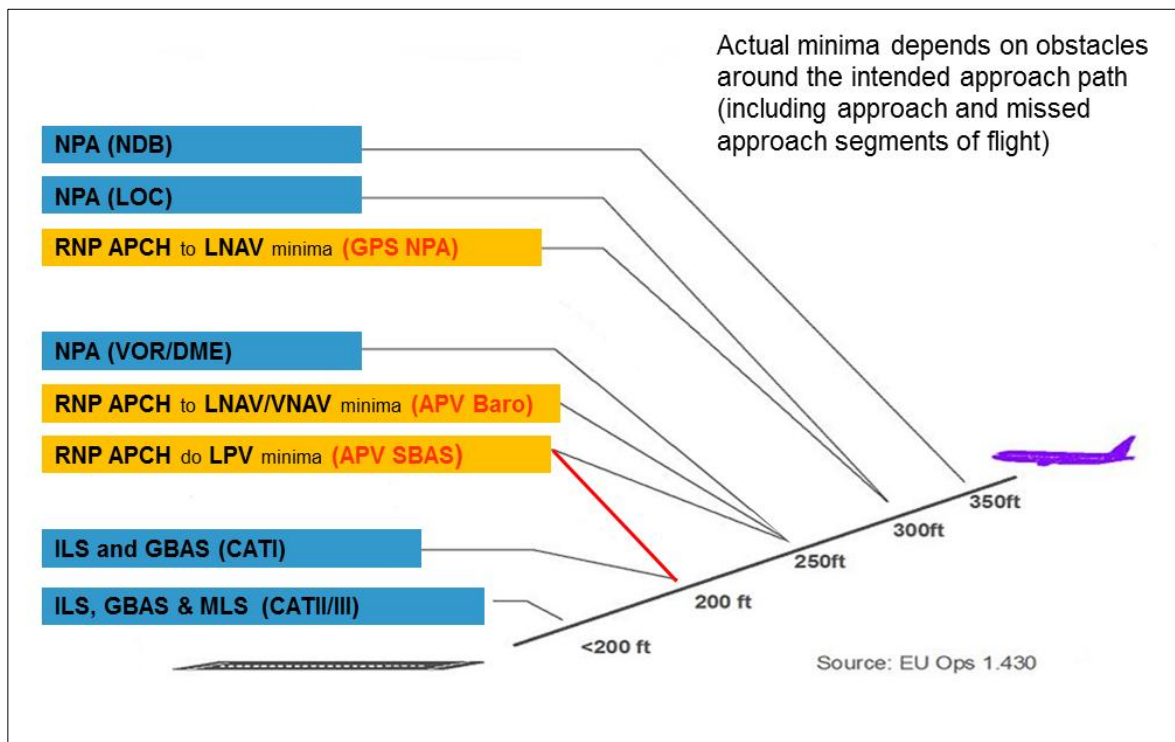


Figure 3 Minimum OCH per approach type

### 3.1. Short description of RNP approaches

GPS NPA (RNP APCH to LNAV minima), shortly also “LNAV” is approach conducted to a minimum descent altitude/height with lateral guidance only based on GPS (with RAIM).

APV BARO (RNP APCH to LNAV/VNAV minima), shortly also “LNAV/VNAV” is approach conducted to decision altitude/height with lateral guidance based on GPS (with RAIM) and vertical guidance based on Baro.

APV SBAS (RNP APCH to LPV minima), shortly also “LPV” is approach conducted to a decision altitude/height with lateral and vertical guidance based on SBAS.

### 3.2. EGNOS and APV SBAS

EGNOS (European Geostationary Navigation Overlay Service) is a Satellite Based Augmentation System (SBAS). SBAS systems are designed to augment the navigation system constellations by broadcasting additional signals from geostationary (GEO) satellites.

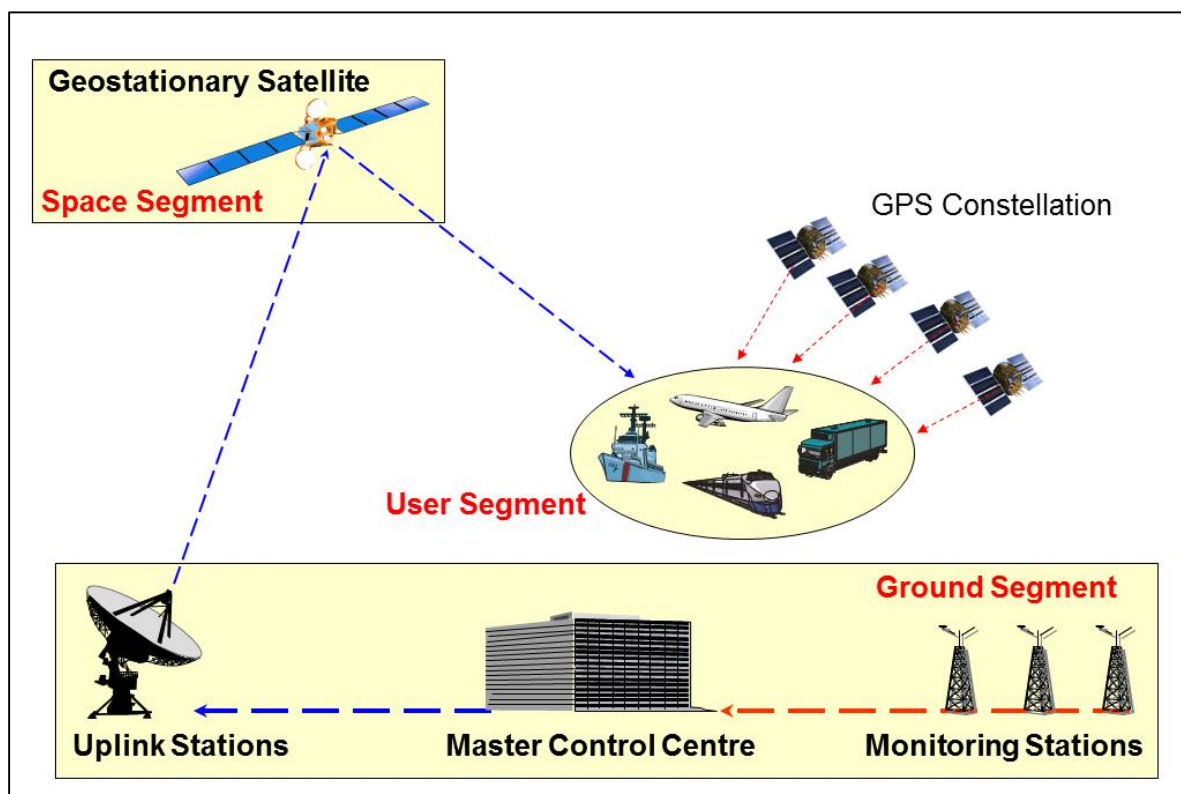


Figure 4 EGNOS components

To support civil aviation operations down to LPV (Localiser Performance with Vertical guidance) minima EGNOS Safety of Life Service has been available since 2<sup>nd</sup> March 2011.

The first LPV procedure in Europe is operational in Pau (France) from 17<sup>th</sup> of March 2011, the first LPV procedures in the Slovak Republic are operational in Bratislava and Košice from 5<sup>th</sup> of February 2015.

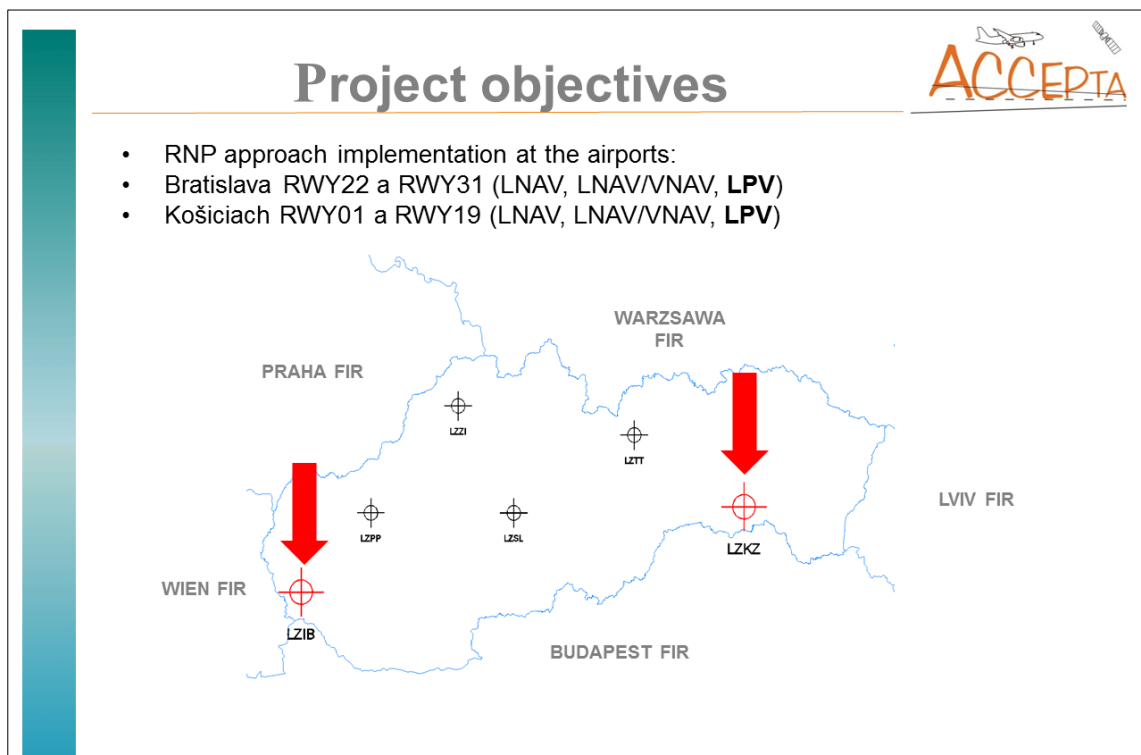
To enable operations down to OCH 200 ft, the EGNOS LPV-200 Service was declared operational on 29<sup>th</sup> September 2015. It enables aircraft approach procedures that are operationally equivalent to CAT I instrument landing system (ILS) procedures.

The first LPV 200 or SBAS CAT I approach was implemented at Paris Charles de Gaulle Airport on 3<sup>rd</sup> of May 2016. Consequently the first LPV 200 procedures in the Slovak Republic are planned to be effective on 2<sup>nd</sup> of February 2017.

## 4. IMPLEMENTATION PROCESS IN THE SLOVAK REPUBLIC

### 4.1. Project ACCEPTA (2012-2014)

Everything started in 2012 when LPS SR was involved in the project ACCEPTA (ACCelerating EGNOS AdoPTion in Aviation). The project objectives from our point of view were development and publication of RNP approaches down to all 3 minima (LNAV, LNAV/VNAV, LPV) at airports Bratislava and Košice as it is shown in Fig. 5. At that time EGNOS LPV-200 Service had not been available, therefore the third type of RNP approach is constructed as “LPV only” approach (decision height is not below 250 ft)



**Figure 5** ACCEPTA project objectives

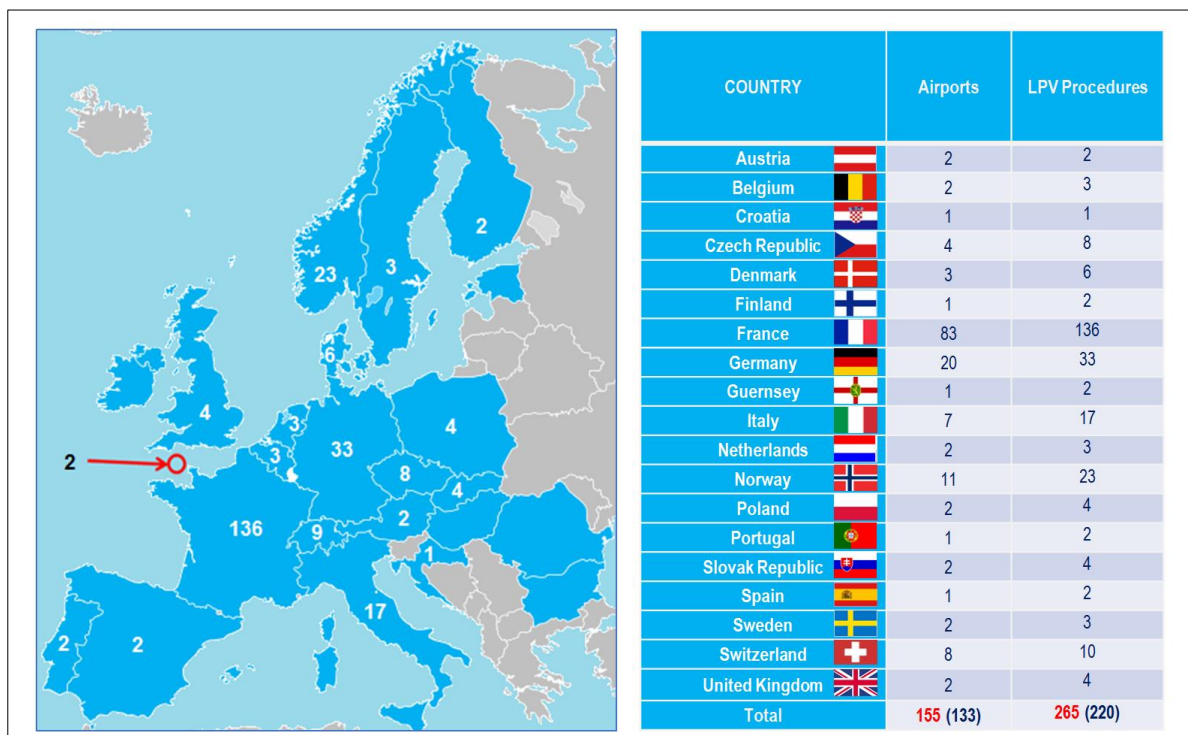
The list of the project milestones gives us the clue how demanding is the implementation process:

1. Feasibility report
2. Obstacle survey
3. RNP APCH procedure design / incl. internal verification
4. Ground validation and flight validation
5. Operational concept
6. Charts development
7. Safety assessment
8. Introduction into service and ATCO training
9. EGNOS working agreement (EWA) preparation

After almost 2,5 years of work the first results appeared:

10. 1<sup>st</sup> of January 2014 Signature of EWA (EGNOS Working Agreement)
11. 30<sup>th</sup> of October 2014 AIC A4/14 Publication – Implementation of RNP APCH in the Slovak Republic
12. 23<sup>rd</sup> of December 2014 AIRAC AIP AMDT NR 164 - Procedures publication
13. 5<sup>th</sup> of February 2015 finally RNP Approaches have become valid

It had taken almost 3 years to complete the work and get Slovakia “blue” with number 4 as a number of instrument runway ends covered by RNP APCH (LPV included).



**Figure 6** Getting blue

The implementation of RNP approaches at airports in Bratislava and Košice was done under umbrella of ACCEPTA funding, a European grant given by GSA (European GNSS Agency) to foster the use of EGNOS in the aviation domain. The next intention was to implement RNP approaches at airports in Piešťany, Žilina and Poprad.

#### 4.2. Project IMPROWE (2015-2017)

After the successful completion of ACCEPTA project, the project IMPROWE (IMplementing RNP APCH Operations With Egnos) with participation of LPS SR, Austrocontrol and German company DLR as project coordinator has started. The project objectives from our point of view were development and publication of RNP approaches down to all 3 minima (LNAV, LNA/VNAV, LPV) at airports Piešťany, Žilina and Poprad-Tatry as shown in Fig. 7. We plan to implement LPV 200 procedures at these airports. Only 5 airports within Europe (4 in France and 1 in Switzerland) have been covered by this type of procedure so far.



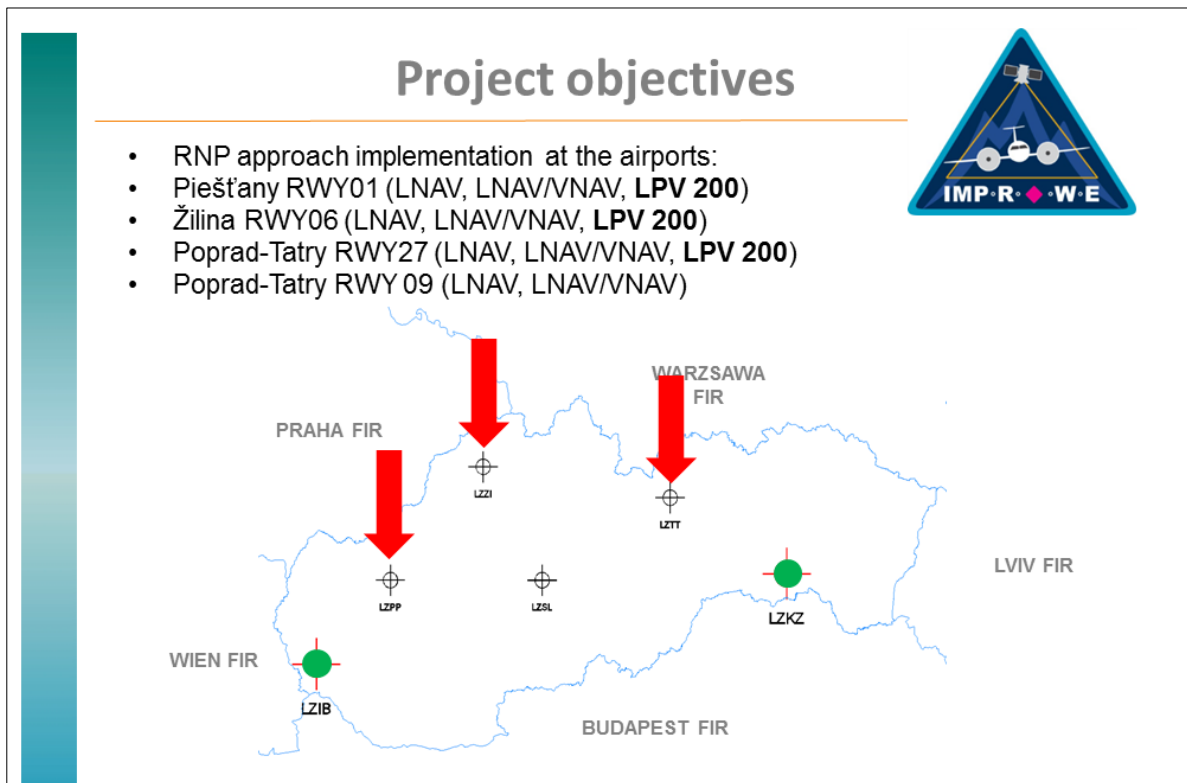


Figure 7 IMPROWE project objectives

#### 4.3. Project SPICE (2016-2020)

SPICE (Synchronised PBN Implementation Cohesion Europe) is last but not least project for the time being. The project objective is an upgrade of LPV to LPV 200 procedures at airports Bratislava and Košice. In addition RNAV standard instrument departures and arrivals are going to be implemented under this project. From the point of view of navigation infrastructure, the project objective is DME-DME coverage improvement by increasing the number of DME stations.

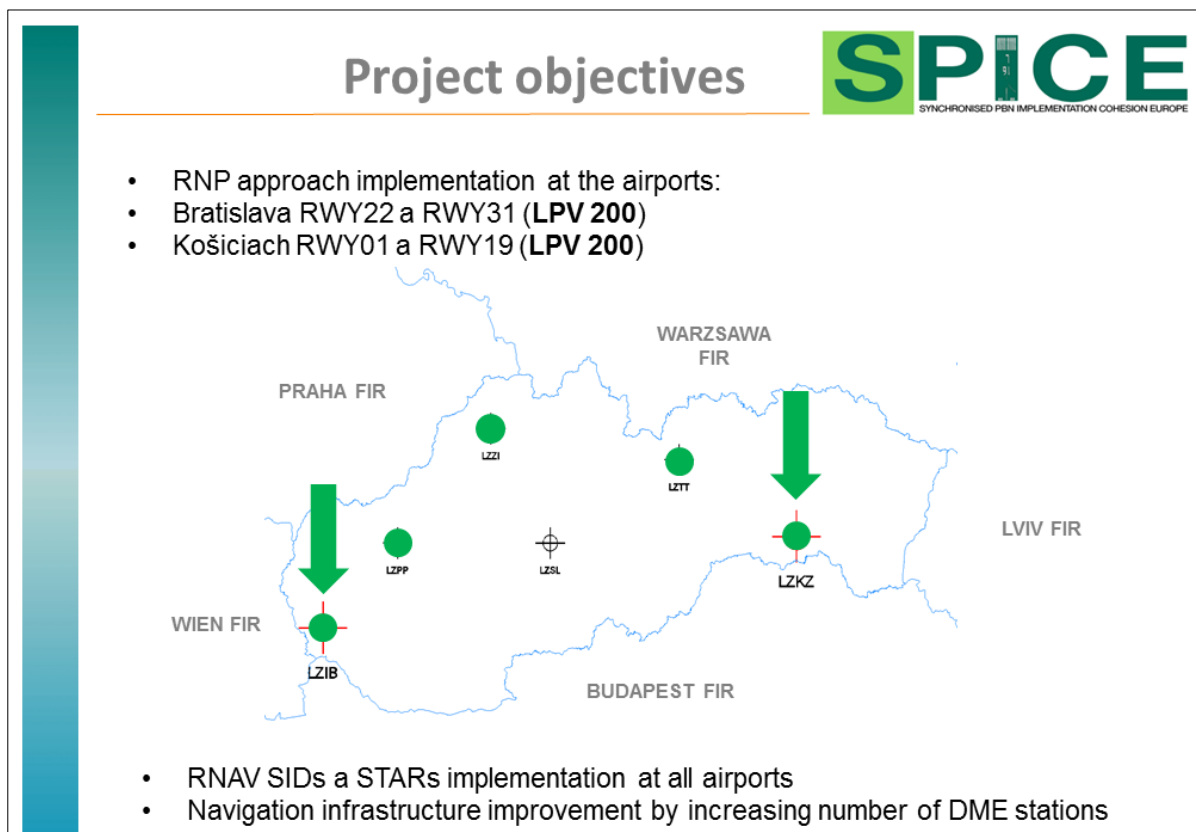


Figure 8 SPICE project objectives

## 5. CONCLUSION

RNP approaches implementation at the airports where ANS are provided by LPS SR is going to be completed in the first half of 2017, almost in line with ICAO recommendations.

The main goal of RNP approaches implementation is increasing the safety, because continuous descent guidance is provided to the aircrew. This makes the approach easier to fly and reduces chances of controlled flight into terrain (CFIT).

It could be mentioned also reductions in minima to a level equivalent to ILS CAT I, which can allow successful approaches in bad weather conditions (in case the ILS is out of operation), which would otherwise cause a missed approach, delay or cancellation of the flight.

Once GNSS-based procedures are widely used, some airports could de-commission ground based navigation aids accordingly.