Presentation of the First Deputy Director, Scientific and Research Institute of Airnavigation

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PBN implementation plan for the Russian airspace and its first results

PBN TF/8 meeting, Paris 23-24 January 2013
In accordance with Resolution A36-23 of the ICAO Assembly, a plan has been drawn up in the Russian Federation for the introduction of PBN in Russian airspace. The plan has been drawn up based on Performance-based Navigation (PBN) Manual (Doc 9613) in order to implement the benefits of PBN with minimal expense for aircraft operators and air navigation service providers, and to integrate the Russian air navigation system into the regional European and international air navigation systems. The plan has been published on the website of the European and North Atlantic (EUR/NAT) regional ICAO office under the section http://www.paris.icao.int/documents_open_meetings/files.php?subcategory_id=78.
Selection of PBN specification to be implemented in the Russian Federation

The main initial data on selecting a specification are aircraft fleet condition and its development prospects, navigation infrastructure and governmental decrees.

In view of these conditions the implementation of the following main PBN specifications is considered expedient:

RNAV-5 for aircraft en-route operations in the upper airspace along area navigation paths. This type of specification can be implemented for the most of existing aircraft on the base of VOR/DME.

RNAV-1 for operations in the terminal area and landing approaches.

The selection of these specifications types is based on the following:

1) It is really achievable for the existing aircraft fleet.

2) The use of lower accuracy in the terminal area is not reasonable as it will not allow to attain advantages of area navigation.
RNAV-5 procedures implementation is possible on the basis of the following systems:

- VOR/DME;
- DME/DME;
- GNSS.

RNAV-1 procedures implementation is possible on the basis of the following systems:

- DME/DME;
- GNSS.
Characteristics of the radio navigation field in the Russian airspace

Currently the navigation service for aircraft operations when flying along the Russian air paths is provided by 386 non-directional beacons. In general, there is a large number of NDBs in Russia operated, among them separate NDBs – 716, locator middle with middle radio marker and locator outer with outer radio marker – 1514. NDBs do not meet the requirements to modern navigation due to low navigation accuracy and lack of the possibility to be used for automated aircraft navigation.

The navigation service is also provided by 34 complex (D)VOR/DME facilities installed mainly on the aerodromes. Characteristics of azimuth radio beacons (D)VOR/DME meet all modern navigation requirements. The use of this equipment allows to carry out flights in area navigation conditions along air paths, but they cannot be used as an area navigation means in terminal areas.
Radio navigation fields produced by installed radio beacons (D)VOR/DME at a height above H=3600 m
Radio navigation fields produced by radio beacons (D)VOR/DME installed and planned for installation at a height above $H=3600$ m for operations per RNAV-5 requirements.

In accordance with the FTP «ATM upgrading» it is planned to install (D)VOR/DME in 69 locations.
Radio navigation system on the basis of DME/DME

The radio navigation system formed by DME/DME has better navigation performance compared to the complex (D)VOR/DME.

It is planned to install 39 DME facilities in the area of responsibility of the Moscow ACC. It will lead to the possibility to provide operations using area navigation methods:

RNAV-1 with the flight altitude of 500 m and above in the terminal areas of the Moscow hub;

RNAV -2 with the flight altitude of 3600 m and above in the whole area of responsibility of the Moscow ACC.
Radio navigation field DME-DME at the height of 500m (RNAV1) in the airspace of the Moscow hub terminal areas
Radio navigation field DME-DME at the height of 3600m (RNAV2) in the area of responsibility of the Moscow ACC
Surveillance methods with regard to their functional capabilities to serve operations with the use of RNP and RNAV navigation specifications

The concept of area navigation implementation implies operations in controlled airspace.

Currently the secondary surveillance radar field covers the Russian airspace virtually completely, with the exception of the Northern part of North-Eastern Siberia where the primary radar field exists.

Automated Dependent Surveillance (ADS-B) is expected to be more and more significant, in airspaces with procedural control as well.

Radar surveillance of the ATC system must be used to support the specified path in case of coarse errors of the navigation system.
Automation technologies for ATC processes

The PBN implementation may require upgrading of the automation technologies for ATC processes to provide controllers with necessary information on aircraft capabilities.

Such changes may include:

• Modifications of software for flight data processing (FDP) of the automated air traffic system;
• If necessary, modification of software for radar data processing (RDP);
• Necessary modifications of the ATC air situation display;

In January of 2012 the Amendment №1 to Doc. 4444 was implemented with changes of the ICAO flight plan form for fields 10 and 18 related to PBN.
Conclusion:

The navigation infrastructure in the Russian Federation is defined by separate (D)VOR/DME, which do not provide a continuous navigation field. It is practically impossible to create a continuous radio navigation field in the Russian Federation with the help of conventional ground means.

This can be provided by the Global Navigation Satellite System (GNSS).
GNSS use in area navigation operations

In view of the Russian geography, extensive use of the PBN conception will be possible only after large-scale implementation of satellite navigation systems GLONASS/GPS and their augmentations GBAS and SBAS in the Russian Civil Aviation industry.

By now a suite of regulatory documents has been prepared that allow to use GNSS as the main means of aircraft navigation en-route and in the terminal airspace, which will enable implementation of RNAV procedures based on the GNSS use.
KEY ACTIVITIES ON PBN IMPLEMENTATION

Development and approval of necessary regulatory legal documents on the use of GNSS as the means of compliance with the requirements to PBN operations.

Accomplishment of the geodetic surveying of aeronautical marks in the terminal airspace.

Development of PBN routes in airways and in the terminal airspace with regard to flight safety level assessment, and their publication in the Russian AIP.

Development and approval of regulatory legal documents on authorization of Russian operators’ aircraft to PBN operations.

Crews training for carrying out PBN operations.

Controller’s staff training to provide PBN operations, in mixed flights also.
Geodetic surveying of aeronautical marks (ANM) at the Russian aerodromes

By now geodetic surveying of 84 Russian aerodromes is accomplished in the system PZ-90.02:

Of which - 27 international and federal aerodromes (total - 34);
International – 0 (total - 34);
Federal - 4 aerodromes (total - 51);
Others - 53 aerodromes (total - 249).
Existing regulatory legal documents related to the use of satellite navigation

1. Letter of 10.10.98 № 3.10-41 of the Federal Aviation Service (FAS) of Russia «On implementation of the Regulations on Procedure of aircraft authorization for BRNAV operations in the European region», sent to the addresses of regional directors of FAS, and directors of airlines, enterprises and organizations under the jurisdiction of FAS of Russia;

2. Order of the Federal Aviation Service of 4.03.1998 № 61 «On implementation of airborne GPS receivers in the Russian Civil Aviation services»;

3. Instruction of the State Civil Aviation Authority of 25.01.2002 № HA-36-p «On implementation of technical requirements to support and carry out procedures for non-precision approach with area navigation via a satellite navigation system»;

4. Instruction of Ministry of Transport of the Russian Federation of 4.02.2003 № HA-21-p «On implementation of recommendations on aircraft preparation and operators’ training for P-RNAV (precise area navigation) operations in the European region with RNP-1 requirements». 
Existing regulatory legal documents related to the use of satellite navigation (continued)

5. Qualification requirements
KT 34-01 «Airborne equipment of satellite navigation», 4th revision;
KT-253 «Airborne equipment of GNSS/GBAS»;
KT-229 «Airborne equipment of GNSS/SBAS».


8. Instructions on designing en-route and terminal flight procedures with RNAV.
Existing regulatory legal documents related to the use of satellite navigation (continued)

9. Provision on support and execution of operations in the terminal area during arrivals and departures with area navigation via a satellite navigation system.

10. Provision on validation of flight safety with area navigation procedures implementation.

11. List of equipment subject to equipping with means of global navigation systems GLONASS or GLONASS/GPS to the benefit of air navigation service.

Normative legal documents subject to approval

1. «Instructions on the use of the Global Navigation Satellite System in the Russian Civil Aviation».

2. FAR «Radio communication procedures in the airspace of the Russian Federation».

PBN implementation strategy in the RF

The PBN implementation strategy in the RF implies three stages:

• Short-term - 2009-2012;
• Mid-term - 2013-2017;
Short-term PBN implementation plan (2009-2012)

In ocean airspaces and on remote continental routes
Provision of RNP-10 for aircraft operations on area navigation paths over the Arctic Ocean and other open waters where the Russian Federation is responsible for ATM, and on paths in remote continental regions with poor ATM infrastructure with the use of navigation based on an autonomous airborne navigation system and GNSS.

In continental airspace
Implementation of RNAV-5 for aircraft operations on area navigation paths in continental regions with the use of navigation based on an autonomous airborne navigation system, VOR/DME, DME/DME and GNSS;

In the terminal area
Implementation of SID/STAR operations (up to 5% of non-international and up to 20% of international airports) with RNAV-1 for aircraft equipped with DME/DME and GNSS. Conventional maneuvering procedures and ATM for mixed conditions also remain.

Landing approach
Implementation of RNP APCH including Baro-VNAV, in international airports (up to 20% of international airports).

At this conventional navigation equipment and approach patterns will remain.
Implementation of precision approaches per ICAO Category I for aircraft equipped with GNSS/GBAS in a number of airports (up to 30 airports including 20 international airports).
Implementation of PBN in aerodromes

STAR and SID procedures are developed and published that are based on area navigation via the satellite navigation system (RNAV GNSS). Specification RNAV-1 is used. Currently these procedures are published in AIP documents for 15 aerodromes.

Approach procedures (APPROACH) are developed and published that are based on area navigation via the satellite navigation system (RNAV GNSS). Specification RNP APCH is used. Currently these procedures are published in AIP documents for 16 aerodromes.

When developing precision and non-precision approaches via the satellite navigation system, a calculation of minimum safe obstacle clearance altitudes for Baro/VNAV is performed. These values are planned to publish on procedures: as an appendix in the precision approach procedures (GLS); as an option for approaches with vertical guidance (APV) in non-precision approach procedures (NPA).
**Approach procedure of the Surgut aerodrome**

**Diagram:**
- **Surgut, Russia (Surgut Runway RNAV (GNSS) VNP 07):**
  - Approach procedure details with diagrams showing the approach path, waypoints, and altitude changes.
  - Minimum Instrument Departure (MID) details are provided.
  - Minimum Instrument Approach (MIA) details are provided.

**Text:**
- Approach procedure guidelines for safe landing at the Surgut aerodrome.
- Specific instructions for pilots regarding approach and descent.
- Diagrams illustrating the approach path with key points and altitudes.
**SID RNAV GNSS, STAR RNAV GNSS procedures published in the Russian aeronautical information documents as of 02 August 2012**

<table>
<thead>
<tr>
<th>Airport name</th>
<th>Procedure</th>
<th>Runway</th>
<th>Last publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vladivostok (Knevichi)</td>
<td>STAR RNAV GNSS</td>
<td>07L,R; 25L,R</td>
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<td>2. Vnukovo</td>
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<td>01/19</td>
<td>17.11.11</td>
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<td>3. Domodedovo</td>
<td>STAR RNAV GNSS</td>
<td>14R,L/32R,L</td>
<td>17.11.11</td>
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<td>4. Yekaterinburg</td>
<td>STAR RNAV GNSS</td>
<td>26L/26R</td>
<td>31.05.12</td>
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<tr>
<td>5. Kazan</td>
<td>STAR RNAV GNSS</td>
<td>11L 29R</td>
<td>28.06.12</td>
</tr>
<tr>
<td>8. Mineralnye Vody</td>
<td>SID RNAV GNSS, STAR RNAV GNSS</td>
<td>12/30</td>
<td>31.05.12</td>
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<td>9. Murmansk</td>
<td>SID RNAV GNSS, STAR RNAV GNSS</td>
<td>13/31</td>
<td>31.05.12</td>
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<tr>
<td>10. Nizhnevartovsk</td>
<td>STAR RNAV GNSS</td>
<td>03/21</td>
<td>28.06.12</td>
</tr>
<tr>
<td>11. St.-Petersburg</td>
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<td>10L,R/28L,R</td>
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<td>13. Tyumen</td>
<td>STAR RNAV GNSS</td>
<td>03/21  12/30</td>
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<td>14. Sheremetyevo</td>
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<td>07R,L/25R,L</td>
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<td>15. Yakutsk</td>
<td>SID RNAV GNSS, STAR RNAV GNSS</td>
<td>05R/23L</td>
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### NPA GNSS procedures published in the Russian aeronautical information documents as of 02 August 2012

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<td>15/33</td>
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PA GNSS (GLS) procedures published in the Russian aeronautical documents as of 02 August 2012

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SID RNAV GNSS, STAR RNAV GNSS procedures developed by FSUE SRDI for Airnavigation, but not published in the Russian aeronautical documents as of 02 August 2012

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<td>1. Nizhny Novgorod</td>
<td>1. Surgut (SID development, STAR adjustment)</td>
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<td>(Vityazevo)</td>
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<td>4. Sochi</td>
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In ocean airspaces and on remote continental routes
Beginning of RNP-4 implementation for aircraft operations on area navigation paths over the Arctic Ocean and other open waters where the Russian Federation is responsible for ATM with the use of navigation based on an autonomous airborne navigation system and GNSS.

In continental airspace
Continuation of RNAV-5 implementation on paths in continental regions of the Russian Federation (up to 60% paths) with the use of navigation based on an autonomous airborne navigation system, VOR/DME, DME/DME and GNSS.

In the terminal area
Implementation of SID/STAR operations (up to 15% of non-international civil airports and up to 60% of international airports) with RNAV-1 for aircraft equipped with DME/DME and GNSS. Conventional maneuvering procedures and ATM for mixed conditions also remain.

Landing approach
Implementation of precision approaches per ICAO Category I for aircraft equipped with GNSS/GBAS (up to 70 airports including 50 international airports).

At this conventional navigation equipment and approach patterns will remain.

Helicopters operation
Authorization for en-route operations, maneuvering in the area of terminal/landing place, approaches with RNAV-1 of helicopters equipped with GNSS, and precision approaches for helicopters equipped with GNSS/GBAS.

Deployment of ADS-B infrastructure as a means of surveillance in locations of intensive helicopter operations including regions of hydrocarbons production.
Long-term PBN implementation plan (2018-2022)

This period is characterized by full deployment of the GNSS infrastructure in the Russian airspace.

In ocean airspaces and on remote continental routes
Accomplishment of the transition to RNP-4 for aircraft operations on paths over the Arctic Ocean and other open waters where the Russian Federation is responsible for ATM based on INS and GNSS.

In continental airspace
Accomplishment of the RNAV-5 implementation on paths in continental regions of the Russian Federation with navigation based on INS, VOR/DME, DME/DME and GNSS.
Partial transition from RNAV-5 to RNAV-2 in airspace with high density air traffic.
Reduction of paths used by aircraft not equipped with RNAV systems.

Aerodrome airspace
Implementation of SID/STAR operations (up to 50% of non-international civil airports and up to 100% of international airports) with RNAV-1 for aircraft equipped with DME/DME and GNSS. In some cases conventional navigation aids may not be restored.

Landing approach
Implementation of RNP APCH including Baro-VNAV in international airports.
Implementation of precision approaches per ICAO Category I for aircraft equipped with GNSS/GBAS, beginning of implementation of approaches per ICAO Categories II/III with the use of GBAS.
In some cases conventional navigation aids may not be restored.
Beginning of implementation of approaches type RNP AR APRCH.

Helicopters operation
Wide use of GNSS together with ADS-B to provide services for helicopters at all flight stages.
The use of RNP AR APPROACH procedures at the Sochi airport to lower meteorological minima for the period of 2014 Winter Olympic Games
Группа вариантов В

Вариант В4

Вариант В5

Минимумы для посадки при использовании RNP AR TBD

Градиент при уходе % 2,5 3 4 5
ВНР (м) 235 195 170 160

Минимумы для посадки при уходе левым разворотом TBD

Государственная граница
Current objectives in the context of PBN implementation for the Russian airspace

1. To select efficient ways for PBN implementation in the Russian airspace with regard to national features.

2. To prepare version 2 of the PBN implementation plan for the Russian airspace.

3. To speed up the implementation of PBN in the Russian airspace.