PBN Hybrid Procedures as an Enabler for Airport Accessibility in Challenging Terrain

*the example of Innsbruck/Austria*

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Where did we come from? A little bit of history

- we are facing complex terrain challenges in Innsbruck
- after only having a cloud break procedure with high minima initially, the first real answer to it was the LOC/DME East approach for RWY26 in 1980
- procedure minima (OCH) between 3010 ft (for 2.5% climb gradient) down to 1410 ft (for 5%) could be achieved now without special approval
Where did we come from? A little bit of history

- the real “quantum leap” came in 2005 with the publication of Europe’s first RNP AR approach to RWY 26

- minima (DH) could be reduced to as low as 710 ft (for RNP 0.3) or even 610 ft for RNP 0.15

- despite enormous improvement the winter season 2012/13 showed that critical morning fog banks can still require lower minima
Innovation does the trick: The LOC/RNP Merge

- concept of conventional/PBN merge concepts

- no ICAO guidelines as yet, however strong potential seen by ICAO and airspace users

- discussed widely during the ICAO PBN Workshop 2012 in Montreal (examples shown from Seattle/USA)

- idea came up to use “the best of both worlds” (LOC App and RNP MApp) for Innsbruck – Austria and Austro Control once again in pioneer role in Europe

- intensive stakeholder integration followed after initial drafts and led to the well-tested and proven LOC R approach, which went live on Nov 14th, 2013
What is the idea behind the LOC/RNP merge?

The idea is to use the very tight protection area for the LOC Approach, which goes below the RNP 0.3 protection in close Vicinity of the the LOC station - green area can be disregarded!
And here it is:

WI007 LOC-RNP transition

Up to 350ft lower than RNP AR!
Requirements established together with Aircraft Operators

- transitioning from LOC approach mode to RNP missed approach track
- making sure NAV mode can transition directly to LNAV (RNP 0.3) from previous LOC tracking (TOGA to LNAV)
- appropriate crew training for both conceptual and situational awareness of this new type of “hybrid” approach
- No navigation based on FMS “overcoding” allowed, NAV source has to be the LOC/DME on final approach, before transitioning to GNSS/INS based RNP 0.3 missed approach
- the procedure is an AUTHORIZATION REQUIRED procedure, just like the RNP AR RWY26 approach
Benefits of the new LOC R Approach

- with 5% climb gradient the minimum (height) is reduced from 710 ft in the RNP AT to 360 ft (!) on the LOC R Approach!

- this is achieved by the tighter LOC protection area at close range to the LOC station, thus avoiding an otherwise critical obstacle

- the approach combines “known and proven” elements that existed previously (the LOC/DME final approach and the RNP missed approach from the RNP AR procedure)

- a slight LOC beam correction to the south (angular change by 1,5 degrees) provides better alignment with runway (only 3,5 degrees track change and RWY C/L – LOC C/L crossing around 1 nm before TD) and provides better flight comfort

- the 350 ft improvement in the minimum guarantees better accessibility in critical winter season!
User Response and Feedback

- High acceptance on operators' side due to the early inclusion in the design process.

- Flyable by all RNP capable aircraft currently flying to Innsbruck (Embraer 190/195, Airbus A320 family, Boeing 737NG, Bombardier Dash 8 Q400).

- Approval process can be combined with a “package” approval for all RNP AR procedures at Innsbruck (including an AR SID), which is seen as a very user-friendly solution.

- NAV mode-change is perceived as manageable without additional workload and easily monitored.

- One airline has made the AR procedures the default approach type for their Innsbruck operation.

- ANSP/CAA oversight can be easily managed through the AR approval process, i.e. no risk of non-familiarized users.
International Recognition

AIR TRANSPORT

OPERATIONS MICHAEL GUBISCH INNSBRUCK

Hybrid is right approach for Innsbruck

According to Air Berlin’s Boeing 737 fleet manager Michael Touzas, the hybrid approach the carrier is using at Innsbruck’s Alpine airport “combines the best of both worlds” from traditional radio-based instrument landing systems and the new required navigation performance procedure.

The airline started using an RNP-based approach for the Alpine gateway’s runway 26 in 2012. The carrier lowered the decision height from 1,500ft for the standard ILS to around 700ft under the satellite navigation RNP procedure, also cutting visibility from 3,700m to 2,400m.

However, since December 2013 the airline has been employing a hybrid approach, which has further reduced the decision height to 360ft — thus enabling the carrier to land in weather conditions characterised by lower cloud ceilings.

Innsbruck is located in a valley between mountain ranges peaking at 10,500ft, while the airport has a field elevation of 1,800ft.

A main improvement of the RNP operations was a simplified missed approach procedure for runway 26.

This allowed pilots to climb to a safe altitude while continuing to fly through the valley — roughly along the Inn river — before turning around and following the same flightpath in the opposite direction, to a holding area above the Rotenberg non-directional beacon.

If pilots cannot see the runway at decision height during a standard ILS approach, they have to make a 200° climbing left turn for a return to Rotenberg NDB.

The radius during that turn — over rising terrain — must not exceed 0.9nm (1.5km), which equates to a 25° bank angle at an airspeed of 155kt (287km/h).

A missed approach under RNP operations is hence much less demanding than the ILS procedure.

RNP employment also reduced the glidepath angle from nearly 3.6° to 3.5°. This allows pilots to extend wing flaps and landing gear at a later point during the approach, and also cutting noise and fuel consumption.

However, greater lateral precision of the ILS signal over the RNP flightpath — especially in the final approach segment — led air navigation service provider Austro Control to revert to the former technology for the development of a hybrid procedure.

While the ILS localiser and glidepath signals create a funnel-like approach zone with increasing precision as the aircraft comes closer to the airport, the RNP procedure — which is based on GPS positioning and an onboard navigation databank — calculates a box-shaped approach corridor, says Touzas.

The width of that corridor is determined by minor, accepted tolerances in the GPS data. It also means that from the decision height onward, pilots have to visually continue the approach.

A number of obstacles are located in the vicinity of Innsbruck airport. As the RNP procedure does not provide sufficient separation to these structures, pilots must be able see them — which in turn determines the decision height. But by moving the localiser transmitter — its approach path is now located slightly further south than before — Austro Control was able to provide sufficient separation to the obstacles through the ILS.

The transmitter adjustment also reduced the offset angle between the localiser signal and the runway. During the original ILS procedure, aircraft were tracking 254° toward the runway — which has a 259° heading — with pilots having to make a 5° right turn around 1.5nm from the threshold to line up with the centreline.

Today, the localiser creates a 255° approach track.

The simplified RNP missed approach procedure has meanwhile been kept for the hybrid navigation mode dubbed “LOC R 26”, with the letter R standing for RNP. It is Europe’s first certificated hybrid landing approach procedure, says Air Berlin. The carrier is employing it along with a number of other operators.

Touzas says “a large part” of Air Berlin’s 737 fleet has been equipped with the software module and navigational database for RNP operations.

The airline’s narrowbody fleet comprises 10 Boeing 737-700s and 39 737-800s, as well as 11 Airbus A319s, 32 A320s and 11 A321s. FlightGlobal’s Ascend Online database shows.

No decision has been made on whether the CPM International CFM56-powered A320-family aircraft will be equipped for RNP operations, Touzas adds.
Outlook

- hybrid procedures can be a bridge between conventional navigation and PBN

- would enable adaptive use of advanced procedures for different avionics equipage levels

- ICAO has adopted hybrid concepts like RNP to ILS in their latest edition of PANS-OPS (amendment 7, applicable since November 2016)

- ICAO DOC 9643 (Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways – SOIR) adopts hybrid concepts for the use in high-density environments

- lack of standards in avionics mode change continues to be a challenge
Thank you for your attention and interest!