Operational Use of VOR

Agenda Item 22: FAQ (Part 1) & Lessons Learned (Part 2)

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Paradigm Change

- **Past / Today**: *Conventional* Navigation Aids supporting *conventional* procedures and operations
  - **Today / Tomorrow**: *Terrestrial* Navigation Aids providing *reversionary* capabilities in PBN Environment
- Role of VOR in PBN: **Very Limited**
  - Many ANSP base B-RNAV Provision on VOR/DME
  - Very few aircraft use this (lowest on FMS priority list)
  - If used, some FMS limit use to 25NM range
  - Apart from some cross-checking roles, VOR has *no place* as a PBN service *to support RNAV modes of operation*
- Many states have actively started to reduce VOR
  - All plan to reduce to about 50% of current installations
  - Going straight to zero considered too ambitious
- **Need to clarify future operational role to enable suitable transition**

Why does future role of VOR need to be clarified?

- Many VOR well beyond their service life (parts obsolescence)
  - ANSP must decide if to renew or not in cost pressured environment – need clear decision criteria
  - Facility renewal means VOR will stay in system another 20 years – must be the right ones to stay
- VOR serves many roles – interconnected ENR, TMA and Landing Use plus many *undocumented uses*
- Can be significant airspace change effort to remove VOR
- Need to build DME/DME Network – must build on existing / to be retained VOR/DME to be cost efficient
- FAA is planning a VOR Minimum Operational Network (MON)
- **PBNTF/RAISG is asked to confirm list on following slide**
  - Based on ongoing discussions at ICAO Navigation Systems Panel

Future Operational Roles of VOR

- As a reversionary navigation capability in particular for general aviation operations
  - Important to avoid airspace infringements
- To provide navigation, cross-checking and situational awareness especially for terminal area operations
  - Pilot MSA awareness
  - Support correct AFCS arming for ILS intercept
  - Aircraft contingency procedures such as engine failure on take-off
  - Missed approaches if required by local safety cases
- For non-precision approaches as long as users are not equipped for RNP approaches and if no ILS is available
- For conventional SID/STAR as long as users are not equipped
- As required to support the operations of State aircraft
- To support procedural separation (as per Doc 4444)

Summary of Cockpit Assumptions

- VOR has practically no role in PBN, e.g., *B-RNAV infra provision should **not** be based on VOR/DME only*
  - Minor exception: at low altitude where DME/DME coverage is limited FMS may automatically switch to VOR/DME
  - *Only if no GNSS – A-PNT Issue? (Use below MSA)*

    (A-PNT: Alternate Positioning, Navigation & Timing)

- VOR remains nonetheless a useful cockpit instrument, for many diverse purposes
  - Maintain NAV Display updating if not equipped with DME/DME
  - Provide basic rho-theta situational awareness
  - Facilitates ability of pilots to comply with ATCO instructions (important to minimize ATCO workload in GNSS outage scenario)

Conclusion

- Eurocontrol **proposes to push for a Minimum Operational Network based on VOR/DME, with priority given to VOR/DME located at airports**
  - In addition & complement to the DME/DME Network
  - Will enable an initial rationalization of VOR to well below 50% in high density areas
  - Basis for A-PNT Network Development at European Level
  - ***PBNTF/RAISG invited to provide perspective & advice on how to validate further***

Lessons Learned: VOR Colocation Issue

- Reported by FAA: FMS Database checks in RNP AR Procedures failed (60 feet tolerance per 8260 forms)
  - Cause: Colocated VOR/DME - Procedure design used VOR as a waypoint reference, avionics use DME for waypoint
  - Resolution: Use RNAV Waypoints even if VOR/DME is at location
    - RNP & RNAV Error Budgets: PDE = 0 m
- ICAO Annex 10/15 provisions for VOR/DME not written for PBN
  - Annex 10 Colocation tolerance is 80m for “those facilities used in terminal areas for approach purposes or other procedures where the highest position fixing accuracy of system capability is required”
  - Otherwise 600m (!)
  - Best practice: always publish both sets of coordinates
- Brought to PBNTF/RAISG for awareness
  - Without specific requests, no further action is planned
  - REF ICAO NSP March13/WGW/WP38