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Agenda Item 5: ATM and CNS Systems Modernization

**IMPLEMENTATION OF ESTABLISHED ON RNP AR (EOR) OPERATIONS AT
SHENZHEN BAO'AN INTERNATIONAL AIRPORT**

(Presented by China)

SUMMARY

Shenzhen Airport operates three parallel runways and is one of the busiest airports in the Asia-Pacific region. Constrained by airspace structure, Shenzhen Airport cannot implement independent approaches based on traditional ILS during northbound operations, which limits its operational efficiency. EoR operations, based on RNP AR procedures, can support the implementation of independent approaches for Shenzhen Airport's northbound operations under constrained airspace conditions, thereby enhancing operational efficiency. This paper introduces the background, work plan, flight validation, expected benefits, future tasks and challenges of Shenzhen Airport's exploration of EoR operations.

1. INTRODUCTION

1.1 EoR is an innovative operational concept that can combine Required Navigation Performance Authorization Required (RNP AR) approaches with conventional Instrument Landing System (ILS) approaches to enable independent approaches on parallel runways. By leveraging the high-precision track-keeping capability, EoR allows aircraft to operate with reduced separation standards, thereby eliminating the need for lateral separation and enhancing efficiency.

1.2 The International Civil Aviation Organization (ICAO) updated the parallel runway operations provisions in 2018 to accommodate the EoR concept. In September 2024, the Civil Aviation Administration of China (CAAC) formally issued the ***Provisional Regulations on EoR Operations for Parallel Instrument Runways***, providing a regulatory framework for EoR implementation in China.

1.3 Shenzhen Bao'an International Airport (ZGSZ), as one of the busiest multi-runway airports in the Asia/Pacific region, has been facing significant airspace constraints, particularly during northbound operations. With the commissioning of its third runway, the airport's traffic volume has continued to grow. EoR has become the key approach to breaking through the operational bottleneck at Shenzhen Airport.

2. DISCUSSION

Background and Objectives

2.1 **Airspace Challenges at Shenzhen Airport.** Shenzhen Airport operates three parallel runways (15/33, 16L/34R, and 16R/34L), but the airport's northbound operations are particularly constrained by the complex airspace structure. When conducting conventional ILS approaches, the final segment is too short for aircraft to maintain vertical separation until established on their respective localizer courses. This prevents the implementation of independent approaches during northbound operations at Shenzhen Airport, making it difficult to maximize runway capacity utilization.

2.2 **Project Initiation.** In response to these challenges, and under the guidance of the Middle-South Regional Administration CAAC, a multi-stakeholder working group was established comprising the Middle-South Regional Air Traffic Management Bureau (MS-ATMB), Shenzhen Bao'an Airport, Shenzhen Airlines, and Airbus. The project aimed to explore EoR as a viable solution to unlock the northbound airspace bottleneck and enhance the airport's operational efficiency.

2.3 **Objectives.** The primary objectives of the Shenzhen EoR project are:

- a) to validate the safety and operational feasibility of EoR operations in the complex terminal airspace environment of Shenzhen;
- b) to achieve independent approaches during northbound operations, thereby increasing arrival capacity; and
- c) to reduce track miles, flight time, fuel consumption, and carbon emissions through optimized RNP AR approach procedures.

Expected Operational Benefits

2.4 **Capacity Enhancement.** By implementing EoR operations, Shenzhen Airport is expected to overcome the long-standing northbound airspace bottleneck that has prevented independent parallel approaches. The elimination of the requirement for lateral separation between aircraft on adjacent parallel runways during the approach allows for more efficient sequencing and higher arrival throughput, particularly during instrument meteorological conditions (IMC).

2.5 **Efficiency and Environmental Benefits.** The RNP AR approach procedures support curved approach paths, thereby yielding the following benefits:

- a) reduced track miles per arrival;
- b) decreased flight time;
- c) lower fuel consumption and CO₂ emissions; and
- d) reduced noise exposure in surrounding communities.

2.6 **Workload Reduction and Safety Enhancement.** The EoR operations reduce both pilot and controller workload by:

- a) eliminating the need for continuous lateral separation monitoring between aircraft on adjacent parallel approaches;
- b) providing predictable, stabilized approach tracks through RNP AR guidance;
- c) allowing controllers to focus on overall traffic management rather than lateral spacing constraints.

Work Plan and Flight Validation

2.7 **Overall Work Plan.** In accordance with CAAC's regulation, to implement EoR operations at Shenzhen Airport, extensive preparatory work is required, including flight procedure design, flight procedure review, flight validation of the procedure, flight procedure approval, application for trial operations, conduct of trial operations, and ultimately, formal operations.

2.8 **Procedure Design.** The EoR procedure for Shenzhen Airport was designed based on the airport's specific runway configuration and airspace constraints. The core design concept is that one runway utilizes conventional ILS approaches while the other parallel runway utilizes RNP AR approaches. The RNP AR procedures with fixed-radius-to-fix (RF) legs and curved final approach segments enable aircraft to align with the landing runway via shorter tracks. With the precise lateral navigation capability provided by the RNP AR procedure, controllers are not required to provide additional lateral separation for aircraft, enabling independent approaches in complex airspace environments and addressing the efficiency constraints of northbound operations at Shenzhen Airport.

2.9 **Dual-Aircraft Simultaneous Validation Flight.** Following the completion of a series of preparatory activities, the project reached a critical milestone—flight validation of the procedures. In April 2026, Shenzhen Airport conducted China's first dual-aircraft simultaneous validation flight for EoR operations. The validation exercise covered four subjects, four procedure types, and two independent approach modes. Two Airbus A320 aircraft, operated by Shenzhen Airlines, conducted simultaneous independent parallel approaches to Runways 33 and 34L (and 34R on subsequent sorties) in a northbound configuration. The two aircraft maintained a minimum lateral separation of 1.6 kilometers during the final approach phase, successfully validating the safety, soundness and reliability of the RNP AR and EoR procedures.

Experience from Flight Validation

2.10 **Multi-Stakeholder Collaboration.** The success of the Shenzhen EoR validation was attributable to the close collaboration among regulators, air navigation service providers, the airport operator, airlines, and aircraft manufacturers. This collaborative model ensured that operational, regulatory, technical, and training aspects were addressed in an integrated manner.

2.11 **Dual-Aircraft Validation Methodology.** The working group pioneered the "dual-aircraft simultaneous validation" approach in China, which provided a more robust validation of the safety and operability of EoR by testing real-time interaction between two aircraft on adjacent parallel approaches. This methodology offers a reference for other airports in the region planning EoR implementation.

2.12 **Regulatory Framework.** The issuance of the CAAC Provisional Regulations on EoR Operations for Parallel Instrument Runways in September 2024 provided a clear regulatory basis for the Shenzhen project.

Future Work and Challenges

2.13 **Trial Operation and Formal Operation.** After the successful validation in April 2026, the RNP AR procedures of Shenzhen Airport have been approved by the regional administration. Currently, MS-ATMB is applying for EoR trial operations at Shenzhen Bao'an Airport. All preparatory work, including training and aeronautical information publication, is progressing according to plan, with trial operations expected to commence in November. Upon successful completion of the trial operations, the project will proceed to formal operations.

2.14 **Fleet Equipage and Airline Participation.** The benefits of EoR are contingent on the proportion of RNP AR-capable aircraft in the operating fleet. Continued efforts are needed to encourage airlines to obtain RNP AR operational approvals and to equip their fleets with the necessary avionics.

2.15 **Controller and Pilot Training.** Sustained training programs are essential for both controllers and pilots to maintain proficiency in EoR operations, particularly in handling mixed-mode operations where some aircraft are EoR-capable while others are not.

2.16 **Future Expansion.** The working group is exploring the potential extension of EoR operations to additional runway configurations at Shenzhen Airport, with the aim of establishing Shenzhen's experience as a replicable validation methodology and operational framework for other multi-runway airports across China and the Asia/Pacific region facing similar airspace constraints.

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
- a) note the information contained in this paper;
 - b) discuss the preparations for EoR operations; and
 - c) discuss any relevant matters as appropriate.

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