INTERNATIONAL CIVIL AVIATION ORGANIZATION

SIXTH MEETING OF THE PERFROMANCE BASED NAVIGATION TASK FORCE (PBN TF/6)

Hong Kong, 3 – 5 February 2010

Agenda Item 8: Feasibility of Establishing a Regional RAIM Prediction System

8.2 REGIONAL RAIM PREDICTION SYSTEM

(Presented by Thailand)

SUMMARY

GNSS is considered a main navigation infrastructure supporting PBN operations.
It is now also becoming a critical component of surveillance system, such as ADS-B. Unpredicted outage of GNSS services can cause undesired interruptions on aircraft operations. ICAO Annex 10 and ICAO PBN manual require States and ANSPs to provide timely warnings of GNSS RAIM outages. RAIM prediction results are needed daily by pilots, flight dispatchers, air traffic controllers and airspace planners.

This working paper discusses a proposal to establish regional RAIM Prediction System. A common, regional RAIM prediction services can prove to be an effective solution that will enhance seamless air traffic operation, while providing cost-effective investment solution.

1. INTRODUCTION

1.1 Implementations of PBN and GNSS facilitate more efficient use of airspace and more flexibility for operational procedure. They cooperatively result in enhanced safety, access, capacity, predictability, operational efficiency, fuel economy, and environmental sustainability.

1.2 Implementation of PBN is strongly supported by major aviation stakeholders, including ICAO, IATA, and CANSO. On April 1, 2009, a joint industry declaration in support of PBN implementation was issued calling upon all leaders of the civil aviation community to fully support implementation of PBN into the air navigation system in accordance with the ICAO provisions and established timetable.

1.3 GNSS is considered the main navigation infrastructure supporting PBN operations. GNSS provides highly accurate and high-integrity navigation and positioning services for aircrafts. GNSS also enables on-board monitoring and alerting capability which are required for Required Navigation Performance (RNP) operations.

1.4 Unpredicted outages of GNSS services can cause undesired interruptions on aircraft operations. Safety impacts may become more severe during approach phase of flights especially if pilots are not aware of such outages.

1.5 ICAO APANPIRG at its 20th meeting was reminded that GPS prediction service was a necessary part of GNSS approvals to allow for the fluctuations in service availability. Concern was also raised over possible future GNSS outages due to satellite constellation anomalies and other factors.

1.6 GNSS is presently not only used for navigation but also becoming a critical component of surveillance system, such as ADS-B, plus many aviation applications that depend on accurate timing, for example SSR radar.

2. REQUIREMENTS FOR RECEIVER AUTONOMOUS INTEGRITY MONITORING

2.1 Receiver Autonomous Integrity Monitoring (RAIM) provides integrity monitoring of GNSS satellites for aviation applications. RAIM utilizes redundancy of satellite signal measurements combined with aircraft barometric altitude equipments to detect any faulty satellite signal based on satellite geometry and probability analysis.

2.2 ICAO Annex 10 and ICAO PBN manual require States and Air Navigation Service Providers (ANSPs) to provide timely warnings of GNSS RAIM outages. A pre-flight GNSS RAIM prediction analysis is required by the FAA for flights intending to use RNAV/RNP routes and departure and arrival procedures while using GPS as the sole navigation source.

2.3 RAIM prediction results are needed daily by pilots, flight dispatchers, air traffic controllers and airspace planners. The use of appropriate RAIM prediction services is considered as a necessary part of GNSS approvals. Pilots and air traffic controllers need such information to ensure proper flight planning during possible service unavailability.

2.4 RAIM prediction is required for en-route, terminal area, and approach operations. RAIM prediction algorithms for different types of GNSS receivers and avionic configuration are also different.

3. REGIONAL RAIM PREDICTION SERVICES

3.1 Because RAIM service prediction algorithms use pre-determined satellite orbit and maintenance schedule to assess future outages, one single RAIM prediction system can technically provide a RAIM prediction service for the whole world or an entire region.

3.2 However, it is still within States' responsibilities to provide RAIM outage information to airspace users and aviation stakeholders. All safety-related information provided by a RAIM prediction service will need to be recognized and authorized by State before it can be used.

3.3 With these reasons, it is thus not cost effective for each State to invest on an individual RAIM prediction system. Moreover, various implementations of RAIM prediction services may result in inconsistency of RAIM prediction information provided by various States. This may cause operational problems especially during en-route operation over international airspace.

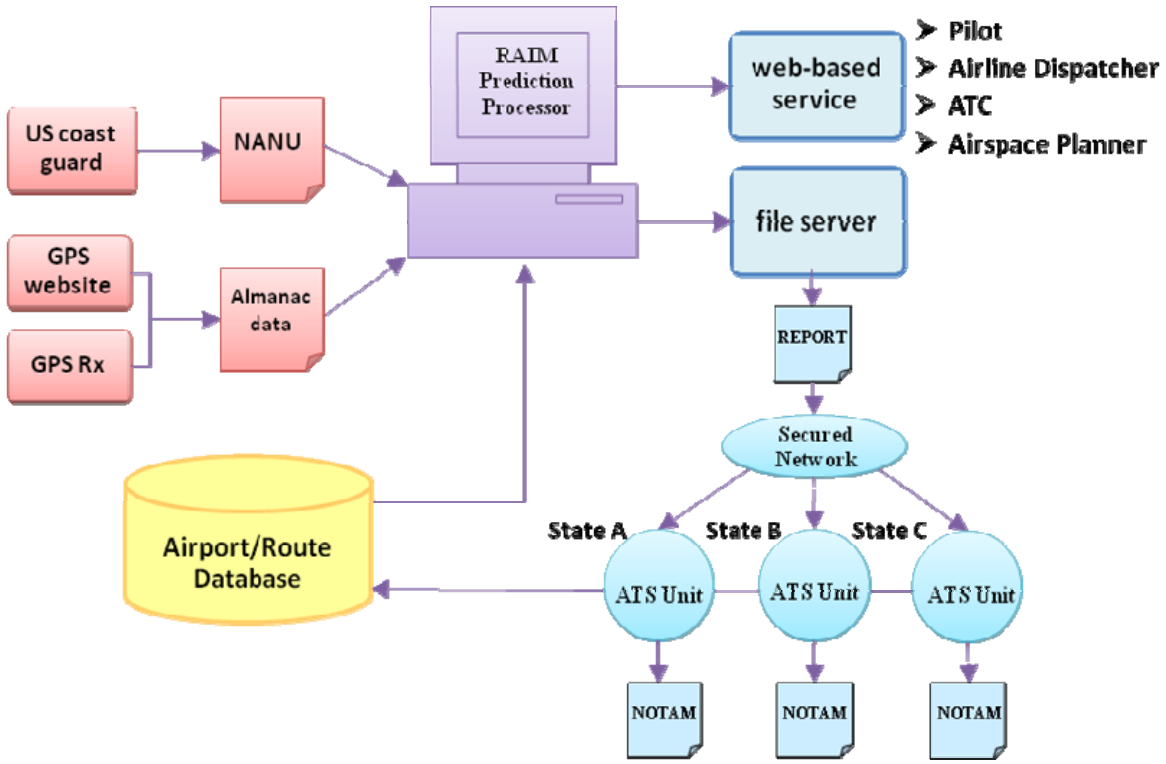
3.4 A common, regional RAIM prediction service for region such as South-East Asia can prove to be an effective solution. By harmonizing RAIM prediction information among States, the regional RAIM prediction service will **enhance seamless air traffic operation**, while **providing a cost-effective investment solution**. A regional RAIM project will also provide a **forum for States to share their knowledge and experiences**.

3.5 ICAO APANPIRG Decisions 20/38 and 20/39 task the ICAO PBN Task Force to examine the feasibility of establishing a regional RAIM prediction system and invite ICAO to develop guidance materials on establishing common implementation rules and technical standards for GNSS reporting and prediction requirements.

3.6 The 46th DGCA Conference encouraged States to support and place priority on the ICAO Task Forces and work programmes for the Asia-Pacific. Proposals on specific mechanisms, such as a regional RAIM prediction service, could also be looked into.

3.7 The APEC GNSS Implementation Team (GIT), a team established under the Asia-Pacific Economic Cooperation (APEC) Transportation Working Group, during its thirteenth meeting in 2009, has expressed its willingness to work cooperatively with ICAO PBN Task Force to support the establishment of a regional RAIM prediction service.

4. POSSIBLE SYSTEM ARCHITECTURE FOR A REGIONAL RAIM PREDICTION SYSTEM



5. ACTIONS BY THE MEETING

4.1 The Meeting is invited to note:

1) note the importance and requirements for RAIM prediction services for GNSS and PBN operations;

2) consider encouraging States to work cooperatively with ICAO PBN Task Force and the APEC GIT to establish a regional RAIM prediction service for South East Asia;

3) note that Thailand through AEROTHAI is willing to serve as a project coordinator for this important regional activity.

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