ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues
6.2 : Navigation policy issues in the light of present and envisaged GNSS services and architectures, integration and back-up options

CURRENT STATUS AND PERSPECTIVE FOR NAVIGATION SYSTEM IN JAPAN

(Presented by Japan)

SUMMARY

This paper presents the current status and perspective for navigation system in Japan. Toward the transition to GNSS, some of existing navigation systems are expected to be phased out and prevalence of SBAS receiver should be promoted. This paper also describes technical, procedural and legal issues of GNSS.

Action by the conference is in paragraph 6.

1. CURRENT NAVIGATION SYSTEM

1.1 NDB

1.1.1 Currently there are fifty-nine non-directional radio beacons (NDBs) operating in Japan, of which thirty-five serve for terminals and twenty-four for en-routes purposes. NDB will be phased out based on the transition plan made by JCAB in 2001 because NDB is less accurate than other navigation facilities such as VHF omnidirectional radio range/distance measuring equipment (VOR/DME) or Global Positioning System (GPS), and does not support the area navigation (RNAV). As the global navigation satellite system (GNSS) is being extensively used worldwide, all NDBs will be completely phased out by 2015.

1.2 VOR/DME and VORTAC

1.2.1 There are ninety-four VOR/DMEs and twenty-three VORTACs in Japan. The total number is one hundred and seventeen facilities of which sixty-five serve for terminals and fifty-two serve for en-route purposes. The facilities are being used for approach or departure in terminal areas and to constitute thirty RVAV routes on en-routes.

1.2.2 The number of facilities will be also decreased as navigation services transit to GNSS. On the transition plan, the VOR/DME including VORTAC will start to be phased out after the completion of abolishment of NDBs. However, parts of the facilities that constitute major en-route will remain in the future to serve as backups for GNSS service failure.

1.3 ILS and MLS

1.3.1 Instrument landing systems (ILSs) are implemented at fifty-six major airports. CAT II/III ILSs are installed at five airports such as international airports with frequent arrivals and departures or airports that are frequently affected by heavy fog.

1.3.2 Currently there is no radio interference or multi-pass effect for ILS as a major operational problem, and ILS will be continued to serve for precision approach at airports. There is no implementation plan for microwave landing system (MLS) in Japan with the above reason.

2. USE OF GPS IN JAPAN

2.1 The equipage of GPS on commercial jet airplanes owned by Japanese major airlines is thirty-five per cent that is almost used by international flight. One-third of small aircrafts of general aviation (GA) including the helicopters are also equipped with GPS avionics. The equipage rate of commercial jet as well as GA is expected to increase continuously in the future.

2.2 To facilitate smooth transition to GNSS, the coordinates of airport runway and air navigation facilities have already been publicized in Aeronautical Information Publication (AIP) in accordance with World Geodetic System 84 (WGS-84). The use of GPS is limited to supplemental means for instrument flight procedures in Japan. On the oceanic areas such as North Pacific (NOPAC) route, GPS is used to update the position of inertial navigation system (INS) and contributed to RNP-10 operation. The implementation plan of GPS overlay approach and GPS approach is now being studied.

3. TRANSITION TO GNSS

3.1 Multifunctional transport satellite (MTSAT) multifunctional transport satellite-based augmentation system (MSAS) has been implemented to augment GPS using MTSAT and will begin to operate from 2005. MSAS will be a pioneer to lead GNSS transition in Japan and to encourage GPS/MSAS based approach as well as en-route operations. In parallel with MSAS implementation, JCAB has been preparing the GPS/MSAS operations and procedures by establishing the committee comprised of expertise from universities, national laboratories and airlines.

3.2 It is also important to encourage airlines and GA to equip GPS/satellite-based augmentation system (SBAS) receiver in order to promote the GNSS usage. Especially for small aircrafts that cannot afford expensive INS, the use of MSAS will provide them with great benefits and enable them to fly without depending on ground-based navigation systems. For larger aircrafts, the use of MSAS will increase availability of GPS navigation. However, since there are no avionics available to receive SBAS signals for larger commercial jet airplanes, a development and prevalence of less expensive SBAS receivers are highly expected. Since SBAS messages are transmitted on the L1 frequency, exactly the same frequency of the current GPS receiver, the SBAS receiver can function as a GPS receiver even in the SBAS system failure. Considering the fact that the wide area augmentation system (WAAS) has already started operation and the European Geostationary Navigation Overlay Service (EGNOS), Indian GAGAN and MSAS will operate soon, it should be appropriate to have a SBAS function in a newly released GPS receiver as a standard feature.

3.3 The research and development of the ground-based augmentation system (GBAS) has also been conducted at Electronic Navigation Research Institute (ENRI) in Japan. While there is no concrete implementation plan of GBAS yet, JCAB will decide its implementation based on several factors such as international trend, technological development and cost-benefit analysis for individual airports.

4. OTHER ISSUES FOR GNSS

4.1 Ionospheric issue

4.1.1 In the southern region of Japan that is close to the geomagnetic equator where the ionospheric condition is not stable, research and analysis have actively been conducted for monitoring of ionosphere condition and its impact to GNSS performance. The research shows that the ionospheric changes are very active in that region and it is difficult to predict GNSS signals delay perfectly. In addition, the scintillation has been observed and it also may affect GNSS performance. Therefore, it is necessary to study and understand the ionospheric behaviour at the geomagnetic equator area and establish the countermeasures for ionospheric irregularity for GNSS operations. JCAB would continue to contribute to the ICAO activities through providing information and analysis about ionospheric irregularity in this region.

4.2 Technical complexity issue

4.2.1 As the performance of GNSS depends highly on the software of aircraft-based augmentation system (ABAS), SBAS and GBAS, the verification of system performance and quality assurance for GNSS require higher expertise than conventional navigation systems. In order to encourage global usage for GNSS, those States who have implemented GNSS, SBAS and GBAS should provide other States with technical supports. It is necessary to cooperate among neighbouring States, if the high quality of navigation services by GNSS is enjoyed globally and seamlessly.

4.3 Legal issues

4.3.1 The SBAS services can be utilized over many flight information regions (FIRs), because the SBAS messages are broadcasted on L1 frequency by the geo-stationary satellite whose coverage is almost one-third of the entire globe. Therefore, it is indispensable to make it clear what the State's responsibility is for the usage of SBAS services. While it is commonly understood the bilateral agreement should be concluded

between the SBAS service provider State and the recipient State, it is highly recommended that guidance material specifying each State's responsibility be developed by ICAO as a common standard practice.

5. CONCLUSION

5.1 Toward the transition to GNSS in Japan, some of the existing navigation systems are expected to be phased out or decreased. For the use of GPS, about one-third of both commercial jet airplanes and GA are equipped with a GPS receiver and this ratio is expected to increase continuously in the future. However, for successful transition to GNSS, the encouragement for SBAS receiver development and the promotion for prevalence of SBAS receiver are necessary. In order to provide seamless navigation services by GNSS, the standard flight operational procedure should be immediately developed.

6. ACTION BY THE CONFERENCE

6.1 The conference is invited to recommend that ICAO:

a) assist in the transition to GNSS and encourage the use of GNSS;

b) develop international Standards for flight operational procedures with GNSS in order to provide seamless navigation services; and

c) work with technical and legal matters and encourage a smooth transition to GNSS.

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