

ELEVENTH AIR NAVIGATION CONFERENCE

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Agenda Item 7 Aeronautical air-ground and air-to-air : communications

CURRENT STATUS AND PERSPECTIVE FOR AERONAUTICAL MOBILE COMMUNICATION SYSTEM IN JAPAN

(Presented by Japan)

SUMMARY

This paper presents the current status and perspective for aeronautical mobile communication system in Japan. Toward the smooth transition to VDL, the selection of the most appropriate VDL system has to be made taking into consideration the future voice traffic and data link traffic within the limited VHF frequency band for AMS. Toward the smooth transition to AMSS, the ADS/CPDLC trial operations through AMSS should be promoted on a global basis involving ATS providers, aircraft operators, and related entities. Through ADS/CPDLC trial operations, the technical as well as operational problems have to be collected and scrutinized for smooth transition to actual ATS operations through AMSS.

Action by the conference is in paragraph 5.

1. CURRENT AERONAUTICAL MOBILE COMMUNICATION SYSTEM IN JAPAN

1.1 VHF communication

VHF voice communication

1.1.1 VHF voice communication is widely used not only in terminal areas but also in en-routes in Japan. There are about 100 airports where the air traffic services (ATS) is provided through VHF voice communication. There are 41 remote center for air to ground VHF voice communication (RCAG) for

en-route use. The voice service is currently operated over the 25 KHz DSB-AM system. Since there is no VHF frequency congestion problem in Japan, there is no plan for the introduction of 8.33 KHz DSB-AM system. As to the avionics, the international flight that is flying to Europe is equipped with 8.33 KHz DSB-AM in addition to 25 KHz DSB-AM system. The rest is only equipped with 25 KHz DSB-AM system.

VHF data link communication

1.1.2 There is one VHF data link service provider called AVICOM Japan. The AVICOM Japan was established in September 1989 in order to provide the data link service through the aircraft communications addressing and reporting system (ACARS) to newly released B747-400. They are now operating 48 VHF Remote Ground Stations (RGS) including airport sites and mountain sites covering entire Japanese archipelago. There are two frequencies (131.25 MHz, 131.45 MHz) assigned for ACARS operation in Japan.

1.1.3 JCAB has implemented data link processor (DLP) in Tokyo ACC in order to provide the automatic terminal information service (ATIS) and aeronautical en-route information service (AEIS) through VHF data link. After the JCAB's DLP was connected to AVICOM Japan's ACARS host computer in September 1993, ATIS and AEIS became available from VHF data link system in Japan.

1.1.4 The AVICOM Japan is now upgrading the current ACARS system to VHF digital link (VDL) Mode 2 (AOA) system with a new frequency of 136.975 MHz. Ten new VDL ground stations (VGS) will be added for this VDL Mode 2 (AOA) operation. This new VDL Mode 2 (AOA) operation is expected to commence in October 2003.

1.2 HF communication

HF voice communication

1.2.1 HF voice communication is mainly used for oceanic area where VHF communication cannot be reached because of the line of sight and limited power. The voice service is currently operated over the 3 KHz SSB-AM system. JCAB is responsible for two flight information regions (FIRs), Tokyo FIR and Naha FIR where there exists vast oceanic area. In order to handle oceanic flights, HF communication centres called Tokyo radio and Naha radio have been implemented for each FIR. Tokyo radio is in charge of HF voice communication in North Pacific Region (NP) and Central West Pacific Region (CWP), and Naha radio is only in charge of CWP.

1.2.2 The HF frequencies are assigned to each HF communication centre. In Tokyo radio, 6 frequencies for NP-1, 6 frequencies for NP-2, 4 frequencies for NP-3, 5 frequencies for CWP-1, and 6 frequencies for CWP-2 are assigned. In Naha radio, 5 frequencies for CWP-1, and 6 frequencies for CWP-2 are assigned. Some of the frequencies are commonly shared with neighboring HF radio stations.

1.2.3 Since the international traffic between Asia and North America has been increasing very rapidly, the number of new HF frequency had been added in the past. While the number of international traffic will continue to increase in North Pacific, the addition of new HF frequency does not seem to be required in the future because of the transition from HF voice communication to aeronautical mobile-satellite service (AMSS) communication.

HF data link communication

1.2.4 The Standards and Recommended Practices (SARPs) for HF data link system have already been developed and specified in Annex 10 in ICAO. While JCAB recognizes the existence of SARPs for HF data link, and knows that the HF data link operation for ATS purposes has already been conducted over the North Atlantic on a trial basis, there is no plan at this stage for JCAB to allow the use of HF data link system for oceanic ATS operation.

1.2.5 This is because HF data link system does not appear to be reliable and stable enough to support oceanic ATS in a very congested traffic environment. Since the number of international traffic in North Pacific has been increasing rapidly due to recent new airport developments in Asia, the air traffic capacity in North Pacific has to be increased with the reduction of aircraft separation minima by using automatic dependent surveillance (ADS) and controller-pilot data link communications (CPDLC) through the AMSS according to the provisions detailed in the ICAO PANS-ATM. Thus, JCAB opts for AMSS communication rather than HF data link communication. While further study will be required, JCAB considers that HF data link would not meet the performance required for the application of the reduced longitudinal separation minima using ADS/CPDLC.

1.3 Aeronautical mobile-satellite services (AMSS)

AMSS voice communication

1.3.1 While AMSS voice communication is widely used by air passengers, AMSS voice communication for ATS purposes is allowed only for non-routine and emergency situation according to the FANS concept of ICAO. There is a special emergency telephone at Tokyo Rescue Coordination Center (RCC), which is connected to the Ground Earth Station (GES) of KDDI Corporation in Yamaguchi. Fortunately, it has not been used single time since it was installed in 1995.

1.3.2 AMSS voice communication for ATS purposes had been conducted on a trial basis in some countries. JCAB, however, believes that AMSS data link communication should be used as primary means of communication in oceanic ATS environment since that is the most suitable place to use data link services through AMSS for ATS automation. An ICAO global policy for the use of AMSS voice communication for ATS purpose should be developed, if it is considered that there exists another use other than non-routine and emergency situation.

AMSS data link communication

1.3.3 The Informal Pacific ATS Co-ordination Group (IPACG), which is a bilateral group of FAA and JCAB, decided to start data link operations over North Pacific (NOPAC) and Central Pacific (CENPAC) through the AMSS system operated by INMARSAT in 1997. Some 20 aircraft operators currently participate in the operation. 30 to 50 per cent of aircraft operating in NOPAC/CENPAC, depending on tracks, are data link capable aircraft. CPDLC is the primary means of communications for NOPAC/CENPAC. ADS system has been implemented at Tokyo ACC and will be used for ATC with introduction of 50 NM longitudinal separation minimum discussed later.

1.3.4 The IPACG established the FANS Interoperability Team (FIT) in order to monitor and enhance the data link operations in NOPAC/CENPAC in 1999. The FIT is composed of ATS service

providers, aircraft operators, data link service providers, aircraft and avionics manufactures, international organizations, and regulatory agencies. The JCAB and FAA have established Central Reporting Agencies (CRA) for jurisdictional oceanic airspace to collect the technical and operational problems associated with data link operations, and develop recommendations for improving the system and operational procedures.

2. TRANSITION TO VDL IN JAPAN

2.1 While the ACARS system has been operated by AVICOM Japan for more than ten years, JCAB has conducted only limited ATS applications such as ATIS and AEIS provision through ACARS. The ACARS system was developed originally to serve for aeronautical operational control (AOC) and aeronautical administrative communication (AAC). The ACARS system does not assure the priority of ATS message and the quality of service, and its transmission speed is very low. That is why JCAB provided only ATIS and AEIS that are not time-critical and have a backup system of voice broadcast system.

2.2 ATS providers need more reliable and high-speed VHF communication system to be used not only for data but also for voice communication in ATS operation, because the rapid growth in air traffic requires the dramatic increase of channel capacity in a limited VHF frequency band. JCAB is now in the process of studying the future implementation of VDL Mode 3.

2.3 The Electronic Navigation Research Institute (ENRI) has been working on the research and development (R&D) of VDL Mode 3 system since 1998. As part of R&D work, ENRI evaluated the performance of four Vocoders requested by ICAO AMCP. ENRI has almost completed the development of VDL Mode 3 airborne and ground test equipments, and the evaluation of the impacts of radio interference and fundamental performance assessment on VDL Mode 3 in 2002. ENRI will be conducting the actual flight tests using experimental aircraft (B-99) for evaluation of data link performance and voice quality in 2003.

2.4 JCAB is confident that VDL mode 3 is the most sophisticated and appropriate next generation air-ground communication system to integrate the voice and data communications in ATS operation. The digital-voice services are planned to be operational in 2010 in Japan and data link services are expected to follow in two or three years later.

3. TRANSITION TO AMSS IN JAPAN

3.1 As described in section 1.2 and 1.3, in order to cope with the rapid increase of international traffic in North Pacific (NOPAC), it is inevitable for JCAB to introduce ADS and CPDLC through the AMSS for the reduction of aircraft separation minima. When data link is lost and it is considered that there is a possibility of loss of separation and action is required to resolve potential conflict, alternate means of separation using HF shall be applied. It is not always possible to appropriately apply the alternate means of separation using HF. That is why the dependable AMSS system with high reliability and integrity is needed to support oceanic ATS in a very congested traffic environment.

3.2 Therefore, JCAB decided to develop a new aeronautical satellite system called multifunctional transport satellite (MTSAT) in 1994. There will be two aeronautical satellites, MTSAT-1R and MTSAT-2 available for Asia and Pacific Region. There are also two aeronautical satellite centres where two GESs are implemented in each centre. The instantaneous switch over between two satellites and four

GESs is fully assured in the MTSAT. The technical details of the MTSAT and the high redundant system configuration can be found in AN-Conf/11-IP/34.

3.3 With the MTSAT-1R scheduled for launch in early 2004, JCAB intends to apply 50 NM longitudinal separation minimum using ADS for appropriately equipped aircraft. With the MTSAT-2 scheduled for launch in early 2005 and obtaining operational experiences, JCAB will further reduce the longitudinal separation minimum to 30 NM. JCAB closely coordinates with FAA and aircraft operators through IPACG meetings for the introduction of these separation minima.

3.4 With the increase of data link capable aircraft in NOPAC/CENPAC in the future, the number of HF frequencies will be decreased at Tokyo and Naha radios. Even though the aircraft is 100 per cent equipped with AMSS avionics, the minimum system of HF voice communication should be maintained in the future so as to back-up AMSS. This is because the current system configuration of aircraft earth station (AES) does not assure full redundancy. There is a single antenna, Low Noise Amplifier (LNA), high power amplifier (HPA), and satellite data unit (SDU) in the aircraft. If one of the components of AES fails, then the total loss of communications may occur over the oceanic areas. Thus, the carriage of HF voice communication system in the aircraft will still remain mandatory in the future too.

4. CONCLUSION

4.1 VDL

4.1.1 The selection of the most appropriate VHF digital link (VDL) system for ATS operation has to be made taking into consideration the future voice traffic and data link traffic within the limited VHF frequency band for AMS. Once the selection is made based on the technological advantages and cost/benefit analysis, the transition plan for VDL on a global basis has to be formulated in order to ensure smooth transition from the existing system to future system.

4.2 AMSS

4.2.1 ADS/CPDLC system is a complex system. In order to obtain operational experience and become familiar with the system, ADS/CPDLC trial operations through AMSS should be promoted to the area where considered to be suitable, on a global basis involving ATS providers, aircraft operators, data link service providers, aircraft and avionics manufactures, ATC system manufactures, international organizations, and regulatory agencies. Through ADS/CPDLC trial operations, the technical as well as operational problems have to be collected and scrutinized for smooth transition to actual ATS operations through AMSS.

4.2.2 It is important to note that fragmented implementation of the data link system would not provide required benefit. It is considered that harmonious implementation with the neighboring States is vital. The economical and efficient operation could only been achieved, when the ATS are provided among the neighboring States/FIRs with the similar level.

5. ACTION BY THE CONFERENCE

5.1 The Eleventh Air Navigation Conference is invited to recommend that:

- a) ICAO should discuss the most appropriate VDL system for ATS operation taking into consideration the future voice traffic and data link traffic within the limited VHF frequency band for AMS;
- b) ICAO should develop the transition plan for VDL on a global basis, once the selection is made on VDL based on the technological advantages and cost/benefit analysis;
- c) ICAO should assist the transition to AMSS and encourage the use of AMSS for ATS in oceanic and remote airspace; and
- d) ICAO should promote ADS/CPDLC trial operations, so that the technical and operational problems have to be identified to ensure the smooth transition to AMSS.

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