

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept

1.2 Enabling concepts in support of the global ATM operational concept
:

AUTOMATIC DEPENDENT SURVEILLANCE IN MONGOLIA

(Presented by Mongolia)

SUMMARY

This paper presents some background information on the present air navigation system in Mongolia and the findings and recommendations from the real-time simulations of a possible ADS infrastructure combining ADS-B and ADS-C in Mongolia.

Action by the conference is in paragraph 6.

1. INTRODUCTION

1.1 The East Gate project was established as a cooperative effort between Sweden and Mongolia in support of the development of the aviation infrastructure and air traffic management (ATM) functions in Mongolia. By complementing the available automatic dependent surveillance -contract (ADS-C) functions with ADS-broadcast (ADS-B) both air-ground and air-to-air surveillance functions can be supported as well as other data link based functions like controller-pilot data link communications (CPDLC) and distribution of flight information and weather data. As a part of exploring the possibilities in combining ADS-C and ADS-B in the Mongolian environment, air traffic management (ATM) real-time simulations were conducted from 18 to 22 November 2002 by the ATM Research and Development group of the Swedish Civil Aviation Administration (SCAA) in cooperation with the Mongolian CAA.

1.2 This paper presents some background information on the present air navigation system in Mongolia and the preliminary findings and preliminary recommendations evolving from the real-time simulations of a possible ADS infrastructure combining ADS-B and ADS-C in Mongolia.

2. OVERVIEW OF THE MONGOLIAN AIR NAVIGATION SYSTEM

2.1 Mongolia is a vast, sparsely populated and landlocked country with limited road and railroad infrastructure, relying heavily on air transport. The terrain is characterized by large semi-desert and desert plains, with mountains in the west and southwest and with the Gobi desert in the southeast. The harsh environment and the limited road, terrestrial communications and power distribution infrastructure place specific requirements and constraints on the operation of the air transport system.

2.2 The Mongolian CAA is the national provider of air navigation services, providing airport and air traffic services (ATS) and operating an extensive supporting technical infrastructure across the country. The Mongolian CAA is also the regulator of civil aviation in Mongolia, responsible for aviation safety and certification.

2.3 Operating from the Ulaanbaatar airport, Buyant-Ukhaa, domestic airports are being served by the national carrier MIAT (Mongolian Civilian Air Transport) and various domestic carriers. A network of domestic ATS routes connects Ulaanbaatar and some 20 airports across Mongolia, 13 of which have scheduled instrument flight rules (IFR) services. Most of the airports have radio navigation facilities allowing operations to some degree in instrument meteorological conditions. Many of the airports do not have a paved runway surface and a complete instrument landing system (ILS) is only available at Ulaanbaatar. Whereas MIAT is the all-dominant operator on domestic destinations, in 2001 seven other airlines operated on domestic destinations. Most of these served smaller airports with small fixed-wing aircraft or helicopters. As a result of the transition to market economy, domestic traffic has dropped in recent years; however, there is a significant potential for future growth of the traffic volume from the current low level, considering the limited road and railroad infrastructure.

2.4 MIAT also operates to international destinations such as Beijing, Hohhot (China), Irkutsk, Moscow, Tokyo, Osaka and Seoul. An Airbus A310 is the backbone for operations on long-distance destinations, while a recently acquired B737-800, B727s and AN24s are used on the short-distance international sectors, as well as on the MIAT domestic destinations along with AN26s and Mi8 helicopters. Whereas the A310, B737 and B727s have modern navigation equipment, the AN24/26s are not VOR/DME equipped¹. The AN24s are expected to be phased out within the next few years; however, the replacement aircraft type is yet to be decided.

2.5 Foreign carriers operating into Ulaanbaatar include Aeroflot, All Nippon Airways, China Air, Japan Airlines and Korean Air. In 2001, MIAT operated nearly three times as many international flights as the foreign air carriers combined. The total number of international passengers was greater than the number of domestic passengers.

2.6 A significant portion of air traffic between the Far East and Europe crosses Mongolian airspace. The number of international overflights has increased significantly in recent years and is forecast to continue to increase rapidly in the future, from about 29 000 recorded movements in 2001 to 40 000 in 2005,

¹ The only VOR/DME station in Mongolia is at Ulaanbaatar. Hence en-route navigation is mainly based on NDB supported by GNSS (GPS).

2.7 A single flight information region (FIR) covers the entire Mongolian airspace. Currently, controlled airspace only exists in the Ulaanbaatar terminal control area (TMA) and control zone (CTR), while there is no formal controlled airspace for protection of IFR flights on ATS routes and at local airports. A phased implementation of ICAO airspace classifications, TMA/CTRs and traffic information areas/traffic information zones (TIA/TIZ) is planned. Ulaanbaatar FIR borders on Russian (Chita, Irkutsk and Kizil) and Chinese FIRs (Beijing, Lanzhou and Urumqi).

Figure 1. Route structure in the upper airspace

2.9 Air traffic control services in Mongolia are based entirely on procedural methods. There is no radar service, and ADS-C is used by the area control centre (ACC) sectors for trial and demonstration purposes only and is not used for surveillance at this time.

3. ADS SIMULATION

3.1 The real-time simulations of ADS in Mongolia were conducted at the Swedish ATS Academy (SATSA) facilities at the Malmö/Sturup airport in Sweden from 18 to 22 November 2002. Traffic characteristics were the same for all exercises. For the upper airspace, the traffic volume replicated real statistics increased by 30 per cent.

3.2 In the upper airspace of Ulaanbaatar FIR, Mongolian and Swedish controllers were responsible for the ATC service from three control positions. The sectorization and division of responsibility were the same as in live operations in Mongolia today. Five exercises were conducted, focusing on four different communications, navigation, and surveillance/air traffic management (CNS/ATM) infrastructure options. Exercises 1 and 2 focused on procedural control supported by extrapolated flight plan tracks presented on the controller displays (this replicated the present system in Mongolia). In exercise 3, radar was introduced for a limited part of the Ulaanbaatar FIR. In exercise 4, ADS-C capabilities were available for 70 per cent of the overflying traffic in the upper Ulaanbaatar FIR. Exercise 5, the final exercise, focused on ADS-B. The aircraft equipped with ADS-C in the previous exercise now carried ADS-B equipment instead.

3.3 In the lower airspace of Ulaanbaatar FIR, two system options were investigated, one with and one without ADS-B implemented. Today the traffic operating into Ulaanbaatar and some provincial (Aimag) airports is controlled, whereas all other traffic is only provided with flight information service (FIS) and search and rescue (SAR) service. This traffic was displayed at four pseudo-operational positions acting as the control towers at Ulaanbaatar, Muren and Khovd, and the lower flight information service unit at Ulaanbaatar. In the ADS-B exercises, all aircraft belonging to MIAT were ADS-B equipped, whereas other flights were not. The number of ADS-B ground stations was sufficient to provide overlapping coverage and the flights could be followed continuously on the displays.

3.4 The real-time ATM simulator (SMART) supports full-scale gate-to-gate operations including apron management, tower, approach and area control. All aircraft can also be monitored from the pilot's perspective on a cockpit display of traffic information (CDTI).

4. FINDINGS

4.1 ADS-B in the upper airspace

4.1.1 The value of ADS-B in the upper airspace is substantial. Most flights will be granted their requested levels, it is easy to apply separation, the tracks will be shorter and there are substantial safety benefits.

4.1.2 The mix of equipped and non-equipped flights is a problem and it was found that the percentage of equipped flights must be high. The 70 per cent equipage used in the simulations seemed to be too small a percentage. The mix could constitute a risk, e.g. because of different separation minima and the need for the controller to split the attention between the strips and the situation display. The point in time when a sufficiently large percentage of aircraft is equipped is uncertain; however, aircraft equipage with the new techniques will increase gradually (see paragraph 4.2.1 below).

4.2 ADS-B in the lower airspace

4.2.1 The implementation of ADS-B in the lower airspace also provides substantial benefits. It offers surveillance possibilities and thus better service in the form of FIS and SAR and could also, if needed, be used for separation purposes. A possible first step is to implement ADS-B for traffic in the lower airspace. Aircraft operated in this airspace are on the Mongolian registry and can be mandated to equip. When regional agreements have been reached, the new techniques could be extended into the upper airspace with marginal new investments.

4.2.2 The ADS-B ground infrastructure will also support navigation capabilities through a ground-based regional augmentation system and could also be used to support data link communications. With a CDTI, the pilot's situational awareness would increase dramatically, providing additional safety benefits.

4.3 ADS-B in Ulaanbaatar TMA/CTR

4.3.1 The tower controller will be able to see most flights on the ADS display making ATC much more effective. Only a few aircraft in the TMA will need to be procedurally controlled.

4.3.2 The mix of ADS-B equipped and non-equipped flights could be a problem, but since only very few of the aircraft operating into Ulaanbaatar are not on the Mongolian registry, this problem would be much smaller than in the upper airspace where almost all aircraft are foreign.

4.3.3 Aircraft not equipped with VOR/DME receivers will be able to use GNSS for navigation. A CDTI would enhance the pilot's situational awareness and support precision navigation in the TMA.

4.4 ADS-B at provincial airports

4.4.1 Ground stations supporting both ADS-B surveillance and GNSS approaches would be of benefit for provincial airports.

4.5 ADS-C in the upper airspace

4.5.1 The value of ADS-C was found to be very small because of the mix of equipped and non-equipped aircraft, and the small difference between longitudinal distance-based separation minima in an RNP/RNAV environment using ADS-C and time-based procedural separation minima.

4.5.2 Procedures to be used to implement RNP and RNAV routes and ADS and reduced vertical separation minima (RVSM) are normally based on a regional air navigation agreement. No benefits would be achieved by implementing, for instance, RNP 10 in Mongolia only; it has to be done for several contiguous FIRs covering longer routes.

5. **RECOMMENDATIONS**

5.1 Based on the findings the following recommendations on ADS-B implementation in Mongolia were made:

- a) implement ADS-B ground stations to provide surveillance coverage for domestic traffic in the lower airspace;
- b) equip the unit responsible for surveillance of the lower airspace, Ulaanbaatar tower and a number of aerodrome control towers with ADS-B displays;
- c) modify the presentation displays for the upper airspace in the ACC to support presentation of ADS-B data;
- d) mandate aircraft operators operating Mongolian registered aircraft in Mongolia to install ADS-B equipment in all aircraft;
- e) collaborate with ICAO and States concerned to reach a regional air navigation agreement on ADS-B; and
- f) collaborate with foreign aircraft operators, especially those operating into Buyant-Ukhaa (Ulaanbaatar), on ADS-B solutions.

5.2 Based on the findings the following preliminary recommendations on GNSS for navigation were made:

- a) implement ground stations to support GNSS navigation including approach procedures. (VDL Mode 4 ground stations supporting ADS-B also include a GNSS augmentation function); and
- b) collaborate with ICAO and States concerned to reach regional air navigation agreements on CPDLC, RNP, RNAV routes and RVSM.

6. **ACTION BY THE CONFERENCE**

6.1 The conference is invited to:

- a) note the successful activities on ADS and ADS-B in Mongolia;
- b) recommend that States in a similar situation consider the same approach; and
- c) recommend that other States in the region investigate the possibility to make a similar approach in order to implement ADS/ADS-B along major traffic flows over several FIRs to allow for reductions in separation minima, providing for increased safety and efficiency.

— END —