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

COMPUTERISED AERONAUTICAL INFORMATION SERVICES SYSTEM CONCEPT

(Presented by the Secretariat)

SUMMARY

In the future air traffic management (ATM) system, as described in the operational concept, the aeronautical information service (AIS) plays a critical supporting service role. If aeronautical information of required quality is made available in real-time and in the common format to any airspace user, any time, anywhere, this will provide the basis for improved decision making by all participants of the ATM community and thus, will contribute overall to increased aviation safety and performance. This paper describes a system concept for AIS to support the future ATM system.

Action by the conference is in paragraph 4.

1. INTRODUCTION

1.1 The global Air Traffic Management (ATM) operational concept, as described in AN-Conf/11-WP/4, is based on users requirements and is intended to ensure that the expectations of the ATM community are met. To satisfy those requirements and expectations, the operational concept prescribes that the ATM system should be globally interoperable, based on worldwide standards, procedures and uniform principles which will ensure operational interoperability of ATM systems and facilitate homogeneous and non-discriminatory global, regional and national air traffic flows.

1.2 In the ATM operational environment, the aeronautical information service (AIS) plays a critical supporting service role. If aeronautical information of required quality is made available in real-time, this will provide the basis for improved decision making by all participants of the ATM community. Furthermore, not only will the real-time provision of aeronautical information improve the decision making

process, but also the wide availability of high quality information or data made available in the common format to any airspace user, any time, anywhere, will contribute overall to increased aviation safety and performance.

1.3 To ensure the cohesion and linkages between different components of the operational concept and accomplish the role of AIS, consideration must be given by AIS to the interchange and management of aeronautical information to be used by different services and users, while taking into account interoperability of existing and future systems. When aeronautical information is interchanged on a system-wide basis, it will allow the ATM community to conduct its business and operations in a safe and efficient manner while information management will achieve real-time availability, quality assured maintenance and seamless interchange of relevant aeronautical information between parties in an interoperable, flexible, adaptable and scalable manner.

1.4 The ATM community will depend extensively on the availability of real-time, accredited and quality-assured aeronautical information and, from an airspace user perspective, this will provide decision support and more autonomy in decision-making including conflict management. From a service provider perspective, including that of an aerodrome operator, the ability to operate within an information-rich environment, with real-time data, as well as with system trend and predictive data, combined with a range of automated decision-support of decision-making tools, will enable optimization of service to airspace users.

2. DISCUSSION

2.1 The objective of the AIS is to ensure the flow of aeronautical information necessary for the safety, regularity and efficiency of international air navigation. The role and importance of aeronautical information has changed significantly with the implementation of area navigation (RNAV), required navigation performance (RNP) and airborne computer-based navigation systems. To support those operations and systems, aeronautical information must be provided in a timely manner and must be of required quality (i.e. accuracy, resolution and integrity).

2.2 Annex 15 — *Aeronautical Information Services*, defines standards and recommends practices to exchange aeronautical information that is vital to the safety of air navigation. Currently, States exchange aeronautical information in a paper-based format using the aeronautical information publication (AIP). Each State is responsible for the creation and maintenance of its own AIP. In addition, to its AIP, each State must also create and promulgate AIP Amendments, AIP Supplements and NOTAM to notify other States and users of changes to its AIP.

2.3 To achieve the future ATM objective of making informed collaborative decisions for the most efficient operations and business practices, aeronautical information necessary for the safety, regularity and efficiency of international air navigation must be shared on a system-wide basis, must be pertinent and must be available for access by any ATM participant when and where required. To accomplish this, the Secretariat has envisioned a computerized aeronautical information services (CAIS) system concept that:

a) is a three-tier architecture system concept consisting of a database, servers and clients;

b) is a publisher-subscriber type system;

c) will maintain AIP information of all States in an electronic format, referred to as an aeronautical data package (ADP); and

d) will promulgate changes to ADP to States and other subscribers in an electronic format.

2.4 The CAIS system solution to this issue involves two major concepts; the ADP and the aeronautical communications and transmissions protocols (ACTP). These would enable communicating changes to an ADP on a real-time basis, ultimately eliminating the need for AIP Amendments, AIP Supplements and NOTAM, consequently, enabling all States and other authorized (subscribed) users to have access to up-to-date ADP information at all times. The ADP would, therefore, be an electronic version of a State's AIP and it in effect, would represent an always up-to-date AIP. The ADP would be electronically encoded (formatted) as an extensible mark-up language (XML) document type definition (DTD) structure. This structure would be based on the textual layout of the AIP as specified in Annex 15 and the *Aeronautical Information Services Manual* (Doc 8126). The use of this layout would make it easy for a State that currently does not employ an electronic database to transfer its AIP into an ADP. Similarly, the XML DTD would define an exchange format that can easily be populated by any State already using a database solution for its AIP.

2.5 The envisioned aeronautical information database (AID) would contain ADPs of all States. The AID, which is envisioned to reside on a centralized server, would need to be implemented on a reliable commercial database platform for a production quality system. Each ADP would be stored as multiple sections in the database. The use of relational database technology would allow the leveraging of existing software and a path for expansion of the system over time.

2.6 The ACTP are sets of rules and regulations that would be adopted for electronic communication of aeronautical information between organizations and subscribers. The ACTP is envisioned to be composed of many cooperating computer systems (nodes) connected by a secure data communications network (see the Appendix). Five types of nodes are envisaged in the ACTP and they have been arranged in a hierarchical structure from the lowest level representing aerodrome AIS offices, other services involved in the provision of raw aeronautical information and users, to a global coordinated database that would synchronize the versions of all ADPs in the network. The ACTP would need to be implemented in a robust and well-understood programming language, using both encryption and error checking technologies.

2.7 A global server is identified as a central aeronautical global information server (CAGIS) and there would exist one logical CAGIS, for which there would be redundant backups. There would also exist multiple aeronautical global information servers (AGISs), strategically placed across the globe to position information closer to States and subscribers, thus providing faster data access. The CAGIS would contain a copy of each State's ADP in the AID. The CAGIS would be responsible for version control of the ADPs. Whenever an ADP was updated on the CAGIS, it would push a copy (push technology[1]) of the new version of the ADP to all of the AGISs in the system. Each AGIS would contain a cached copy of each State's ADP, therefore, providing consistent data across all AGISs which would allow for any of them to serve as an alternate source for aeronautical information in the event of an AGIS failing.

2.8 A State level server is identified as an aeronautical state information server (ASIS). There would exist one ASIS for each State. An ASIS would maintain a list of AGISs to contact for ADP retrieval and updates. There would be two subscriber lists maintained by an ASIS. The first list would be a list of

[1] **Push technology**: Sending information to a target server without receiving a request for such information.

States and subscribers that need to be notified when an update is made to the given State's ADPs. The second list would be a list of in-state servers that need to be notified when update messages are received by the given ASIS. An ASIS would store all ADPs retrieved to allow faster access to an ADP. Before an ADP is distributed, the ASIS would perform an ADP version check with an AGIS to provide the most up-to-date version of the ADP. In-State entities would communicate through the given ASIS for ADP retrieval, updates, and update notifications.

2.9 An aeronautical information office in a State would be served by an aeronautical in-state information server, centre for update proposals (AISIS_CUP) or an aeronautical in-state information server, ADP request centre (AISIS_ARC). Both of these two servers could request (pull technology[2]) through their AISIS, an ADP of any State. There can exist multiple AISIS_ARCs and AISIS_CUPs within a State and the only difference between them would be that an AISIS_CUP may make proposals to its own State's ASIS for an ADP update. Each of these servers would maintain the information needed to communicate with their own ASIS to retrieve an ADP and/or receive ADP update messages from which they may also request an ADP version check to determine if it had the most up-to-date version of an ADP. To allow faster access to ADP data, an AISIS_ARC or an AISIS_CUP would store all retrieved ADPs.

2.10 To demonstrate the CAIS system concept envisioned by the Secretariat, East Tennessee State University (ETSU) through its Design Studio developed a prototype ADP by using one subset of aeronautical information contained in an AIP (ENR 5.1 was used as the subset). The ADP prototype, implemented in Java, delivered a proof of concept that aeronautical information can be exchanged electronically by practically demonstrating on several computers, the following capabilities:

a) storing/updating an ADP subset;

b) retrieving stored/updated ADP subset;

c) displaying a retrieved ADP subset as a document;

d) sending/receiving messages about ADPs, including proposals for ADP updates, requests for ADP retrieval and messages of confirmation or failure of ADP updates; and

e) simulating all the servers defined in the ACTP.

3. CONCLUSION

3.1 The ATM operational concept envisages evolution to a cooperative and collaborative decision-making environment, where expectations of the members of the ATM community will be balanced to achieve the best outcome. AN-Conf/11-WP/21 describes the next step towards the development and implementation of a global ATM system which includes the development of ATM requirements. In accordance with AN-Conf/11-WP/21, the ATM requirements specify the scope, characteristics and attributes forming the ATM system environment. Aeronautical information management and information interchange at the global level (taking into account interoperability of systems) are at the heart of the operational concept and can be considered as the most important prerequisites of the concept. It is, therefore, of the highest

[2] **Pull technology:** Retrieving information on demand from a source rather than receiving information from a source on a predetermined interval of time.

importance that the above aeronautical information aspects be taken into account when ATM requirements are developed.

3.2 Several advantages have been identified in the CAIS system concept, i.e. the autonomy and responsibility of States for the provision of quality aeronautical information in accordance with Annex 15 provisions is maintained, the concept is based on data exchange, network traffic is minimized and the system is expandable and modular. By focussing on the exchange process, Annex 15 and Doc 8126 should be used to develop an XML exchange format. The prototype developed by ETSU and practical demonstration proved that currently available technology could be used to exchange electronically aeronautical information and that given sufficient support and resources, a full working system could be developed along the same lines.

4. ACTION BY THE CONFERENCE

4.1 The conference is invited to:

a) note the information concerning the computerised aeronautical information services (CAIS) system concept and provide any comment thereon; and

b) agree to the following recommendation:

Recommendation 1/xx — ATM requirements — Aeronautical information

That ICAO, when developing ATM requirements, define corresponding requirements for aeronautical information as one of the most important enabling services required to support the global ATM operational concept, taking into account the computerized AIS system concept and any other available systems or concepts of data interchange and their mutual interoperabilities.

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