International Civil Aviation Organization

AIDC Review Task Force Meeting

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Agenda Item 2: **Review of experience gained and lessons learned in the implementation of the AIDC**

Agenda Item 4: **Future Work Program**

IMPLEMENTATION OF THE AUTOMATED ATM SYSTEM IN THAILAND

Summary

This paper introduces the information regarding the implementation of automated ATM (Air Traffic Management) system in Thailand, which integrates several communication, surveillance and processing subcomponents. The main focus of this information paper is on the description of the AIDC subcomponent. It reviews the standards of ATN-based AIDC and how ATN-based AIDC has been implemented, in conjunction with other related automation subcomponents, in Thailand.

(Prepared and presented by Thailand)

1. Background

Time-critical-mode ground-ground data communication technologies, affiliating voice systems, among air traffic controllers have been evolved for years in certain parts of the world. However, they have been implemented based upon aging data communication infrastructures. Consequently, the requirements to improve data communication frameworks have been finalized at the concept of ATN, which, in addition, is expected to serve the entire communication requirements in aviation. Being one of the components in ATN, the ATN-based AIDC system has been standardized in the fashion that has the resemblance on the message set and their state transition to those of other standards such as APANPIRG AIDC or European FDP's OLDI. However, the definition of messages and their state transition for ATN-based AIDC is much more extensive.

This information paper introduces the description of the ATN-based AIDC and the experiences gained from the implementation of the AIDC in Thailand.

2. Review of the ATN-based AIDC standards

There are 2 main sets of materials that contain the information concerning the standards for ATN-based AIDC; Doc 9705 (ATN SARPs) [1] and Doc 9739 (CAMAL) [2]. This section reviews some concepts of ATN and AIDC from such materials.

2.1 Coverage of Doc 9705 [1]

According to Doc 9705 [1], the scope of communication in ATN may be classified into the following 3 main levels:
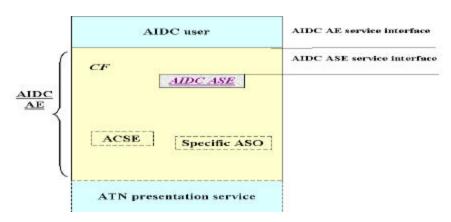
I) ATN ICS (internet communication services);
II) ATN ULCS (upper layer communication services); and
III) ATN applications

- Main applications
    - MHS (Message handling system)
    - AIDC (ATS interfacility data communication)
    - CM (Context management)
    - CPDLC (Controller-pilot datalink communication)
    - ADS (Automatic dependent surveillance)
    - ARF (ADS report forwarding)
    - FIS (Flight information system)
- Supporting applications
    - Security
    - SM (Systems management)
    - DS (Directory services).

AIDC, as one of the applications in ATN, makes use of the same underlying communication infrastructure as all other ATN applications, ATN ICS and ATN ULCS.

2.2 ATN-based AIDC systems

System structure
The structure of ATN-based AIDC is viewed as an application entity (AIDC AE) that consists of a set of internal functional elements, each of which has its own interfaces to other functional elements, as shown in the figure below.

AIDC user	The user process of the AIDC system, which can be a command issued by or a result delivered to a human air traffic controller or other functioning automation subcomponent
AIDC AE	An AIDC application process
AIDC AE service interface	The interface between AIDC user and AIDC AE

AIDC ASE	AIDC application service element that executes AIDC-specific protocol, enforces AIDC-specific primitive sequencing actions, timer management, and error handling.
AIDC ASE service interface	The interface between AIDC ASE and AIDC user (via AIDC CF)
ACSE	The common service element that provides application association services for any ATN application
Specific ASO	Other service elements that have no direct concern to AIDC-specific protocol but exist as the functions of supporting applications (see 2.1 above) communicating description of an AIDC process with such other supporting application servers
AIDC CF	The service element that does the mappings of primitives received from one element to another

Available user services in ATN AIDC

The interaction between user and AIDC AE is performed by means of **AIDC AE service interface**. There is a set of user services available at this interface. Current version of ATN AIDC SARPs [1] defines the following user services:

1   -   User-confirmation service
2   -   Notify service
3   -   Coordinate-start service

4   -   Coordinate-end service
5   -   Coordinate-negotiate service
6   -   Coordinate-standby service
7   -   Transfer-initiate service
8   -   Transfer-request service
9   -   Transfer-conditions-proposal service
10 -   Transfer-conditions-accept service
11 -   Transfer-control service
12 -   Transfer-communication service
13 -   Transfer-communication-assume service
14 -   Info-transfer service
15 -   End service
16 -   User-abort service
17 -   Provider-abort service

Each user service refers to the manner of transfer of a corresponding AIDC message by the AIDC application process. An AIDC message is defined in the SARPs as a **service primitive**.

ATN AIDC Application timers

The set of timers in the ATN-based AIDC protocol may be shown below:
- User confirmation timer
- Info-transfer timers
- Notifying-Coordinating timers
- Response monitoring timer
- Negative response monitoring timer
- Transfer communications response monitoring timer
- Standby timer
- Coordinating-Transferring timers
- End timer

3. Implementation of AIDC as part of the automation components in AEROTHAI ATM system

AEROTHAI is the organization that provides air traffic management services in Thailand. AEROTHAI has been constantly improving its CNS/ATM technologies. This section demonstrates the way AIDC and other related technologies have been implemented in Thailand.

3.1 AEROTHAI ATM systems

The AEROTHAI ATM system has been implemented by the integration of various physical and automation components. AFTN/ATN communication systems, Radar systems, and flight data processing systems are integrated to maximize the use of automation technologies for the efficient flight safety management and reduced controller workload.

3.2 Presence of the AIDC as part of the AEROTHAI ATM systems

Recently, AEROTHAI has begun the trial operation of AIDC as another means of ground-ground controller coordination within some parts of the country. For the benefits of system feature comparison, there are two sets of AIDC implementations in Thailand, manual and automatic AIDC's.

First is the standalone AIDC system, which requires a human air traffic controller to manually make the decisions how, when, and where to initiate or to keep on the coordination with other air traffic controllers with regards to a particular aircraft. The set of messages and their contents have been customized according to the requirements of local air traffic controllers.

Another one is the AIDC embedded within the FDP system, which provides silent coordination capabilities to ATC operation. That is, the notification, coordination and transfer of control are executed automatically with minimal human intervention. This is possible because of the integration with other communication systems, surveillance systems and flight data processing systems.

The following table summarizes the description of the standalone AIDC and the FDP's AIDC in AEROTHAI.

	Standalone AIDC	FDP's AIDC
Underlying communication services	TCP/IP protocol	
Integration to other main systems	Preflight ATS message system	Preflight ATS message system, Surveillance system, Flight data processing system
Manner of execution of ground-ground controller coordination	Manually	Automatically (Reduced controller workload)
Mainly used coordination messages	Notify, Coordinate, Transfer of control, Inbound estimate, Cancel, Clearance request, Clearance delivery, Clearance readback, Free text	Notify, Coordinate initial, Transfer of control, Transfer of control assume
Message structure	Follow the structure of ICAO ATS messages in Doc 4444 [3]	

3.3 Pros and Cons experienced

It is obvious that air traffic controllers prefer the tools that would assist them in moving the ATC operation workload from human to machine. FDP's automatic AIDC therefore could induce more preferences from the air traffic controllers. However, the automatic AIDC system does not support some rare cases of the ATC operation. That is, within the coordination phase, FDP's AIDC does not fully allow the controllers to negotiate the conditions with which a flight would be crossing the air space boundary. Moreover, the controllers do not have the chance to freely exchange free-text messages.

For the manual AIDC, the only automated part of the system is the feeding of flight plan information from flight plan distribution system. With manual AIDC, the controllers are allowed to interact among one another by the use of any AIDC message at any time. The controllers still have to take care of each execution of flight notification, flight coordination, flight transfer, or any other coordination, on their own. The controller workload is still not lessen.

4. Improvement plan for AIDC as part of the AEROTHAI ATM system

To get the most out of the AIDC as one of the critical automation components in AEROTHAI ATM systems, the improvement of AIDC would be carried out in the way that meets the following requirements:
- Automated ground-ground controller coordination is enabled, with the possibility to manually operate in some cases;
- Conformance to ATN-based AIDC standards.

The implementation of improved AEROTHAI AIDC system mentioned above has been underway.

5. List of acronyms/abbreviations

ACSE	Association control service element
AFS	Aeronautical fixed services
AFTN	Aeronautical fixed telecommunication network
AIDC	ATS interfacility data communication
AIDC AE	AIDC application entity
AIDC ASE	AIDC application service element
ASO	Application service object
ATC	Air traffic control
ATM	Air traffic management
ATN	Aeronautical telecommunication network
ATS	Air traffic services
CAMAL	Comprehensive ATN manual
FDP	Flight data processing system
GM	Guidance materials
ICS	Internet communicaiton services
OLDI	Online data interchange
PER	Packed encoding rules
PICS/OICS	Protocol/Operational Implementation Conformance Statement
SARPs	Standards and recommended practices
ULCS	Upper layer communication services

6. References

[1] International Civil Aviation Organization (ICAO), **Subvolume III (Ground-Ground Applications) – Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN), Doc 9705**, Third Edition, 2002.

[2] International Civil Aviation Organization (ICAO), **Part III (Applications Guidance Material) – Comprehensive ATN Manual (CAMAL), Doc 9739**, Editor's Draft, January 1999.

[3] International Civil Aviation Organization (ICAO), **Procedures for Air Navigation Services - RULES OF THE AIR AND AIR TRAFFIC SERVICES (Doc 4444)**, Amendment 2 to the THIRTEENTH EDITION, 1996.