International Civil Aviation Organization

THE SECOND MEETING OF ASIA/PACIFIC ATS INTER-FACILITY DATA COMMUNICATION (AIDC) IMPLEMENTATIONTASK FORCE (APA TF/2) OF APANPIRG

Bangkok, Thailand, 16 - 18 March 2016

Agenda Item 4: Asia/Pacific AIDC implementation guidance material

DEVELOPMENT OF AIDC GUIDANCE MATERIALS

(Presented by the Secretariat/Hong Kong China)

SUMMARY

This paper presents the Contribution by Hong Kong China for Chapter 7 of the draft AIDC implementation Guidance Materials.

1. INTRODUCTION

1.1 The first meeting of this Task Force agreed to develop the guidance material based on the example of AIGD for ADS-B implementation in the Asia and Pacific Regions. The meeting made Decision 1/ 4 on development of the guidance material by an Ad Hoc Working Group.

2. DISCUSSIONS

2.1 According to the tasks assigned at the second teleconference held on 1 February 2016, Hong Kong, China provided the draft material for Chapter 7 of the GM for review by this meeting.

3. ACTION BY THE MEETING

3.1 The meeting is invited to review the Chapter 7 and its appendices provided in the Attachments to this paper.

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7. SYSTEM INTEGRITY AND MONITORING

7.1 INTRODUCTION

The Communications, Navigation, Surveillance and Air Traffic Management (CNS/ATM) environment is an integrated system including physical systems (hardware, software, and communication networks), human elements (pilots, controllers and engineers), and the operational procedures for its applications.

Recognized by ICAO under its Global Air Navigation Plan (GANP) and Aviation System Block Upgrades (ASBU) framework as an effective tool to reduce manual intervention and ground-ground coordination errors between adjacent ATS Units, the ATS Inter-facility Data Communications (AIDC) is a data link application that provides the capability to exchange data between air traffic service units during the notification, coordination and transfer of aircraft between flight information regions. It is an automated system that facilitates routine coordination by providing a reliable and timely data exchange between ATS units in which accurate information can be derived directly from the system, thus effectively reducing controllers' workload and hence human errors.

Safety issues relating to human errors in ATS transfer were identified by the 18th and 20th Meetings of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/18 and RASMAG/20 meetings) where AIDC was considered as an important means of mitigating Large Height Deviation (LHD[*Note 1]). In addition, AIDC is also recognized as an effective tool to foster better collaborative air traffic management between neighboring ATS units, supporting the ICAO ASBU Module B0-FICE, identified as one of the regional priority modules under the ICAO Asia/Pacific Seamless ATM Plan.

The procedures described in this section aim to ensure system performance by validation, reporting and tracking of possible problems revealed during system monitoring with appropriate follow-up actions.

*Note 1
Large Height Deviation (LHD) means any vertical deviation of 90m/300ft or more from the flight level expected to be occupied by the flight.

7.2 SYSTEM PERFORMANCE CRITERIA

The efficiency gained by adopting AIDC is significant. With continued growth in ATC traffic, more efficiency gained by using AIDC is anticipated.

However, if AIDC messages are not transmitted and received in a timely manner between automation systems, aircraft can potentially cross boundaries without coordination or transfer of control responsibility taking place.

In order to effectively use the AIDC application for the interchange of ATC coordination data, performance requirements need to be specified. These specified performance requirements need to be mutually agreed between neighboring ATS units implementing AIDC. The following are recommended performance figures (such as application response time and operational response time) which are based on the Asia/Pacific Regional AIDC Interface Control Document (ICD) (Version 3.0).

Response Messages

a) **Application Response**

i) Every ASIA/PAC AIDC message received by an ATSU, except a LAM or LRM, shall be responded to with a LAM or LRM. While no LAM is generated for a valid LRM, an ATSU may choose to respond to an invalid LRM with an LRM. Such a response is termed an Application Response, and is generated automatically by the automation system. A LAM shall be transmitted when the receiving automation system found the received message to be syntactically correct and the message data was accepted for further processing or presentation. Otherwise, an LRM message shall be transmitted.

ii) The timeout value T_{alarm} associated with an application response should typically be less than 180 seconds measured from the transmission time of the original message and may be specified by bilateral agreement, corresponding to the nominal value associated with the accountability timer.

iii) The transmission of an application response should be triggered after the semantic and syntactic checks have been performed on the incoming message. This is because the purpose of an application response is to indicate that a received AIDC message has both been received and is semantically and syntactically correct. Failure to receive an expected application response (i.e. a LAM or LRM) within Tr seconds ($\leq T_{alarm}$) shall

result in a re-transmission (up to a maximum number Nr) of the original message. The timeout timer Tr shall be reset upon re-transmission. Failure to receive an application response within T_{alarm} seconds from the original transmission of the message shall result in a warning being issued.

iv) The transmission of a LAM or LRM shall be triggered by the ATC application process, not the communications process. This is because an application response indicates that the received message was examined by the ATC application process(s), not just the communications functions. Note the distinction between an ATC application process, which implements a critical ATC function such as Coordination or Transfer of Control, and a communications process, which is responsible for the reliable delivery of data, but not data interpretation.

v) Receipt of an LRM should cause the ATSU to take a corrective action before re-transmitting the rejected message with a new message identification number. This corrective action may be automatic or manual.

b) **Operational Response**

i) Several ASIA/PAC AIDC messages require a response, in addition to the normal application response, by another AIDC message. Such a response is termed an Operational Response.

Table 1 below indicates the required response to a received message. ASIA/PAC AIDC messages not listed in Table 1 have no operational response.

Received Message	**Required Operational Response**
CPL	ACP or CDN[Note]
EST	ACP
PAC	ACP
CDN	ACP,CDN, or REJ[Note]
TOC	AOC

Table 1 : Required Operational Response

Note. An REJ is not available in an Initial Coordination Dialogue initiated by a CPL, EST or PAC. An REJ is only available in a CDN dialogue while an REJ is not a valid response to a CDN message within an Initial Coordination Dialogue.

ii) Failure to receive a response within an adapted operational response timeout period Top shall result in a warning being issued.

iii) The value of Top is dependent on whether manual processing is required to generate the operational response. In general, Top should be less than a value when a manual action is required to trigger the operational response.

For example, the performance figures specified in Asia/Pacific Regional Interface Control Document (ICD) v3.0 are as follow:

T_{alarm}	180 seconds
Top	≤600 seconds

Table 2 : Performance figures

The system performance of the AIDC will also rely on the performance of its communication link (e.g. ATN/AFTN leased circuits, Common Regional Virtual Private Network (CRV)). In Asia/Pacific Region, a CRV infrastructure is being developed taking advantage of the latest IP-based communication technology. Common and secure networks had successfully been deployed in some other ICAO regions. The figures in Table 3 below reflect the various levels of performance of CRV that may be selected for the purpose of providing data link services for AIDC. Depending on the level of service to be provided, a given ATS unit can determine what the performance needs for the transmission.

Service	Maximum One-Way Latency (ms)	Round Trip Time (ms)
Data1	100	200
Data2	300	600
Data3	100	200
Data4	300	600
Data5	100	200
Data6	300	600
Data7	100	200
Data-BE	300	600

Table 3 : Performance level of CRV

Normally, the latency of the communication link (in msec) is sufficient to support to the application of AIDC (in second), for example, each AIDC message sent will result in at least one technical response (LAM or LRM), and where necessary an operational response (e.g. EST/ACP, TOC/AOC). Some AIDC application timeout with reference to the agreed ICD as mentioned above is required to be set based on performance of the communications circuit.

7.2.1 Reliability (Suggest to move under Section 7.2)

Reliability is a measure of how often a system fails and is usually measured as Mean MTBF expressed in hours. Continuity is a measure equivalent to reliability, but expressed as the probability of system failure over a defined period. In the context of this document, failure means inability to deliver AIDC messages to the adjacent ATC centres. This includes the failure of AIDC system only. For the other factors such as the failures of communication link and the counterpart AIDC systems are not counted in this document. The reliability performance requirement of AIDC is given in ICAO Doc 9694 "Manual for Air Traffic Services Data Link Applications" (99.9%).

7.2.2 Availability (Suggest to move under Section 7.2)

7.2.1 Availability is a measure of how often the system is available for operational use. It is usually expressed as a percentage of the time that the system is available.

7.2.2 Planned outages are often included as outages because the efficiencies provided to the Industry are lost, no matter what the cause of the outage. However, some organisations do not include planned outages because it is assumed that planned outages only occur when the facility is not required.

7.2.3 Availability is calculated as

Availability (Ao) = MTBF/(MTBF+MDT)

where MTBF= Mean Time Between SYSTEM Failure
MDT = Mean Down Time for the SYSTEM

The MDT includes Mean Time To Repair (MTTR), Turn Around Time (TAT) for spares, and Mean Logistic Delay Time (MLDT)
NB: This relates to the failure of the system to provide a service, rather than the time between individual equipment failures. Some organisations use Mean Time Between Outage (MTBO) rather than MTBF.

7.2.4 Availability is directly a function of how quickly the SYSTEM can be repaired. Ie: directly a function of MDT. Thus availability is highly dependent on the ability & speed of the support organisation to get the system back on-line. The availability performance requirement of AIDC is

given in ICAO Doc 9694 “Manual for Air Traffic Services Data Link Applications” (99.996%).

7.3 AIDC SYSTEM VALIDATION (Suggest to rename from “ATC SYSTEM VALIDATION” to “AIDC SYSTEM VALIDATION”)

7.3.1 System Validation Guidelines

ATS units should conduct a validation process before introduction of their new AIDC equipment and procedures. Such processes shall include before and during implementation:

a) A system safety assessment for new implementations is the basis for defining system performance requirements. Where existing systems are being modified to utilize additional services, the assessment shall demonstrate that the ATS Provider’s system will meet safety objectives;
b) Integration test results confirming interoperability for operational use of AIDC messages; and
c) Establishment of the operational instruction (OI)/ Letter of Agreement (LoA) or Memorandum of Understanding (MoU) between ATS units and mutual agreement on the associated parameters for the set of AIDC messages to be implemented.

7.3.2 System safety assessment

The objective of the system safety assessment is to ensure the ATS units that the introduction and operation of AIDC is safe. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

a) Identifying failure conditions;
b) Assigning levels of criticality;
c) Determining risks/ probabilities for occurrence;
d) Identifying mitigating measures and fallback arrangements;
e) Categorising the degree of acceptability of risks; and
f) Operational hazard ID process.

Following the safety assessment, ATS units should institute measures to offset any identified failure conditions that are not already categorized as acceptable. This should be done to reduce the probability of their occurrence to a level as low as reasonably practicable. This could be accomplished through system automation or manual procedures.

During tactical AIDC operation, apart from the application messages to be sent from ATM personnel, the logical/system messages and the associated error code/messages feedback from counterparts are found necessary to be captured, e.g. through the Problem Message Queue (PMQ) of the Flight Data Processor (FDP) of the ATM System, and the expiry of accountability timer of the system to provide each event a resolution/action. Prompt response to the counterparts or associated contingency arrangement, e.g. backup system, fallback to IASC, etc. should be in place and to be agreed with between the two AIDC partners.

7.3.3 Integration test

ATS units should conduct trials (both operational and technical) with adjacent ATS units with AIDC equipment to ensure they meet the operational and technical requirements stated in the agreed test procedure. During the technical test, it is recommended to verify as much AIDC messages as possible since it could reduce safety risk associated with system testing after system commissioning. Regarding trials for operational and technical, please find examples given in Appendix B and C respectively.

7.3.4 Recommendations for AIDC Validation

a) Engage both technical and operational experts in the process of AIDC implementation from initial stage;
b) Define the objectives for trials in the test procedure;
c) Use a direct link (or test link for trial) between two ATS units to conduct validation tests;
d) Conduct validation tests on test/development systems (i.e. Prior to conducting an actual trial with neighbouring ACCs for AIDC tests, a simulator testing for mimicking virtual ACC counterpart for AIDC messages exchange should be conducted);
e) Define operational requirements and specify scope of operational improvements (determine what AIDC messages set is required to be supported) at initial planning stage of the operational trial with agreed test procedure(bilateral agreement);
f) Interoperability between ATM automated systems supporting latest version of AIDC ICDs with full/selected message sets;
g) Interoperability between ATM automated systems from different vendors;
h) Interoperability between ATM automated systems supporting different Cyclic Redundancy Check (CRC) initial values (bilateral agreement);
i) Synchronizing the system time of the communication link to common source (e.g. GPS, satellite);

j) Develop a comprehensive and detailed testing plan including testing scripts to evaluate the process of the implementation;
k) Define the contingency arrangement in the test procedure;
l) Document the test result and share the lessons learnt with the counterparts, and
m) Adopt Target of Opportunity (TOO) during testing wherever appropriate and applicable.

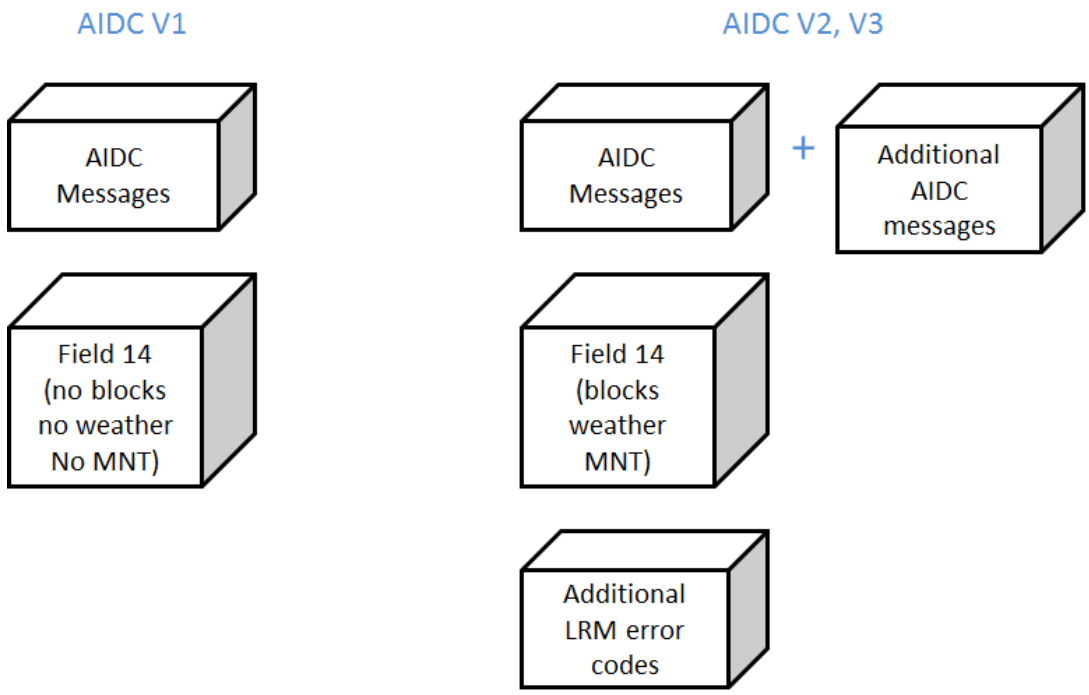
According to the conclusion of The First Meeting of ATS Inter-Facility Data Communication Task Force Meeting (APA TF/1), States/Administrations in the Asia/Pacific Regions is encouraged to use the Pan Regional ICD for AIDC for any planned new ATM automated system or updating ATM automated systems for AIDC function.

There is also an initial suite of messages proposed to allow States/Administrations to enter into the AIDC environment (ABI, EST, ACP, TOC, AOC), details of which are available in the ICAO Asia/Pacific Seamless ATM Plan.

7.3.5 Compatibility Issue between AIDC Versions 1, 2 and 3

The enhancements introduced during the development of AIDC ICD Version 2 and 3 were designed to permit continued interoperability with AIDC ICD Version 1. For example, when a block level format was defined for Field 14, it was explicitly stated that this was an optional format only to be used with agreement between the two ATS units.

The following diagram depicts the significant differences between AIDC Version 1 and the subsequent AIDC versions.



The diagram shows that AIDC messages supported in AIDC Version 1 is included in AIDC V2 and V3. As such, an AIDC V1 ATS Unit is interoperable with an AIDC V2 or 3 ATS Unit. The additional messages in AIDC V2 and V3 are not supported by AIDC V1. However, this could easily be controlled procedurally by simply not sending these messages.

The optional Field 14 formats should not be included in messages sent to an AIDC V1 ATS Unit, which makes Field 14 interoperable too.

The additional LRM error codes were designed to support the new AIDC messages and the Field 14 formats. Because an AIDC V2 or V3 ATS Unit will not be receiving these messages or formats from an AIDC V1 ATS Unit, this means that they will not send these error codes to an AIDC V1 ATS Unit. Therefore AIDC messaging is also interoperable between an AIDC V2/V3 ATS Unit and an AIDC V1 ATS Unit.

7.3.6 Agreement for Validation

States should coordinate with adjacent ATS units to confirm that their tests procedures to ensure harmonization of procedures during testing.

7.4 SYSTEM MONITORING

According to the conclusion of APA TF/1, it is considered necessary to develop a table or database for recording appropriate issues/problems reported by States/Administrations. The meeting agreed the simplified form for use by States/Administrations, as given in **Appendix A** (AIDC issues table) **of** this document. States/Administrations in a position to do so were encouraged to submit identified issues using the form to the ICAO Regional Office for consolidation and review by the APA TF. The APA TF will maintain the AIDC issues table and to follow up with the action plan to resolve the issue as one of the top priorities, while the issues/problems should also be considered and addressed prior to AIDC implementation with neighbouring ACCs.

In addition, States/Administrations in the APAC Region are encouraged to share their implementation plans and experiences with concerned States/ATS units for an expeditious AIDC implementation in a harmonized and timely manner.

7.4.1 The monitoring process

When problems/issues are discovered, the initial analysis should be performed by the organization(s) identifying the problem/issues. In addition, the problem/issue should be logged in the AIDC issues table. As some problems or abnormalities may involve more than one organization, the originator should be responsible for follow-up action to rectify the problem and take lead to record the information in the AIDC issues table. It is essential that all information relating to the problem/issue is documented and recorded and resolved in a timely manner.

The following groups should be involved in the monitoring process and problem/issue tracking to ensure a comprehensive review and analysis of the collected data:

a) ATS Providers;

b) Organizations responsible for ATS system maintenance (where different from the ATS provider);

c) Relevant State regulatory authorities; and

d) Communication Service Providers being used (if appropriate).

7.4.2 Distribution of information

It is important that information that may have an operational impact on other parties be distributed by the authorised groups that are likely to be affected, as soon as possible. In this way, each party is made aware of problems already encountered by others, and may be able to contribute further information to aid in the solution of these problems.

Appendix A
AIDC Issue table

Issue reference	Date of First Report	Description of fault	Fault Type	State/ATSU/Vendor	Priority (assessed by TF or RO)	Actions Taken/Updated Date/Status (Open/Closed)
AIDC-ISSUE-1	yyyy/mm/dd	Brief summary of fault in not more than 20 words	Technical or Operational	STATE/ATSU/VENDOR	High or Low (depending on ops/safety impact, frequency)	Description of correction action
AIDC-ISSUE-2	2014/06/01	**Example**: Not receiving LAM, AOC messages	Technical	SRI LANKA/COLOMBO/THALES	Low	Vendor is investigating, suspect to be test platform issue/18Jun2015/Open.
AIDC-ISSUE-3						
AIDC-ISSUE-4						
AIDC-ISSUE-5						
AIDC-ISSUE-6						
AIDC-ISSUE-7						
AIDC-ISSUE-8						
AIDC-ISSUE-9						
AIDC-ISSUE-10						
AIDC-ISSUE-11						
AIDC-ISSUE-12						
AIDC-ISSUE-13						

Appendix B

See Attachment 1

Appendix C

See Attachment 2