THE FOUTH MEETING OF ATNP WORKING GROUP OF THE WHOLE (WGW/4)

Berlin, 21 August–1 September 2000

Agenda Item:

R&D OF EQUIPMENT FOR ATN IMPLEMENTATION IN JAPAN

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INFORMATION PAPER

SUMMARY

This paper presents the current status of activities and future plans for ATN implementation in Japan.

1. OUTLINE

All ATN-related resaearch and development activities in Japan are led by a study team at the Japan Ministry of Transport s Electronic Navigation Research Institute (ENRI), a national laboratory for ATC-related research.
Under the coordination of ENRI, Oki Electric Industry Co., Ltd., NEC Corporation, Mitsubishi Electric Corporation and a number of other companies have been assigned roles in the research, development and implementation of ATN.

2. HISTORY AND SCHEDULE

ENRI commenced studies on ATN in 1991 in response to a request from the Japan Ministry of Transport s Civil Aviation Bureau (JCAB).
During an initial five-year study plan, ENRI prepared ATN routers and related hardware for evaluating the performance of ATN as an Internet-type infrastructure for ATC, AOC, and APC.
IDRP protocol-compatible ATN routing software was also developed for personal computers running Microsoft's Windows NT operating system.
These efforts culminated in the development and construction in 1996 of the ATN BIS Router Ver. 1 by Oki Electric Co., Ltd., and its installation in the ENRI ATN Simulation Testbed (EAST).
In 1995, JCAB requested ENRI to develop CPDLC and ADS as applications of ATN, and to carry out international ATN connectivity tests during a second five-year study plan from 1996 to 2000.
In 1996, ENRI started the second five-year ATN study plan to continue the research and development of ATN equipment and of an ATC workstation as the human-machine interface (HMI) for ATN applications.
At the beginning of the second five-year plan in 1996, ENRI carried out tests to confirm mutual connectivity between ATN routers using the X.25 protocol. ENRI also carried out tests to evaluate the performance of the ATN router on a public network, using a dummy packet service network, in 1997.
In 1998, ENRI conducted tests to confirm the operational capability of the CNS/ATM-1 package, and to evaluate ATN performance over SATCOM and VHF data-link sub-networks with pseudo-transmission routes.
Based on the results of domestic tests, international connection tests have been conducted since 1998 with a Eurocontrol facility in Paris and with an Airservices Australia facility in Canberra.
International ATN router connection tests between ENRI and Eurocontrol were successfully concluded in December 1998, and those with Airservices Australia were successfully concluded in November 1999.

ENRI is now planning to carry out tests of DFIS and AIDC in 2002, and next-stage tests of modified CPDLC and ADS in 2003. In 2003, the ENRI will start tests for evaluating the performance of MTSAT as a significant ATN sub-network in the Asia-Pacific Area.

The most important issue to be studied for the commercial realization of ATN is mutual interoperation. An essential goal is the resolution of the different interpretations of ICAO SARPs between countries prior to international connection tests.

	-1999	2000	2001	2002	2003
Domestic	CNS/ATM-1 package operation confirmation and performance evaluation (1)Simulated transmission route (STR) not used (2)AMSS STR used (3)VDL STR used		Development of Security Functions for (1) BIS, (2) CM, (3) DFIS, (4) AIDC Improvement of (5) CPDLC, (6) ADS	Development of (1) Directory Server Security Tests of (2) BIS and CM Service Tests of (3) DFIS Connectivity Tests of (4) CPDLC/AIDC (5) ADS	Sub-network Performance and Connectivity tests of (1) VDL mode-2, and (2) AMSS of MTSAT
Inter-national	Connectivity Test with Eurocontrol (1) CPDLC Connectivity Test with ASA (Airservices Australia) (2) ATN Routers, (3) CPDLC	Connectivity Test with Eurocontrol (1) ADS Connectivity Test with ASA (2) ADS, (3) AMHS	AMHS Connectivity Tests with Hong Kong and other countries	AIDC Connectivity Tests	

Table 1: History and schedule of ATN R&D activities in Japan

3. ATN INTERNATIONAL CONNECTION TESTS

3.1. THE EAST ATN TESTBED

EAST, the ENRI ATN simulation testbed, has been developed since 1991.
The aforementioned international mutual connection tests with Eurocontrol and Airservices Australia were carried out using the 1997 configuration of EAST.
The complete EAST system consists of two domains: a ground side domain and an aircraft side domain.
The ground side domain consists of an ATN router and various kinds of ATN end systems, such as CPDLC, ADS and CM, and ATC workstations.
The aircraft side domain consists of an ATN router and a cockpit part-task simulator. The part-task simulator allows pilot operation of airborne ATN functions such as CPDLC, ADS and CM to be simulated.

The connection between the current ATN routers uses the X.25 protocol. Two EAST ATN routers have been connected via public packet service networks with ATN routers in Eurocontrol and Airservices Australia in international mutual connection tests.

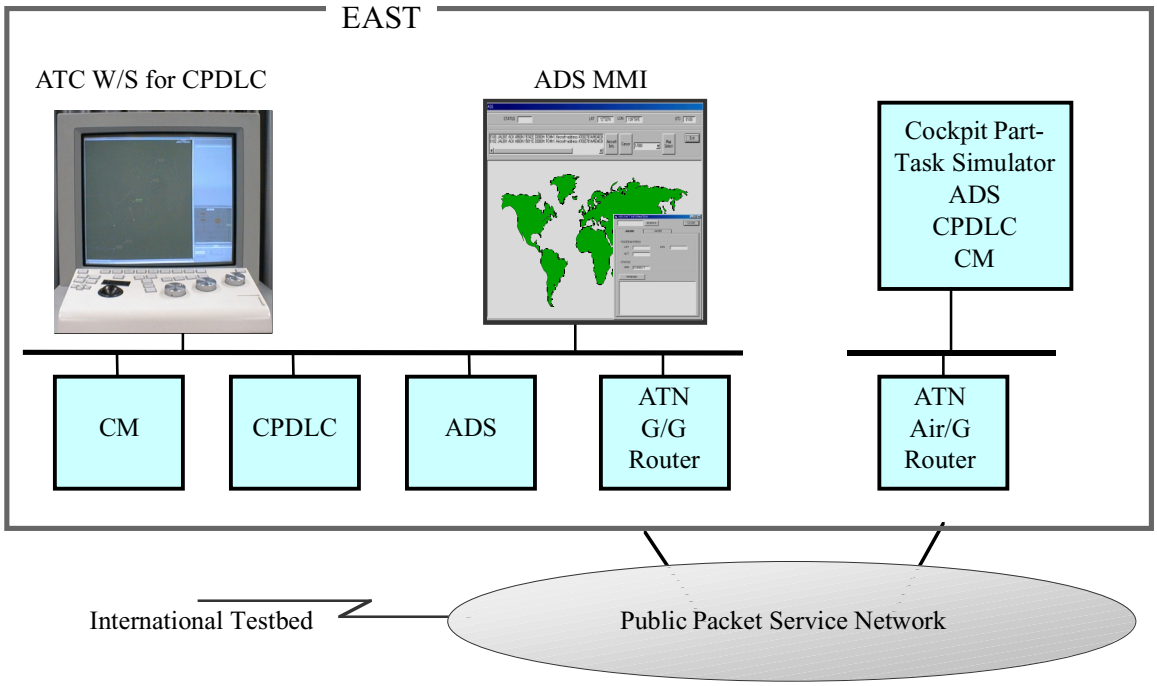

Figure 1: Configuration of EAST

3.2. INTERNATIONAL TEST ITEMS

During the connection trials, ATN Router connection tests were performed first of all, followed by application level connection tests of CPDLC, ADS and so on. The schedule of the international trials conducted so far is shown in the following list.

	Test item	Implementation dates
with Eurocontrol	ATN Router connection	Dec. 1998 (Trial implementation finished)
	CPDLC connection	Dec. 1999 (Partial implementation finished) Jan. 2000 (Trial implementation finished)
	ADS connection	Jun. 2000 (Partial implementation finished) Jul. 2000 (Trial implementation finished)
with Airservices Australia	ATN Router connection	Nov. 1999 (Trial implementation finished)
	CPDLC connection	Dec. 1999 (Completion time resetting) Jun. 2000 (Trial implementation finished)
	ADS connection	Jun. 2000 (Partial implementation finished) Jul. 2000 (Trial implementation finished)

3.3. ATN ROUTER CONNECTION TESTS

ATN Router connection tests were realized as shown in the figure below.

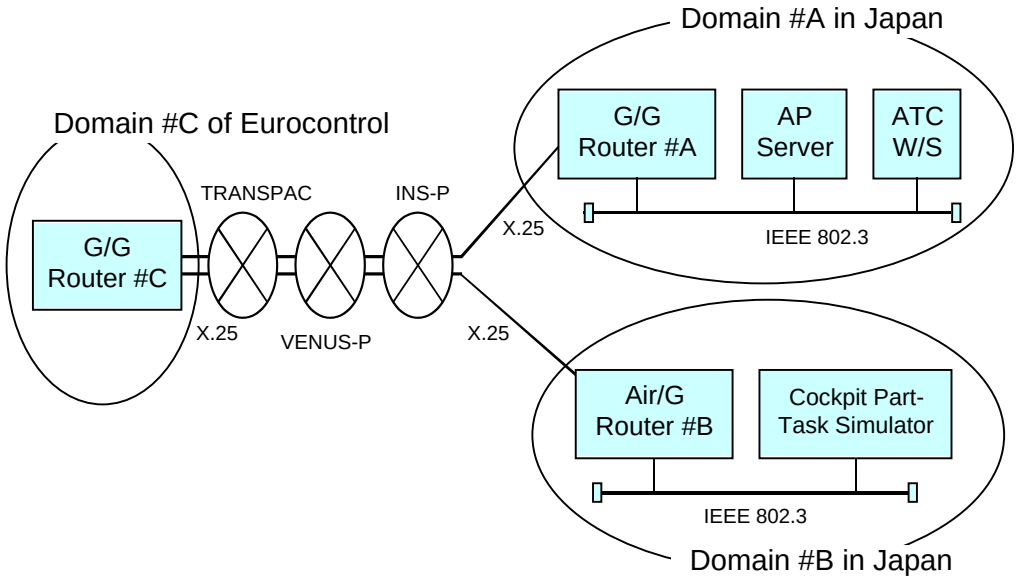

Figure 2: Structure of the ATN Router connection test system

In one test scheme, data were transmitted between two terminals in Japan via an ATN Router at Eurocontrol. This confirmed connections between mutual communication systems in between Eurocontrol and Japan, and also verified the exchange of ATN Router data between terminals on the Japan side.
Two domains were located in Japan and one was located at Eurocontrol .
Connections between Japan and Eurocontrol were routed through three packet communication networks (TRANSPAC, VENUS-P, INS-P) belonging to public network providers.
By sending data from one router in Japan to another via Eurocontrol, this scheme tested the connections between Japan and Eurocontrol in both directions. The tests with Airservices Australia were carried out in the same way.

The ATN Router connection test aimed to confirm mutual connection for the Internet Communication Service as specified by ICAO SARPs.
Major test items are shown below.

a) BIS (Boundary Intermediate System: ATN Router) connect and route addition
b) Multiple BIS connect and route addition
c) BIS disconnect and route deletion
d) Normal data transmission
e) Data transmission when malfunctions occurred in terminals
f) Data transmission when there are malfunctions between BISs
g) Malfunctions between BISs and BIS reconnection

3.4. CPDLC CONNECTION TESTS

CPDLC connection tests were realized as shown below.

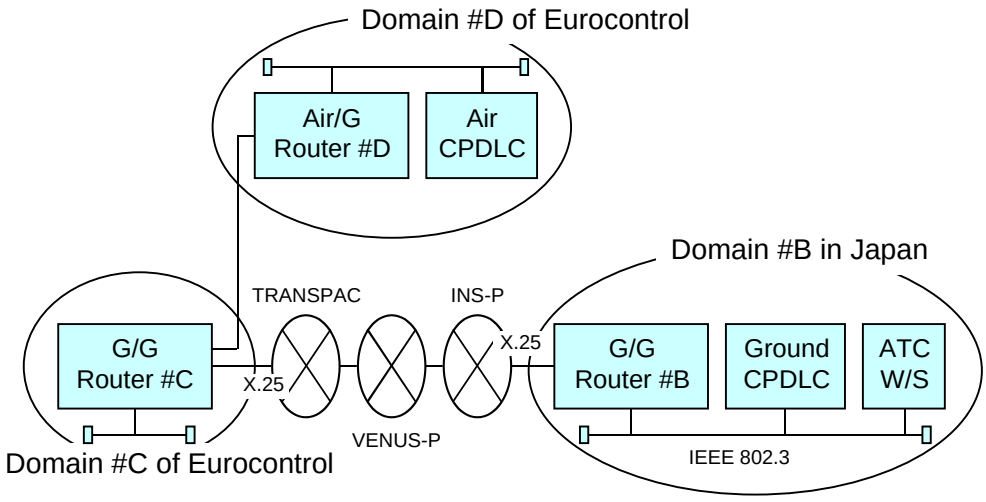

Figure 3: Example structure of a CPLDC connection test

In one test scheme, Japan and Eurocontrol assumed the roles of a ground facility and an aircraft, respectively.

CPDLC communications between an ATC Workstation application in Japan and a cockpit CPDLC application at Eurocontrol via ATN routers connected through public packet networks was confirmed.

The CPDLC connection test aimed to confirm mutual connectivity regarding CPDLC applications.
[Test Items]

a) CPDLC-start service with CPDLC Message parameter
b) CPDLC-message service for some kinds of CPDLC messages
c) CPDLC-end service with CPDLC Message parameter
d) CPDLC-user-abort service
e) CPDLC-provider-abort service

In CPDPL message communication tests, the Japanese domain s system implemented 74 of the total of 236 defined CPDLC Uplink messages, and 27 of the total of 113 defined Downlink messages. However, due to constraints of the Eurocontrol system, tests could only be carried out with two Uplink messages and three Downlink messages.

3.5. ADS CONNECTION TESTS

ADS connection tests were realized as shown below.

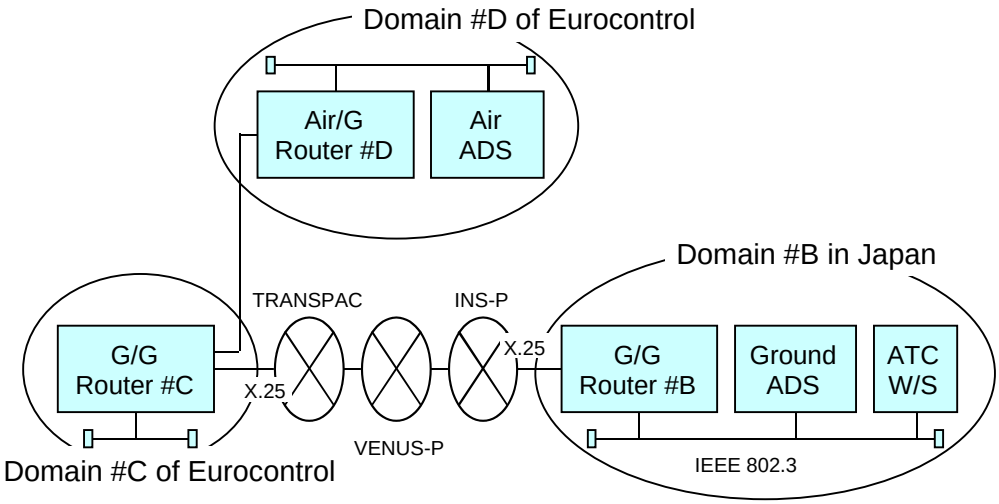

Figure 4: Example structure of an ADS connection test

The connection test of ADS aimed to confirm mutual connectivity regarding ADS applications.
Seven of the eleven ADS service items were selected for the tests.

a) ADS-demand-contract Service

b) ADS-periodic-contract Service
c) ADS-cancel-contract Service
d) ADS-cancel-all-contract Service
e) ADS-user-abort Service
f) ADS-provider-abort Service
g) ADS-report Service

4. PROGRESSIVE STATUS OF TESTS

4.1. ATN Router

Tests were carried out successfully with Eurocontrol in December 1998, and with Airservices Australia in November 1999.

4.2. CPDLC

Tests have been carried out successfully for the most part with Eurocontrol between December 1999 and January 2000, and with Airservices Australia in February-June 2000. However, there were problems due to differences in the implementation of elements by JCAB and Eurocontrol/Airservices Australia. Full coordination is needed regarding the data structures generated by the CPDLC to resolve this problem.

4.3. ADS

Test were carried out with Eurocontrol in June-July 2000, and with Airsevices Australia during the same period.
Some of test items were completed successfully. The remaining test items will be completed by July 2000.

5. CONCLUSION

(1) ATN router connection tests were carried out with Eurocontrol on 17–~~1~~8 December 1998, and with Airservices Australia on 24 November 1999.
CPDLC tests were carried out with Eurocontrol on 21–~~2~~2 December 1999, and on 20 January this year.

(2) ADS tests were carried out with Eurocontrol on 15–~~1~~6 June, and on 10–~~1~~1 July, but could not be completed due to problems with the testbed at Eurocontrol.
The ADS tests carried out with Airservices Australia on 17 July could also not be completed due to similar problems with the testbed at Airservices Australia.
ENRI and Oki will continue their efforts until the tests are successfully accomplished.

(3) ENRI is now planning to carry out tests of DFIS and AIDC in 2002, and to conduct next stage tests of CPDLC and ADS in 2003. The development of functions for security services of the ATN Router and CM has already begun. In 2003, ENRI will start tests to evaluate the performance of MTSAT as a significant ATN sub-network in the Asia-Pacific Area.

ENRI is now designing an ATC workstation for an IFR room ATC controller/ATC coordinator team.

Figure 5: ATC Workstation for IFR room

The key concept of the ATC workstation is the compatibility between voice communication and data communication.

This ENRI-led workstation development project is progressing with the collaboration of Oki Electric Co., Ltd. and NEC Corporation.

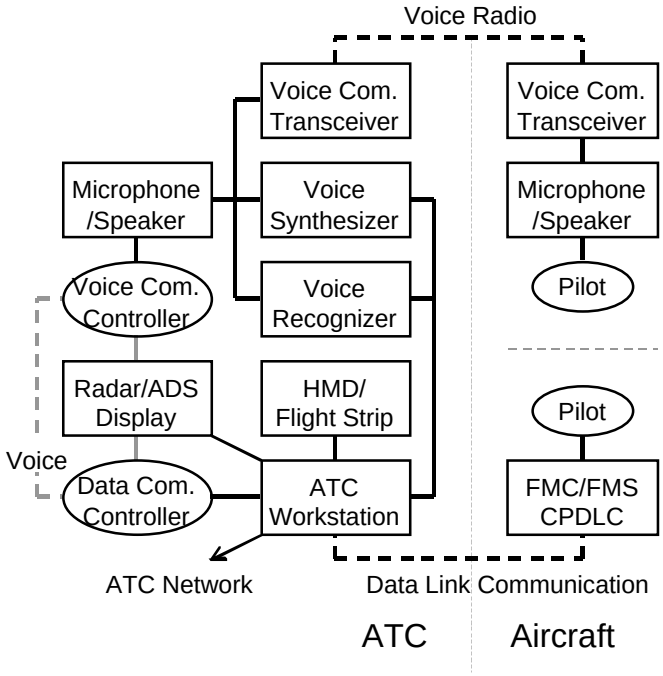

Figure 6: Concept of ATC Unit

Design of Distributed Air Traffic Control Unit by K.Shiomi and et.al., Proc. of the 43rd ATCA in 1998.

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