INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

ASIA/PAC ATN GROUND-GROUND TRANSITION PLAN

Second Edition – March 2004

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EXECUTIVE SUMMARY

This document provides technical guidance on the transition from the ground infrastructure support of the Aeronautical Fixed Telecommunication Network (AFTN) services to the Aeronautical Telecommunication Network (ATN) for the ASIA/PAC Region.

The ASIA/PAC ATN Ground-to-Ground Transition Plan outlines the requirements to increase bandwidth and upgrade protocols for those trunks that will support the main data flow of traffic through the ASIA/PAC Region. The plan also provides target dates of implementation of the trunks, BBISs and BISs to ensure a smooth transition to the ATN within the region.

This transition plan also takes into consideration the air to ground aspects and presents the transition activities required for the ASIA/PAC Region.

This document was adopted by 12th Meeting of APANPIRG held in 2001 for distribution to States in the ASIA/PAC and adjacent regions.

1. INTRODUCTION

This document presents a plan on the ATN ground transition activities applicable to the ASIA/PAC Region. The document provides information on the ground infrastructure required to support the ATN and to take into consideration the ATN air-to-ground requirements of the region.

1.1 OBJECTIVE

The objective of this document is to provide guidance and information on the transition activities that will need to occur for the ASIA/PAC Region to migrate from the AFTN to the ATN.

1.2 SCOPE

The scope of the document includes:

- A brief description of the existing ground infrastructure based on AFTN;
- The types of ATN applications that will be used over the ground infrastructure;
- The types of trunks that will need to be upgraded to cater for ATN traffic; and
- A proposed implementation schedule on how the ATN should be transitioned within the region.

1.3 REFERENCES

Reference 1 Manual of Technical Provisions for the ATN (Doc 9705-AN/956) Third Edition
Reference 2 ASIA/PAC Routing Architecture Plan
Reference 3 ICAO Location Indicators – Document 7910
Reference 4 ICAO Asia/Pacific CNS Facilities and Services Implementation Document (FASID) – Doc. 9673 Existing Ground Infrastructure

2. EXISTING GROUND INFRASTRUCTURE

The existing AFTN is mainly made up of low speed circuit links operating at 300 bps to 9600 bps using X.25 or asynchronous protocols. There are also some low speed circuits operating at 50 baud using telegraph technology. Currently there are over 90 International AFTN circuits that operate within the Region and between neighboring regions. Further details for each AFTN circuit within the ASIA/PAC Region are documented in Table CNS 1A of the ICAO Asia/Pacific CNS Facilities and Services Implementation Document (FASID).

When reviewing the current AFTN topology, the majority of AFTN circuits link will not be suitable to be used for the ATN without some form of upgrade. These upgrades will need to be in the form of high-speed links (bandwidth capacity) and the use of protocols such as X.25 that is compatible with the ATN lower layers.

It can also be assumed that due to different planning activities by States, not all States within the region will be migrating to the ATN at the same time. Therefore, there will be a need to maintain existing AFTN circuits to operate in parallel with any new implementation of high-speed links to meet ATN requirements.

It may also be possible for some States that operate private sub-networks using protocols such as X.25 that they could be in a position to carry transit ATN traffic between States that have implemented ATN without being forced to implement ATN in their own country straight away. This would allow the progression of the ATN to continue within the Region without being restricted or having to operate expensive links as a temporary measure while waiting for other States to start their implementation programs.

3. ATN END SYSTEM APPLICATIONS

There are currently six end system applications identified in the Manual of Technical Provisions for the ATN.

Table 3 –1 lists these applications and provides a brief summary of their functions.

Application	Function
Context Management (CM)	An ATN application that provides a logon service allowing initial aircraft introduction into the ATN and a directory of all other data link applications on the aircraft.
Automatic Dependent Surveillance (ADS)	An ATN application that provides data from the aircraft to the ATS unit(s) for surveillance purposes.
Controller Pilot Data Link Communication (CPDLC)	An ATN application that provides a means of ATC data communication between controlling, receiving or downstream ATS units and the aircraft, using air-ground and ground-ground sub-networks.
Flight Information Service (FIS)	An ATN application that provides to aircraft information and advice useful for the safe and efficient conduct of flight.
ATS Message Handling Service (ATSMHS)	The set of computing and communication resources implemented by ATS organizations to provide the ATS message service.
ATS Inter-facility Data Communication (AIDC)	An ATN application dedicated to exchanges between ATS units of ATC information in support of flight notification, flight coordination, transfer of control, transfer of communication, transfer of surveillance data and transfer of general data.

Table 3-1 ATN Applications

4. ATN TRAFFIC

4.1 GROUND-GROUND TRAFFIC

With the introduction of AMHS as the replacement for AFTN, a number of AFTN circuit between centres will need to be upgraded to cater for the increase in traffic load generated by AMHS overheads. Table 4-1 shows a comparison of different size messages transmitted over both an AFTN service and an AMHS service using X.25. From the results shown in Table 4-1, there is an increase in message size of 93% due to overheads generated by AMHS for a typical message of about 250 bytes. As the message size increases the amount of overheads generated becomes less significant to the size of the body of the message. In transitioning from AFTN to AMHS, States will have to anticipate this increase in bandwidth to accommodate AMHS traffic so as to maintain current or better performance of traffic delivery.

It is also important to note that there will also be an increase in other forms of data traffic due to implementation of other ATN applications such as the ATS Inter-facility Data Communication (AIDC) application. AIDC will generally be used by Flight Data Processors (FDP) to communicate between each other, which are normally established in each Fight Information Region (FIR). It can therefore be expected that data generated by this application will increase bandwidth requirements on those links that are required to pass this information between FIRs.

States will need to ensure that not only are the links that are established between States are capable of transferring data in a timely manner but also for those links that provide an alternate path for the applications to use in times of disruption to the primary links.

Data Set #	Set # 1	Set # 2	Set # 3	Set # 4
Size of user message (A)	42	255	7480	13
AFTN				
Size of complete message including overheads **(B)**	98	311	7845	N/A
Size of total data transported - user data **= (B) - (A)**	56	56	365	N/A
Ratio of user message / total message size (%) **= (A)/(B) %**	42.86%	81.99%	95.35%	N/A
AMHS				
Size of complete message including overheads and delivery report **(C)**	4231	4448	12783	4271
Size of total data transported - user data **= (C) - (A)**	4189	4193	5303	4258
Ratio of user message / total message size (%) **= (A)/(C) %**	0.99%	5.73%	58.52%	0.30%
AMHS vs. AFTN				
Ratio of total AFTN / total AMHS (%) **= (B) / (C) %**	2.32%	6.99%	61.37%	N/A
Ratio of total AMHS / total AFTN **= (C) / (B)**	43.17	14.30	1.63	N/A

Table 4 – 1 Comparison of X.25 Message Sizes Using AFTN and AMHS

4.2 AIR-GROUND TRAFFIC

With the implementation of the air-ground applications it is important to ensure that transit response times are kept to a minimum level so as not to affect the overall response time that it takes for traffic such as ADS reports and CPDLC messages to be delivered to their final destination. This again reflects the need to ensure that critical ground links within the Region are capable of handling this information efficiently.

Another important factor with air-ground traffic is the generation of routing information that is caused by aircraft that will move between various ATN routing domains. To maintain this information in a defined area requires a minimum number of backbone routers to be implemented which protects the majority of all other ATN routers from being flooded with routing information. This information is further explained in Section 5

5. ATN ROUTING ARCHITECTURE

The ATN infrastructure can be divided into two main areas to support both the air-ground and ground-ground applications that will operate over the ATN.

For air-ground support the ATN needs to support an ATN Routing Backbone network so that routing information about where an aircraft is can be maintained by this backbone. As aircraft move through various coverage media and FIR boundaries the ATN Routing Backbone will be notified of the changing routing data for each mobile aircraft in the region. The type of ATN Routing Backbone architecture for the ASIA/PAC Region is document in the ASIA/PAC ATN Routing Architecture Plan and is summarized in Figure 5-1 of this document.

It is anticipated that the trunks used for the ATN Routing Backbone will also be used to carry ground-ground application data such as the AMHS. This of course depends upon the routing policies set up between each router, which determine which links are to be used for the different classes of traffic that can be expected to transverse the network.

Figure 5-1 shows the proposed ATN Routing Backbone for the ASIA/PAC Region. The ATN Router Backbone tries to use existing trunks that have already been established between the nominated States who will operate the backbone that is currently used for the AFTN. Virtually these trunks will need to be upgraded to cater for the increase in traffic load that will be handled by the ATN. Further details about these trunks are documented in Section 6.

To improve the resilience and redundancy aspects of the ATN routing backbone, it is proposed that additional trunks be incorporated to ensure minimal disruption to the air-ground applications. This effectively ensures that the ASIA/PAC Region can function on its own without support from other regions relaying information on behalf of a failed router or trunk service within the ASIA/PAC Region. These additional trunks have been shown as dashed lines in Figure 5-1. Also shown are the inter-regional connections between the ASIA/PAC Region and its neighboring Regions. Additional inter-regional connections are also proposed and are further documented in Section 6.

It is important to also note that costs will increase due to implementing higher bandwidth links. Therefore the region should review its requirements in having to use point to point circuits everywhere when a number of strategically placed links may suffice with alternate dial up on demand capabilities being deployed between key sites. This may help to offset the costs and still provide for an efficient ground-ground network for the ATN.

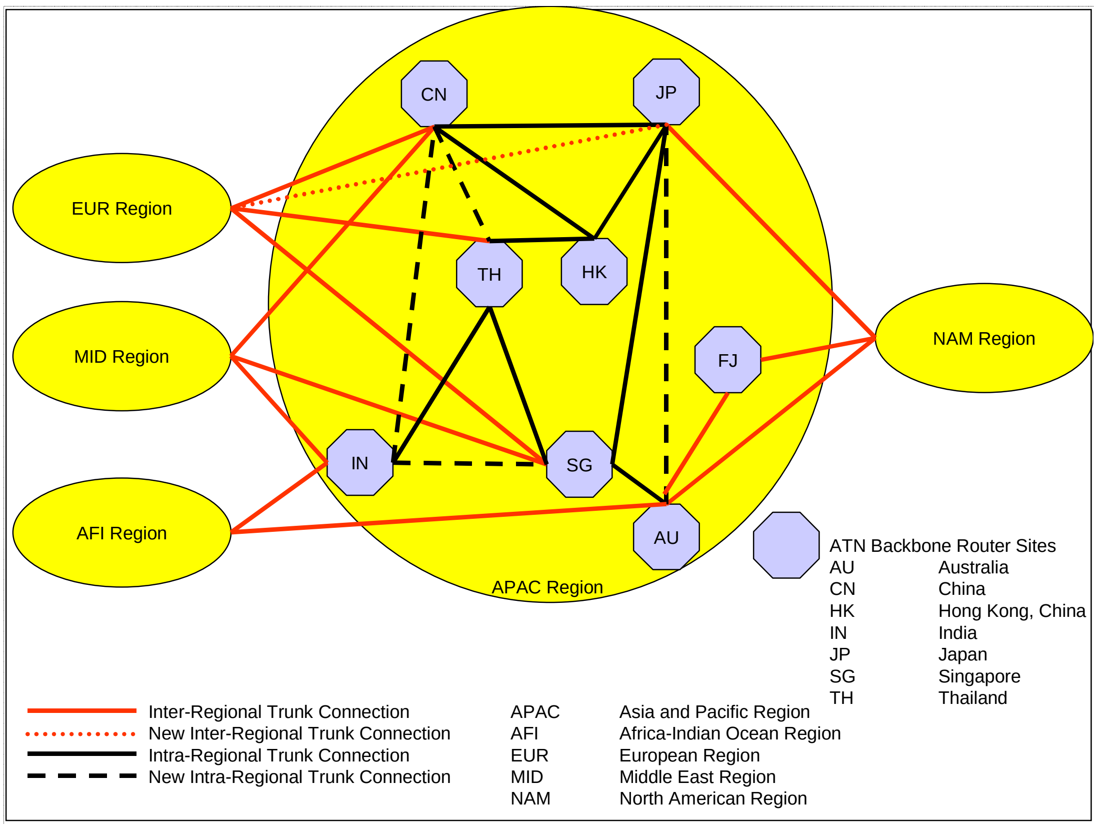

Figure 5 -1 ASIA/PAC ATN Backbone Routing Architecture

6. ATN BACKBONE TRUNKS

Table CNS-1B of FASID provides a list of existing or proposed upgrading of AFTN circuits that have been selected for the transition to the ATN routing backbone. Also provided in the table are proposed additional new trunks that should be considered to provide the necessary redundancy and backup services for the ATN for the region.

As part of the transition from AFTN to the ATN, the existing link capacity, especially those using X.25, must be able to handle both AFTN and ATN for those States who do not intent to migrate to AMHS straight away. It is assumed that States that have been nominated to provide the ATN backbone routing environment will do so in a timely manner so as to allow those States who are ready to start their implementation programmes can do so without too much restriction within the region. Where a nominated State cannot provide the ATN backbone then an alternative arrangement should be put in place for another State, who is willing to provide the service.

INTERCONNECTION OF ATN ROUTERS

This section describes the interconnection requirements for ATN routers for the ASIA/PAC Region. Figure 6-1 shows a pictorial view of the interconnection between various States in the ASIA/PAC Region.

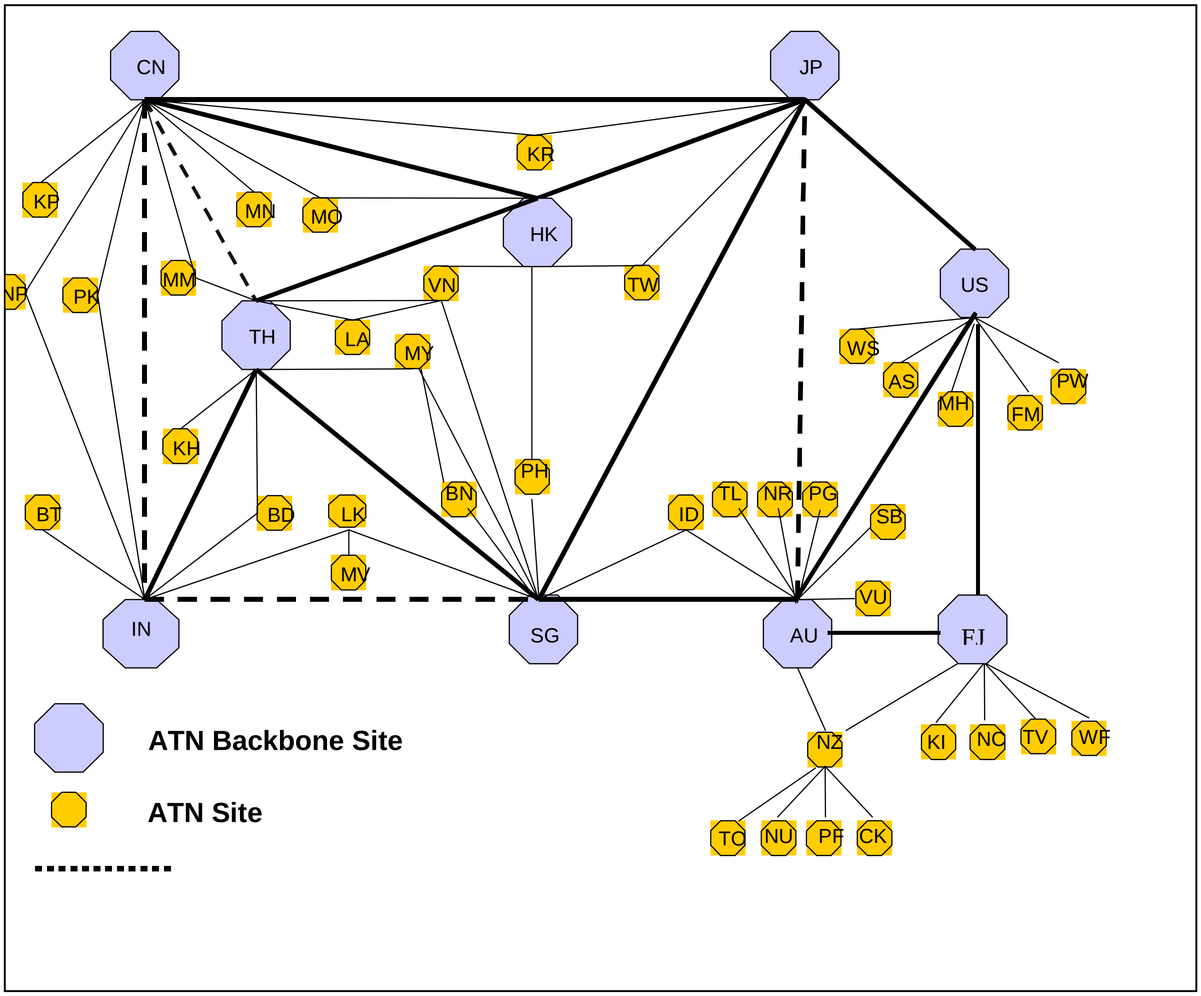

Figure 6 -1 ASIA/PAC ATN Router Interconnection

Note for code used in the figure 6 – 1

Country	ISO Code	Country	ISO Code
American Samoa	AS	Mongolia	MN
Australia	AU	Myanmar	MM
Bangladesh	BD	Nauru	NR
Bhutan	BT	Nepal	NP
Brunei Darussalam	BN	New Caledonia	NC
Cambodia	KH	New Zealand	NZ
China	CN	Niue	NU
Cook Islands	CK	Pakistan	PK
DPR. Korea	KP	Palau	PW
East Timor	TL	Papua New Guinea	PG
Fiji	FJ	Philippines	PH
French Polynesia	PF	Samoa	WS
Hong Kong, China	HK	Singapore	SG
India	IN	Solomon Islands	SB
Indonesia	ID	Sri Lanka	LK
Japan	JP	Taibei	TW
Kiribati	KI	Thailand	TH
Korea, Republic of	KR	Tonga	TO
Lao	LA	Tuvalu	TV
Macau China	MO	United States	US
Malaysia	MY	Vanuatu	VU
Maldive Islands	MV	Viet Nam	VN
Marshall Islands	MH	Wallis and Futuna Islands	WF
Micronesia, Federated States of	FM		

It is proposed that all existing AFTN circuits are upgraded as soon as practicable to use X.25 or other modern protocols that are compatible with the ATN Lower Layers. In doing so, these links would be sized to cater for both AFTN and ATN. This would allow the region to set-up a sub-network that could support current operational requirements for AFTN and to allow trials and operation services of the ATN to be implemented at minimal cost to the region.

Further details are provided in the ASIA/PAC ATN Router Plan included in Table CNS-1B of the CNS Part of FASID in 2002, which lists all international connections between countries and their proposed bandwidth requirements and implementation dates.

7. TRANSITION ACTIVITIES

It is recommended that there will be three phases in the implementation of the ATN infrastructure.

- Phase 1, Upgrade of existing subnetwork infrastructure to support the Backbone BISs (BBISs);
- Phase 2, Implementation of the ATN Regional BBISs; and
- Phase 3, Implementation of supporting ATN BISs.

7.1 PHASE 1

This phase consists of upgrading existing AFTN circuits where possible that will support the introduction of the ATN Backbone BISs.

In regards to bandwidth requirements, Table CNS-1B proposes a preferred speed that will be required when full ATN is implemented. However, lower speeds may be introduced in the initial implementation phases between some locations by bilateral arrangements between States. States will be expected to monitor the performance of these links and increase bandwidth requirements as traffic load increases.

Where new circuits have been identified these will only need to be introduced on a case by case basis as BBISs are implemented.

In respect to the upgrade of protocols, it is recommended that X.25 will be the preferred protocol to be used for the ATN between States in the first instance. However as other more efficient Wide Area Network protocols are implemented in ATN routers such as Frame Relay and Asynchronous Transfer Mode (ATM) it is expected that these protocols will be implemented on a bilateral arrangement between States.

7.2 PHASE 2

Phase 2 consists of implementing the Backbone BISs (BBISs) that will support the ASIA/PAC Region. The BBISs are important to the success of the ATN implementation program for the region and will need to be reviewed regularly to determine if contingency arrangements should be put in place where nominated States fail to provide the infrastructure in a timely manner.

Table CNS-1B provides target dates in which these facilities should be provided.

Note: Implementation of Inter-Regional BBIS connections between Asia/Pacific and neighboring regions will also need to be determined and encouraged during this phase.

7.3 PHASE 3

Phase 3 is the implementation of all other BISs that will connect to the Backbone BISs.

Further information including initial target dates for the upgrade of the sub-network links and protocols and implementation of the BISs for each State can be found in the table CNS 1B – ATN Router Plan of the FASID. Refinement of the target dates will continue to be updated as States start to develop their implementation programs and can provide feedback to the ICAO ASIA/PAC Regional Office.