International Civil Aviation Organisation

Fifth Meeting of Aeronautical Telecommunication Network (ATN) Transition Task Force

Phuket, Thailand, 9-13 June 2003

Agenda Item 4: **Review the development status of ATN technical documents**

Status of Asia /Pacific ATN IDRP Routing Policy

(Presented by the Rapporteur of the ATNTTF Ad Hoc Working Group)

SUMMARY

This paper presents the status Asia/Pacific ATN IDRP Routing Policy.

Executive Summary

The subject document provides global policy for Aeronautical Telecommunication Network (ATN) routers operating in the Asia and Pacific Region.

Background

The ATN Transition Task Force (ATNTTF) has been assigned a number of tasks to prepare the region for the introduction of the ATN. At the third meeting of the ATNTTF Working Group B meeting held in Bangkok, Thailand on 27 through 30 August 2001, a specific action item was identified to develop documentation on Routing Policy. The Asia/Pacific ATN IDRP Routing Policy is in response to that action.

Status of the Asia/Pacific ATN IDRP Routing Policy

1. In its current state the subject document defines a set of routing policy requirements, which are intended to ensure efficient distribution of routing information on a regional, state, and local basis. The specified policy is consistent with the recommendation in Sub-Volume V of ICAO Doc. 9705 to form a backbone of ATN routers; however, the policy does not require the formation of Routing Domain Confederations within the region but rather takes advantage of a well-defined hierarchical addressing plan, which leads to a simpler structure as is permitted by Doc. 9705. The detailed policy requirements and recommendations specified in the Asia/Pacific ATN IDRP Routing Policy are derived from the following general routing policy goal:

    a. Asia and Pacific region ATN routers will provide global shortest path connectivity with a minimal exchange of routing information.

2. The Asia/Pacific ATN IDRP Routing Policy has explicit requirements for backbone routers as well as a number of recommendations for non-backbone routers intended to meet the above policy goal.

3. The Asia/Pacific ATN IDRP Routing Policy specifies a complete routing policy in support of ground/ground communications to support both AMHS and AIDC applications.

4. The Asia/Pacific ATN IDRP Routing Policy contains a minimal set of recommendations regarding support for Air-Ground Applications. This set of policy recommendations has not matured and additional routing policy requirements and recommendations will be added in future versions of as more experience with ATN Air-Ground Applications is obtained.

5. The Asia/Pacific ATN IDRP Routing Policy document allows states/organizations to have additional local routing policies. Such policies may include various local preferences or Quality of Service based routing, for example, routing based on line error rates, expense, delay, capacity, and priority. Examples of such policies will be included in future versions of the document.

Attachment to ATTF/5-WP/8

International Civil Aviation Organisation

Fifth Meeting of ATNTTF

Phuket, Thailand, 9 – 13 June 2003

Asia /Pacific
ATN IDRP Routing Policy

Prepared by:

Federal Aviation Administration

(ACB-250)

SUMMARY

This paper is an update to the ATN IDRP Routing Policy for the Asia and Pacific region, which was presented at the previous meetings of the ATN Transition Task Force (ATNTTF) Ad Hoc Working Group B. This document incorporates general comments from previous task force meetings and includes diagrams to illustrate routing policies.

Table of Contents

Executive Summary

This document provides global policy for Aeronautical Telecommunication Network (ATN) routers operating in the Asia and Pacific Region in support of Air Traffic Services Message Handling Services (ATSMHS) and other ATN services.

Background

The ATN Transition Task Force (ATNTTF) has been assigned a number of tasks to prepare the region for the introduction of the ATN. At the third meeting of the ATNTTF Working Group B meeting held in Bangkok, Thailand on 27 through 30 August 2001, a specific action item was identified to develop documentation on Routing Policy. This document is in response to that action.

Overview

This document presents relevant background information on routing and provides a general discussion of policy-based routing. With this background, policy is specified for ATN routers in support of inter-regional, intra-regional and local connectivity.

~~Status of this Document~~

~~In its current state this document defines a set of routing policy requirements, which are intended to ensure efficient distribution of routing information on a regional, state, and local basis. The policy specified herein is consistent with the recommendation in Sub-Volume V of ICAO Doc. 9705 to form a backbone of ATN routers. The policy specified herein, however, does not require the formation of Routing Domain Confederations within the region but rather takes advantage of a well-defined hierarchical addressing plan, which leads to a simpler structure as is permitted by Doc. 9705.~~

~~This document specifies a complete routing policy in support of Air Traffic Services Message Handling Services (ATSMHS). There is a minimal set of recommendations regarding support for Air-Ground Applications. Additional routing policy requirements and recommendations may be added in future versions of this document as more experience with ATN Air-Ground Applications is obtained.~~

1. INTRODUCTION

The Aeronautical Telecommunication Network Transition Task Force is preparing a series of documents, which will govern the introduction of the ATN into the Asia and Pacific region. This document is to be the basis of ATN routing policy for the region.

1.1 OBJECTIVES

The objective of this document is to specify global policy for Aeronautical Telecommunication Network (ATN) routers operating in the Asia and Pacific Region in support of Traffic Service Communications (ATSC) and Aeronautical Industry Service Communications (AINSC).

1.2 SCOPE

The scope of the document includes:

- An introduction to relevant routing concepts;
- An overview of the Inter-domain Routing Protocol (IDRP) and the rational for its use in the ATN
- Routing policy requirements for ATN routers in the Asia and Pacific Region.

1.3 REFERENCES

Reference 1 Manual of Technical Provisions for the ATN (Doc 9705-AN/956)

Reference 2 Asia/Pacific ATN Routing Architecture

Reference 3 ISO/IEC TR 9575, Information technology – Telecommunications and information exchange between systems – OSI Routeing Framework

Reference 4 ISO/IEC 10747, Information technology – Telecommunications and information exchange between systems – Protocol for Exchange of Inter-domain routeing Information among Intermediate Systems to Support Forwarding of ISO 8473 PDUs.

Reference 5 Asia/Pacific ATN Addressing Plan

1.4 Terms Used

Backbone Router – A backbone router (in the Asia and Pacific region) is a Class 4 Ground/Ground ATN router which has been designated by the operating state/organization to provide an appropriate level of performance and support the routing policies for inter-regional and intra-regional connectivity, and whose operation as a backbone router has been approved by the ICAO regional office as agreed-to by all other member states/organizations.

Network Addressing Domain – A subset of the global addressing domain consisting of all the NSAP addresses allocated by one or more addressing authorities.

Network Entity (NE) – A functional portion of an internetwork router or host computer that is responsible for the operation of internetwork data transfer, routing information exchange and network layer management protocols.

Network Entity Title (NET) – The global address of a network entity.

Network Service Access Point (NSAP) – Point within the ISO protocol architecture at which global end users may be uniquely addressed on an end-to-end basis.

Network Service Access Point (NSAP) Address – A hierarchically organized global address, supporting international, geographical and telephony-oriented formats by way of an address format identifier located within the protocol header. Although the top level of the NSAP address hierarchy is internationally administered by ISO, subordinate address domains are administered by appropriate local organizations.

NSAP Address Prefix – A portion of the NSAP Address used to identify groups of systems that reside in a given routing domain or confederation. An NSAP prefix may have a length that is either smaller than or the same size as the base NSAP Address.

Routing Domain (RD) – A set of End Systems and Intermediate Systems that operate the same routing policy and that are wholly contained within a single administrative domain.

Routing Domain Confederation (RDC) – A set of routing domains and/or routing domain confederations that have agreed to join together. The formation of a routing domain confederation is done by private arrangement between its members without any need for global coordination.

ROUTING

1.4 ROUTING CONCEPTS

In this document the primary concern is routing through the ATN at the network layer. In order to establish a common framework, certain fundamental concepts are described. See Reference 3 for more detailed information.

The routing process in any network involves a forwarding function and a route maintenance function. Forwarding refers to those actions, which result in actual relaying of network packet data units (NPDUs) through nodes in the network. From a simplified perspective, forwarding is the process of accepting an incoming NPDU, accessing the routing database to determine the next network node or locally attached system, and sending the NDPU on to that node or system. Route maintenance refers to the update of the routing database. Route maintenance may be static, in which case, it is performed through management operations in either an on-line or off-line mode, or it may be dynamic (also known as adaptive routing). Dynamic route maintenance involves the exchange of routing packet data units (RPDUs). RPDUs may be received from a single source such as a Network Control Center, in which case, routing is said to be centralized. Alternatively, RPDUs may be exchanged among the nodes in a network, in which case routing is said to be distributed. See Figure 2-1. In the ATN a distributed adaptive routing procedure is adopted.

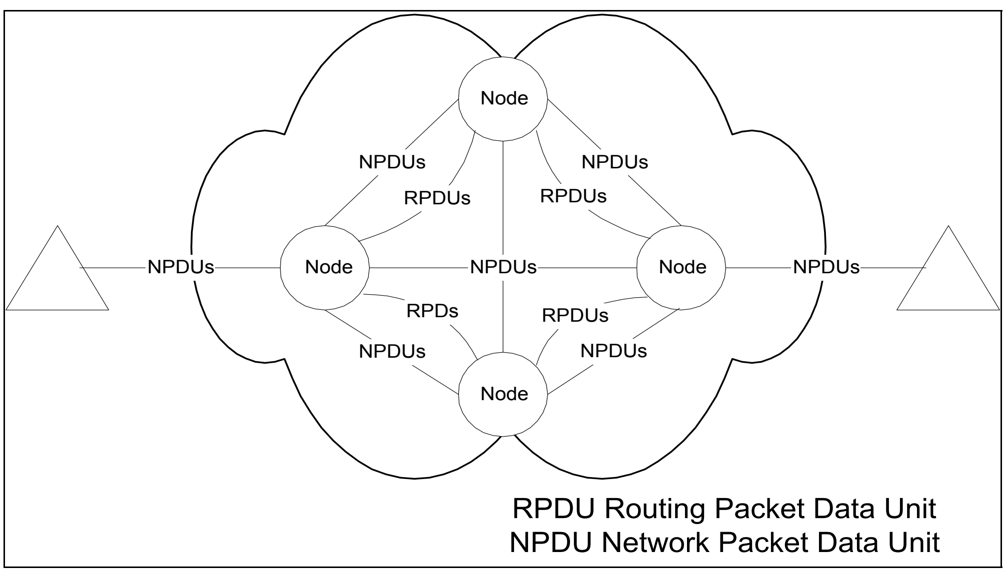

Figure 2-1. Exchange of NPDUs and RPDUs in Generic Network Environment

The route maintenance and forwarding functions under a distributed adaptive routing procedure are depicted generically in Figure 2-2. The routing database is partitioned into a Routing Information Base, which is the primary concern of the Route Maintenance Function, and a Forwarding Information Base, which is the primary concern of the Forwarding Function. The Route Maintenance and Forwarding Functions are conceptually connected through a Decision Process. The Decision Process determines:

1. Which routes are accepted into the Routing Information Base,
2. Which routes are placed into the Forwarding Information Base in support of the forwarding function, and
3. Which routes are to be advertised to other nodes in the network.

As will be described in more detail below, the decision process is affected by policy.

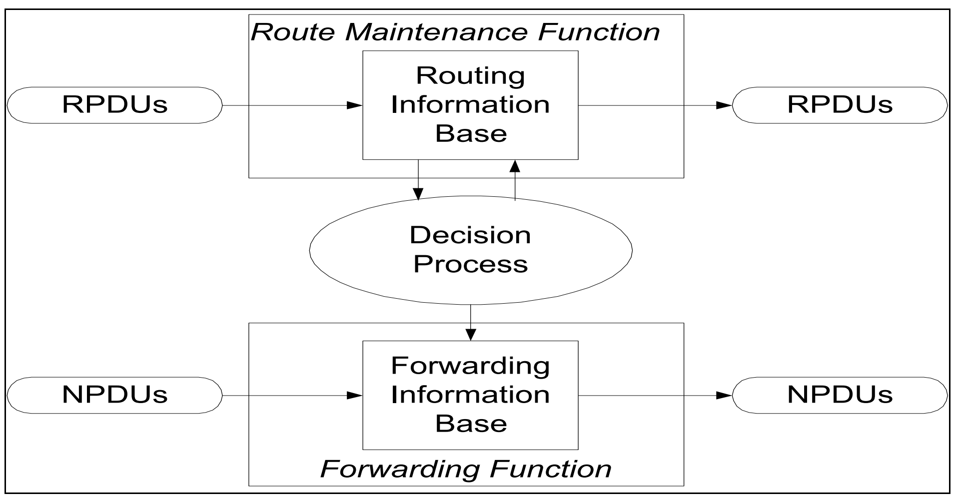

Figure 2-2 Generic Routing Functions

1.5 INTER-DOMAIN ROUTING PROTOCOL (IDRP)

In this section the rational for the use of IDRP in the ATN is summarized. The three general reasons for using IDRP are support for mobility, support for policy-based routing, and support for secure exchange of routing information.

1.5.1 SUPPORT FOR MOBILITY

A fundamental objective of the ATN is to maintain connectivity from ground-based ATSC and AINSC end systems to their airborne counterparts. This is to be accomplished over multiple subnetworks, that is, over the various VHF Digital Links, over Mode_S and over AMSS. This objective is essentially a routing problem. If we consider the general approaches to routing, it is immediately obvious that static routing would not work. This is because routes to an aircraft are inherently dynamic, that is, aircraft traverse multiple subnetworks and within each subnetwork they traverse multiple ground stations. Thus we are left with some type of adaptive routing. A centralized approach to adaptive routing has the problem that the central control center where changes would be reported becomes a bottleneck, especially in a global environment. Even if enough capacity could be provided, there are associated timing considerations, that is, a reported change in an aircraft's location must be available to communicating ground systems in real time. There are also administrative considerations with centralized adaptive routing. These considerations include determining which administration (a particular CAA, service provider, etc.) would operate the central control center and what are the liabilities associated with such an operation. Accordingly, since neither static routing nor centralized adaptive routing would be appropriate, we are led to some type of distributed adaptive routing approach as the solution to mobility.

There are two general approaches to distributed adaptive routing. The first is called *link state* routing and the second is called *distance vector* routing. Under link state routing, each change in the network topology (in connectivity to an aircraft in the context of support for mobility) is broadcast to every other node in the network. Upon receipt of each change message, each node updates its image of the network topology and calculates the complete (shortest) path to the destination in the change message. The main problem with this approach is that the number of messages required to report changes in network topology becomes quite large in a global environment. Thus we arrive at a distance vector approach to distributed adaptive routing approach in the ATN. Under distance vector routing, a change in connectivity is propagated (i.e., advertised) to affected ATN routers throughout the network. The RPDU consists of a vector containing a destination prefix and a distance metric, which is generically a measure of the cost associated with the path being advertised to a particular destination.[1] The difference

[1] In the context of the OSI Routeing Framework (Reference 3) IDRP would be classified as a distance vector routing protocol. However, in the technical literature, IDRP is often called *path vector* routing protocol. This is because IDRP can advertise multiple metrics called path attributes associated with a particular route to a destination rather than a single distance metric.

however (from link state routing) is that not all routers need be affected. In other words, not every router needs to know about every change. Particular changes need only be propagated to a point where a choice of routes is to be made. Beyond that point either an aggregate route may be advertised to other routers or these routers may be configured with a default path to that point. For example, a service provider with a ground-ground router connected to a CAA's ATN router on one side and with connections to multiple service provider air-ground routers on the other side may not need to advertise a new route each time an aircraft connects to a new air-ground router. The service provider ground-ground router may rather only advertise an aggregate route to the ATN router when the aircraft connects with the first air-ground router and withdraw the aggregate route when the aircraft is no longer connected to any air-ground router. At the same time, non-backbone routers belonging to the CAA need not receive routes to individual aircraft but rather may be configured to forward all aircraft NPDUs to the backbone router.

1.5.2 SUPPORT FOR POLICY-BASED ROUTING

1.5.2.1 IDRP Model of Operation

ATN routers execute a particular distributed adaptive routing protocol for route maintenance. The protocol is labeled IDRP, which stands for Inter-domain Routing Protocol (Reference 4). Figure 2-3 depicts a simplified model of IDRP route maintenance and CLNP forwarding.[2]

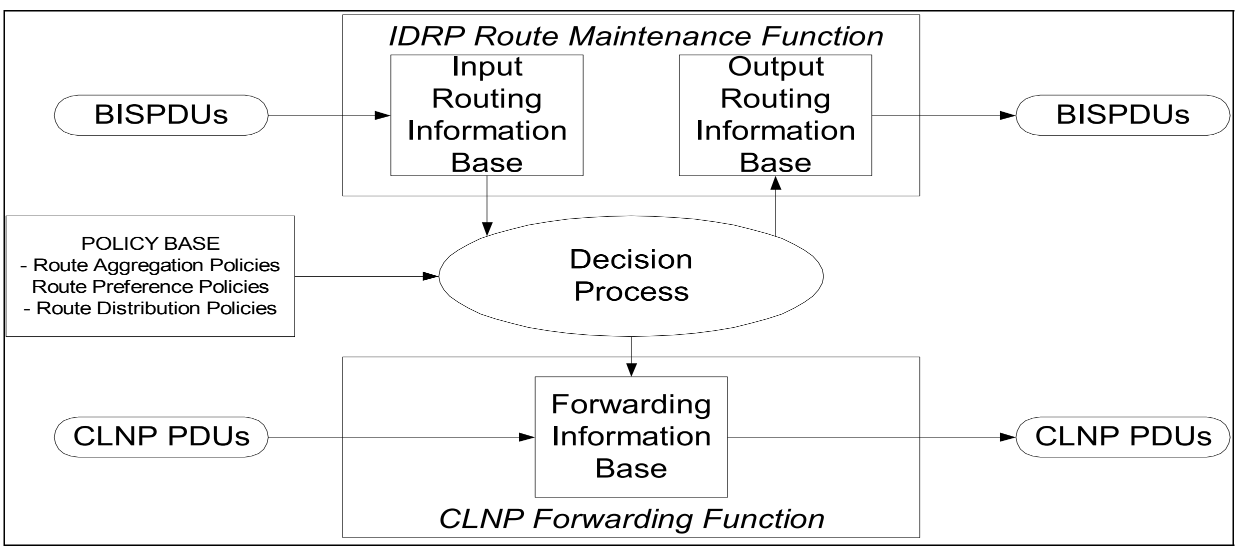

Figure 2-3. IDRP Route Maintenance and CLNP Forwarding

[2] The model of routing components in this document is a simplified form of the IDRP model. The IDRP specification (Reference 4) contains a more detailed model involving the concept of a multiple local RIBs for combinations of path attributes.

In the context of IDRP, an ATN router is a Boundary Intermediate System (BIS), and accordingly the routing PDUs exchanged are called BISPDUs. Similarly, in the context of CLNP, the forwarded NPDUs are called CLNP PDUs. As depicted in the figure and described in the following section, the IDRP decision process is conditioned by a policy base.

1.5.2.2 Types of Policy

The IDRP decision process (and thus ATN routing policy) is conditioned by three types of policy concerns.

- *Route Aggregation* policies permit ATN routers to reduce the amount of routing information propagated throughout the ATN.
- *Route Preference* policies determine which routes received in BISBPUs will be installed in the Forwarding Information Base. Route preference policies thus determine which path an ATN router will select to forward CLNP NPDUs on.
- *Route Distribution* policies determine which routes an ATN router will advertise to other ATN routers. Route distribution policies are a key aspect of a domain's transit policy in that they determine which routes will be permitted in a domain. An ATN router will not propagate a route, which it does not wish to support. By selective advertisement of routing information ATN routers control the use of their own resources since other routers cannot choose a route they do not know about.

1.5.3 Support for Secure Exchange of Routing Information

A final general advantage of using IDRP in the ATN is that it has a mechanism for the secure exchange of routing information. The mechanism takes advantage of a transport protocol built in to IDRP operation. When an IDRP connection is established (through the exchange of OPEN BISPDUs), the type of security to be applied to subsequent BISPDUs is signaled. In Edition 3 of the SARPs, procedures for performing *Type 2* authentication are specified. With type 2 authentication each ATN router can be assured that the routing updates it receives are from a peer ATN router whose identity has been confirmed using strong (cryptographic) authentication.

2. ROUTING POLICY GOALS FOR ATN ROUTERS

The ATN infrastructure and each region of the infrastructure must support a consistent set of routing policies to provide paths to ground systems at an inter-regional, intra-regional and local level and paths to airborne systems without an inordinate number of routing protocol updates. Accordingly, the detailed policy requirements and recommendations specified in section 4 are derived from the following general routing policy goal:

a. Asia and Pacific region ATN routers will provide global shortest path connectivity with a minimal exchange of routing information.

2.1 NETWORK ORGANIZATION FOR ROUTING TO GROUND SYSTEMS

For ground ATSC and AINSC applications the ATN infrastructure may be partitioned into various levels of organization. See Figure 3-1, which depicts routing domains supporting for three states in the Asia Region. Routing domains at the highest level are associated with an ICAO region. As depicted in Figure 3-1, the NSAP address prefix for ATSC applications in this region is 4700278181. Within a particular region, routing domains are next associated with a particular state or organization. Figure 3-1 depicts three arbitrary states (s1, s2, and s3). Note that in accordance with the regional addressing plan s1, s2, and s3 would actually be a two-byte field with the two ASCII characters assigned to the state or organization. Finally, within a particular state or organization there may be multiple local routing domains. Figure 3-1 depicts one routing domain in states s1 and s2 and three routing domains in state s2. Within this framework ATN ground routers may be characterized and their policy requirements specified according to the type of connectivity they have to adjacent ATN ground routers. ATN routers connecting to adjacent routers in another region are said to have "inter-regional" connectivity. ATN routers connecting to adjacent routers in another state or organization within a particular region are said to have "intra-regional" connectivity. ATN routers connecting to adjacent routers within a particular state or organization are said to have "local" connectivity, i.e. intra-state or intra-organizational connectivity.

2.2 NETWORK ORGANIZATION FOR ROUTING TO AIRBORNE SYSTEMS

For air-ground ATSC and AINSC applications the ATN it is useful to distinguish ground state domains from ground domains operated by Service Provider organizations. See Figure 3-1. This figure depicts two distinct Air-Ground subnetwork Service Provider domains, which are connected to the regional backbone. Note that a state may operate its own Air-Ground subnetwork, in which case the concepts that apply to Service Providers apply to the state-operated subnetwork.

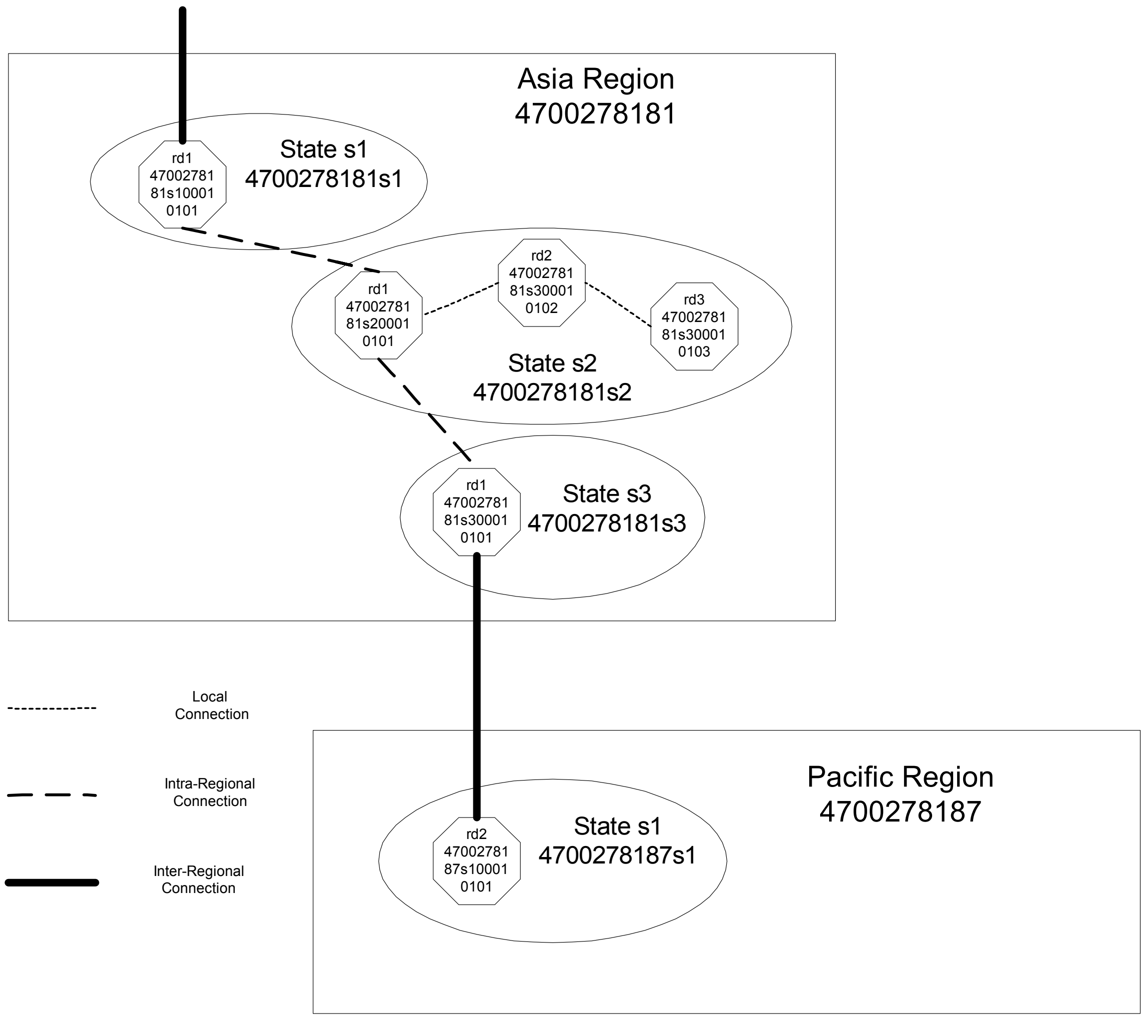

Figure 3-1. Connectivity of Ground Routing Domains

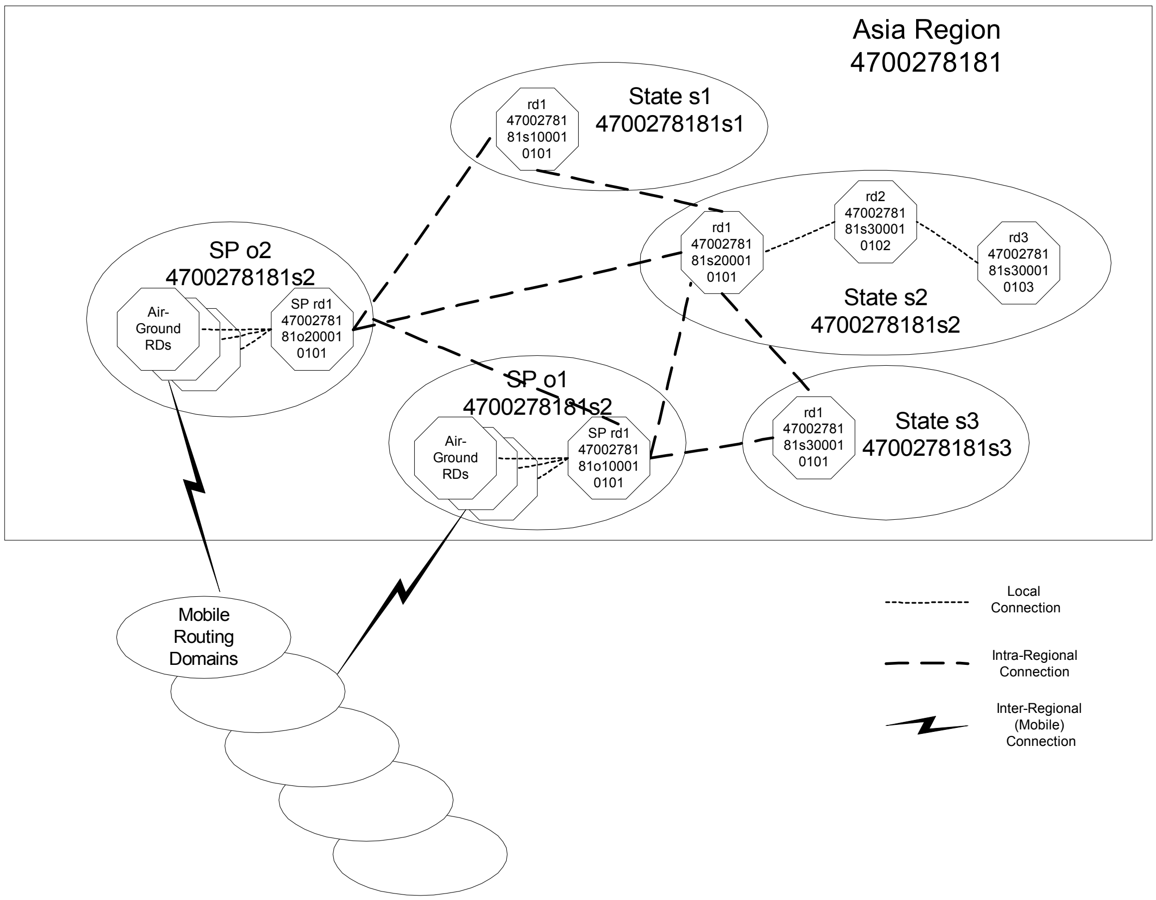

Figure 3-2. Connectivity of Air-Ground Service Providers to Regional Backbone

3. POLICY REQUIREMENTS FOR ATN ROUTERS

The policy for ATN routers in the Asia and Pacific region is specified in this section 4. The policy requirements are partitioned at a first level into policy for routes to ground (i.e., fixed) systems in section 4.1 and to policy for routes to airborne (i.e., mobile) systems in section 4.2. Within each of these first-level sections, policy requirements are next partitioned ~~at a second level~~ into policy for inter-regional routes, policy for intra-regional routes, and policy for local routes. Within these second-level sections policy requirements are ~~finally~~ partitioned at a third level according to the types of policy concerns identified in section 2.2,; that is, policy requirements are partitioned at a third level into aggregation policies, preference policies, and distribution policies.

Note 1. – This section specifies routing policy requirements for backbone routers in the Asia/Pacific region. A backbone router is a Class 4 Ground/Ground ATN router which has been designated by the operating state/organization to provide an appropriate level of performance and support the routing policies for inter-regional and intra-regional connectivity, and whose operation as a backbone router has been approved by the ICAO regional office as agreed-to by all other member states/organizations. This section also contains a number of recommended policies non-backbone routers.

Note 2. – This document and companion documents specify requirements for ATN routers in the "Asia/Pacific region"; however, from the perspective of the ATN NSAP Addressing Planthere is not a single "Asia/Pacific region" but rather there is a distinct Asia region and a distinct Pacific region each with a unique region identifier.

3.1 POLICY FOR ROUTES TO GROUND SYSTEMS

~~*Note. – This document and companion documents specify requirements for ATN routers in the "Asia and Pacific region". However, from the perspective of ATN routing there is not a single "Asia and Pacific region" but rather there is a distinct Asia region and a distinct Pacific region each with a unique region identifier.*~~

3.1.1 GENERAL POLICY

a) If ~~an ATN router~~a backbone router receives multiple routes to an aggregate or specific destination, the route with the shortest path (i.e., lowest value of RD Hop Count) shall be selected.

b) All ATN routers in the Asia and Pacific shall authenticate the identity of peer ATN routers.

Note. – Authentication may be accomplished via IDRP Type 2 Authentication as specified in Edition 3 of ICAO Doc 9705 or via local means via Bilateral Agreement between the responsible organizations.

3.1.2 POLICY FOR INTER-REGIONAL AGGREGATE ROUTES TO GROUND SYSTEMS

Inter-regional route aggregation permits advertisement of a single aggregate route, which identifies all systems in an ICAO region. Aggregation at an inter-regional level refers to aggregating NLRI fields to an NSAP prefix up through the first octet of the ADM field. (Reference 5)

3.1.2.1 Route Aggregation Policies for Inter-Regional Routes

a) ~~ATN routers~~Backbone routers with inter-regional connectivity shall be configured with aggregate routes to ground systems for ATSC and AINSC applications at an inter-regional level.

3.1.2.2 Route Preference Policies for Inter-Regional Aggregate Routes

a) ~~ATN routers~~Backbone routers with inter-regional connectivity shall accept inter-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

b) **Recommendation. -** ~~ATN routers~~Backbone routers with inter-regional connectivity should only accept inter-regional aggregate routes on these connections.

Note 1. - A simple method is to not accept routes with an NSAP prefix longer than the first octet of the ADM field. An alternative is to only accept inter-regional aggregate routes, which have been pre-configured (using a so-called access control list).

Note 2. – This policy statement is a recommendation since in the future other routes such as routes to an airline's "home" routing domain may need to be supported.

c) ~~ATN routers~~Backbone routers with intra-regional connectivity shall accept inter-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

d) ~~ATN routers~~Backbone routers with local connectivity (i.e., intra-state or intra-organization) shall accept inter-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

3.1.2.3 Route Distribution Policies for Inter-Regional Aggregate Routes

a) ~~ATN routers~~Backbone routers with inter-regional connectivity shall distribute inter-regional aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers.

b) ~~ATN routers~~Backbone routers with intra-regional connectivity shall distribute inter-regional aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers.

c) ~~ATN routers~~Backbone routers with local connectivity shall distribute inter-regional aggregate routes to ground systems for ATSC and AINSC applications

to adjacent ATN routers.

3.1.3 Policy for Intra-Regional Aggregate Routes to Ground Systems

Intra-regional route aggregation permits advertisement of a single aggregate route, which identifies all systems in a particular state or organization of an ICAO region. Aggregation at an intra-regional level refers to aggregating NLRI fields to an NSAP prefix up through the complete ADM field. (Reference 5)

3.1.3.1 Intra-Regional Route Aggregation Policies

a) ~~ATN routers~~Backbone routers with intra-regional connectivity shall be configured with aggregate routes to ground systems for ATSC and AINSC applications at an intra-regional level.

3.1.3.2 Intra-Regional Route Preference Policies

a) ~~ATN routers~~Backbone routers with intra-regional connectivity shall accept intra-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

b) **Recommendation.** ~~ATN routers~~Backbone routers with intra-regional connectivity should only accept inter-regional or intra-regional aggregate routes on these connections.

c) ~~ATN routers~~Backbone routers with local connectivity shall accept intra-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

d) **Recommendation.** Non-Backbone routers with local connectivity accept intra-regional aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers.

3.1.3.3 Intra-Regional Route Distribution Policies

a) ~~ATN routers~~Backbone routers with intra-regional connectivity shall distribute intra-regional aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers.

b) ~~ATN routers~~Backbone routers with local connectivity shall distribute intra-regional aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers.

c) **Recommendation.** Non-Backbone routers with local connectivity should distribute intra-regional aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers.

3.1.4 POLICY FOR AGGREGATE ROUTES TO GROUND SYSTEMS FOR DISTINCT ROUTING DOMAINS WITHIN A STATE/ ORGANIZATION

Distinct Routing Domain-level aggregation permits advertisement of a single aggregate route, which identifies all systems in a specific routing domain of a particular state or organization of an ICAO region. Aggregation at this level refers to aggregating NLRI fields to an NSAP prefix up through the complete ARS field. (Reference 5) ATN routers connecting to adjacent routers within a particular state or organization, i.e., with intra-state or intra-organizational connectivity, are said to have "local" connectivity.

3.1.4.1 Distinct Routing Domain Route Aggregation Policies

a) **Recommendation.** ATN routers serving individual routing domains should~~shall~~ be configured with aggregate routes to all ground systems for ATSC and AINSC applications.

3.1.4.2 Distinct Routing Domain Route Preference Policies

a) **Recommendation.** ATN routers with local connectivity should~~shall~~ accept state/organizational-level aggregate routes to ground systems for ATSC and AINSC applications from adjacent ATN routers within the same state or organization.

3.1.4.3 Distinct Routing Domain Route Distribution Policies

a) **Recommendation.** ATN routers with local connectivity should~~shall~~ distribute state/organizational-level aggregate routes to ground systems for ATSC and AINSC applications to adjacent ATN routers within the same state or organization.

3.2 POLICY FOR ROUTES TO AIRBORNE SYSTEMS

3.2.1 POLICY FOR AGGREGATE ROUTES TO AIRBORNE SYSTEMS

Aggregation of routes to airborne (i.e. mobile) systems permits advertisement of a single aggregate route to airborne systems rather than advertisement of individual routes to each airborne system. Aggregation of routes to mobile systems may occur at a coarse level to "all mobile" or may occur at a "home domain" level of all aircraft belonging to an airline or the General Aviation aircraft of a given country of registration.

3.2.1.1 Route Aggregation Policies for Routes to Airborne Systems

a) **Recommendation. -** ATN routers in an Air-Ground subnetwork with intra-regional connectivity (to the regional backbone routers) should be configured with aggregate routes to airborne systems for ATSC and AINSC applications at a "home domain" level.

Note –The basic assumption of this recommendation is there are multiple service

providers operating in a region and that an airline will contract with one service provider as the primary provider of air-ground service and optionally contract with a second service provider for back-up service. It is also assumed that the state is not operating its own air-ground subnetwork in which case it may be preferred to receive routing updates for individual aircraft.

b) **Recommendation. -** ATN routers in the regional backbone with local connectivity should be configured with aggregate routes to airborne systems for ATSC and AINSC applications at an "all mobile" level.

3.2.1.2 Route Preference Policies for Routes to Airborne Systems

a) **Recommendation. -** ATN ground routers in the regional backbone with intra-regional connectivity to ATN routers in an Air-Ground subnetwork should accept aggregate routes to airborne systems for ATSC and AINSC applications from adjacent ATN routers at a "home domain" level.

b) **Recommendation. -** ATN ground routers with local connectivity to ATN routers should accept aggregate routes to airborne end systems for ATSC and AINSC applications from adjacent ATN routers at an "all mobile" level.

3.2.1.3 Route Distribution Policies for Routes to Airborne Systems

a) **Recommendation. -** ATN ground routers with intra-regional connectivity to ATN routers should distribute aggregate routes to airborne systems for ATSC and AINSC applications at a "home domain" level to adjacent ATN ground routers.

b) **Recommendation.** ATN ground routers with local connectivity to ATN routers should distribute aggregate routes to airborne systems for ATSC and AINSC applications at an "all mobile" level to adjacent ATN ground routers.

3.3 LOCAL STATE/ORGANIZATIONAL ROUING POLICYS

Individual states/organizations may have additional routing policies consistent with the above general policies for routes to ground systems and airborne systems. Such policies may include various local preferences or Quality of Service based routing, for example, routing based on line error rates, expense, delay, capacity, and priority.