International Civil Aviation Organization
Asia and Pacific Office

Asia/Pacific Regional AMHS MTA Routing Policy

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1.0 Introduction

Within the Asia/Pacific Region, work is underway to implement the ATN AMHS as a replacement and complement to the AFTN. The Region has already prepared planning documents on AMHS naming standards as well as draft guidelines on the implementation of AMHS within the Region. To progress implementation, planning documents for the routing of AMHS message between systems within the Region and to systems outside the Region are needed to serve as guidance.

1.1 Objective

This document presents AMHS routing policies to be used within the Asia/Pacific Region for implementation of AMHS. The development of AMHS message routing policies is based on the need for States and AMHS administrators to be able to control the flow of messages into individual AMHS systems.

1.2 Scope

The MTA routing policy document covers policy for AMHS systems to route AMHS messages between MTAs within Asia/Pacific Region both in the transitional phase and final phase of AMHS implementation. It also outlines the policy for inter-region AMHS connections between the regions. It does not, however, specify the characteristics for MTAs or how the connections between MTAs are established.

1.3 Reference

1) ICAO Doc. 9705-AN/956 *Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN).* Third Edition 2002.

2) ICAO Doc. 9739-AN/961 *Comprehensive Aeronautical Telecommunication Network (ATN) Manual.* First Edition 2000.

3) ICAO AFSG Operations Group *Routing Directory for AFTN and CIDIN Centres in the EUR/NAT Region.* Part IV COM Charts per ICAO Region, Version 1.2 – March 2004.

4) ATNTTF/6 – *Report of the Sixth Meeting of Aeronautical Telecommunication Network (ATN) Transition Task Force of APANPIRG (ATNTTF/6).* Table CNS-1A AFTN-PLAN, Appendix A – April 2004

5) ATNTTF/6 – *Report of the Sixth Meeting of Aeronautical Telecommunication Network (ATN) Transition Task Force of APANPIRG (ATNTTF/6).* Table CNS-1B ATN Router Plan, Appendix A – April 2004

6) ATNTTF/6 – *Report of the Sixth Meeting of Aeronautical Telecommunication Network (ATN) Transition Task Force of APANPIRG (ATNTTF/6).* Table CNS-1C ATSMHS Implementation Plan, Appendix A – April 2004

7) ATNTTF/6 – WP10. *MTA Transitional Routing Policy.* Presented by Japan.

8) ATNTTF/6 – WP15. *AMHS Routing Impact.* Presented by Hong Kong, China.

2.0 Background

The ATN AMHS is designed according to the X.400 email standards. It is further complemented by the history that ICAO has with the AFTN. As an X.400-based system, the ATN AMHS is specified in such a way that messages can be transferred from the sender to the recipient by passing reliably through intermediate ATN AMHS systems.

The ATN AMHS system at originating station, when it first receives a newly submitted message, must determine the ATN AMHS system that will receive the AMHS message. This may be:

- the destination ATN AMHS,
- a relay ATN AMHS, or
- the AFTN.

If one looks at the Internet and its SMTP-based email system as an example, it becomes clear that routing policies need to be developed for the successful exchange of messages between senders and recipients. First, it is possible for any AMHS system to send a message directly to the destination AMHS system if it has the appropriate NSAP and TSEL of the destination system. This is due to the fact that ATN routing should provide a path between any two ATN end systems. Second, it is logical that some, if not most, ATN operators will choose to manage their systems in a way that limits its use of bandwidth and the amount of information it must maintain. Third, systems will most likely be configured to take advantage of logical cooperation between States and Organizations to minimize costs and complexity.

Of particular concern is the need for ATN system operators to be able to control what systems are able to get connected to its system and to protect the integrity of its systems through access control.

3.0 Routing Overview

The ATN AMHS is not defined with routing protocols that dynamically pass routing information amongst the cooperating ATN AMHS systems. Rather, the “routing tables” maintained by the ATN AMHS are static and are typically established through manual configuration by system operators.

The ability of ATN AMHS systems to dynamically route AMHS messages is based on the implementation and sophistication of the algorithms and is not based on provisions in the SARPs or X.400 standards.

AMHS MTAs perform routing by matching the X.400 O/R address with the routing information maintained by the MTA. The destination MTA affects whether direct delivery or relaying messages is required. The complexity of routing decisions that a particular MTA makes is entirely a local implementation issue.

3.1 Routing Fundamentals

An MTA becomes responsible for the routing and delivery of a message when it is successfully submitted to the MTA either from a UA (or MS), another MTA or directly connected AMHS gateway. The MTA routing process is entirely based upon the destination addresses and the internal routing tables. An MTA compares the destination addresses against its criteria for forwarding to another MTA. If the results of the MTA lookup are not in the current traceable information, the message is forwarded. If it is in the current traceable information, an NDR is generated and the message is discarded.

The central issue in establishing a local MTA routing table is the trade-offs between: routing table size, performance, and security. Routing decisions and security are considered in the next section.

The trade-off between routing table size and performance is due to the nature of routing. For optimal performance – which means a single hop between source MTA and destination MTA – each MTA would potentially need routing information about every other MTA in the ATN. While in early stages of AMHS implementation, the number of MTAs may be small. In later stages the number of MTAs maybe too large for simple routing table to process. As the number of entries rise in the routing table, the costs of searching the table and the complexity of maintaining the table will increase. On the other side, as the number of routing entries is reduced the potential for longer message propagation delays increase as messages are routed and relayed through other MTAs.

The development of routing policies attempts to optimize the performance while maintaining a reasonable sized routing table.

3.2 Routing and Security

Routing can be performed by providing each MTA with sufficient information so that the MTA can send every AMHS message directly to its destination. In other words, AMHS messages would always go directly from the sender to the recipient MTA and leave the routing process for the network infrastructure.

Routing can also be performed by providing each MTA with the addresses of only a limited number of other MTAs, which is called "Access Control List." In this case, an AMHS message addressed to one of the limited MTAs would be routed just like the first case; but a message addresses to any other MTA would need to be relayed.

The choices of which method of routing is to be used, is a decision by the operators of the MTAs. In the first case, MTAs must be configured to accept Bind Requests from any MTA (as indicated by the MTA-name parameter). This implies that all incoming Bind Requests will be accepted and traffic will be accepted. In the second case, an MTA may compare the MTA-name against a list of MTAs from which it will accept connections, and forward messages.

However, considering security for the first case, an MTA configured to accept all incoming Bind Requests, regardless of the source system, is open to both malicious attacks and traffic. A malicious attacker may launch a Denial of Service (DoS) by sending many Bind Requests (and associated large amounts of data) to a MTA in order to overwhelm it. Similarly, if traffic is being accepted from all MTAs, a system must be engineered to provide for larger number of incoming connections, potentially larger traffic loads are generated and consequently increasing the system complexity. Therefore, both security and network management technique should be implemented together with this policy to prevent the problems, such as authentication using IDRP version 2 or router authentication on network sub-layer.

For the second case, security aspect is already considered when the MTA operator generates the "Access Control List." The MTA system only accepts Bind Request and messages from MTAs within the list and denies Bind Requests from the rest. This policy is similar with the current AFTN routing table and therefore shares the same deficiencies, such as inflexibility, but it offers greater control for the operator.

It is desirable for MTA operators to be able to provide sufficient security with delivering and receiving messages with minimum resource utilization. However, the policy and implementation of any supporting mechanism are considered a local or bilateral matter for operators.

4.0 AMHS MTA routing policy

4.1 Backbone MTAs

Backbone MTAs are the currently assigned inter-regional MTAs, which are entry/exit points of AMHS connection between Asia/Pacific region and other regions. Each backbone MTA should independently send/receive messages with other (backbone) MTAs of other regions and between each other within the region. Because the networking capability of the ATN, the operation of backbone MTA is more flexible and can handle more capacity than the current AFTN operation. Therefore, unlike the AFTN, the designation of backbone MTAs can be independent of the main inter-region communication links at the respective COMM Centers. The table of proposed location of backbone MTAs within Asia/Pacific region is provided in Appendix B.

4.2 AMHS System Interconnection

Within the Asia/Pacific Region, routing of AMHS messages will be as follows:

- **Messages exchanged within the region:** All MTA within the region should be able to send/receive AMHS message directly with each other or have direct MTA-to-MTA routing. Consequently, the number of hop for sending a message within the region will be one, and the MTA routing table will contain entries of all other MTAs within the region.

- **Messages exchanged between States within the Region and other regions:** All AMHS messages exchanged between States within Asia/Pacific region and others should pass through backbone MTAs. To send AMHS messages to other MTAs outside the region, the source MTA will first send those messages to backbone MTA responsible for sending messages to the destination MTAs. In reverse direction, the backbone MTAs act as a gateway for incoming messages from corresponding MTAs outside of the region and relays the messages to the destination MTA within the region.

However, the aforementioned routing policy will not be fully implemented immediately due to the different AMHS transition timeframes of each State. Instead, there will be a transitional period during which the Aeronautical Fixed Service (AFS) in the region will be provided by a mixture of interoperating AMHS and AFTN sites, with “islands” of directly connected AMHS sites gradually expanding and merging, and AFTN links progressively being eliminated. The transitional routing policy and example figures are presented in Appendix A.

APPENDIX A Transitional Routing Policy

During the transition period, it is proposed that the following transitional policy be adopted to ensure smooth transition from AFTN to AMHS.

- **Message exchanged between states that have implemented AMHS:** States that have implemented AMHS shall use direct MTA-to-MTA routing among themselves, forming an “island” of AMHS sites. However, to ease the transition process, whenever a new AMHS system is implemented, the initial routing configuration should correspond to the AFTN routing table exactly. Once it has been operational, it is necessary to carry out coordination with all States in the island. The coordination should also include connection tests between the MTA system and all other AMHS systems to which it will connect. In conclusion, the following steps are recommended:
    - If the new MTA is introduced to the AMHS Islands, it is recommended that during the initial phase of implementation, the new MTA use AFTN routing table for routing configuration.
    - As the new MTA gain more experience from the operation of AMHS, it should enter bi-lateral agreement with other MTAs to establish direct message exchange at a later stage.

- **Message exchanged between States using AFTN and States using AMHS:** The AMHS/AFTN gateway function should be implemented alongside with the AMHS systems to provide message exchange service with states using AFTN. However, in order to avoid changes in the AFTN routing directory, the AMHS should also route messages to adjacent states, which are using AFTN, based on the current AFTN Routing Directory. It should be noted that even if a state connects to other states using only AMHS, an AMHS/AFTN gateway function would still be necessary to support domestic legacy AFTN networks.

The following figures illustrate the AMHS routing mechanism and transitional routing policy:

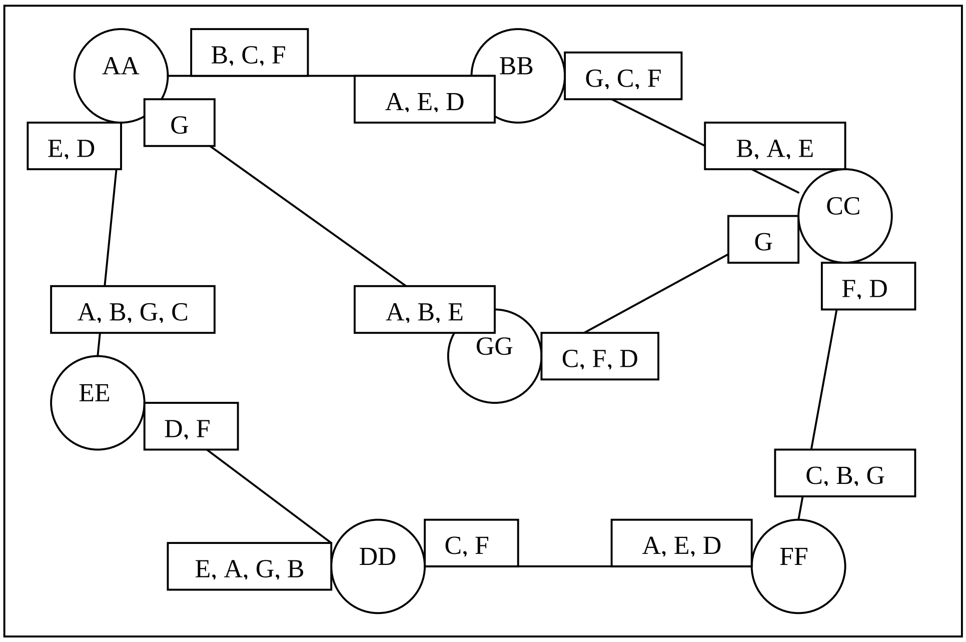

Figure 1 Example of configuration with all organization using AFTN

Figure 1 displays the configuration where all organizations have implemented AFTN and already configured the routing paths among themselves. The circle illustrates an organization with its name inside. The lines between circles illustrate the physical connections between organizations. The box above the line adjacent to the circle shows the routing configuration on that connection. The box with letters ‘C, F’ signifies that all messages with destination addresses starting with C or F will be routed though this connection.

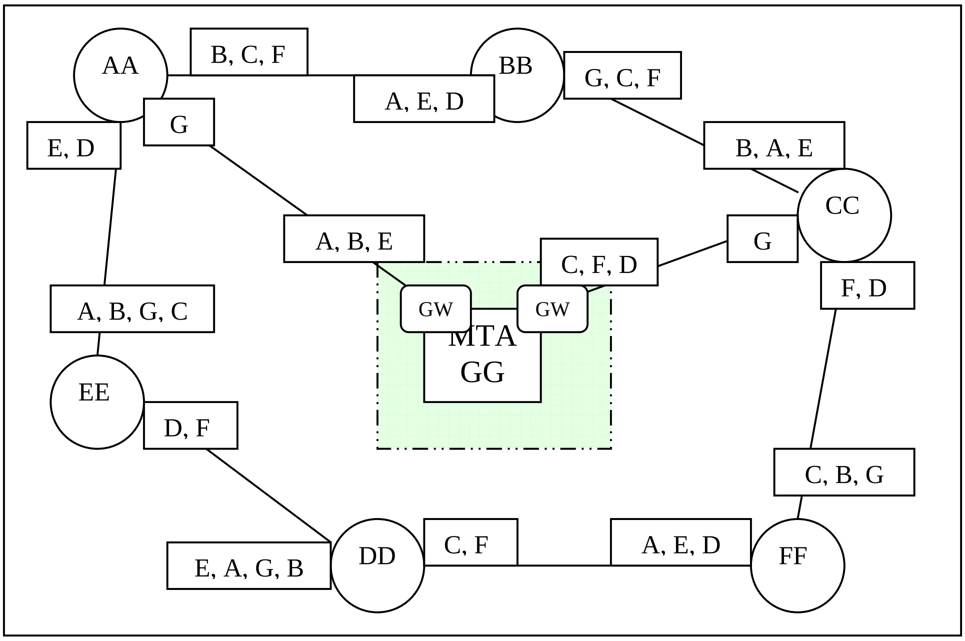

Figure 2 Example of configuration with only one MTA presented among AFTN nodes

Figure 2 displays the configuration when one organization has started implementing AMHS and setting up MTA. In this example, the organization GG is the first to implement MTA. However both organization AA and CC, to whom GG is connected, have not implemented AMHS. Furthermore, the MTA of GG will require function of AFTN/AMHS gateway to be able to seamlessly transmit messages with AFTN sites. Therefore, following the transitional policy, the messages from GG to AA and CC will follow the same AFTN configuration as in figure 1. For GG, messages with destination addresses starting with C, F and D will be routed through AFTN/AMHS gateway and to organization CC, and messages with destination addresses starting with A, B, and E will be routed through gateway to organization AA.

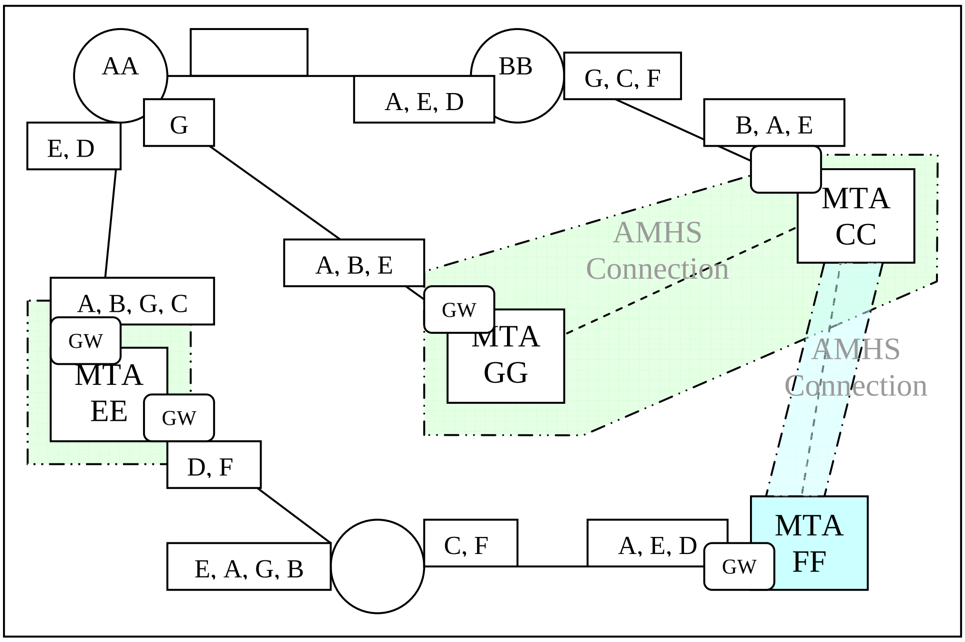

Figure 3 Example configuration with more than one MTAs

Figure 3 displays the situation when more than one organizations have implemented AMHS in the region. In this example, organization GG, CC, FF, and EE have implemented MTA systems. Because the MTA of EE does not have direct connections to other MTAs, it will connect with neighbor AFTN using gateway functions as described in figure 2. As previously stated in the policy, the gateways should be configured to be compatible with the routing table configuration as defined in figure 1. Organization GG establishes AMHS connection with CC with the route configuration corresponding with AFTN routing table. Organization FF also establishes AMHS connection and exchanges all AMHS messages with CC only. As FF and GG become confident in AMHS operation, they may enter bi-lateral agreement with each other to test and later establish AMHS connection.

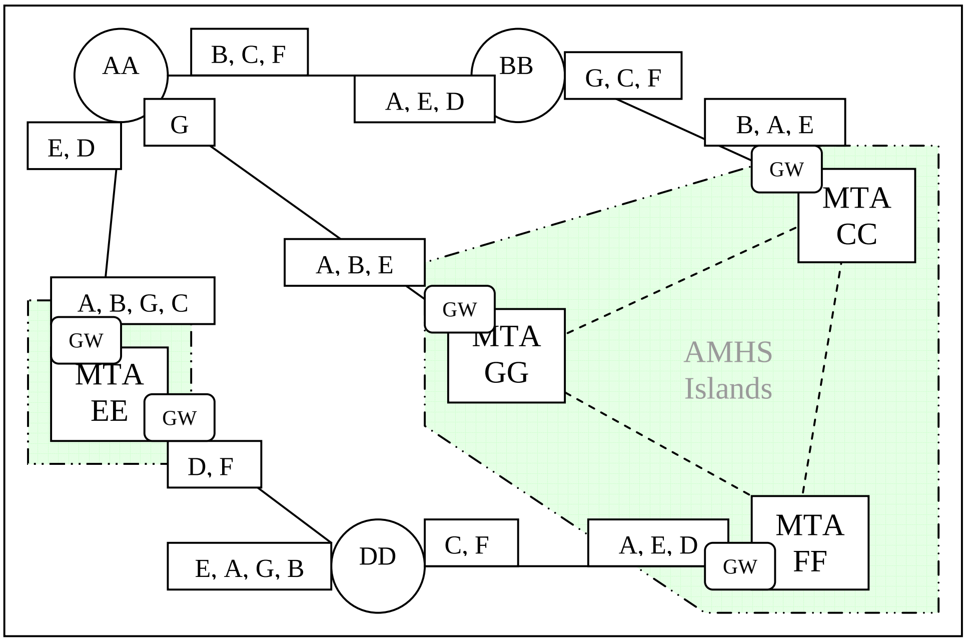

Figure 4 Example configuration with more than one MTAs presented

Figure 4 displays the situation when more than one organizations have implemented AMHS in the region. Following figure 3, after organization FF becomes confident with the AMHS operation and request bi-lateral agreement with organization GG, it establishes 'logical AMHS connection' with GG. Consequently, all MTAs within the island establish logical 'direct MTA-to-MTA[1]' connections, which are illustrated as dotted lines, for transmitting AMHS messages between themselves. The AFTN/AMHS gateway functions are still required at the edge of the island where messages are transmitted from AMHS MTAs to AFTN.

[1] The above "direct MTA-to-MTA" connection shows a logical connection and it may not be necessarily the same as a physical connection using ATN Routers. At least two physical connections are necessary between the organization GG, CC and FF in the above case.

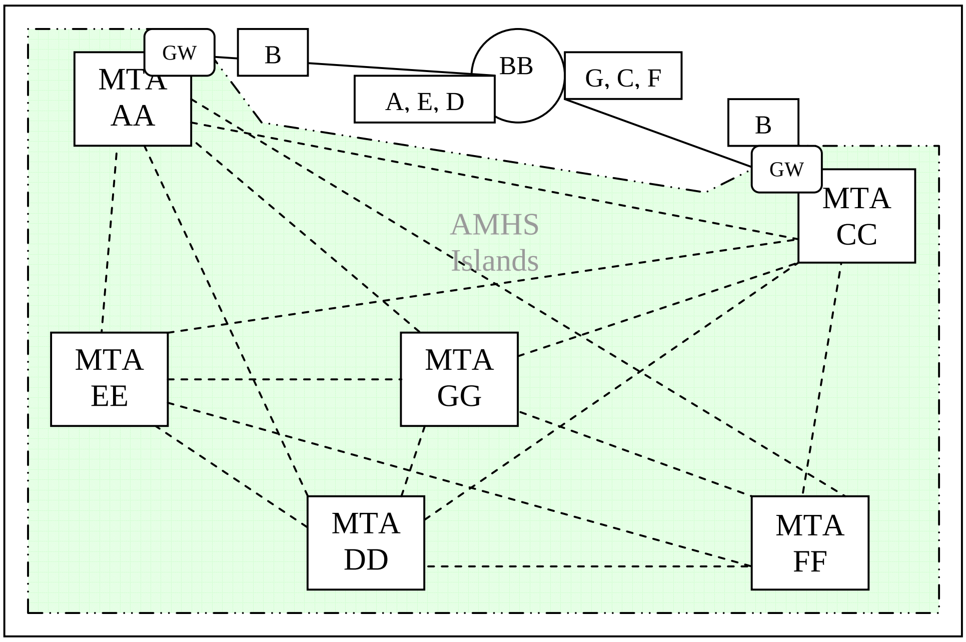

Figure 5 displays the situation when more organizations have implemented AMHS than AFTN. All MTAs will from AMHS islands and have logical 'direct MTA-to-MTA[2]' connection between them. At the edge of the island, MTAs will connect with AFTN using AFTN/AMHS gateway functions. From the figure, however, only organization BB has not implemented AMHS MTA, thus the gateways are configured to send messages with destination addresses starting with B only.

[2] The above "direct MTA-to-MTA" connection shows a logical connection and it may not be necessarily the same as a physical connection using ATN Routers. At least one physical path must exist between the MTAs.

APPENDIX B Table of Proposed Backbone MTAs Site in Asia/Pacific Region

The following table contains the proposed location of Backbone MTAs within the Asia/Pacific region:

Name and location of Proposed Backbone MTA
NFFN – Nadi International Airport, Fiji
NZCH – Christchurch International Airport, New Zealand[3]
RJAA – New Tokyo International Airport, Japan
VABB – Mumbai/Jawaharlal Nehru International Airport, India
VHHH – China (Hong Kong) COMM Center
VTBB – Bangkok ACC/FIC/COM, Thailand
WSSS – Singapore Changi Airport, Singapore
YBBB – Brisbane (FIS/FIC/ACC/COM/MET/NOF), Australia
ZBBB – Beijing City, China

Table 1 Proposed Backbone MTA in Asia/Pacific Region[4]

[3] The connection between New Zealand and the US will be considered as a restricted link for AMHS use only.
[4] KSLC [Salt Lake City, US] is considered to be in the North America region and thus is outside the scope of this table. However, there are many pacific islands with connections with KSLC. They will be considered exceptions because they will become UAs to the KSLC AMHS as stated in the table CNS-1C [5].

APPENDIX C ACRONYMS

AFS	(Aeronautical Fixed Service)
AFTN	(Aeronautical Fixed Telecommunication Network)
AMHS	(ATS message handling system)
ATN	(Aeronautical Telecommunication Network)
ATS	(Air Traffic Service)
ATSMHS	(ATS Message Handling Service)
DoS	(Denial of Service)
IDRP	(Inter-domain Routing Protocol)
MS	(Message Storage)
MTA	(Message Transfer Agent)
NDR	(Non-Delivery Report)
NSAP	(Network Service Access Point)
O/R Address	(Originator/Recipients Address)
SARPs	(Standards and Recommended Practices)
SMTP	(Simple Mail Transfer Protocol)
TBD	(To Be Determined)
TBP	(To Be Proposed)
TSEL	(Transport Selector)
UA	(User Agent)