International Civil Aviation Organization

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

Phuket, Thailand, 9-13 June 2003

Agenda Item 9:   Review ATN implementation activities/issues

AMHS ROUTING ISSUES

SUMMARY

This paper describes routing issues related to AMHS connections.

(Presented by Japan)

1.   Introduction

The FAA and JCAB have agreed to commence AMHS service between the USA and Japan in March 2004. Also, Hong Kong CAD and JCAB have recently agreed to commence AMHS service between Hong Kong and Japan in September 2004.

The rule for the current AFTN alternate routing system is based on the AFTN message forwarding mechanism, where the message is forwarded from a State to another one by one. On the other hand, the Asia/Pacific regional rules for ATN BIS (ATN Router) IDRP Routing and MTA (AMHS) Routing currently being developed assume a semi-mature network with number of ATN BIS and AMHS systems established.

However, neither the ATFN rule nor the ATN rule is applicable to the linear topology that will connect only the three States of the USA, Japan and Hong Kong (China). Therefore, it is necessary at this stage to formulate suitable rules for BIS and AMHS alternate routing for this configuration.

2.   Discussion

2.1   Network Configuration

Figure-1 shows the current AFTN connections among the USA, Japan and Hong Kong (China), before the implementation of AMHS. The dotted lines indicate AFTN alternate routing paths via a number of other States.
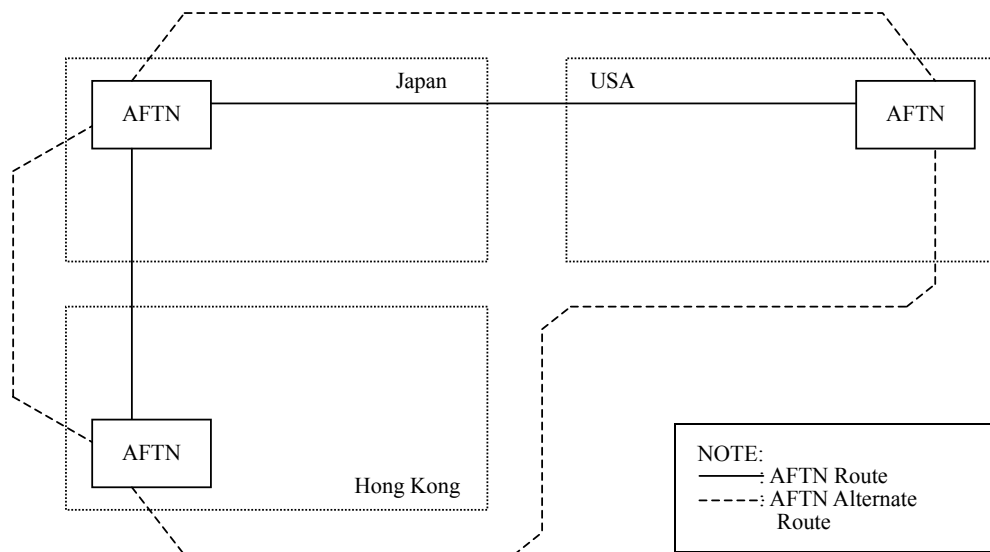
Figfure-1   AFTN Connections

Figure-2 shows the network configuration after the implementation of AMHS among the USA, Japan and Hong Kong (China). The ATN connection topology is linear, not triangular. Therefore, there is no means for AMHS alternate routing other than using the existing AFTN alternate routing system.
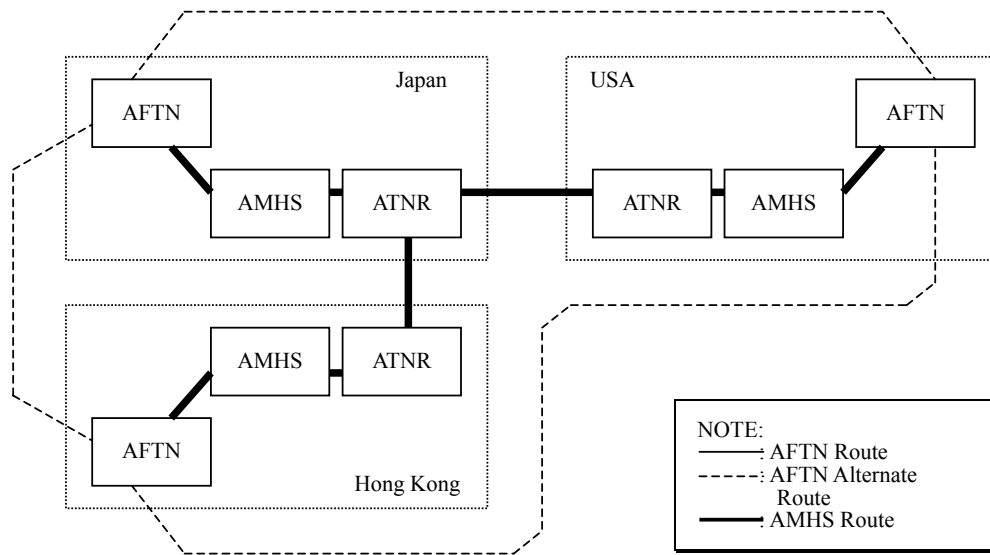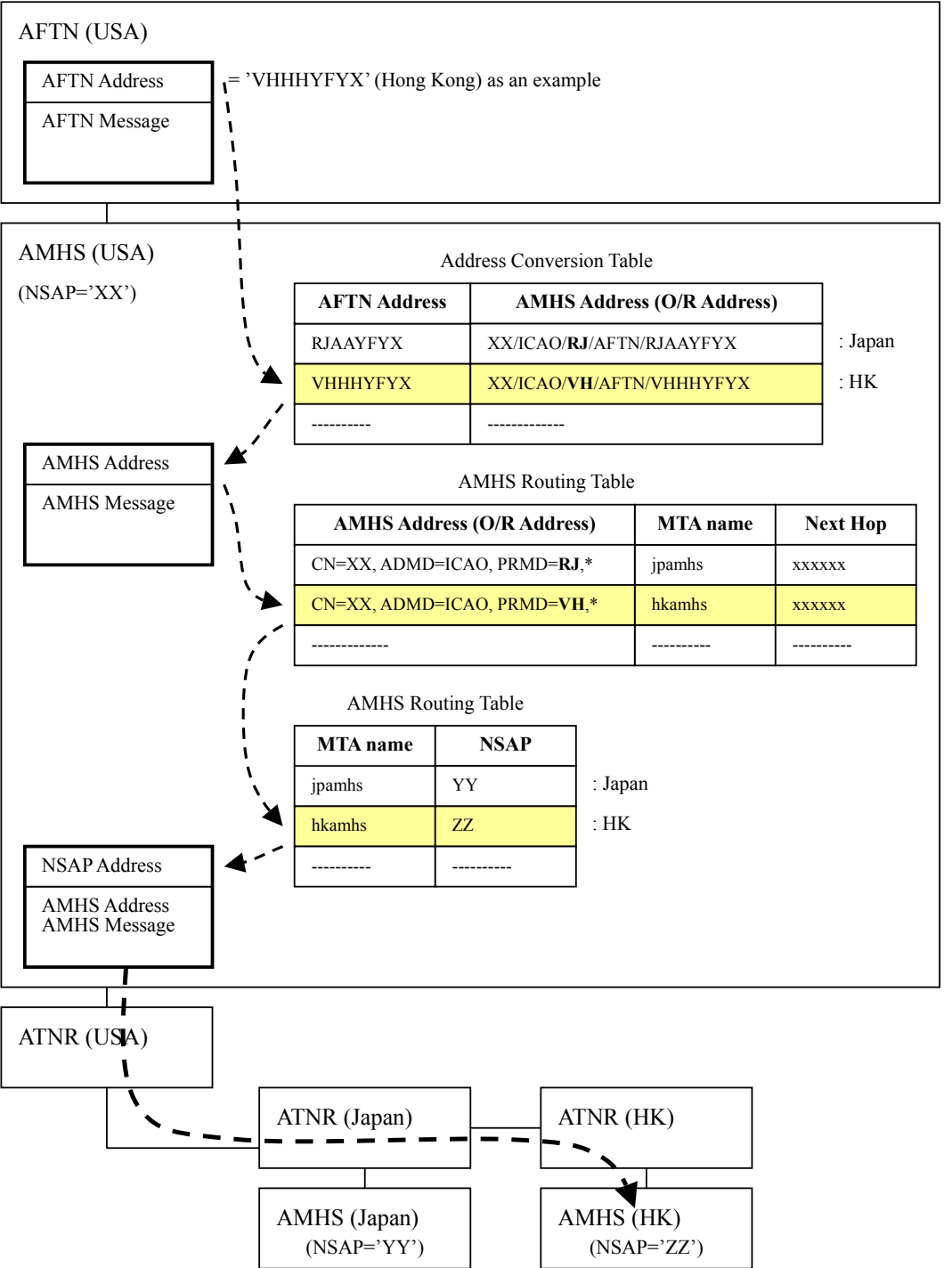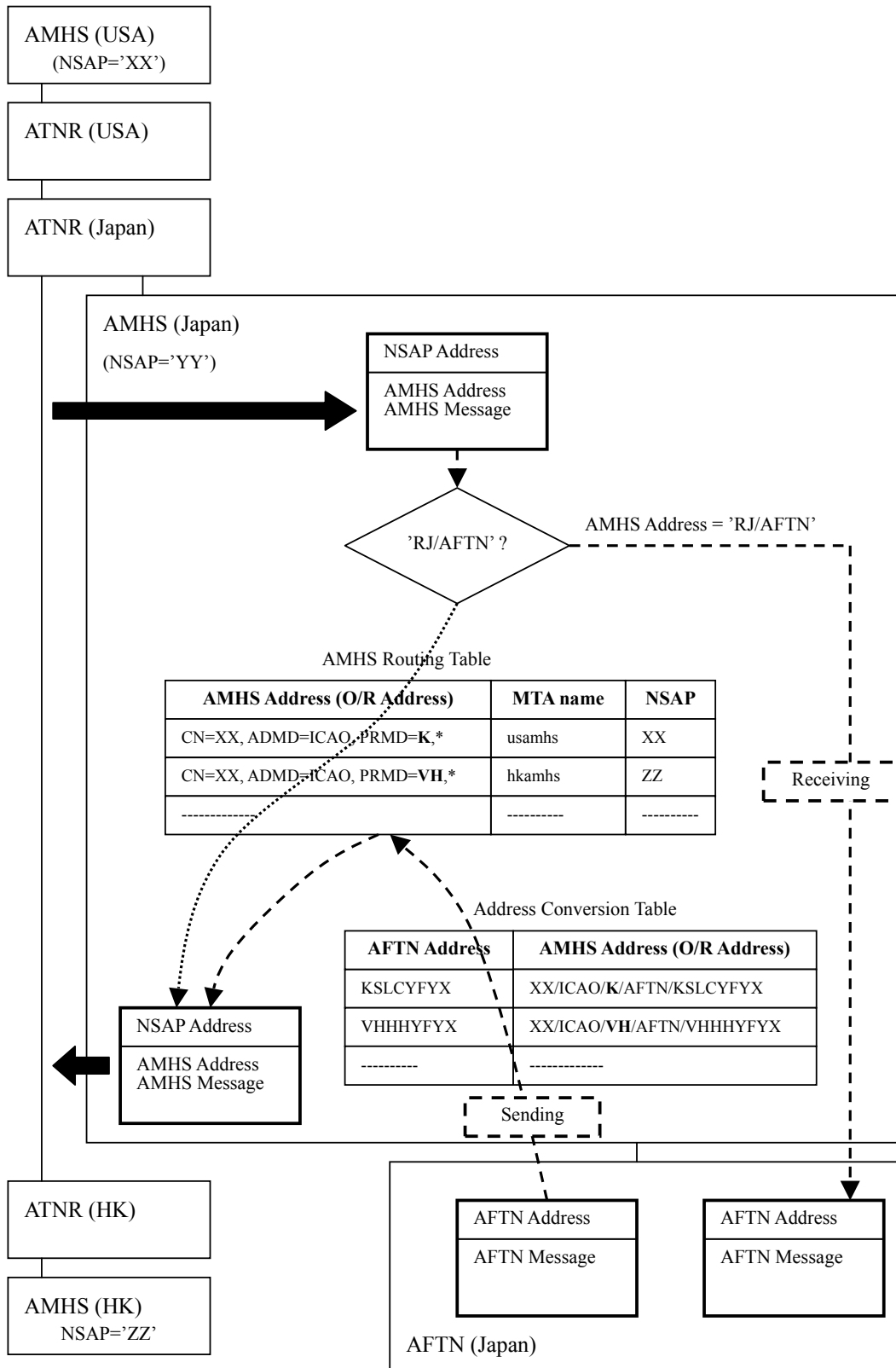

Figure-2   AFTN and AMHS Connections

The following pages explain the routing process in further detail.

2.2   Routing Process

As an example, the following diagram shows the process in the USA for sending an AFTN message to Hong Kong over AMHS/ATN. The AMHS message is sent from the USA to Hong Kong (China) directly via the ATN Router in Japan, and does not enter the Japan AMHS system.

AFTN (USA)

| AFTN Address | = 'VHHHYFYX' (Hong Kong) as an example |
| AFTN Message | |

AMHS (USA)

(NSAP='XX')

Address Conversion Table

AFTN Address	AMHS Address (O/R Address)	
RJAAYFYX	XX/ICAO/**RJ**/AFTN/RJAAYFYX	: Japan
VHHHYFYX	XX/ICAO/**VH**/AFTN/VHHHYFYX	: HK
----------	-------------	

| AMHS Address |
| AMHS Message |

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	Next Hop
CN=XX, ADMD=ICAO, PRMD=**RJ**,*	jpamhs	xxxxxx
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	xxxxxx
-------------	----------	----------

AMHS Routing Table

MTA name	NSAP	
jpamhs	YY	: Japan
hkamhs	ZZ	: HK
----------	----------	

| NSAP Address |
| AMHS Address |
| AMHS Message |

ATNR (USA)

ATNR (Japan)   **ATNR (HK)**

AMHS (Japan)   **AMHS (HK)**

(NSAP='YY')   (NSAP='ZZ')

The following diagram shows how the Japan AMHS processes messages it receives and messages that are sent to Hong Kong (China) or to the US by Japan's AFTN system..

```
┌─────────────────────┐
│  AMHS (USA)         │
│   (NSAP='XX')       │
└─────────────────────┘
┌─────────────────────┐
│  ATNR (USA)         │
└─────────────────────┘
┌─────────────────────┐
│  ATNR (Japan)       │
└─────────────────────┘
```

AMHS (Japan)
(NSAP='YY')

NSAP Address
AMHS Address AMHS Message

'RJ/AFTN' ?

AMHS Address = 'RJ/AFTN'

Receiving

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	NSAP
CN=XX, ADMD=ICAO, PRMD=**K**,*	usamhs	XX
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	ZZ
------------	----------	----------

Address Conversion Table

AFTN Address	AMHS Address (O/R Address)
KSLCYFYX	XX/ICAO/**K**/AFTN/KSLCYFYX
VHHHYFYX	XX/ICAO/**VH**/AFTN/VHHHYFYX
----------	-------------

NSAP Address
AMHS Address AMHS Message

Sending

AFTN Address		AFTN Address
AFTN Message		AFTN Message

AFTN (Japan)

```
┌─────────────────────┐
│  ATNR (HK)          │
└─────────────────────┘
┌─────────────────────┐
│  AMHS (HK)          │
│    NSAP='ZZ'        │
└─────────────────────┘
```

2.3   AMHS Routing Issues

In the case of trouble with the ATN connection between the ATN Routers of Japan and Hong Kong (China), for example, messages will not be able to be sent directly from the USA to Hong Kong (China). There are two means for providing alternate routing to deliver messages in this case:

i)   Case-1: Alternate routing using AFTN

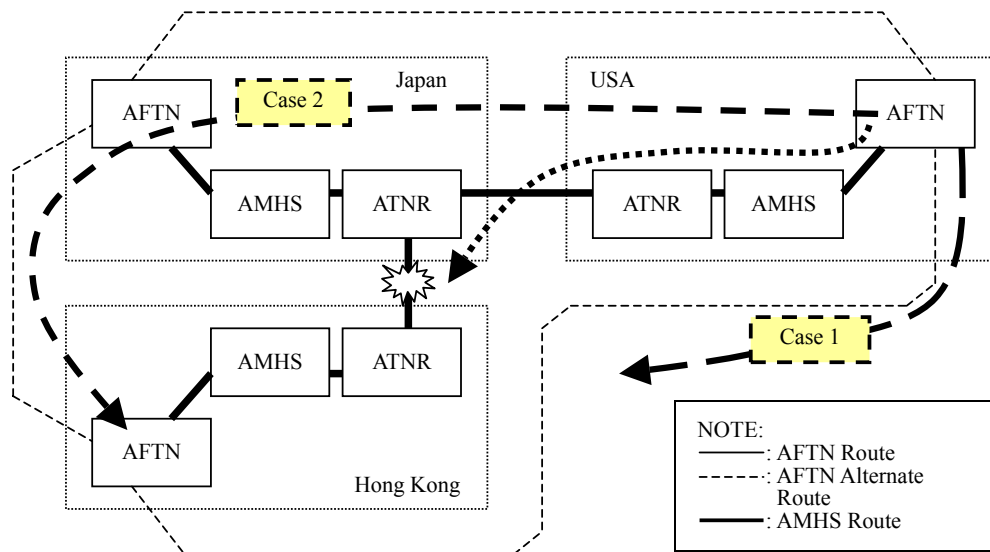ii) Case-2: Alternate routing using the Japan AMHS and AFTN systems

Figure-3   Two Cases for Alternate Routing

Since there is no current rule for AFTN alternate routing that covers the condition "when connection between the USA and Hong Kong (China) is not available to the USA", it will be necessary to create a new rule if Case-1 is applied.

On the other hand, the AMHS mechanism (routing process) is not suitable for Case-2 as will be described later.

2.4   Alternate Routing

2.4.1   Case-1

1)   Overview of Case-1

In this case, the process will be as follows:

[1] The USA AMHS system detects that message delivery to the Hong Kong (China) AMHS fails

[2] The USA AMHS reports the error to the USA AFTN system

[3] The USA AFTN system switches to routing AFTN messages over the AFTN network, either automatically or manually
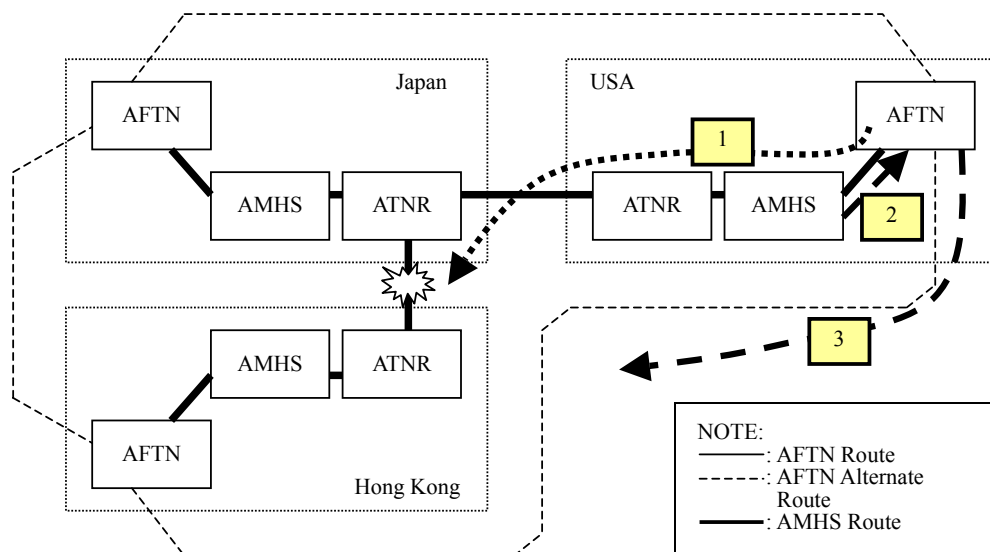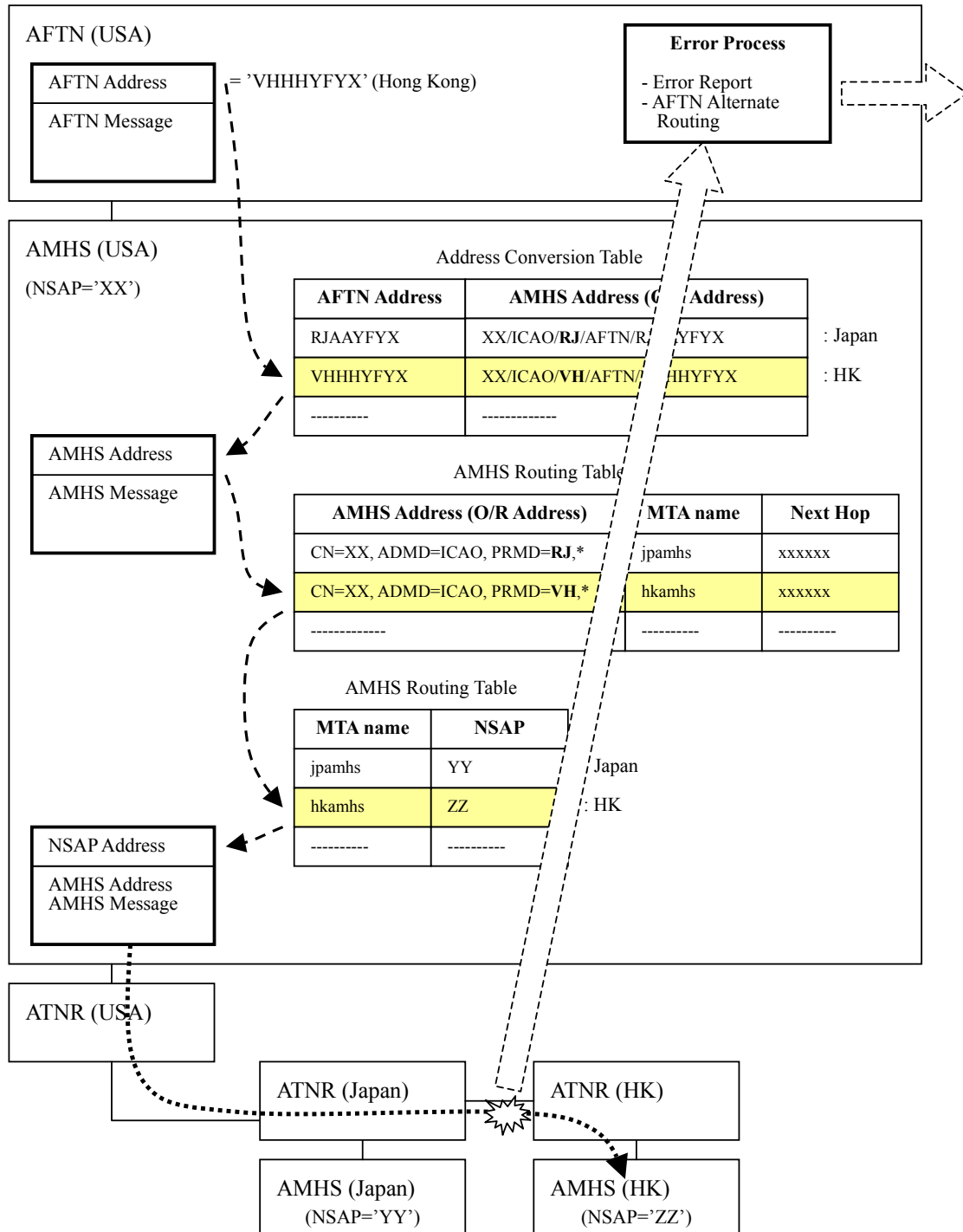

Figure-4   Overview of Case-1

The routing process is described in detail on the following page.

2) Routing Process of Case-1

The following diagram shows the process in the USA. An error will be detected when an attempt to send a message from the USA to Hong Kong (China) fails. Message delivery will then switch to AFTN alternate routing.

2.4.2   Case-2

1) Overview of Case-2

In this case, the process will be as follows:

[1] The USA AMHS system detects that the delivery of a message to the Hong Kong (China) AMHS fails

[2] The USA AMHS re-transmits the same message to the Japan AFTN system via the Japan AMHS, either automatically or manually

[3] The Japan AFTN system tries to send the received message to Hong Kong (China) over ATN, and detects an error

[4] The Japan AFTN system switches to using AFTN alternate routing, either automatically or manually
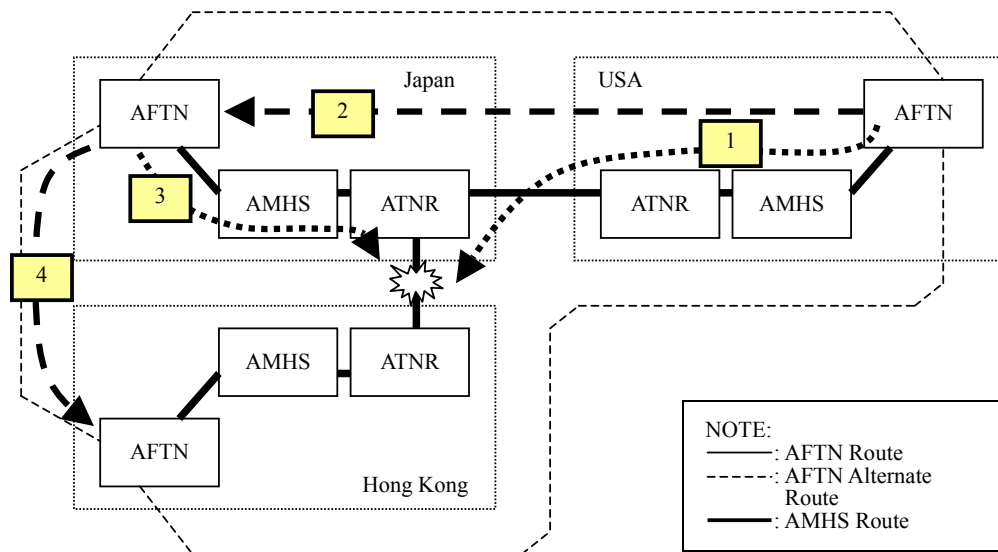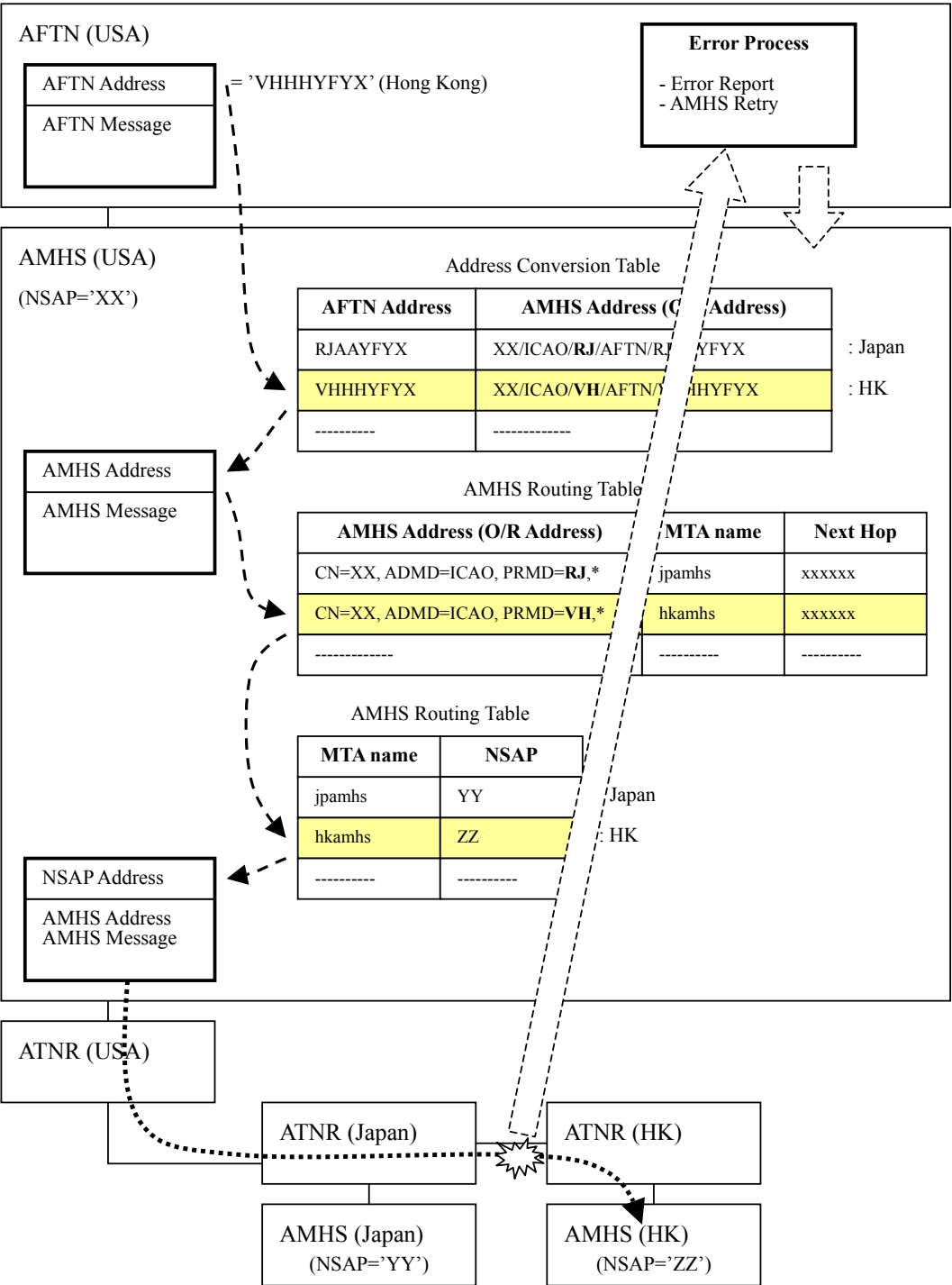
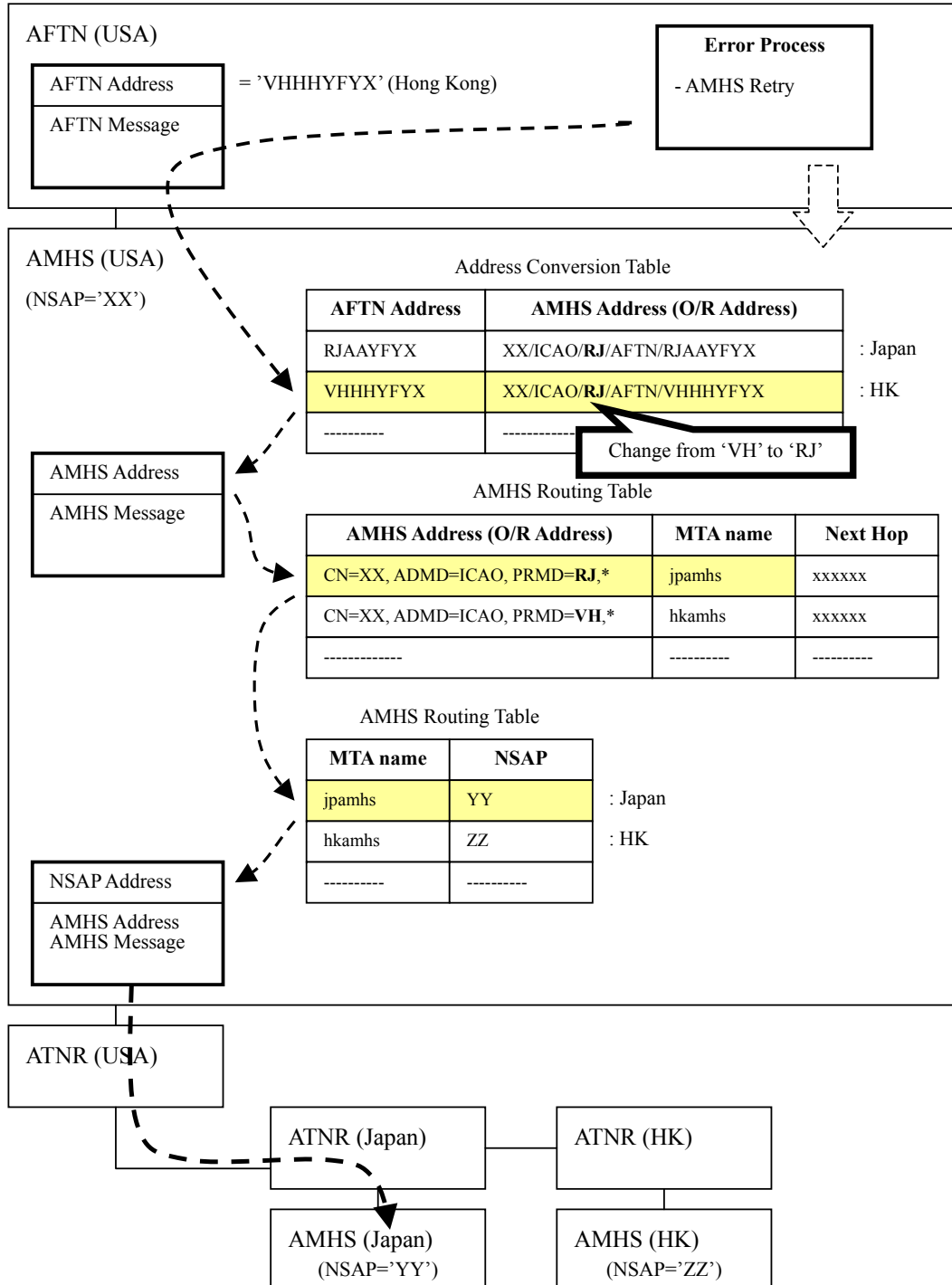Figure-5   Overview of Case-2

The routing process is described in detail in the following pages.

2) Routing Process of Case-2

The following diagram shows the process in the USA. First, an error will be detected when sending a message from the USA to Hong Kong (China). The AMHS system will then attempt to send the message again.

AFTN (USA)

| AFTN Address | = 'VHHHYFYX' (Hong Kong) |
| AFTN Message | |

Error Process

- Error Report
- AMHS Retry

AMHS (USA)
(NSAP='XX')

Address Conversion Table

AFTN Address	AMHS Address (O/R Address)	
RJAAYFYX	XX/ICAO/**RJ**/AFTN/RJAAYFYX	: Japan
VHHHYFYX	XX/ICAO/**VH**/AFTN/VHHHYFYX	: HK
----------	-------------	

| AMHS Address | |
| AMHS Message | |

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	Next Hop
CN=XX, ADMD=ICAO, PRMD=**RJ**,*	jpamhs	xxxxxx
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	xxxxxx
-------------	----------	----------

AMHS Routing Table

MTA name	NSAP	
jpamhs	YY	: Japan
hkamhs	ZZ	: HK
----------	----------	

| NSAP Address | |
| AMHS Address AMHS Message | |

ATNR (USA)

ATNR (Japan)

ATNR (HK)

AMHS (Japan)
(NSAP='YY')

AMHS (HK)
(NSAP='ZZ')

The following diagram shows the retry process in the USA. Before re-transmission, the O/R address (AMHS address) corresponding to the AFTN address for Hong Kong is altered by changing its PRMD field, which indicates a domain, to that of Japan. As a result, messages destined for Hong Kong will be sent to the Japan AMHS system.

AFTN (USA)

| AFTN Address | = 'VHHHYFYX' (Hong Kong) |
| AFTN Message | |

Error Process

- AMHS Retry

AMHS (USA)

(NSAP='XX')

Address Conversion Table

AFTN Address	AMHS Address (O/R Address)	
RJAAYFYX	XX/ICAO/**RJ**/AFTN/RJAAYFYX	: Japan
VHHHYFYX	XX/ICAO/**RJ**/AFTN/VHHHYFYX	: HK
----------	-------------	

Change from 'VH' to 'RJ'

| AMHS Address |
| AMHS Message |

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	Next Hop
CN=XX, ADMD=ICAO, PRMD=**RJ**,*	jpamhs	xxxxxx
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	xxxxxx
-------------	----------	----------

AMHS Routing Table

MTA name	NSAP	
jpamhs	YY	: Japan
hkamhs	ZZ	: HK
----------	----------	

| NSAP Address |
| AMHS Address |
| AMHS Message |

ATNR (USA)

ATNR (Japan) — **ATNR (HK)**

AMHS (Japan)
(NSAP='YY')

AMHS (HK)
(NSAP='ZZ')

The following diagram shows the process in Japan on receiving the message re-transmitted by the USA destined for Hong Kong (China). The message will enter the AFTN system, which will then attempt to send it to Hong Kong (China) over the ATN [3]. However, an error will occur and be detected. The message will then be re-sent to the Hong Kong (China) AFTN via AFTN alternate routing [4].
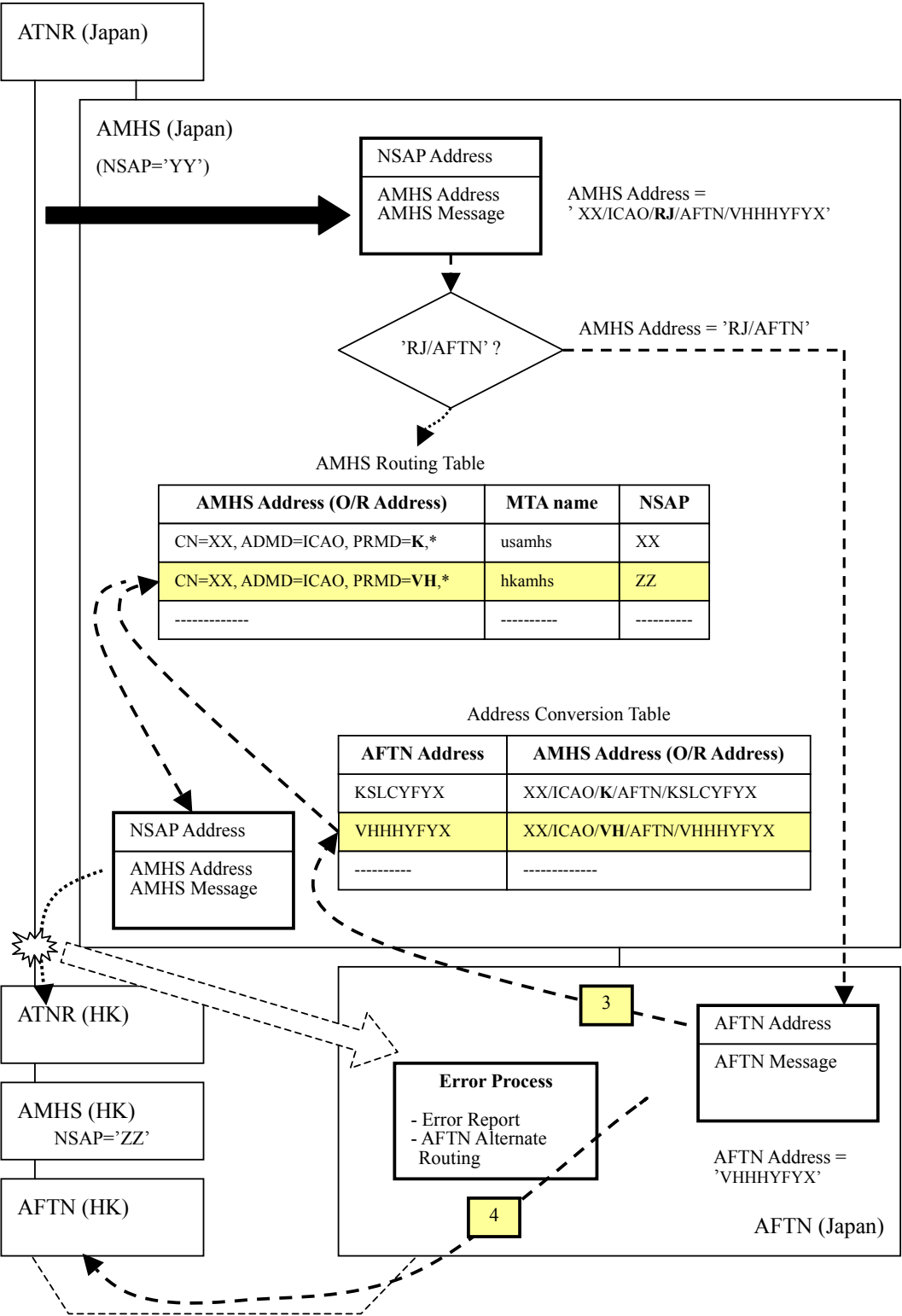
2.4.3   BIS Alternate Routing (IN THE FUTURE)

In the future, when the regional ATN network has developed to the extent that there is a triangle of
ATN connections between the ATN Routers of Japan, the USA and Hong Kong (China), the BIS-BIS
IDRP routing mechanism means that the network will dynamically reconfigure in the event of router
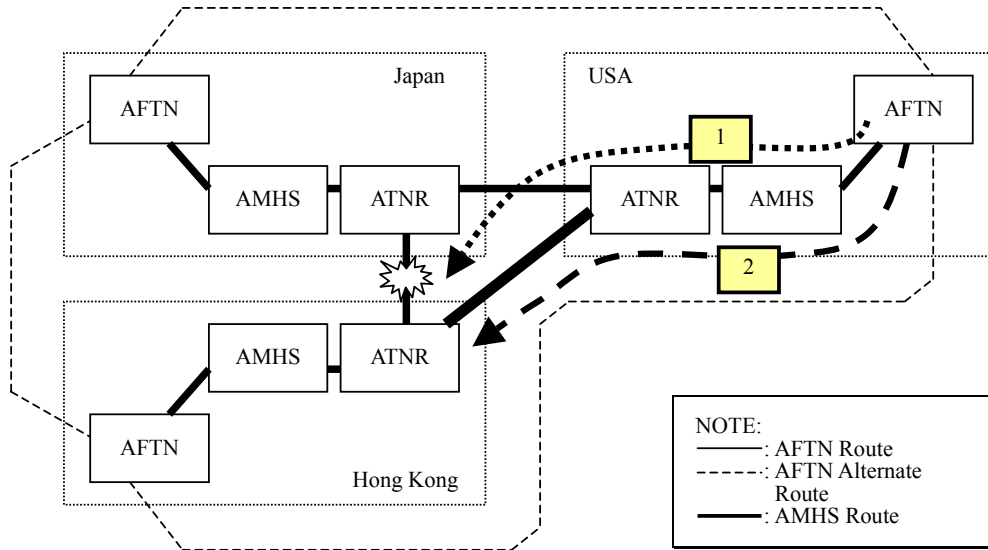or connection failure so that "alternate routing" of NPDUs will occur automatically.

Figure-6   Future BIS Routing

2.5   Recommendation

To apply the mechanism for alternate routing of Case-1 above, a rule such as "use AFTN alternate routing in the event that ATN connection between the USA and Hong Kong (China) is unavailable" will be necessary. However, as there is no direct AFTN connection between the USA and Hong Kong (China), there is no such AFTN alternate routing rule. The current rule is only for the AFTN connection and its alternation between the USA and Japan based on the AFTN message forwarding mechanism from a State to another one by one.

In addition, it is not suitable to forward messages among the USA, Japan and Hong Kong (China) through an alternate routing via non-related States, considering the resulting additional workload on the operators and the additional load on AFTN circuits that will result.

As an intermediate solution till a triangle of ATN routes is available among the States, Case-2 is recommended, since Case-1 is far from the current AFTN Alternate Routing rule.

3.   Action by the Meeting

The meeting is invited to;
   i)   adopt the recommendation above, where the AFTN/AMHS alternate routing among the USA, Japan and Hong Kong (China) should be the Case-2 described in this paper; and
   ii)   recommend that other States connected by a linear ATN/AMHS topology also adopt the same interim rule.

Appendix: AMHS Alternate Routing (Some Case in the Future)

1)   Overview of AMHS Routing

This case is the routing by using the AMHS (MTA) Routing explicitly. (However, it is also possible to use direct ATN Router routing from the USA to Hong Kong via 'Other State'.)
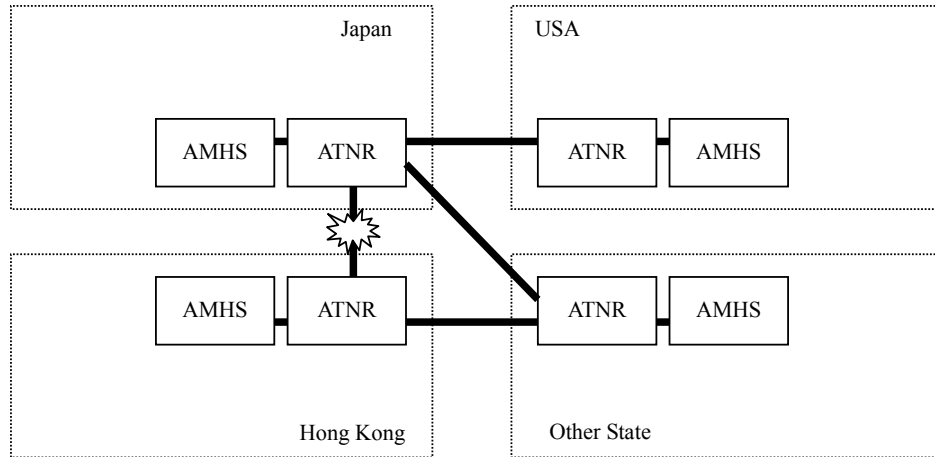
Figure-A1   Future AMHS Routing

In the case of any trouble in the ATN Router connection between Japan and Hong Kong (China), as an example, automatic AMHS alternate routing can be used in the sequence of [1] to [4].
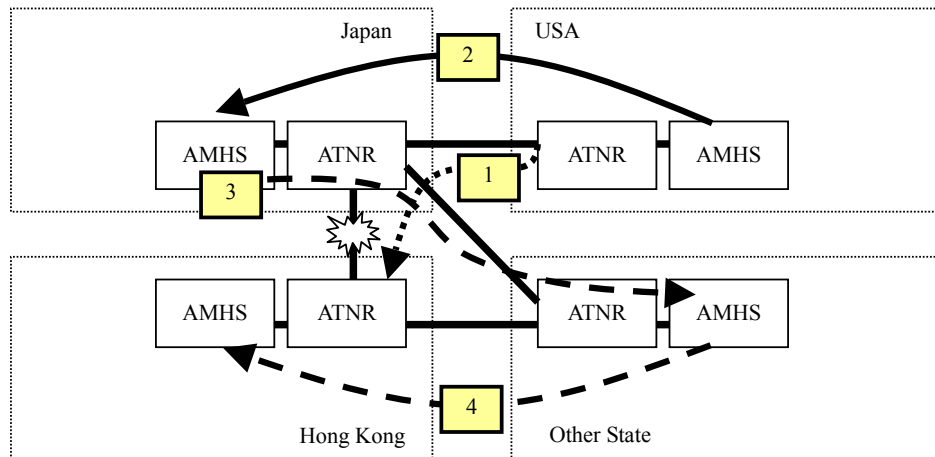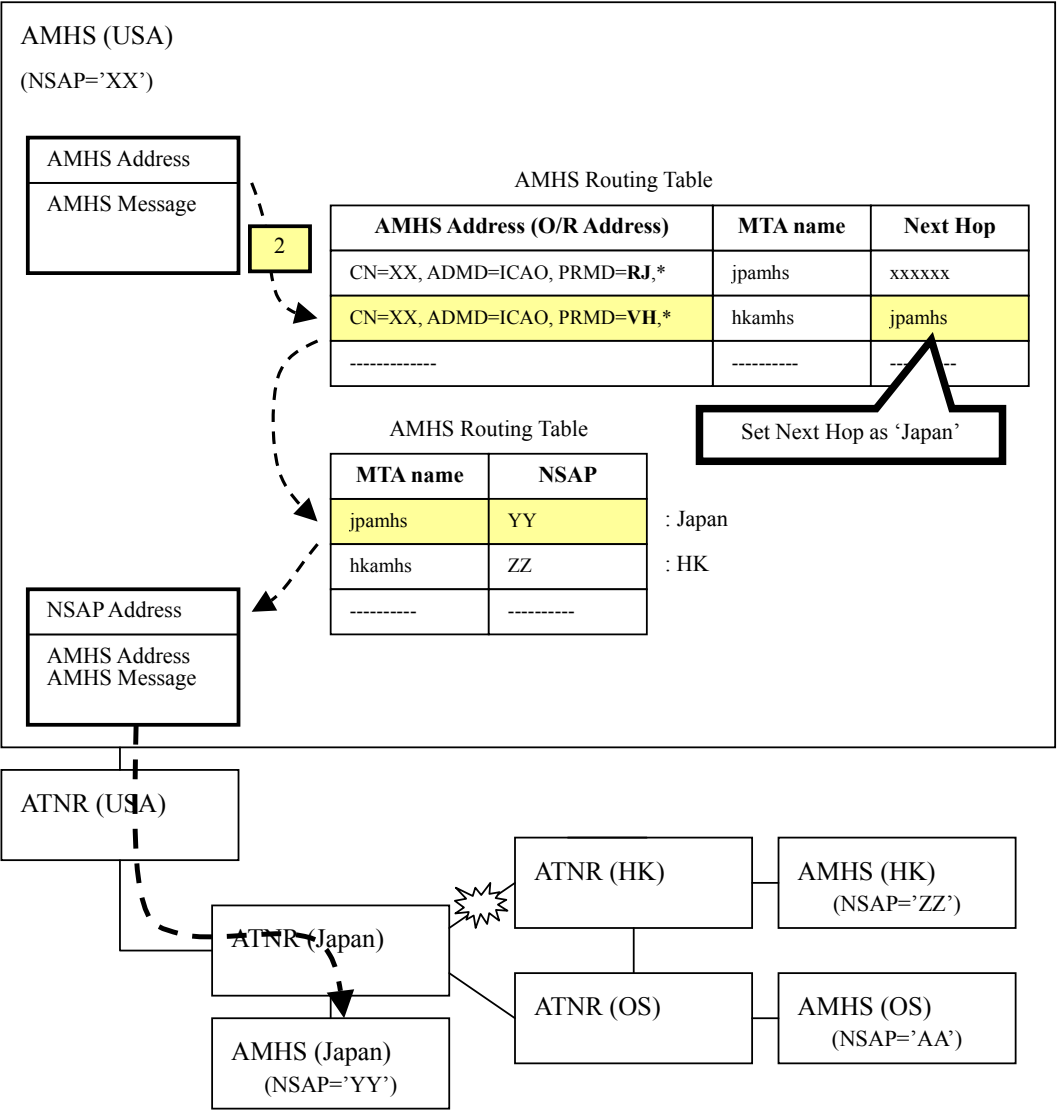
Figure-A2   Future AMHS Alternate Routing

2) Routing Process of AMHS Routing

The following diagram shows the process in the USA AMHS system. After an error is detected when sending a message directly to Hong Kong (China) [1], the same message will be re-sent to the Japan AMHS referring to the "Next Hop" entry of the AMHS Routing Table [2].

AMHS (USA)

(NSAP='XX')

AMHS Address

AMHS Message

| 2 |

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	Next Hop
CN=XX, ADMD=ICAO, PRMD=**RJ**,*	jpamhs	xxxxxx
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	jpamhs
-------------	----------	---------

Set Next Hop as 'Japan'

AMHS Routing Table

MTA name	NSAP	
jpamhs	YY	: Japan
hkamhs	ZZ	: HK
----------	----------	

NSAP Address

AMHS Address
AMHS Message

ATNR (USA)

ATNR (Japan)

ATNR (HK)

AMHS (HK)
(NSAP='ZZ')

ATNR (OS)

AMHS (OS)
(NSAP='AA')

AMHS (Japan)
(NSAP='YY')

The following diagram shows the process in the Japan AMHS. After receiving the message from the USA destined for Hong Kong (China), an error will be detected when relaying the message directly to Hong Kong (China) via ATN. The same message will be re-sent to AMHS of the 'Other State' referring to the AMHS Routing Table [3]. The message will then be sent by the 'Other State' AMHS to Hong Kong (China)'s AMHS [4].

ATNR (Japan)

AMHS (Japan)
(NSAP='YY')

AMHS Address
AMHS Message

AMHS Routing Table

AMHS Address (O/R Address)	MTA name	Next Hop
CN=XX, ADMD=ICAO, PRMD=**K**,*	usaamhs	xxxxxx
CN=XX, ADMD=ICAO, PRMD=**VH**,*	hkamhs	otamhs
CN=XX, ADMD=ICAO, PRMD=**OT**,*	otamhs	xxxxxx

Set Next Hop as 'Other State'

AMHS Routing Table

MTA name	NSAP	
usaamhs	XX	: Japan
hkamhs	ZZ	: HK
otamhs	AA	: Other States
----------	----------	

NSAP Address
AMHS Address
AMHS Message

3

ATNR (Japan)

ATNR (HK)

AMHS (HK)
(NSAP='ZZ')

4

ATNR (OS)

AMHS (OS)
(NSAP='AA')