International Civil Aviation Organization and the Directorate General of Air Communication, Indonesia

SIXTH MEETING OF AERONAUTICAL TELECOMMUNICATION NETWORK (ATN) TRANSITION TASK FORCE OF APANPIRG

Bali, Indonesia, 26-30 April 2004

Agenda Item 3: Discussions and Review AMHS Activities – MTA Routing Policy

MTA TRANSITIONAL ROUTING POLICY

(Prepared and Presented by Japan)

SUMMARY

This working paper summarises AMHS and AFTN routing issues in the initial stage of transition from AFTN to AMHS/ATN, and presents two methods for AMHS routing during the initial transition phase.

1 INTRODUCTION

During the 8th meeting of the ATN Transition Task Force ad hoc working group (ATNTTF WG/8), it was recognised that before an ATS Message Handling System (AMHS) Routeing Policy can be developed for the Asia/Pacific region, number of issues need to be addressed concerning the transition from aeronautical fixed communications between states using the Aeronautical Fixed Telecommunication Network (AFTN) to communications using AMHS.

In response to the above meeting, during the 9th meeting of the ATN Transition Task Force ad hoc working group (ATNTTF WG/9), Japan presented a working paper WP/10 “AMHS Transition Issues”. The WP proposed a means of effecting smooth transition to AMHS during the early stage of ATN transition where some AFTN links are replaced by ATN/AMHS. During the transition, AFTN and AMHS operate together and the priority must be to ensure a smooth transition during which operation of the AFS is stable. The WP proposed AMHS routing based on the current AFTN routing, which would thus have no impact on the current AFTN routing. The working group appreciated the paper, and considered it to be a good paper to present to ATNTTF/6.

This working paper presents the same contents of the above WP in the next section “Discussion”. As a summary, some AMHS transitional issues are identified and two methods for AMHS routeing during the initial phase of AMHS transition are discussed. Then two methods, neither of which impacts the current AFTN routing are proposed. The first of these is considered preferable.

- Method 1: “Routing by relaying through adjacent AMHS sites based on the current AFTN routing directory”;

- Method 2: “Direct MTA-to-MTA routing between states that have introduced AMHS based on the current AFTN routing directory”.

2. DISCUSSION

2.1. Considerations in formulating AMHS Routeing Policy

The following issues should be borne in mind when formulating AMHS routeing policy.

2.1.1 Asia/Pacific ATN Transition

The Asia/Pacific regional Aeronautical Telecommunication Network (ATN) transition plan is based on the incremental replacement of the current AFTN network with a ground network infrastructure incorporating ATN routers, and carrying out messaging using the AMHS that operates as an application on top of this infrastructure. The transition from AFTN to ATN/AMHS will occur while the worldwide aeronautical fixed service (AFS) is operating over the AFTN network.
The plan for the Asia/Pacific regional ATN network incorporating ATN router sites is contained in CNS Table 1B of the ICAO ASIA/PAC FASID document. According to the ATN router plan contained in this table, states that currently host the main AFTN communication centres in the Asia/Pacific region will serve as ATN backbone sites.

2.1.2 The Initial Phase of ATN/AMHS Transition

Based on the Asia/Pacific plan contained in the FASID CNS Table 1B, existing AFTN circuits between pairs of states are replaced by ATN circuits based on bilateral co-ordination. The pairs of states that have transitioned to ATN may then introduce AMHS for AFS operations while using their existing AFTN connections for AFS operations with states that have not yet transitioned to AMHS.

During the initial phase of transition to ATN/AMHS, the highest priority consideration of states that have introduced AMHS must be to proceed the transition without impacting on the existing AFTN operations of other states by, for example, disrupting their communications operations or causing then to incur extra cost burdens.

2.2 AMHS Routing Policy

From the above discussion, AMHS routeing policy must consider the necessity of implementing the Asia/Pacific ATN ground network and transitioning from AFTN to ATN/AMHS in such a way as not to cause problems. In particular, since during the initial stages of ATN transition nearly all of the states apart from those few that have transitioned to AMHS will be operating AFTN, it will be necessary to minimise any effects on AFS operations over the AFTN network.

It will therefore be most effective and definite if AMHS routeing is considered with the following stages:

(1) The initial stage of ATN/AMHS transition.
(2) The “backbone complete” stage in which some progress has been made towards ATN transition (ATN links are established between backbone sites, and AMHS systems are established at those sites).
(3) The final stage, when most of the Asia/Pacific states have transitioned to ATN/AMHS.

AMHS routeing in stage (1), the initial stage of ATN/AMHS transition is discussed below. After this it will be necessary to consider routeing for stages (2) and (3) following on from stage (1).

2.3 AMHS Routeing during the Initial Phase of Transition to ATN/AMHS

As mentioned above, during the initial phase of transition to ATN/AMHS, AFS will operate over an AFTN network in which parts have been replaced by AMHS messaging over ATN circuits. In other

words, the AFS will operate over a mixed network that includes both the AFTN Switching System and AMHS.

In order to enable a smooth transition to ATN without affecting the operations of AFTN communication centres, it will therefore be necessary to implement AMHS routeing based on existing AFTN routeing policy. Two methods of implementing AMHS routeing based on the existing AFTN routeing directory are as follows.

Method 1: AMHS routeing based on adjacencies in the current AFTN routeing directory. For example, in the case that United States, Japan and Hong Kong have introduced AMHS, messages from the US AMHS addressed to Hong Kong are first sent to the Japan AMHS, which then transmits them to the Hong Kong AMHS.

Method 2: Direct MTA-to-MTA routeing between states that have introduced AMHS based on the current AFTN routeing directory.
Based on the current AFTN routeing directory, states that have introduced AMHS send AMHS messages directly to their destination AMHS systems over the ATN network; that is, without passing through another AMHS Message Transfer Agent (MTA). For example, in the case that United States, Japan and Hong Kong have introduced AMHS, messages sent from the US AMHS to the Hong Kong AMHS, which would be sent via Japan under the existing AFTN routeing directory, are sent directly from the US AMHS to the Hong Kong AMHS without passing through the Japan AMHS.
These methods are described in further detail below.

Method 1: AMHS routeing based on adjacencies in the current AFTN routeing directory

In this method, messages are relayed between AMHS MTAs via the adjacencies in the existing AFTN routeing directory. Examples illustrating how this works for various normal operation and failure scenarios are shown in figures 1–6.

Normal Operation

Since AMHS routeing is carried out according to the AFTN routeing directory, it is not necessary to change the AFTN routeing directory and there is no effect on other AFTN centres.

Circuit Failure

In the event of a circuit failure at an intermediate communication site that acts as a relay for message traffic, while under current AFTN operations the intermediate site concerned carries out alternate routeing to ensure the delivery of message traffic passing through it, in the case of AMHS an MTA that cannot send a message forward sends a Non-Delivery Report (NDR) to the MTA that originated the message and so the *originator* of the message, when it receives such an NDR, has to apply alternate routeing to ensure its delivery. While in the case of AFTN the responsibility for re-routeing messages to ensure delivery is borne by the relaying site, in the case of AMHS the site that sent the message must assume this responsibility. Thus, under AMHS operations sites must implement different alternate transmission to ensure delivery of a message in the event of network failure than they would for AFTN operations.

While relay sites will have a slight change from their AFTN operations in the handling of alternate routeing, because alternate routeing is carried out according to the AFTN routeing directory, it will not be necessary to change the AFTN routeing directory.

Suppose for example that Hong Kong sends a message to the United States via Japan, and a fault occurs in the Japan–United States circuit. Under AFTN, the AFTN centre in Japan would switch to alternate routeing via Singapore. However, in the case that AMHS has been implemented by Japan, Hong Kong and the US, Japan would not route the message via Singapore but would send an NDR to the Hong Kong

AMHS. On receipt of the NDR, Hong Kong would then send messages addressed to the United States via AFTN through the existing AFTN alternate route via Bangkok.

Method 2: Direct MTA-to-MTA routeing between states that have introduced AMHS based on the current AFTN routeing directory

In this method, states that have introduced AMHS send messages directly to the AMHS of the destination state using the ATN network without relay through other MTAs. Examples illustrating how this works for various normal operation and failure scenarios are shown in figures 7–12.

Normal Operation

In the case of direct MTA-to-MTA routeing between pairs of states that have introduced AMHS, it will be necessary to modify the AFTN routeing directory for these states (see note below). However, because message routeing for states that have not introduced AMHS remains based on the current AFTN routeing directory, there is no need to modify the AFTN routeing directory for those states. There is therefore no effect on other AFTN centres.

Note: Changes to the AFTN Routeing Directory

In the case that a pair of states without a direct AFTN connection between them desire to migrate from AFTN to AMHS using direct MTA-to-MTA routeing, the following steps must be followed to update the AFTN routeing directory.

(1) Co-ordination for AFTN routeing table changes between the two states that have adopted direct MTA-to-MTA routeing.
(2) Co-ordination for changes to the AFTN routeing tables of the intermediate state(s) that previously relayed AFTN messages between the two states.
(3) Notification of the change in the AFTN routeing directory to ICAO.

As a result of these changes, states that have introduced AMHS will be able to route AFTN messages according to their updated AFTN routeing tables, while states that have not yet introduced AMHS will be able to route messages with minimal changes to their AFTN routeing tables (no changes if they were not relay sites for the state pair that transitioned to AMHS).

Circuit Failure

Because AMHS messages are sent directly to their destination MTA without relay via an intermediate MTA, if there is a failure of the ATN network connection between a pair of states that employ direct MTA-to-MTA routeing, the AMHS systems of both states should be able to detect the failure. Based on detection of this failure, the site operating the originating AMHS then effects alternate routeing via the AFTN network according to the AFTN routeing directory.

As an example, in the case that an AMHS in Hong Kong is sending messages directly to an AMHS in the United States via a network connection through an ATN router in Japan, and there is a failure in the circuit between the United States and Japan, the Hong Kong AMHS system will be able to detect that messages cannot be sent to the United States AMHS and so detect the loss of network connectivity in the Japan–US ATN circuit. In this case, Hong Kong can send messages addressed to the United States by AFTN alternate routeing.

A comparison of methods 1 and 2 is shown in table 1.

3. ACTION BY THE MEETING

If during the first stage of transition to AMHS, AMHS routeing is based on the current AFTN routeing directory according to either methods 1 or 2 described above, it will be possible to carry out AFS operations without affecting AFTN operations.

Therefore, Japan basically proposes AMHS routeing method 1, but method 2 is also possible if the necessary connection tests are carried out and necessary changes are made to the AFTN routeing directory.

The meeting is invited to note the contents of this working paper and to comment on the proposal presented.

Table 1. Comparison of ATN Transition Initial Phase AMHS Routeing Proposals 1 and 2

	Method 1	Method 2
Routeing based on the AFTN Routeing Directory	Messages are sent to the destination AMHS through adjacent MTAs using the same adjacencies as the current AFTN.	States that have implemented AMHS send messages directly to the MTAs of other states that have implemented AMHS based on the AFTN routeing directory, without relay by other MTAs.
Alternate routeing	Under the current AFTN system, AFTN stations that are unable to relay a message must effect alternate routeing. However, in the case of communication between MTAs, if there is a loss of network connectivity between the originator and destination MTAs then the station operating the AMHS that originated the AMHS message and receives an NDR must effect alternate routeing.	
Amount of traffic	Because routeing occurs over the network in the same way as the current AFTN, the amount of traffic handled by each site is basically the same as under the current AFTN.	Unlike method 1, because each MTA may be directly communicating with several other MTAs there will be a significant increase in the amount of communication traffic.
Connection tests	When a site newly commencing AMHS operations joins the network, it will be necessary to conduct the following connection tests with the AMHS systems with which it will communicate: □ ATN router connection test □ AMHS connection test Also, once connection tests have been carried out between a pair of adjacent AMHS sites, it will be necessary to confirm the relay of traffic between the newly-joined site and non-adjacent sites by intermediate relay sites. (To confirm the AMHS relay function of the relay site.) □	When a site newly commencing AMHS operations joins the network, the following connections tests will be necessary between this site and all MTAs that it will communicate with: □ ATN router connection test □ AMHS connection test

1) Normal Operation

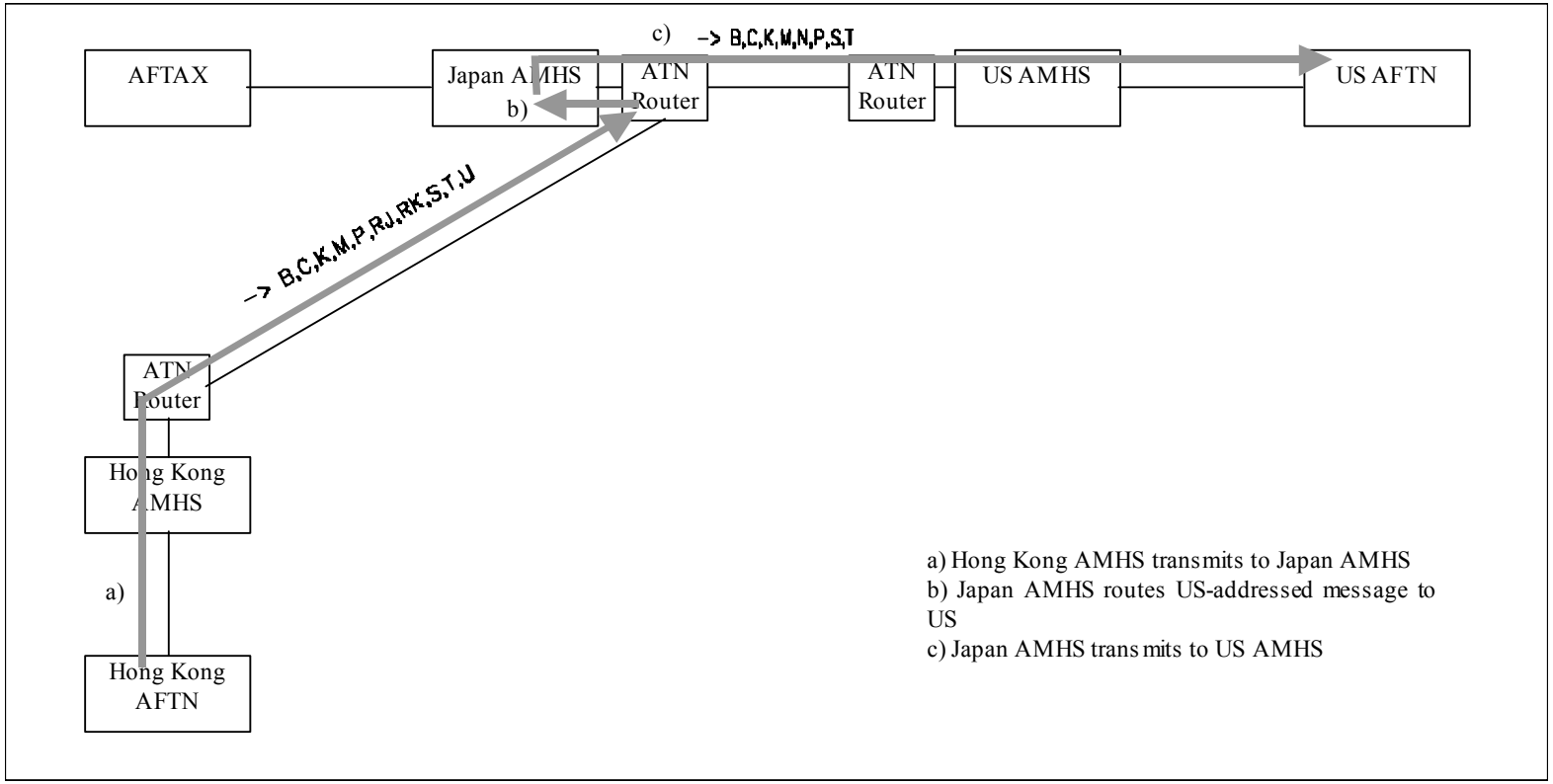

Figure 1. Method 1:
Hong Kong sends a message to the United States

Normal Operation

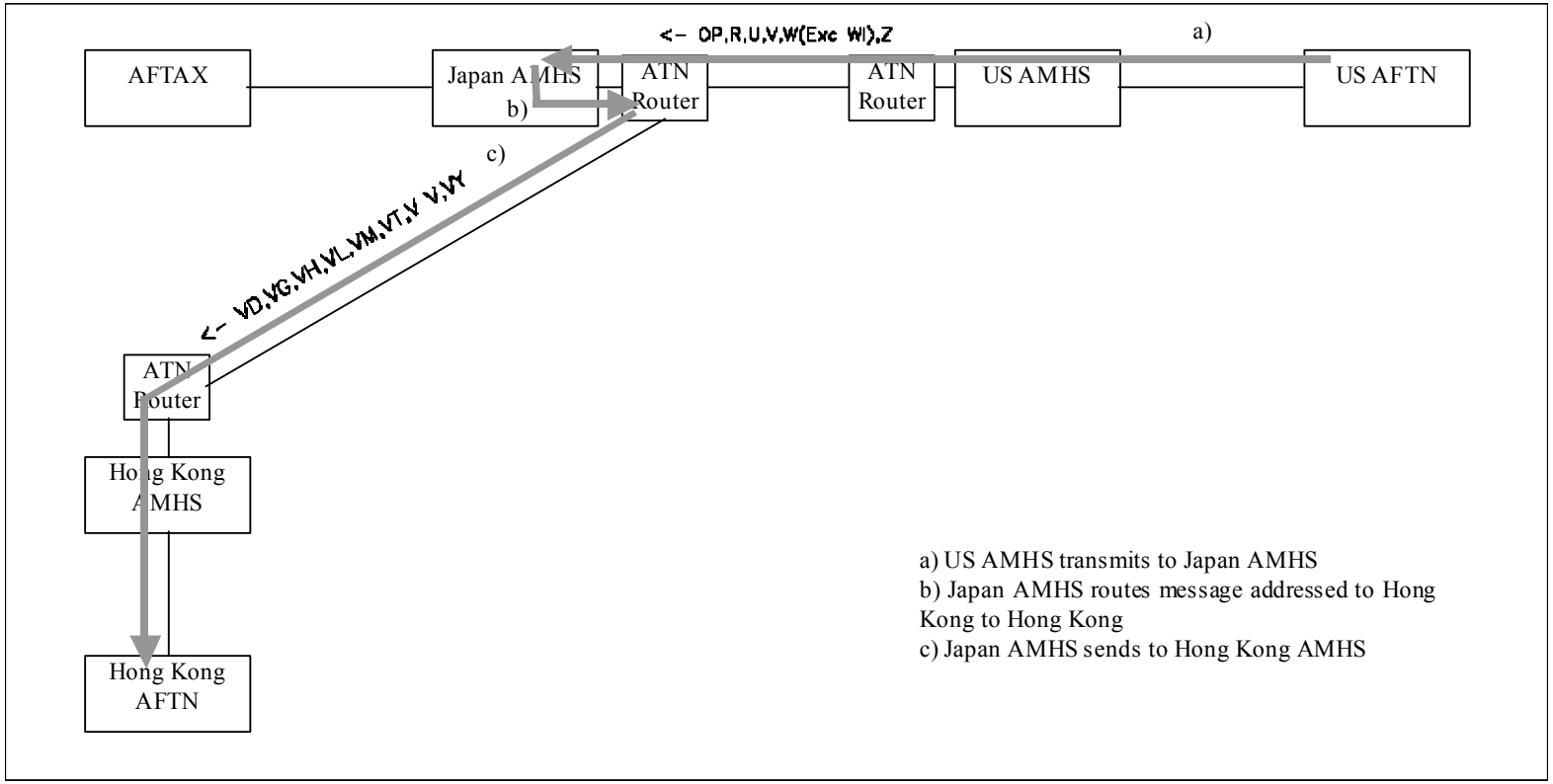

Figure 2. Method 1:
The United States sends a message to Hong Kong

Circuit failure between the US and Japan

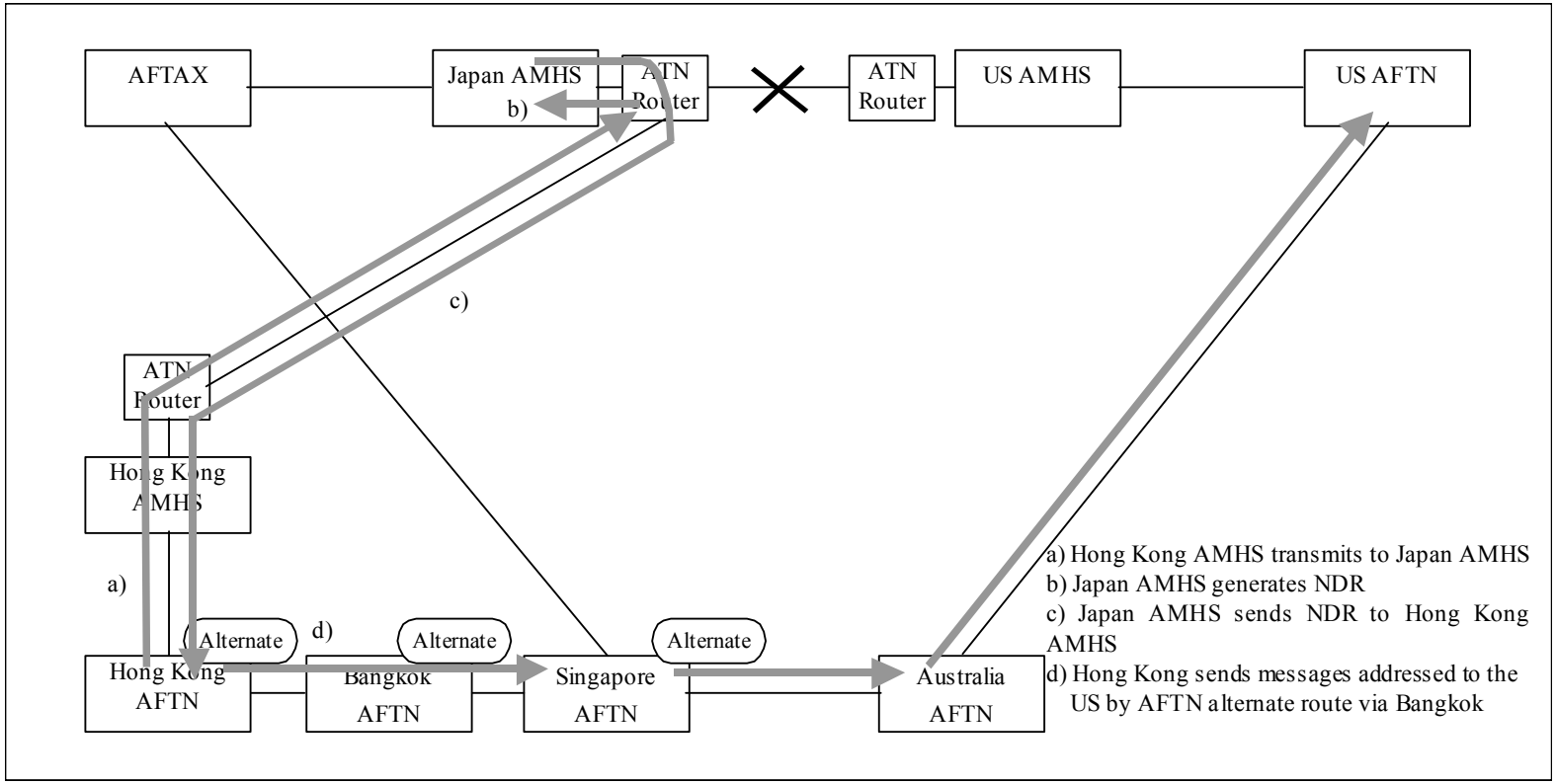

Figure 3. Method 1:
Hong Kong sends a message to the United States (ATN network failure downstream of relay MTA)

Circuit failure between US and Japan

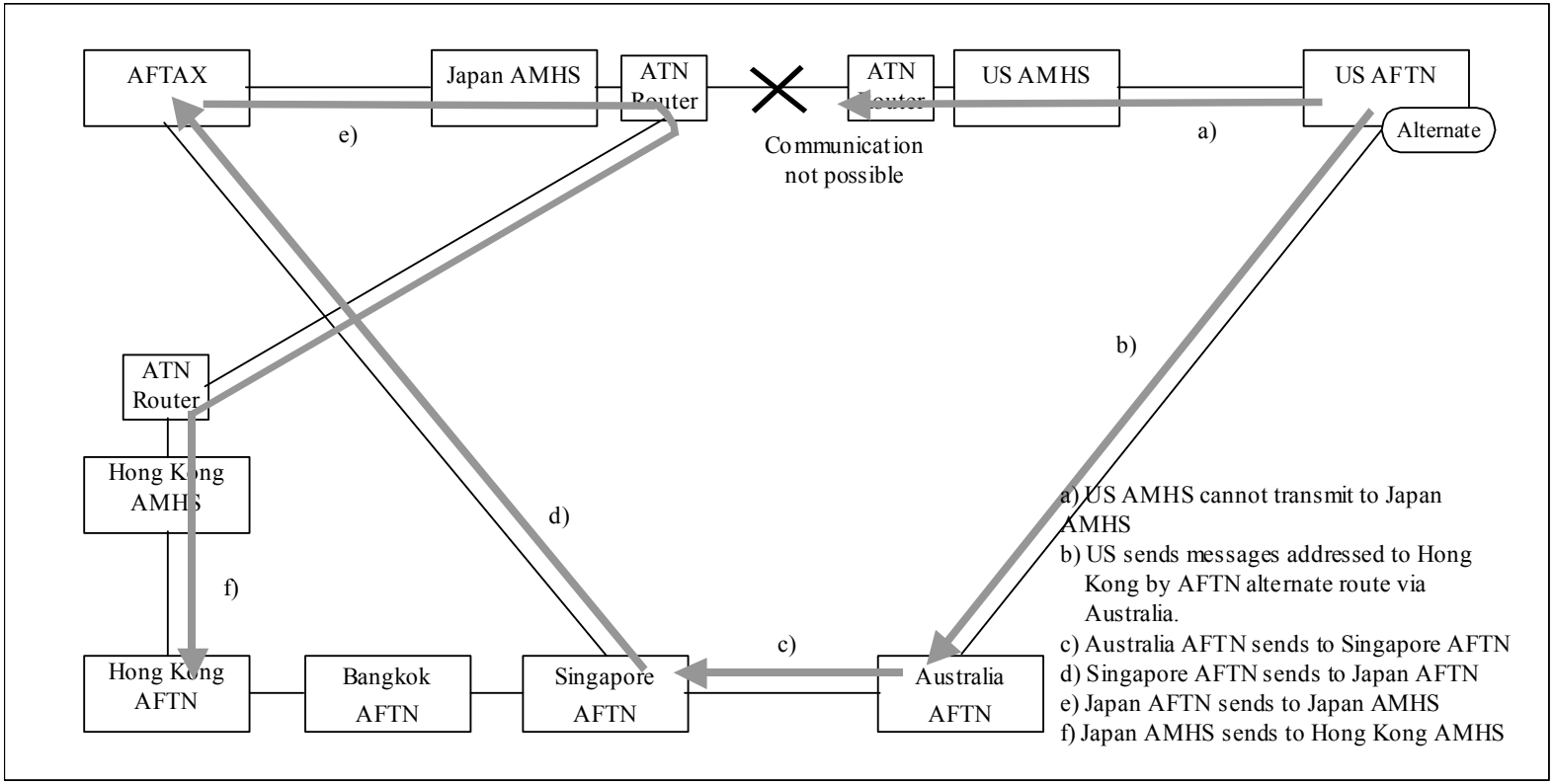

Figure 4. Method 1:
The United States sends a message to Hong Kong (ATN network failure between originator and relay MTA)

Circuit failure between Hong Kong and Japan

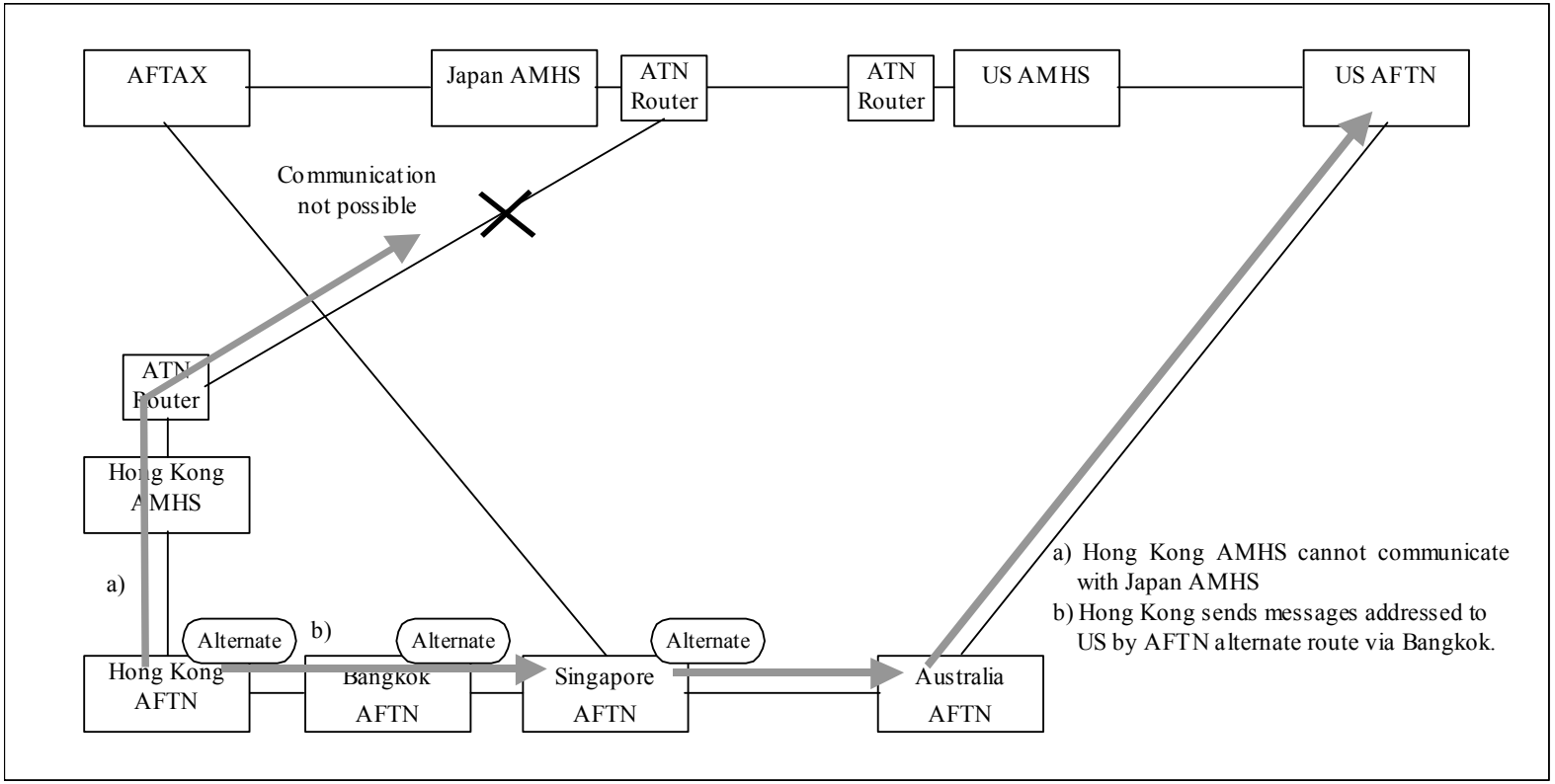

Figure 5. Method 1:
Hong Kong sends a message to the United States (ATN network failure between originator and relay MTA)

Circuit Failure between Hong Kong and Japan

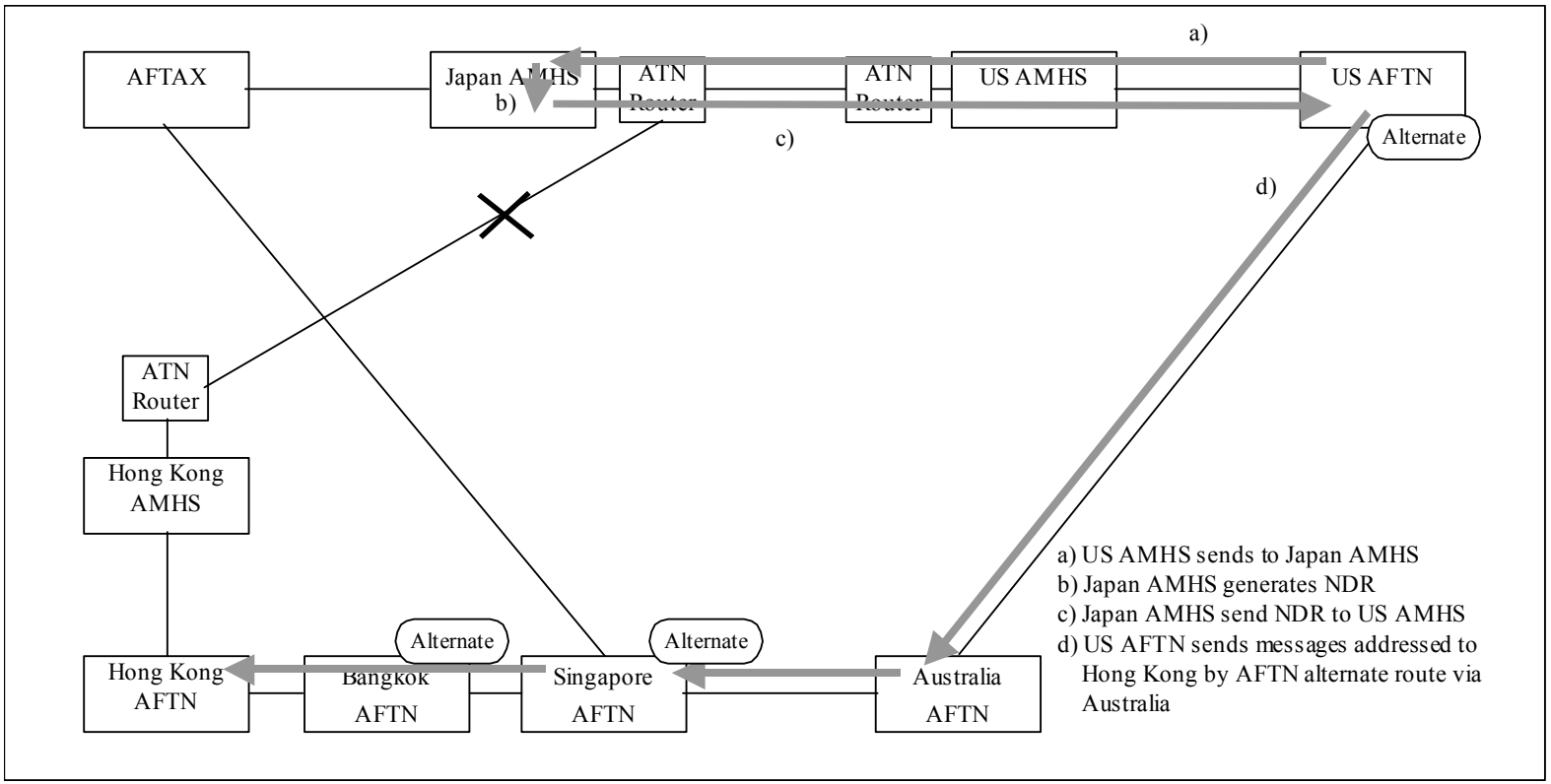

Figure 6. Method 1:
The United States sends a message to Hong Kong (ATN network failure downstream of relay MTA)

Normal Operation

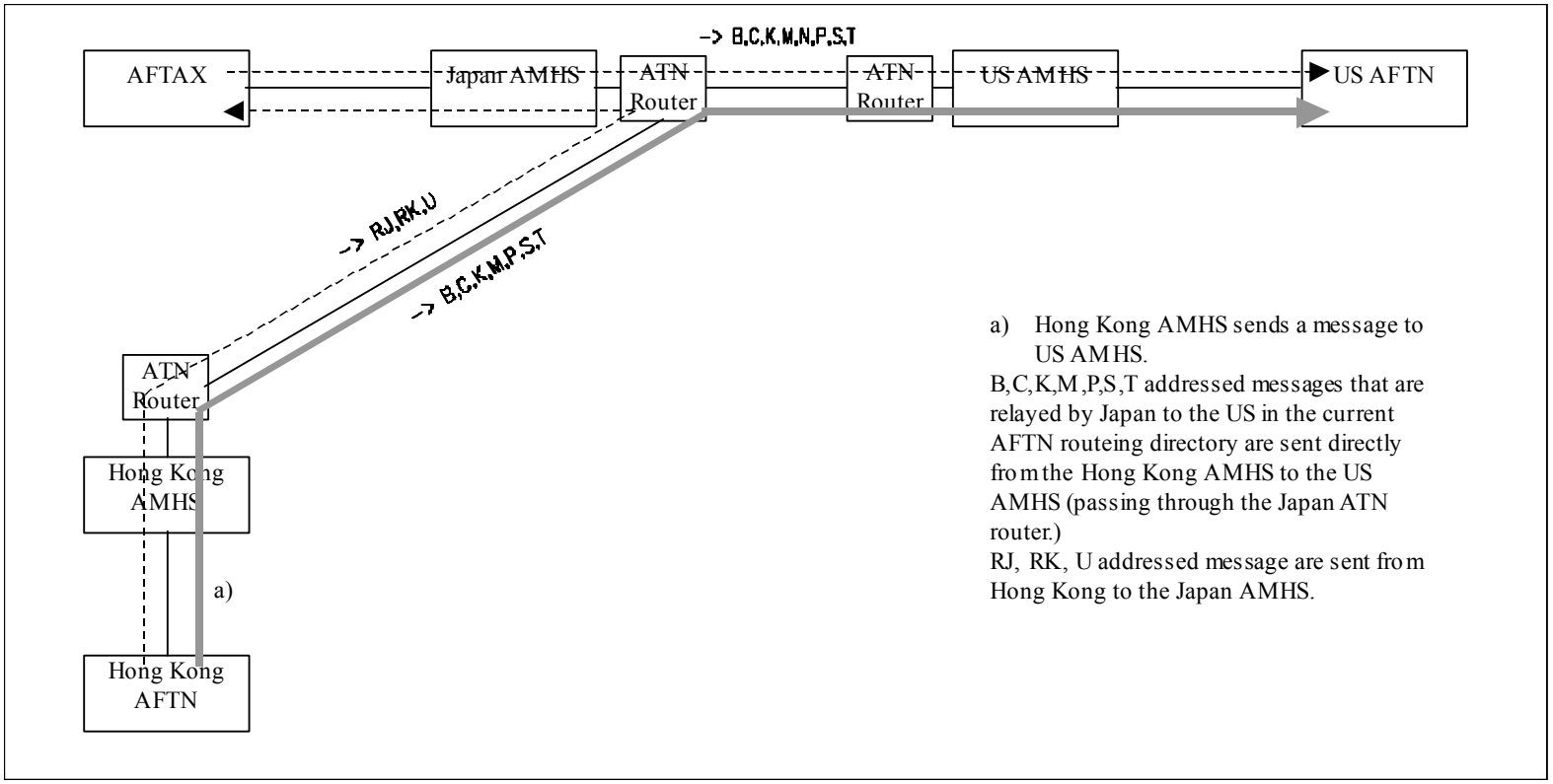

Figure 7. Method 2:
Hong Kong sends a message to the United States

Normal Operation

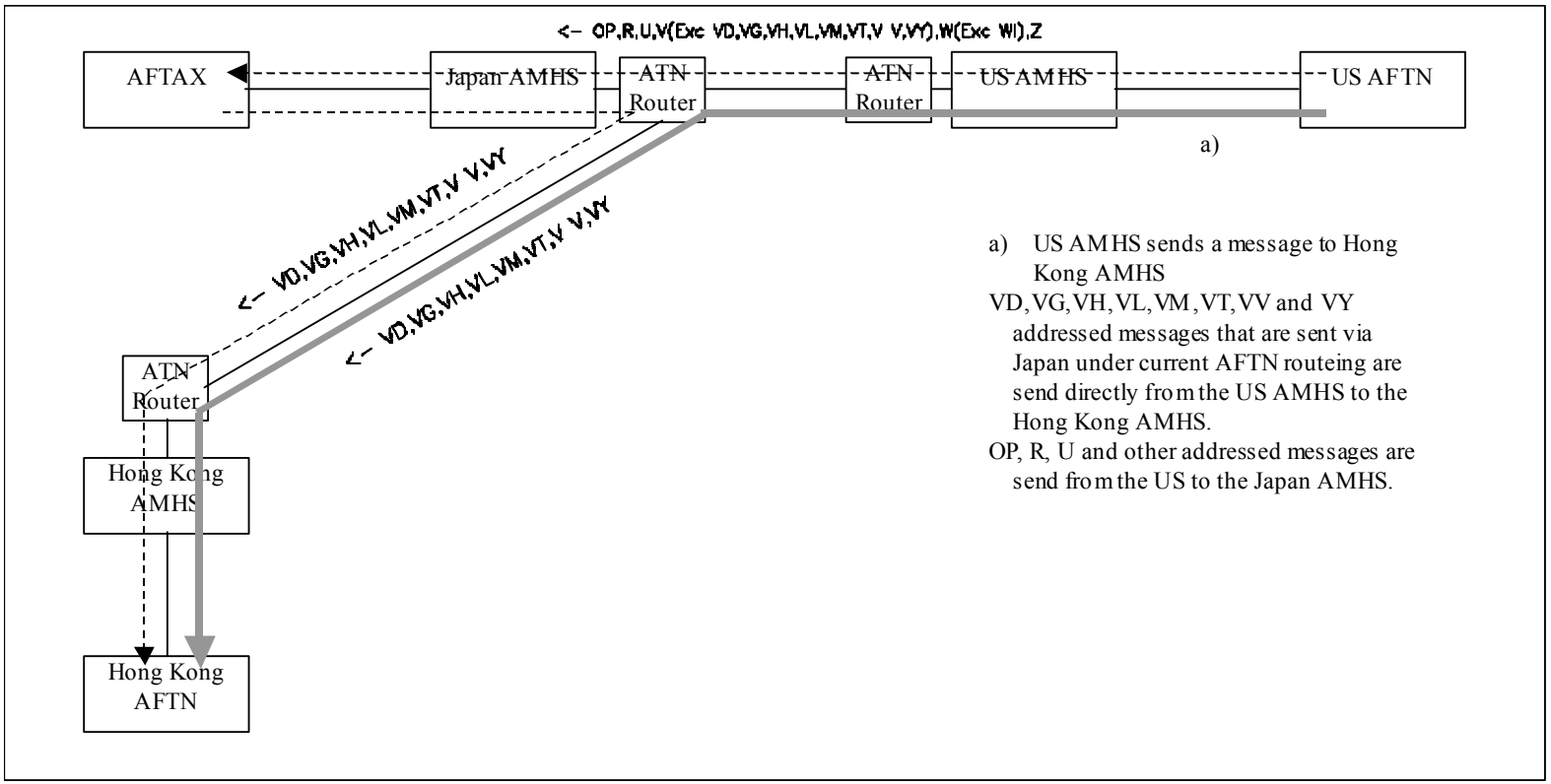

Figure 8. Method 2:
The United States sends a message to Hong Kong

Circuit failure between Japan and the US

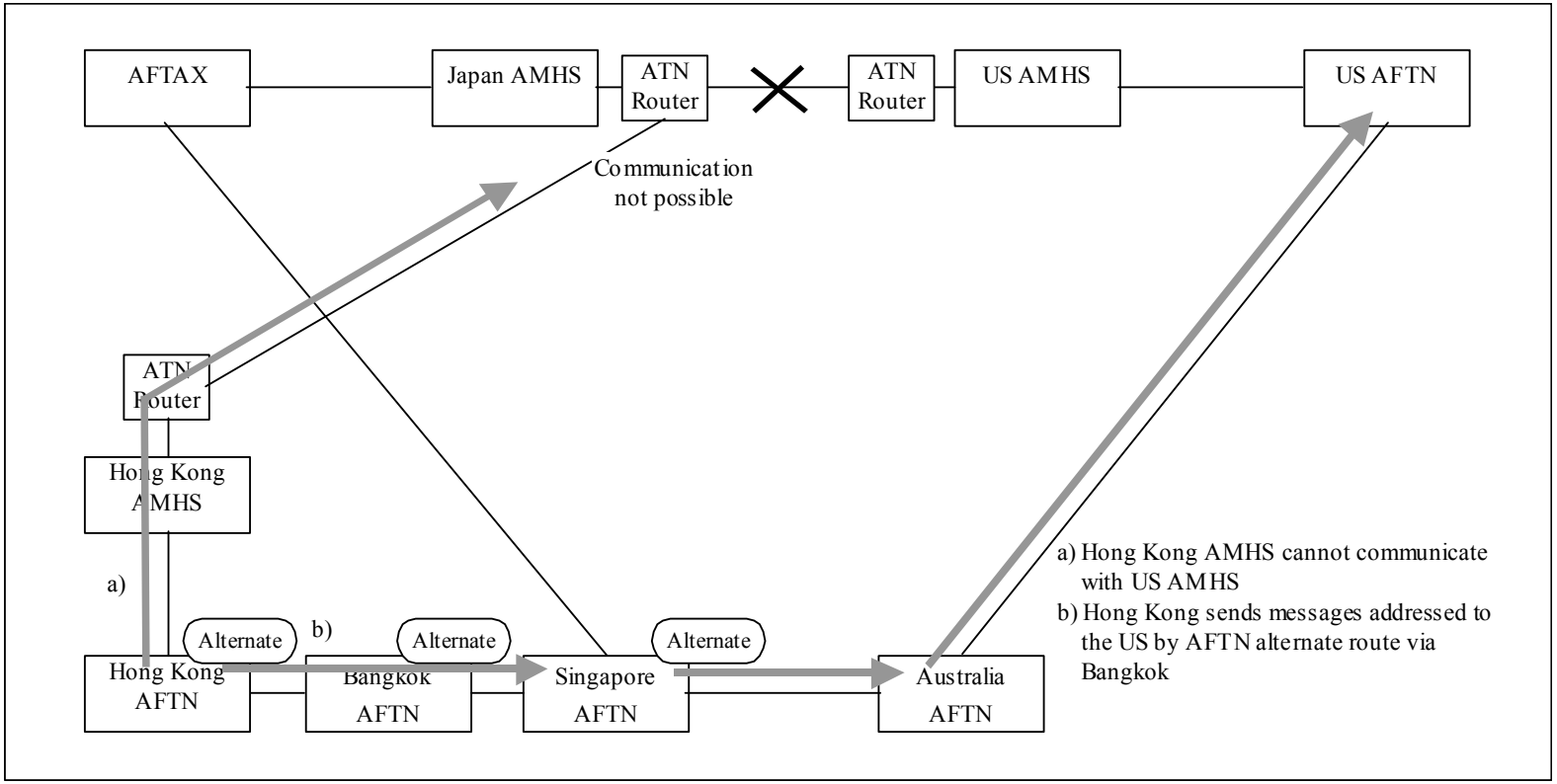

Figure 9. Method 2:
Hong Kong sends a message to the United States (ATN network failure)

Circuit failure between Japan and the US

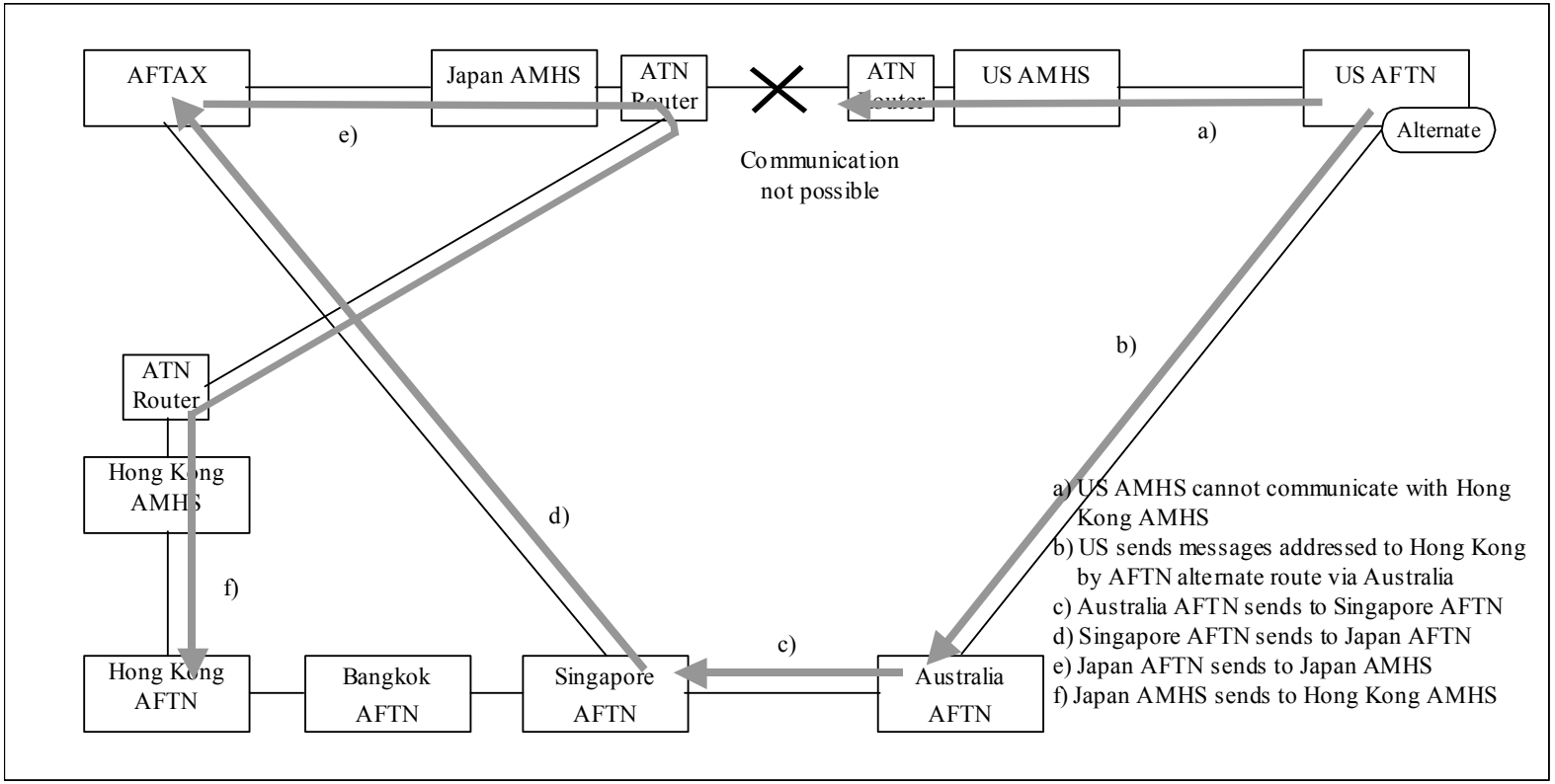

Figure 10. Method 2:
The United States sends a message to Hong Kong (ATN network failure)

Circuit failure between Japan and Hong Kong

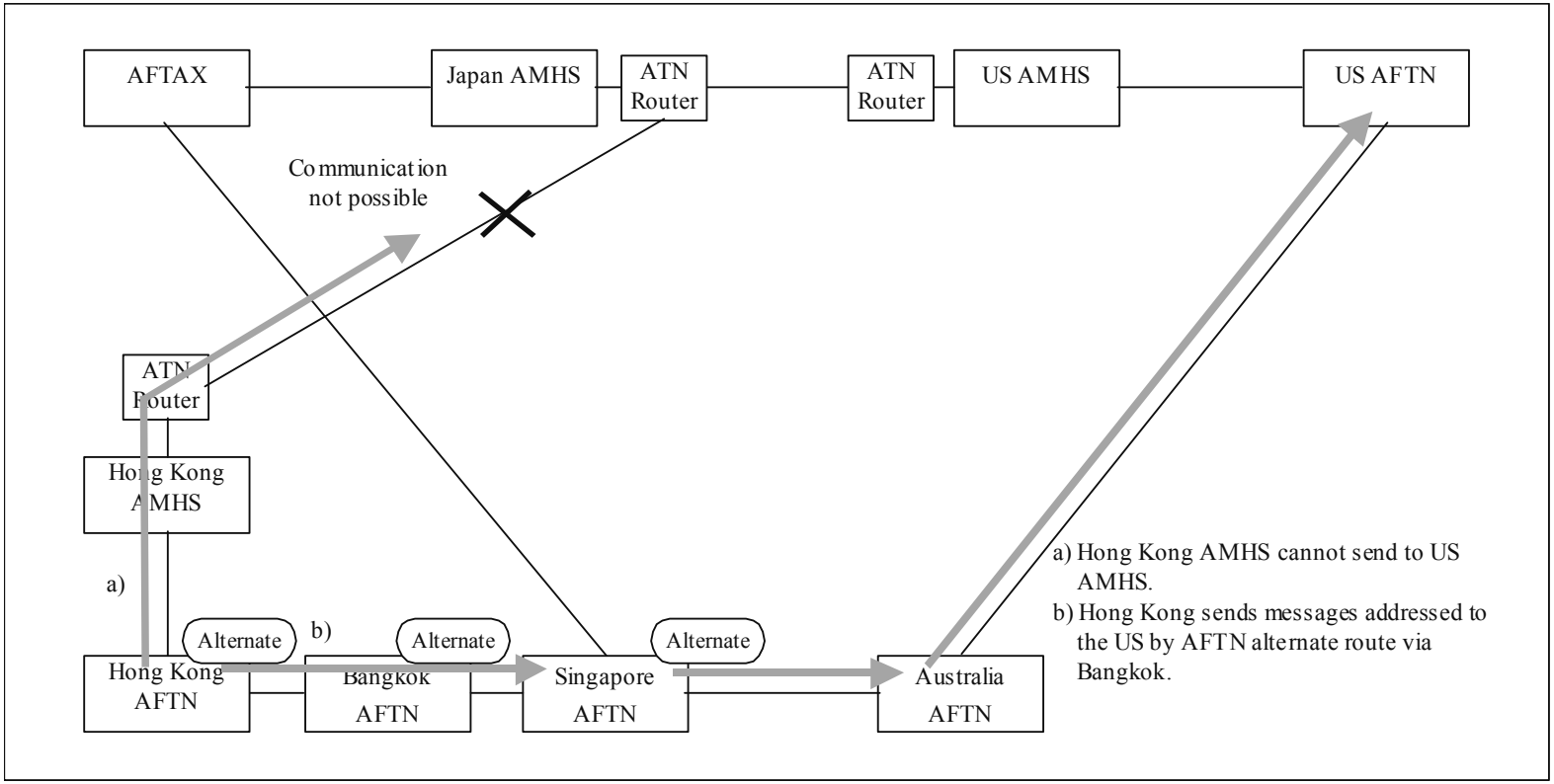

Figure 11. Method 2:
Hong Kong sends a message to the United States (ATN network failure)

Circuit Failure between Japan and Hong Kong

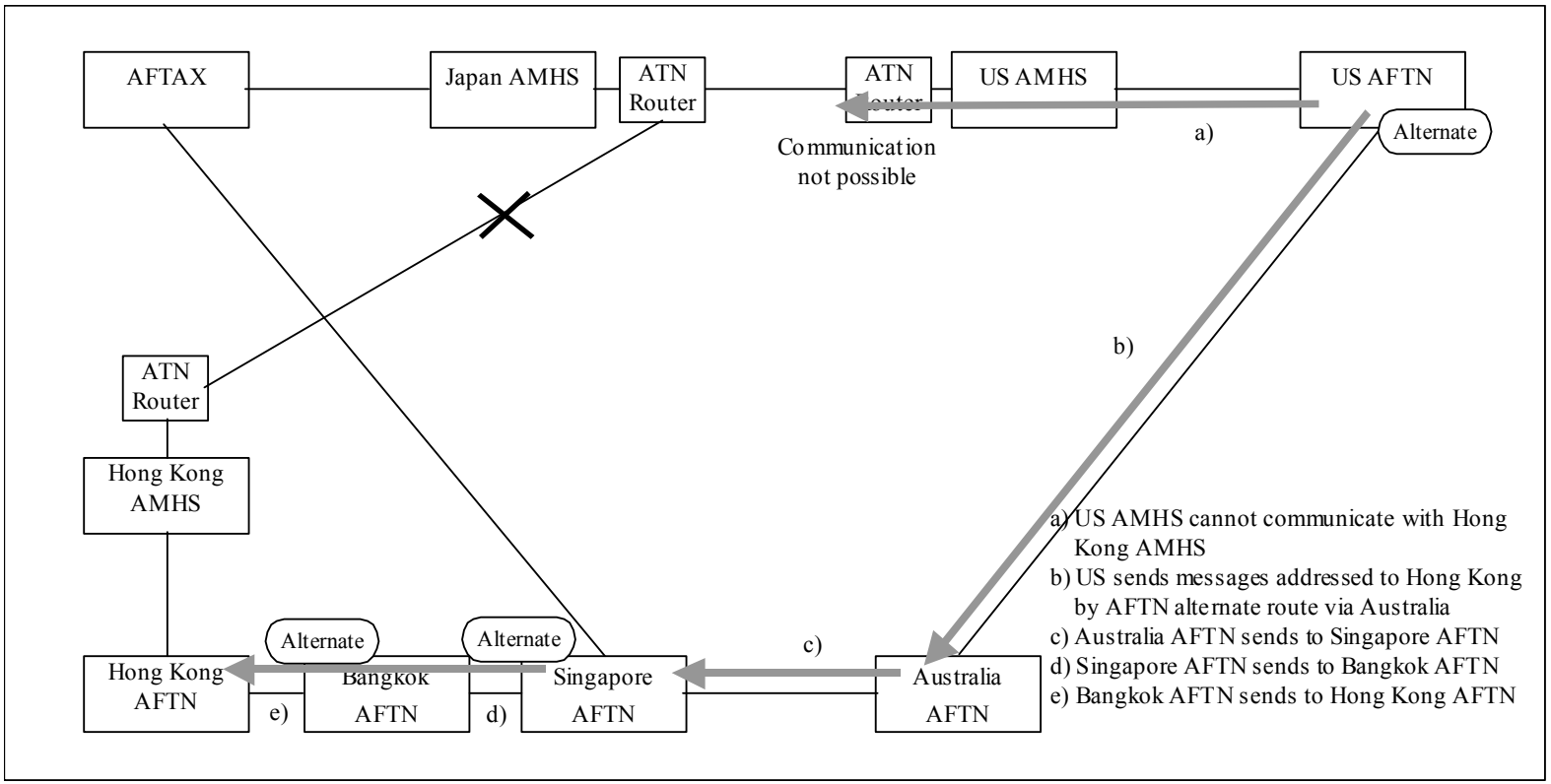

Figure 12. Method 2:
The United States sends a message to Hong Kong (ATN network failure)