ROUTING TRAFFIC WITH SUBNETWORK PRIORITY 14 ON THE AMSS

1. INTRODUCTION

The subject of this paper is to investigate the impact of routing data traffic (IDRP and ISH PDUs) over the AMSS subnetwork, in order to estimate the volume of the ATN data with priority 14 on the AMSS subnetwork. Indeed, routing information is "ATN Systems Management" information, and it is sent over the AMSS with priority 14 on this subnetwork, according to the Table 1.3 of the Core part of the ATN SARPs.

When IDRP (ISO/IEC 10747) is used over the air-ground subnetworks, routing traffic consists of:

- a unique exchange of ISH PDUs during the routing initiation phase,
- BISPDUs exchanged when the IDRP connection is established,
- route updates when there is a change in air-ground connectivity,
- periodic exchanges of KEEPALIVE PDUs in the absence of any other type of routing traffic.

The case of the procedure for the optional non-use of IDRP is not considered in this document.

The sections 2 to 5 describe the exchanges required by the operation of ES-IS or IDRP in each of these phases. The procedures were taken from the sections 5.3, and 5.8 of the ATN SARPs. The sections 6 and 0 summarise estimates of the volume of routing traffic exchanged over the AMSS for two basic scenarios applicable to trans-oceanic flights. Indeed, because of its global coverage, the AMSS is expected to be primarily used over the oceanic areas, whereas VDL or Mode S are expected to be the primary subnetworks over the continental areas.

The volume of communications traffic that is considered is that of ISO/IEC 8208 PDUs in which ISH PDUs or CLNP PDUs are encapsulated. Another part of the traffic at the DTE/DCE interface consists of flow control packets (RR and RNR). These RR and RNR packets are locally generated by the DTEs and DCEs, so they do not load the AMSS subnetwork.

ISO/IEC 9542 (ES-IS) directly relies on subnetwork service primitives, whereas ISO/IEC 10747 (IDRP) relies on the services provided by the connection-less network protocol. Hence BISPDUs are encapsulated in CLNP PDUs. As per 5.7.6.1.2 of the ATN SARPs, the compression of the CLNP PDU headers according to the LREF procedure is taken into account. On the other hand, the possible compression of CLNP user data according to V42bis is not taken into account. The overhead due to re-transmissions within the AMSS subnetwork is ignored, as well as possible retransmission of BISPDUs due to non-optimal IDRP timer settings (e.g. in the IDRP connection establishment phase).

It must be noted that hypotheses were made to compute the lengths of the PDUs. There are far too many options to present an exhaustive analysis in this paper. For instance, the estimates for the lengths of BISPDUs cannot be universal. Some fields in the BISPDUs are variable in length, due to the configuration of the ground network. The lengths given here, as detailed in the Annex, are valid for certain assumptions only.

In Section 5.3.3.1.5.1 of the ATN SARPs, it is indicated that maintaining continuous air/ground communications capability may require that an airborne BIS connects with 2 or more different air/ground BISs at the same time. In the areas in which AMSS is the only available air/ground subnetwork, this would imply opening subnetwork connections with two or more air/ground BISs through the same Ground Earth Station (GES). If multiple air/ground adjacencies are supported by the AMSS in these areas, the routing exchanges corresponding to the routing initiation phase, the opening of IDRP connections, and the periodic KEEPALIVE PDUs must be multiplied by the number of air/ground adjacencies. The case of route updates is developed in Section 4.

2. ROUTING INITIATION OVER THE AMSS

Information on air/ground route initiation is extracted from Section 5.3.5.2 of the ATN SARPs.

This phase will always take place after the AES (Aircraft Earth Station, i.e. the equipment that support the AMSS on board the aircraft) has logged on to a GES (Ground Earth Station). The logon process is usually automatic and starts as soon as the AES is powered on. Upon successful logon, a "Join Event" is sent to the airborne IS-SME, since the AMSS is an air-initiated subnetwork. The "Join Event" contains the DTE addresses of one or more air/ground ATN routers that become reachable via the GES on which the AES is logged.

The IS-SME of the airborne router then initiates the opening of subnetwork connections at AMSS priority 14 (one per air/ground BIS with which it is intended to establish an IDRP connection, as explained in Section 5.3.3.1.5.1 of the ATN SARPs). ISO/IEC 9542 ISH PDUs are exchanged by the airborne and air-ground routers as summarised in the Table below. The ISH PDUs are sent as user data in ISO/IEC 8208 CALL REQUEST or CALL ACCEPTED packets using the fast select facility.

The overhead required by the SNDCF for the application of the LREF procedure (cf. ATN SARPs, 5.7.6.2) is taken into account in the lengths of the CALL REQUEST and CALL ACCEPT packets.

Routing Information (ISO/IEC 9542)	Direction	Size of Routing Information (octets)	Encapsulating ISO 8208 PDU	Total size of SNPDU in octets
ISH PDU	Air to ground	30	CALL REQUEST	77
ISH PDU	Ground to air	30	CALL ACCEPT	77

Table 1: Routing Initiation over AMSS

In the case IDRP is used over the air/ground subnetwork, there is no further transmission of ISH PDUs in either direction after the routing initiation.

3. Establishment of an IDRP Connection

An IDRP connection is established over the AMSS only if there is no pre-existing IDRP connection between the same couple of airborne and air/ground routers. An IDRP connection may already have been established if a VDL or Mode S connection existed between the airborne and air/ground BISs prior to the AMSS logon.

If the IDRP connection has to be opened over the AMSS, the exchange of OPEN PDUs is initiated by the air/ground router. It is followed by an exchange of routes in UPDATE PDUs, which is initiated again by the air/ground router.

The UPDATE PDU sent by the air/ground router advertises aggregated routes to the fixed part of the ATN and the local RD of the air/ground router.

The UPDATE PDU sent by the airborne router advertises routes to the mobile RD. The NLRI consists of a single NET prefix.

All the BISPDUs are encapsulated as user data fields of ISO/IEC 8473 (CLNP) DT-PDUs, which are themselves encapsulated in ISO/IEC 8208 PDUs. They are transmitted over a previously opened subnetwork connection at priority 14. ISO/IEC 8208 encapsulation adds 3 octets in length to the user data (i.e. the DT-PDU).

The headers of the first DT-PDU (sent in the ground to air direction) cannot be compressed by LREF. The headers of all the subsequent DT-PDUs are assumed to be compressed.

Routing Information (ISO/IEC 10747)	Direction	Size of Routing Information (octets)	Encapsulating ISO 8208 PDU	Total size of SNPDU in octets
OPEN PDU	Ground to air	102	DATA	168
OPEN PDU	Air to ground	78	DATA	88
UPDATE PDU	Ground to air	103	DATA	113
UPDATE PDU	Air to ground	97	DATA	107

Table 2: Establishment of an IDRP Connection over AMSS

4. ROUTE UPDATES

Route updates can only be sent by the air/ground router after the routing decision function of IDRP has been performed by the air/ground router. It is assumed that the air/ground router performs information reduction and route aggregation on the routes that are sent to the mobile RD. In this case, the only events that will cause route updates on the air/ground links are the changes in the availability of air/ground connectivity. For instance, the establishment or release of an AMSS connection to another air/ground BIS, or the establishment or release of connections supported by the VDL or Mode S subnetwork.

In case VDL or Mode S connections become available to support the same IDRP connection that AMSS supports, route updates are assumed to be transmitted via VDL or Mode S. In this case, when VDL or Mode S connectivity is lost, an UPDATE PDU is sent uplink via the AMSS to withdraw the route(s) supported by VDL or Mode S. It is assumed that the default is 2 routes (one with the empty RIB-Att, one with the SECURITY RIB-Att).

Routing Information (ISO/IEC 10747)	Direction	Size of Routing Information (octets)	Encapsulating ISO 8208 PDU	Total size of SNPDU in octets
UPDATE PDU (withdrawal)	Ground to air	40	DATA	50

Table 3: Withdrawal of 2 Routes over AMSS

5. PERIODIC EXCHANGES OF KEEPALIVE PDUS

In the absence of other IDRP traffic over the air/ground connection, KEEPALIVE PDUs are exchanged at an interval of one third the Hold Time to check the liveliness of the connection.

The KEEPALIVE PDU are transmitted via the AMSS only if it is the only subnetwork that support the IDRP connection.

Routing Information (ISO/IEC 9542)	Direction	Size of Routing Information (octets)	Encapsulating ISO 8208 PDU	Total size of SNPDU in octets
KEEPALIVE PDU	Air to ground	30	DATA	40
KEEPALIVE PDU	Ground to air	30	DATA	40

Table 4: Periodic Exchanges of KEEPALIVE PDUs over AMSS

6. Scenario A : Exclusive Usage of AMSS

This hypothesis corresponds to the exclusive usage of AMSS for a whole trans-oceanic flight. In this case, the initial IDRP connection must be opened on the AMSS. It is assumed that there is one satellite-to-satellite handover over the ocean that imposes the re-establishment of an IDRP connection via AMSS.

Exchanges at priority 14 of the AMSS would thus consist of:

- ISH PDUs exchanged during the routing initiation phase,
- the BISPDUs exchanged to establish the initial IDRP connection (via the first AMSS logon),
- the periodic transmissions of KEEPALIVE PDUs on the initial IDRP connection,
- ISH PDUs exchanged during a new routing initiation phase after the satellite-to-satellite handover,
- the BISPDUs exchanged to establish a new IDRP connection,
- the periodic transmissions of KEEPALIVE PDUs on the new IDRP connection.

It is supposed that the initial IDRP connection is released after the underlying AMSS subnetwork connections are lost in the handover. This is very likely to happen without exchanging CEASE PDUs prior to the handover.

Nature of Traffic	Direction	Occurrence	Volume per Occurrence (octets)
ISH PDU	Air to Ground	2	77
ISH PDU	Ground to Air	2	77
OPEN PDU	Ground to Air	2	168
OPEN PDU	Air to Ground	2	88
UPDATE PDU	Ground to Air	2	113
UPDATE PDU	Air to Ground	2	107
KEEPALIVE PDU	Ground to Air	Periodic	40
KEEPALIVE PDU	Air to Ground	Periodic	40

Table 5: Summary of Exchanges of Routing Information in Scenario A

Total Traffic	Occurrence	Total in octets
Air to ground	Unique	544
Ground to air	Unique	716
Air to ground	Periodic	40
Ground to air	Periodic	40

Table 6: Volumes of Routing Traffic in Scenario A

Equivalent load on a 7 hour trans-oceanic flight with a period of 10 minutes between transmissions of KEEPALIVE PDUs (i.e. 41 KEEPALIVE PDUs transmitted in each direction):

- **Air to ground = 0.693 bps**
- **Ground to air = 0.748 bps**

Equivalent load on a 7 hour trans-oceanic flight with a period of 3 hours between transmissions of KEEPALIVE PDUs (i.e. 2 KEEPALIVE PDUs transmitted in each direction at most):

- **Air to ground = 0.198 bps**
- **Ground to air = 0.253 bps**

7. Scenario B : Other Subnetworks than AMSS Available at the Beginning and End of the Flights.

In this scenario, the AMSS logon is supposed to take place after the routing initiation and establishment of IDRP connection have taken place via another air/ground subnetwork (e.g.: VDL). This is very likely if there are few air/ground BISs, and if they support connections via all the available air/ground subnetworks.

The routing traffic in this case is limited to:

- ISH PDUs exchanged after the initial logon (but the IDRP connection itself is established via another air/ground subnetwork),
- the withdrawal of routes supported by VDL or Mode S when contact with the ground stations is lost,
- the periodic transmissions of KEEPALIVE PDUs on the initial IDRP connection, while there is no other available subnetwork,
- ISH PDUs exchanged during a new routing initiation phase after the satellite-to-satellite handover,
- the BISPDUs exchanged to establish a new IDRP connection.
- the periodic transmissions of KEEPALIVE PDUs on the new IDRP connection, while there is no other available subnetwork.

It is supposed that the initial IDRP connection is released after the underlying AMSS subnetwork connections are lost in the handover. This is very likely to happen without exchanging CEASE PDUs prior to the handover.

Nature of Traffic	Direction	Occurrence	Volume per Occurrence (octets)
UPDATE PDU	Ground to Air	1	50
ISH PDU	Air to Ground	2	77
ISH PDU	Ground to Air	2	77
OPEN PDU	Ground to Air	1	168
OPEN PDU	Air to Ground	1	88
UPDATE PDU	Ground to Air	1	113
UPDATE PDU	Air to Ground	1	107
KEEPALIVE PDU	Ground to Air	Periodic	40
KEEPALIVE PDU	Air to Ground	Periodic	40

Table 7: Summary of Exchanges of Routing Information in Scenario B

Total Traffic	Occurrence	Total in octets
Air to ground	Unique	349
Ground to air	Unique	485
Air to ground	Periodic	40
Ground to air	Periodic	40

Table 8: Volumes of Routing Traffic in Scenario B

Equivalent load on a 7 hour trans-oceanic flight with a period of 10 minutes between transmissions of KEEPALIVE PDUs (with the further assumption that AMSS was the only available subnetwork for 5 hours and 30 minutes out of the total duration, i.e. that KEEPALIVE PDUs were exchanged 33 times):

- **Air to ground = 0.530 bps**

- **Ground to air = 0.573 bps**

Equivalent load on a 7 hour trans-oceanic flight with a period of 3 hours between transmissions of KEEPALIVE PDUs (with the further assumption that AMSS was the only available subnetwork for 5 hours and 30 minutes out of the total duration, i.e. that at most 1 KEEPALIVE PDUs was sent in each direction):

- **Air to ground = 0.123 bps**

- **Ground to air = 0.167 bps**

8. REFERENCES

[Ref. 1] ATN SARPs
Sub-Volume 5: Internet Communications Service
Version 8.0
12th March 1997

[Ref. 2] ISO/IEC 9542

[Ref. 3] ISO/IEC 10747

[Ref. 4] ISO/IEC 8208

[Ref. 5] ISO/IEC 8473

9. GLOSSARY

AES	Aircraft Earth Station
AMSS	Aeronautical Mobile Satellite Services
BIS	Boundary Intermediate System (a router that implements IDRP)
BISPDU	Generic name of IDRP PDUs
bps	bit per second
CLNP	Connection-Less mode Network Protocol (ISO/IEC 8473)
DCE	Data Communication Equipment
DTE	Data Terminating Equipment
ES-IS	End System to Intermediate System (ISO/IEC 9542)
GES	Ground Earth Station
IDRP	Inter Domain Routing Protocol (ISO/IEC 10747)
IS	Intermediate System (router)
ISH	Intermediate System Hello
PDU	Protocol Data Unit
RD	Routing Domain
RDC	Routing Domain Confederation
RIB	Routing Information Base
RIB-Att	RIB Attribute
SME	System Management Entity
SNDCF	SubNetwork Dependent Convergence Function
VDL	Very high frequency Digital Link

ANNEX: DESCRIPTION OF PDUS

1. ISO 8208 PDUS

1.1 CALL REQUEST/CALL ACCEPTED

Assumptions :

- DTE addresses are 12 octets each (maximum length for X.121 is 15 octets),
- use of Priority facility (parameter length = 1),
- use of Non-Standard default packet size facility (parameter length = 2),
- use of Fast Select facility (parameter length = 1),
- user data contains information to indicate which compression procedures are used by the SNDCF, and the ISH PDU

Field Name	Length in Octets
General Format Identifier + Logical Channel Identifier + Packet Type Identifier	3
Address Length	1
Called and Calling DTE addresses	24
Length of Facility Field	1
Facility	10
Subsequent Protocol Identifier	1
Length Indicator	1
SNDCF Parameter Block	6
User data (ISH PDU)	30

Table 1: Composition of ISO/IEC 8208
CALL REQUEST and CALL ACCEPTED Packets

Total length of CALL REQUEST/CALL ACCEPTED = 77 octets (with ISH PDU as user data).

1.2 DATA Packets

Field Name	Length in Octets
General Format Identifier + Logical Channel Identifier + Packet Type Identifier	3
User data (DT-PDU)	Variable

Table 2: Composition of ISO/IEC 8208 DATA Packets

The encapsulation in an ISO/IEC 8208 DATA PDU adds 3 octets to the length of the user data, which is a CLNP DT-PDU.

2. ISH PDUs

The ISH PDUs always have the same length. They are directly encapsulated in ISO/IEC 8208 packets, CALL REQUEST, CALL ACCEPTED, or DATA packets (if more exchanges are necessary before the IDRP connection is established).

Field Name	Length in Octets
Fixed part of header	9
Network Entity Title Length Indicator	1
NET	20

Table 3: Composition of ISH PDU

Total length of ISH PDU = 30 octets.

3. CLNP DT-PDUs

3.1 Without Compression

The first CLNP PDUs sent in each direction on the subnetwork connection after it has been established by the SNDCF cannot be compressed with LREF.

The "Options" field is necessary for the support of Priority, Security and QoS parameters.

It is assumed that the S/P bit is set, which causes the Data Unit Identifier and Segment Offset fields to be present.

Field Name	Length in Octets
Fixed part of header	9
Destination Address Length Indicator	1
Destination Address	20
Source Address Length Indicator	1
Source Address	20
Data Unit Identifier	2
Segment Offset	2
Total Length	2
Options	6
Data (e.g. BISPDU)	Variable

Table 4: Composition of DT-PDU without Compression

3.2 Compressed Initial DT-PDU

The header of the DT-PDU is compressed according to the LREF procedure.

Field Name	Length in Octets
Compressed header	5
PDU Identifier	2
Data (e.g. BISPDU)	Variable

Table 5: Composition of Compressed Initial DT-PDU according to LREF

4. BISPDUs

The BISPDUs are all the types of PDUs used by IDRP. Over the air/ground subnetworks, OPEN, UPDATE, KEEPALIVE, and CEASE PDUs may be exchanged.

4.1 Fixed-Length BISPDUs

4.1.1 IDRP KEEPALIVE PDU

The KEEPALIVE PDU consists of the common fixed part of the BISPDU header. Its length is 30 octets.

4.1.2 IDRP CEASE PDU

The CEASE PDU consists of the common fixed part of the BISPDU header. Its length is 30 octets.

4.2 OPEN PDUs

4.2.1 Variable Fields in OPEN PDUs

The lengths of the fields detailed in this section depend on the configurations of the BISs.

4.2.1.1 RIB-AttsSet Field

It is assumed that both the airborne and the air/ground BISs support the empty RIB-Att and the Security RIB-Att (5.8.3.2.12 of the ATN SARPs). The RIB-AttsSet in the OPEN PDU sent by either end of the air/ground connection is the same.

Component Name	Length in Octets
Number of Non-empty RIB-Atts	1
Number of DA in only RIB-Att	1
SECURITY	
Type	1
Length	2
Value	
Registration ID Length	1
Registration ID	6
Information Length	1

Table 6: Composition of the RIB-AttsSet Field in OPEN PDU

Total length of the RIB-AttSet field = 13 octets

4.2.1.2 Confed-ID

It is assumed that all the Routing Domain Identifiers (RDIs) are 11 octets long.

Component Name	Length in Octets
Number of RDCs	1
Per RDC	
Length	1
RDI	11

Table 7: Composition of the Confed-IDs Field in OPEN PDUs

With the assumption that the airborne RDs do not belong to any RDC, the total length of the Confed-ID field in the OPEN PDUs sent by an airborne BIS is 1 octet, hence:

length of Confed-ID for airborne BISs = 1 octet.

Each air/ground RD belongs to at least one RDC, the Fixed ATN RDC. So, the length of the Confed-ID field in the OPEN PDUs sent by an air/ground BIS is at least 13 octets. It is assumed here that the air/ground RD will belong to an ATN island contained within the Fixed ATN RDC. Hence:

length of Confed-ID for air/ground BISs = 25 octet.

4.2.2 IDRP OPEN PDU

The lengths computed in this section take into account assumptions on the lengths of the RIB-AttsSet and Confed-IDs fields respectively made in sub-sections 4.2.1.1 and 4.2.1.2.

Field Name	Length in Octets
Fixed header	30
Version	1
Hold Time	2
Maximum PDU Size	2
Source RDI Length Indicator	1
Source RDI	11
RIB-AttsSet	13
Confed-IDs	1
Authentication Code	1
Authentication Data	16

Table 8: Composition of the OPEN PDU sent by the Airborne BIS

Total length of OPEN PDU sent by the airborne BIS = 78 octets

Field Name	Length in Octets
Fixed header	30
Version	1
Hold Time	2
Maximum PDU Size	2
Source RDI Length Indicator	1
Source RDI	11
RIB-AttsSet	13
Confed-IDs	25
Authentication Code	1
Authentication Data	16

Table 9: Composition of the OPEN PDU sent by the Air/ground BIS

Total length of OPEN PDU sent by the air/ground BIS = 102 octets

4.3 UPDATE PDUs

4.3.1 Variable Length Fields in UPDATE PDUs

The lengths of the fields detailed in this section depend on the configurations of the BISs.

4.3.1.1 NLRI

The contents of the Network Layer Reachability Information (NLRI) fields which are described here are those corresponding to the routes exchanged over the air/ground subnetworks only. The NLRIs in the routes advertised within the fixed part of the ATN may be much more complex.

Component Name	Length in Octets
Proto_type	1
Proto_length	1
Protocol	1
Addr_length	2
Addr_info	
Length of prefix	1
Prefix of addresses in local RD	11

Table 10: Composition of the NLRI Field in Routes Advertised by an Airborne BIS

It is assumed that the RDI of an airborne RD will be the prefix of the NSAPs in that RD. Hence:

length of NLRI for routes sent by an airborne BIS = 17 octets.

Component Name	Length in Octets
Proto_type	1
Proto_length	1
Protocol	1
Addr_length	2
Addr_info	
Length of prefix	1
Prefix of addresses in fixed ATN RDC	4
Length of prefix	1
Prefix of addresses in local RD	11

Table 11: Composition of the NLRI Field in Routes Advertised by an Air/ground BIS to an Airborne BIS

It is assumed that the NLRI of the routes sent uplink by the air/ground BIS will consist of:

- the prefix of all the addresses in the Fixed ATN RDC,

- the prefix of the addresses in the RD to which the air/ground BIS belongs.

It is further assumed that the prefix to all the addresses in the Fixed ATN RDC is 4 octets long (AFI + IDI + VER fields, from 5.4.3.8.1.2 of the ATN SARPs), and the prefix of the addresses in the local RD is 11 octets long. Hence:

Length of NLRI for routes sent to an airborne BIS = 22 octets.

4.3.1.2 RD_PATH

The RD_PATH of routes advertised by the airborne BIS is fixed. It consists of a single RD_SEQ path segment.

Component Name	Length in Octets
Path segment type	1
Path segment length	2
Path segment value	
Length of RDI	1
Local RDI	11

Table 12: Composition of the RD_PATH Field in Routes Advertised by an Airborne BIS

Total length of the RD_PATH field in routes advertised by an airborne BIS = 15 octets.

Upon advertisement to the mobile RD, the routes to ground systems exit the Fixed ATN RDC, which fully contains all the other RDCs to which an air/ground BIS may belong. Hence, the RD_PATH field consists of a single RD_SEQ path segment.

Component Name	Length in Octets
Path segment type	1
Path segment length	2
Path segment value	
Length of RDI	1
RDI of Fixed ATN RDC	4

Table 13: Composition of the RD_PATH Field in Routes Advertised to an Airborne BIS

Total length of the RD_PATH field in the first routes advertised by an air/ground BIS to an airborne BIS = 8 octets.

4.3.1.3 Path Attributes in UPDATE PDUs

It is assumed that all the routes advertised over the air/ground subnetworks include the SECURITY RIB-Att, and that routes with the empty RIB-Att are not advertised.

The SECURITY information in the routes advertised by the airborne BISs is limited to the Registration ID. The Air/Ground Security Tag Set, and the ATSC Tag Set are not present in these routes, on the contrary of the routes advertised by the air/ground BISs.

Component Name	Length in Octets
ROUTE_SEPARATOR	
Flag + Tag + Length	4
Value	5
RD_HOP_COUNT	
Flag + Tag + Length	4
Value	1
SECURITY	
Flag + Tag + Length	4
Information	
Registration ID L	1
Registration ID	6
Information L	1
RD_PATH	
Flag + Tag + Length	4
Value	15

Table 14: Composition of the Path Attributes in Routes Advertised by an Airborne BIS

Component Name	Length in Octets
ROUTE_SEPARATOR	9
RD_HOP_COUNT	5
SECURITY	
Flag + Tag + Length	4
Information	
Registration ID + L	7
Information L	1
A/G security tag set	
Tag set nl	1
Tag set n	1
Tag set l	1
Security tag	2
ATSC Class tag set	
Tag set nl	1
Tag set n	1
Tag set l	1
Security tag	1
RD_PATH	
Flag + Tag + Length	4
Value	8

Table 15: Composition of the Path Attributes in Routes Advertised by an Air/Ground BIS to an Airborne BIS

Hence, the path attributes for the routes with the SECURITY RIB-Att are:

- **45 octets long in the routes advertised by an airborne BIS**,
- **47 octets long in the routes advertised by an air/ground BIS**.

4.3.2 IDRP UPDATE PDU with Aggregated Route to Airborne Systems

This UPDATE PDU is the one which is sent by the airborne router in response to the UPDATE PDU from the air/ground BIS which concludes the establishment of the air/ground IDRP connection.

Field Name	Length in Octets
Fixed header	30
Unfeasible Rt Count	2
Path Att Length	2
Path attributes	45
NLRI	15

Table 16: Composition of the UPDATE PDU sent by an Airborne BIS

Total length of the UPDATE PDU sent by the airborne BIS = 94 octets

4.3.3 IDRP UPDATE PDU with Aggregated Route to Ground Systems

This UPDATE PDU is the one which is sent by the air/ground router to the airborne router after the OPEN PDU is received from the airborne BIS.

Field Name	Length in Octets
Fixed header	30
Unfeasible Rt Count	2
Path Att Length	2
Path attributes	47
NLRI	22

Table 17: Composition of the UPDATE PDU sent by an Air/ground BIS

Total length of the UPDATE PDU sent by the air/ground BIS = 103 octets

4.3.4 IDRP UPDATE PDU with Withdrawal of Routes

Such an UPDATE PDU would be sent by the air/ground BIS to the airborne BIS when the airborne BIS is no longer reachable by another subnetwork than AMSS.

It is assumed that 2 routes are withdrawn at the time (one with the empty RIB-Att, one with the SECURITY RIB-Att).

Field Name	Length in Octets
Fixed header	30
Unfeasible Rt Count	2
Withdrawn Routes	8

Table 18: Composition of the UPDATE PDU sent by an Air/ground BIS to Withdraw Routes Supported by VDL or Mode S

Total length of the UPDATE PDU = 40 octets